FINAL

United States Army
Military Munitions Response Program

Munitions Response
Remedial Investigation / Feasibility Study Guidance

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1 INTRODUCTION

After generations of munitions-related activities required to maintain our military's readiness, unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) may be present to some degree at many active and former military installations.

Prior to the National Defense Authorization Act (NDAA) of Fiscal Year (FY) 2002, Congress had informally requested the Department of Defense (DoD) to begin to develop better visibility of the costs associated with UXO. In the FY 2002 NDAA, which modified the Defense Environmental Restoration Program (DERP), Congress directed the DoD to take several actions with regard to UXO, DMM, and MC. These actions included the following: (1) developing and maintaining an inventory of all defense sites known or suspected to contain UXO, DMM or MC; (2) developing a new protocol to prioritize the inventoried sites; and (3) establishing a new program element within the environmental restoration account to track the remediation of UXO, DMM and MC. For many years, the DoD has been responding to properties that were known or suspected to contain UXO or DMM. The DoD established formal Military Munitions Response Program (MMRP) policy in September 2001 to attain a better understanding of MMRP response requirements and gain better visibility of total potential costs.

The DERP, including the MMRP, follows the process outlined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). As appropriate, a site investigation is conducted to analyze and determine suitable response alternatives. This guidance complements and expands existing Remedial Investigation (RI) / Feasibility Study (FS) guidance, providing focus on the unique nature of sites containing UXO, DMM, and MC (see Appendix A references).

1.1 Purpose

The purpose of this guidance is to provide Remedial Project Managers (RPMs) (which include assigned government and contractor project managers providing oversight and execution of an RI/FS) with the process and tools to successfully plan and execute an RI/FS at munitions response sites (MRSs) located on active installations, installations undergoing Base Realignment and Closure (BRAC), Formerly Used Defense Sites (FUDS), and other transferred properties. This guidance applies to locations within the United States and does not apply to military munitions resulting from combat operations (10 United States Code [U.S.C.] §2710 [d]). This guidance relies on the RPM’s knowledge and understanding of DERP and the definitions specific to an RI/FS conducted as part of a munitions response under the MMRP and CERCLA, as provided in Section 1.2.

This guidance document uses examples and call-out boxes to highlight key concepts in managing and executing an RI/FS for an MRS addressed under the MMRP. Where appropriate, program-specific guidance documents are referenced for users to obtain additional detailed information relating to a particular aspect of the MMRP process when applied to an MRS.

1.2 Definitions

The MMRP uses specialized terminology to categorize and discuss munitions response actions. Terminology and associated definitions used by the MMRP and in this RI/FS guidance are as follows:

- ***Defense site*** – Any location that is or was owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used or was permitted for the treatment or disposal of military munitions. (10 U.S.C. §2710(e)(1))

- ***Discarded military munitions (DMM)*** – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include UXO, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. §2710(e)(2))

- ***Explosive ordnance disposal (EOD)*** – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of UXO and of other munitions that have become an imposing danger, for example, by damage or deterioration.

- ***Explosive ordnance disposal (EOD) personnel*** – Military personnel who have graduated from the Naval School, Explosive Ordnance Disposal; are assigned to a military unit with a service-defined EOD mission; and meet service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain chemical agent hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform render safe procedures (RSPs) on nuclear, biological, chemical, and conventional munitions and on improvised explosive devices.

- ***Explosive ordnance disposal (EOD) unit*** – A military organization constituted by proper authority; manned with EOD personnel; outfitted with equipment required to perform EOD functions; and assigned an EOD mission.

- ***Military Munitions*** – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the United

States (U.S.) Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components thereof. The term does not include wholly inert items, improvised explosive devices, nuclear weapons, or nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, have been completed. (10 U.S.C. 10 (e)(4)(A) through (C))

- ***Munitions and explosives of concern (MEC)*** – Specific categories of military munitions that may pose unique explosives safety risks and means UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); or MC (e.g., explosives), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard. (U.S. Army, 2005)

- ***Munitions constituents (MC)*** – Any material originating from UXO, DMM, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C 2710(e)(3))

- ***Munitions debris*** – Remnants of military munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

- ***Munitions response*** – Response actions, including investigation, removal actions, and remedial actions to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC, or to support a determination that no removal or remedial action is required.

- ***Munitions response area (MRA)*** – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. An MRA is composed of one or more MRSs (U.S. Army, 2005).

- ***Munitions response site (MRS)*** – A discrete location within an MRA that is known to require a munitions response.

- ***Other debris*** – Debris found on operational ranges or MRSs, which may be removed to facilitate a range clearance or munitions response that is not related to munitions or range operations. Such debris includes, but is not limited to, rebar, household items (refrigerators, washing machines, etc.),

automobile parts and automobiles that were not associated with range targets, fence posts, and fence wire.

- ***Range-related debris*** – Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., targets, target debris, military munitions packaging and crating material).

- ***Small arms ammunition*** – Ammunition, without projectiles that contain explosives (other than tracers), that is .50-caliber or smaller or for shotguns.

- ***Unexploded ordnance (UXO)*** – Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5)(A) through (C))

Additional definitions and acronyms related to conducting an MMRP RI/FS are provided in Appendix B.

1.3 Military Munitions Response Program

The U.S. Army completed an initial inventory of MRSs (formerly referred to as closed, transferred, and transferring military ranges) eligible for munitions responses under the MMRP. Under the MMRP, the Army may conduct munitions response activities at active and BRAC installations and FUDS in accordance with the following funding eligibility criteria for:

- **MMRP sites at active installations, if:**
  - The release is at a site that is not an operational range, an active munitions demilitarization facility, or an active waste military munitions treatment or disposal unit.

- **BRAC MMRP sites, if:**
  - The release is at a site that is not an operational range, an active munitions demilitarization facility, or an active waste military munitions treatment or disposal unit.

- **FUDS MMRP sites, if:**
  - The release occurred prior to 17 October 1986; and
  - The property was transferred from DoD control prior to 17 October 1986; and
  - The MRS meets other FUDS eligibility criteria as specified in U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 200-3-1 Environmental Quality – FUDS Program Policy.

Funds appropriated to conduct MMRP actions cannot be used for:

- locations outside of the United States or territories;
- the presence of military munitions resulting from combat operations;
- operational ranges (previously defined as active or inactive ranges); or
- a facility that is used or was permitted for the treatment or disposal of military munitions at permitted open burn (OB) / open detonation (OD) sites.

1.3.1 Understanding Munitions Response Sites

UXO, DMM, and MC may be present as a result of munitions-related activities (e.g., live-fire training and testing, munitions manufacturing or maintenance, munitions demilitarization). For example, UXO will most likely be present on impact areas as a result of munitions use; and DMM may be present on such area as a result of the historical practice of burying excess, obsolete, or unserviceable military munitions. MC may be generated from munitions-related activities, including, but not limited to, use, production, or demilitarization. Table 1-1 provides common types of MRSs.

Table 1-1: MRS Types

MRS Type	Typical Munitions Used	Possible UXO/DMM/MC
Small arms range	Small arms ammunition	DMM and MC
Grenade range	Hand and rifle grenades	UXO, DMM, and MC
Artillery range	Medium and large caliber projectiles (Some ranges may contain submunitions from the use of improved conventional munitions [ICMs].)	UXO, DMM, and MC
Bombing range	Bombs (Some ranges may contain submunitions from the use of ICMs.)	UXO, DMM, and MC
Air-to-air range	Small arms ammunition	MC
Air-to-ground range	Small arms ammunition, medium and large caliber projectiles, rockets, and guided missiles	UXO, DMM, and MC
Ground-to-air range	Small arms ammunition, projectiles, rockets, and guided missiles	UXO, DMM, and MC
Ground-to-ground range	Rockets and guided missiles	UXO, DMM, and MC
Multiple use range	Small arms ammunition, medium and large caliber projectiles, grenades, rockets, and bombs	UXO, DMM, and MC
Training/maneuver area	Small arms ammunition, signals, trip flares, and other training devices	UXO, DMM, and MC
OB/OD area	Various military munitions (If permitted, the OB/OD area would not be eligible for the MMRP.)	UXO, DMM, and MC
Military munitions manufacturing facility	Explosives residues, soils at concentrations high enough to pose an explosive hazard	MC
Storage area transfer point	Various unused military munitions	DMM and MC
Firing point	Various military munitions	DMM and MC
Burial pit	Various unused military munitions	DMM and MC

Adapted from EM 1110-1-1200 (USACE, 2003k)

Munitions response alternatives to address UXO, DMM or MC under the MMRP, which may be used individually or in combination, are identified below.

Typical Alternatives for a Munitions Response to MEC:

- No Action Alternative (NAA)
- Land Use Controls (LUCs) including Explosives Safety Education (3Rs--recognize, retreat, report)
- Surface removal plus LUCs
- Subsurface removal plus LUCs
- Long-Term Management (LTM)
- 5-Year reviews

Typical Alternatives for a Munitions Response to MC:

- NAA
- Containment actions
- Excavation and off-site disposal
- Treatment actions
- LTM
- 5-Year reviews

Further discussion of the specific alternatives available and the development and analysis of alternatives is provided in Section 7.

1.3.2 Land Use Considerations

Key to all decisions made when designing a munitions response under the MMRP is understanding the munitions-related activities that may have occurred on the property, the property's ownership, and its current, determined, or reasonably anticipated future use. Active and BRAC installations have varying degrees of control over the use of the MRS that they are addressing. The amount of control is less certain for property transferred outside DoD control (e.g., FUDS). Although the active, FUDS, and BRAC programs seek to reduce the hazard from exposure to UXO, DMM, and MC, certain limitations exist among various programs.

By DoD policy, the Army seeks to focus efforts on addressing the MRS posing the highest relative risk before addressing ones of lower relative risk. Generally, these are MRSs where access cannot be controlled and MEC are known or suspected to be present on the surface.

The following land use considerations guide the Army's MMRP:

- ***Does the DoD control the property?***
  - If an MRS is located on an active Army installation, the Army can control the future use of the site.

- The Army does not control the land use for an MRS that is not under DoD control (e.g., transferred from an active installation or FUDS) and may have limited control of an MRS that is being transferred from DoD control (e.g., BRAC).

- ***Will the existing land use change in the future? Is there a reasonably anticipated future land use?***
  - At an active Army MRS within installation boundaries, the RPM and the installation planning department work together to identify current and reasonably anticipated future land uses.
  - The reuse plan established by the controlling authorities delineates reasonably anticipated land use at installations being closed under BRAC, and installations must be understood by the RPM.
  - FUDS policy generally requires that established land-use restrictions in place at the time of transfer be reflected in the remedy selection. (See ER 200-3-1 for further discussion.)

- ***Can the existing or reasonably anticipated future land use be changed to protect against potential explosives, chemical warfare material, or human health hazards?***
  - For an MRS within an active Army installation's boundary, the RPM may be able to recommend changes in land use that allow for the property's safe use, given any hazards present and any response performed.
  - At BRAC installations, the RPM and the reuse planners can work together to identify areas where the presence of UXO, DMM, or MC influences redevelopment and to identify uses that would allow the property's safe use, given any hazards present and any response performed.
  - Although FUDS policy generally requires that only established land use be considered, the FUDS RPM may, in collaboration with state and federal regulators and the property owner, identify any concerns with current or reasonably anticipated future land use.

- ***Can LUCs be established to protect against potential hazards associated with the known or suspected presence of UXO, DMM, or MC?***
  - Land uses of an MRS on an active installation can be controlled to reduce the potential impact of any hazards present.
  - BRAC installations must ensure that protective measures are in place to address any potential hazard known or suspected to be present before the property is transferred. See Army Regulation (AR) 200-1 (U.S. Army, 2007a) and the BRAC Realignment and Redevelopment Manual (DoD, January 2006a) for more information.
  - On FUDs projects, the Army cannot unilaterally impose LUCs. At all FUDS projects where a use restriction is part of environmental restoration activities, the LUC must be clearly defined, established in coordination with current landowner, regulatory agencies, and appropriate local authorities, and enforceable. Implementation of LUCs for FUDS is discussed in ER 200-3-1.

1.3.3 Explosives Safety

By their nature, MEC encounters are potentially hazardous. Protective measures and risk management are used to minimize potential hazards during munitions responses that involve or potentially involve MEC. Judgment, common sense, and, above all, compliance with established explosives safety procedures, including the use of qualified personnel and compliance with established procedures help ensure the safety of munitions response activities. EOD/UXO-qualified personnel are the most experienced and the only qualified persons to perform or oversee munitions response activities that potentially involve encounters with MEC.

Explosive Safety:

Explosives safety is the paramount priority during a munitions response to MEC.

The golden rule of explosives safety is to "limit the exposure to a

- minimum number of persons,
- for a minimum time,
- to the minimum amount of military munitions consistent with safe and efficient operations."

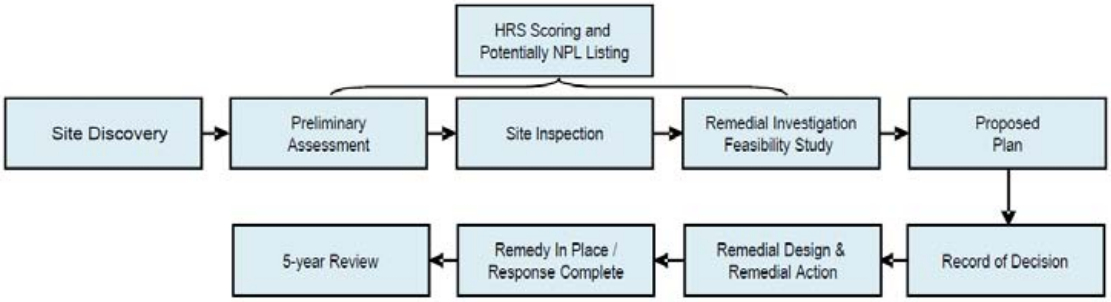
This principle applies during MMRP responses.

Explosives safety is paramount during a munitions response to MEC. Per DoD 6055.09-Standard (STD) DoD Ammunition and Explosives Safety Standards (Department of Defense Explosives Safety Board [DDESB], 2008) and Department of the Army (DA) Pamphlet (PAM) 385-64 (2009a), it is DoD and Army policy to provide the maximum possible protection to people and property from the potential damaging effects of DoD military munitions and to minimize exposures consistent with safe and efficient operations (i.e., expose the minimum number of people for the minimum time to the minimum amount of explosives or chemical agents). These policies apply equally to DoD personnel and DoD contractors performing munitions responses and members of the public potentially exposed to munitions response activities. The safety and health of on-site personnel and members of the public is of paramount importance throughout all munitions response activities that involve or potentially involve MEC. All actions taken during a munitions response to MEC are planned to provide for the safety and health of on-site workers and the public.

During munitions response activities that involve or potentially involve MEC, it is important that everyone involved, including the regulators and stakeholders, understands the potential explosive hazards inherent with MEC. Familiarity with the Army's UXO Safety Education Program and adherence to the 3 Rs of UXO Safety are required of all personnel involved with munitions responses to MEC. For additional information on UXO safety education and the 3 Rs of UXO Safety, visit the DoD UXO Safety Education Program Web site (https://www.denix.osd.mil/UXOSafety).

1.4 CERCLA Process Overview

The MMRP, which is implemented under the DERP, follows the processes outlined in CERCLA and the NCP. The CERCLA process uses distinct phases to evaluate potential releases or environmental damage caused by UXO, DMM, and MC. Figure 1-1 illustrates the major phases of the CERCLA process for munitions response.



Note: An MRS may be closed (NAA) after the Preliminary Assessment or Site Inspection phase, prior to the RI/FS. Removal actions can occur at any step within the process up until the decision document is signed. If a removal action is conducted, the project must transition to the most logical point in the remedial process.
HRS = Hazard Ranking System. More information about the HRS is included below.
NPL = National Priorities List

Figure 1-1: CERCLA process

By following the CERCLA process, Munitions Response Project Teams (MR Project Teams) obtain the data required for an MRS to determine if, and to what extent, a munitions response action is necessary. Informed decisions are then made regarding the appropriate response.

Explosive Hazard:
At this time, CERCLA has no special provisions for dealing with explosive hazards. The potential for contact with MEC and the potential effects of those encounters need to be evaluated differently than the processes developed for chemical contaminants, including MC that do not pose an explosive hazard.

CERCLA Section 105 requires that the U.S. Environmental Protection Agency (EPA) develop a prioritized list of the nation's "worst" hazardous waste sites. This list, the National Priorities List (NPL), includes both federal and non-federal sites. The EPA uses the revised Hazard Ranking System (HRS; as amended 14 December 1991) to identify sites for inclusion on the NPL. The HRS scoring is a numerically based screening system using information from the Preliminary Assessment (PA) and the Site Inspection (SI) to assess the potential of a site to pose a threat to human health or the environment. HRS scoring was developed for chemical constituents and does not directly address MEC. The EPA, not the DoD, conducts HRS scoring.

Executive Order (EO) 12580 delegates authority and responsibility to the DoD for CERCLA responses at DoD facilities. The EPA has oversight of NPL sites. At NPL sites, the Army and the EPA select the remedial action. If unable to reach

agreement, the EPA has the authority select the remedy. State regulatory authorities normally have oversight responsibility for non-NPL sites.

The RI/FS process has been applied for many years at NPL sites. The standard approach for investigating sites must, to a certain degree, be adapted to address MEC, particularly UXO and DMM. This guidance focuses on the evaluation of MEC, but includes discussion of the unique aspects of an evaluation of MC as when compared to an evaluation of other environmental contaminants at an Installation Restoration Program (IRP) site.

1.4.1 Remedial Investigation / Feasibility Study Introduction

Following the identification and the initial evaluation of an MRS (PA/SI), if additional investigation is required, the RI/FS is used to provide detailed analysis of remedial alternatives based on site characterization. The purposes of the RI/FS are to analyze the data necessary to conduct site characterization, develop a baseline risk assessment, and to identify and screen alternatives for long term remedial actions (EPA, 1988). The baseline risk assessment includes evaluation of any explosive safety hazard posed by MEC, and any human health or ecological safety risks posed by MC. It provides a means to proceed from a position of limited information about a site to one of sufficient information such that an assessment of potential risk, and, if necessary, selection of a cost effective and efficient method to reduce risk can be achieved.

It is critical for the RPM to engage the regulators and stakeholders continuously and effectively throughout the RI/FS process (Please see Sections 1.6, 1.7, and 4.5 for more detailed information regarding regulator and stakeholder involvement). The Army recommends the Technical Project Planning (TPP) process as the site management method to conduct an RI/FS. Additional RI/FS site management processes include the EPA Systematic Planning Process, the EPA Triad Process, and the U.S. Army Environmental Command's (USAEC's) Principles of Environmental Restoration.

RI/FS Consensus Building: Regardless of the RI/FS site management process selected, "consensus building" among the regulators and stakeholders is the key to RI/FS project success!

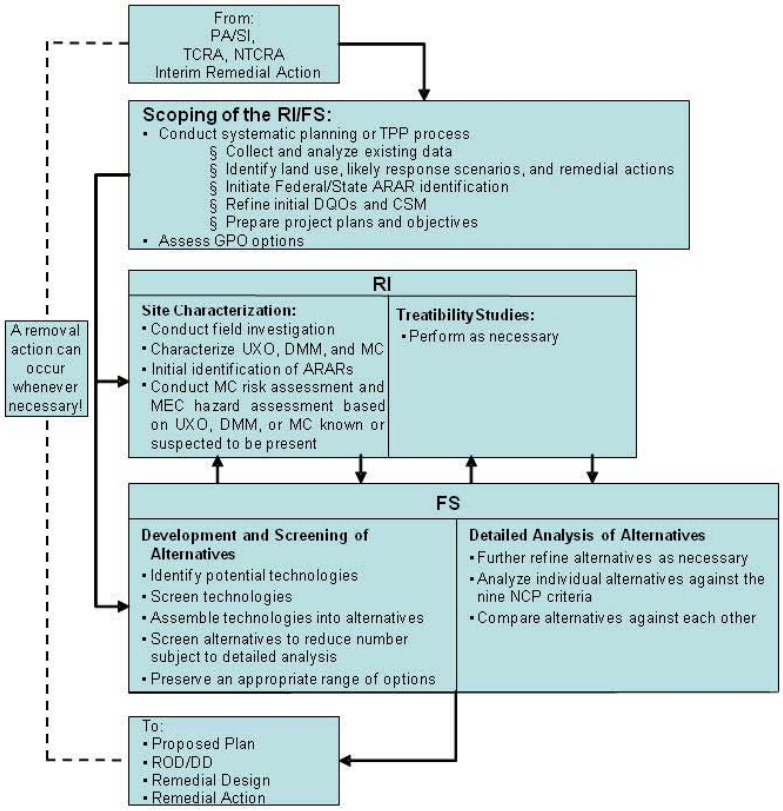
Intuitively, it may seem that the RI/FS process would be conducted in a linear manner; however, as discussed in the EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (1988), a well-done RI/FS is fully integrated with the RI and the FS conducted in an overlapping series of steps establishing the two studies as essentially concurrent and interactive. Data collected during the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and scope of treatability studies and additional field investigations.

During an RI/FS, sufficient information must be collected to be able to select and implement a munitions response alternative that is protective given current, determined or reasonably anticipated land-use of the MRS being addressed. Information collected / analysis conducted should include:

- determining MRS boundaries;
- characterizing MRS conditions;
- determining the type and density/concentration of UXO, DMM, and/or MC present;
- assessing risk and safety concerns to human health and the environment;
- assessing available technologies and their associated costs; and
- identifying and evaluating munitions response alternatives.

Early in the RI/FS process, it is important to discuss the current, determined or reasonably anticipated use of all MRSs being addressed, as different uses may require different degrees of munitions responses and levels of data collection during the RI/FS.

The RI/FS process consists of three phases, as shown in Figure 1-2: scoping, site characterization, and development and analysis of alternatives.



Notes:
ARAR = applicable or relevant and appropriate requirement
CSM = conceptual site model
DD = decision document
DQO = data quality objective
GPO = geophysical prove-out
NTCRA = non-time-critical removal action
ROD = record of decision
TCRA = time-critical removal action

Figure 1-2: RI/FS Process

Scoping is the initial planning phase of the RI/FS process, and many of the planning steps begun here are continued and refined in later phases of the RI/FS. Existing site data, including data from previous investigations, are evaluated to determine the need for and develop initial approaches for further site characterization and the evaluation of response alternatives. The RI/FS scoping process is discussed further in Section 4.

Site characterization includes performing any necessary field investigation, developing an MC risk assessment, developing a risk/hazard assessment including use of the Munitions and Explosives of Concern Hazard Assessment (MEC HA), and conducting treatability studies as needed. The processes and tools used for characterizing an MRS are discussed further in Section 5. Treatability studies are discussed in Section 6.

Development and detailed analysis of alternatives usually begins during scoping, when likely cleanup scenarios are first identified. Using the information gathered during the site characterization, the alternatives are evaluated based on nine criteria established in the NCP. Further discussion of the specific alternatives available and the development and analysis of alternatives is provided in Section 7.

1.5 RCRA Overview

While the DoD prefers to conduct the MMRP under CERCLA, the Army recognizes that some installations may be required to address an MRS under the Resource Conservation and Recovery Act (RCRA) Corrective Action process. It should be noted that RCRA-permitted sites are normally ineligible for the MMRP and will continue to be addressed under RCRA programs.

Both CERCLA responses and RCRA Corrective Action responses are executed through comparable processes that include an initial site evaluation, a detailed SI and assessment, and ultimately, the design and implementation of the chosen remedy. The comparison of the processes used for each of these programs is shown in Figure 1-3.

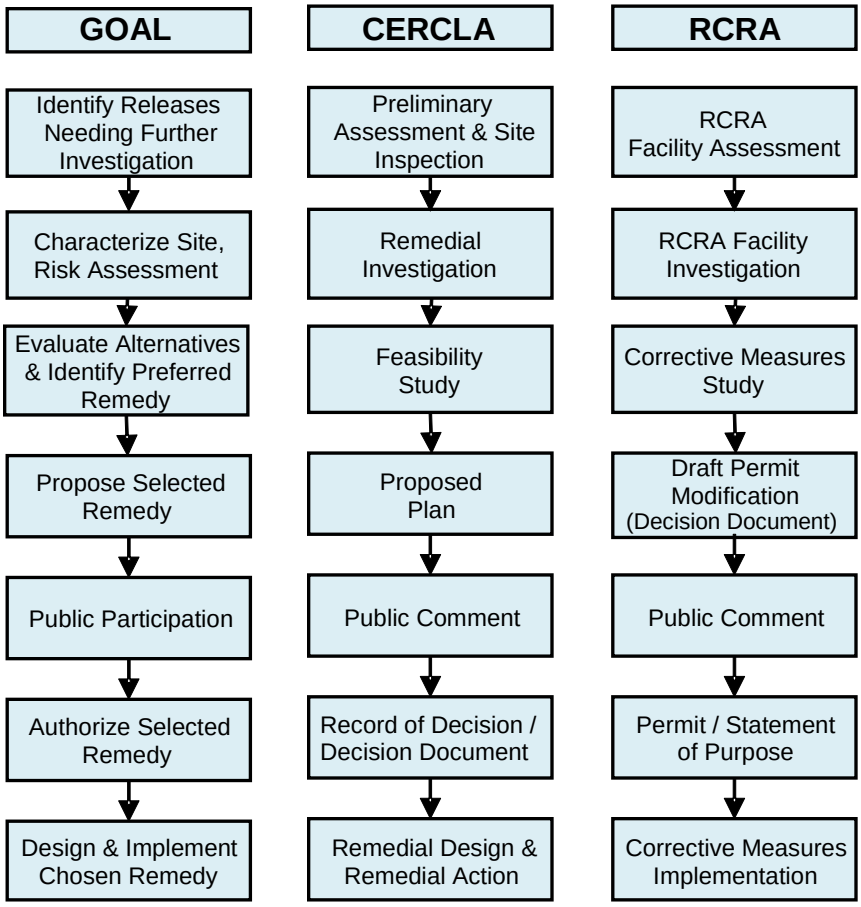


Figure 1-3: CERCLA and RCRA Corrective Action comparison

CERCLA and RCRA RI/FS Process: The RPM should realize that any procedural differences between CERCLA and RCRA should not substantively affect the outcome of the RI/FS munitions response action.

Both programs also allow for short-term remedial actions referred to as removal actions under CERCLA or interim remedial actions and interim response measures under RCRA Corrective Action. Decisions regarding short-term removal actions are developed using an Engineering Evaluation / Cost Analysis for CERCLA programs. Removal actions have their place in the cleanup process, but they are not mechanisms used to achieve a site's final decision. Following a removal action, the site must reenter the remedial process, either CERCLA or RCRA Corrective Action.

Although CERCLA and RCRA are separate statutory authorities, each remedial cleanup program should operate consistently with the other and should yield similar environmental solutions when presented with similar circumstances. Any procedural differences between CERCLA and RCRA should not substantively affect the outcome of the RI/FS at an MRS.

1.6 Regulatory Interface

The Army recognizes that the EPA, American Indians and Alaska Natives, federal land managers, and states may rely on different authorities or have a different perspective on how to implement a munitions response; however, the organizations share a common goal of protecting public health and the environment. Problem solving through a process that seeks to achieve consensus provides parties involved in the design, execution, or oversight of munitions responses a means of resolving differences without denying the parties an opportunity to exercise their respective authorities should the process fail to achieve mutual agreement. To provide the Army's consensus approach the greatest possibility of success, organizations responsible for munitions responses should work in a collaborative manner with environmental regulators and safety officials to attempt to achieve mutual agreement (consensus) throughout the response process, but particularly at critical decision points. Simply put, the Army approach to munitions responses should seek to establish a cooperative working relationship with environmental regulators and safety officials, encouraging respect for other views and efforts to achieve Army goals. Army organizations responsible for the conduct of munitions responses should attempt to arrive at mutually acceptable solutions that incorporate the following principles:

- Establishing a collaborative (cooperative) working relationship with environmental regulators and safety officials to achieve mutual agreement (consensus) throughout the response process, but particularly at critical decision points;

- Raising, when mutual agreement cannot be achieved at one level, the matter to the next level of authority to attempt resolution using the collaborative decision-making process; and

- Acknowledging, when issues of authority arise, the differing opinions and seeking to focus on areas related to the substantive aspects of the munitions response, rather than addressing the authorities issue through a formal exchange of legal opinions.

1.7 Stakeholder Involvement

The Army recognizes the benefit and importance of stakeholder involvement in the munitions response process as early as possible and throughout the process. Stakeholder involvement is an effective way to identify and address stakeholder concerns about environmental and safety issues related to an MRS. For stakeholder involvement to be successful, effective two-way communication is necessary. The Army believes that a proactive stakeholder involvement program facilitates the munitions response process and helps ensure the protection of human health and the environment.

2 PROGRAMMATIC OVERVIEW

This section includes a brief overview of current Army DERP and MMRP policies, the DoD and Army environmental organizational structures, and the roles and responsibilities including interaction and partnership with applicable regulatory agencies.

2.1 DERP and the MMRP

The DERP was formally established by Congress in 1986 and is codified at 10 U.S.C. §2701–2710. The program provides for the cleanup of DoD hazardous waste sites consistent with the provisions of CERCLA as amended by the Superfund Amendments and Reauthorization Act (SARA) Section 211; the NCP (40 Code of Federal Regulations [CFR] §300); and EO 12580, Superfund Implementation.

The DoD *Management Guidance for the Defense Environmental Restoration Program* addresses active installations, installations undergoing BRAC, and FUDS. This guidance contains three program categories: the IRP, the MMRP, and the Building Demolition / Debris Removal Program (DoD, 2001a). It should be noted that the 29 December 2008 Office of the Secretary of Defense (OSD) Memorandum titled Interim Policy for DERP Eligibility, supersedes Section 3, Applicability and Scope, and Section 7, Funding Eligibility, of the DoD Management Guidance for the DERP. This interim policy rescinds the previously established release cutoff dates (DoD, 2008).

Under 10 U.S.C. §2701(a)(2), remedial actions taken under the DERP to address releases of hazardous substances and pollutants and contaminants (as defined by CERCLA, as amended) must be conducted under CERCLA, as amended, and the NCP (DoD, 2001a). As a matter of DoD policy, munitions responses are conducted per CERCLA, as amended, and the NCP.

The NDAA for FY 2002 (Public Law 107-107) formally amended the DERP by establishing the MMRP as a new program element for the cleanup of property known or suspected to contain UXO, DMM, or MC.

DERP and MMRP policy states that the Army:

- exercises its authority, expertise, and responsibility to protect DoD personnel, the public, and the environment from explosive safety risks presented by UXO, DMM, or MC;
- conducts munitions responses per CERCLA, the NCP, and applicable federal and state laws;
- conducts environmental restoration responses in a manner that does not compromise explosives safety;

- integrates, to the extent practicable, munitions responses with other environmental responses;

- considers reasonably anticipated future land use in the design and implementation of a munitions response action;

- bases munitions response activities on site-specific data and uses best available and appropriate technologies and methods;

- provides, to the fullest extent practicable, the opportunity for meaningful involvement of other federal agencies; state, tribal, and local governments; and members of the public in the munitions response process; and

- establishes and maintains an inventory of MRSs and a process for assigning a relative priority for munitions response actions.

Detailed objectives, targets, success indicators, reporting mechanisms, and management review processes applicable to the MMRP are included in the Army Environmental Cleanup Strategic Plan (U.S. Army, 2009), which is updated every two years.

2.1.1 Army Policy for Active Installations

The Army's MMRP integrates, to the extent practicable, munitions responses with other environmental responses and conducts such responses in a manner that does not compromise explosives safety. It does so while sustaining its ability to preserve the installation infrastructure needed to maintain a trained and ready Army. For active installations, the *Army Defense Environmental Restoration Program Management Guidance for Active Installations* provides background information, outlines roles and responsibilities, and provides guidance on the management and execution of the Army IRP and MMRP (U.S. Army, 2004a).

2.1.2 Army Policy for Formerly Used Defense Sites

The USACE ER 200-3-1 *Environmental Quality—Formerly Used Defense Sites (FUDS) Program Policy* provides USACE Districts the framework for the implementation of DoD and Army policy governing the FUDS program. Currently, FUDS policy applies to real property that was under the jurisdiction of the Secretary and owned by, leased by, or otherwise possessed by the United States (including governmental entities that are the legal predecessors of the DoD or the components) and those real properties where accountability rested with the DoD but where the activities at the property were conducted by contractors (i.e., government-owned, contractor-operated properties) that were transferred from DoD control prior to 17 October 1986. The Army is the Executive Agent for the FUDS program. USACE executes and provides day-to-day management of the program for the Army.

2.1.3 Army Policy for Base Realignment and Closure

The Army established its BRAC program to meet the requirements of the Base Closure and Realignment Act of 1988 and the Defense Base Closure and Realignment Act of 1990, as amended. The BRAC program is charged with closing and realigning military installations. The *Base Redevelopment and Realignment Manual* (DoD, 2006a) and the *Army Defense Environmental Restoration Program Management Guidance for BRAC Installations* (U.S. Army, 2004b) provide background information, outline roles and responsibilities, and provide guidance on the management and execution of the Army BRAC Environmental Restoration Program, including the MMRP. The goals of the Army BRAC Environmental Restoration Program are to reduce risk to protect human health and the environment and to comply with legally enforceable agreements, orders, and laws through implementation of cost-effective remedial actions, while concurrently effecting timely property transfer (U.S. Army, 2004b).

2.2 Roles and Responsibilities

2.2.1 Department of Defense

The Deputy Under Secretary of Defense for Installations and Environment (DUSD(I&E)) establishes DERP policy and program goals and provides program management oversight.

The Department of Defense Explosives Safety Board (DDESB) establishes explosives safety standards (DoD 6055.09-STD [2008]; DDESB, 2008), policy, and guidance applicable to the life cycle (i.e., research, development, and testing; hazard classification; production; transportation; handling; storage; inspection; maintenance; use; and disposition) of DoD military munitions. It also establishes such standards for the conduct of munitions and other environmental response at real property known or suspected to contain MEC, including chemical munitions and chemical agent in other than munitions configurations.

The services' Explosive Safety Technical Centers (for the Army, the U.S. Army Technical Center for Explosives Safety [USATCES]) and the DDESB help ensure explosives safety throughout the conduct of a munitions response to MEC by ensuring the adequacy of protective measures and compliance with DoD 6055.09-STD (DDESB, 2008). The USATCES formally reviews, evaluates, and provides Army approval of measures to protect Army employees and the public from the potential hazards associated with munitions responses to MEC. USATCES also ensures that the design of a munitions response to MEC addresses any residual explosive hazards potentially present at an MRS after completion of such responses.

The DDESB staff performs a technical review of required submissions and recommends approval or disapproval, as appropriate, by the Chair, DDESB, on behalf of the DDESB. Although the DDESB requires other safety submissions, for explosives safety for remedial investigation purposes, the submission

normally used for a munitions response to MEC is the munitions response Explosive Site Plan (ESP). For a munitions response that may involve chemical warfare material (CWM) (i.e., chemical munitions and chemical agents in other than munitions configurations; referred to as CWM responses), a munitions response Chemical Site Plan (CSP) is required. When the work is to be performed for the remedial or removal action, a Munitions Response Explosive Safety Submission (MRESS) is required for a munitions response to MEC. A Munitions Response Chemical Safety Submission (MRCSS) is required for munitions response that involves CWM. The MRESS/MRCSS needs to be considered during the RI/FS phase in order to assure proper data are gathered. Procedures for improved chemical munitions are described in Section 4.2.6.

These munitions response safety submissions address explosives safety requirements for munitions response activities (e.g., field activities) that involve the intentional physical contact with MEC or the conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC. A munitions response MRESS/MRCSS fulfills this function for CWM responses.

DDESB Technical Paper (TP) Number 18, *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel*, provides minimum qualification standards for UXO-qualified personnel who perform UXO-related operations (e.g., munitions responses to MEC, range clearance activities) in support of the DoD. TP 18 does not address the qualifications for DoD EOD personnel (DDESB, 2004b).

The DDESB also approves the explosives safety provisions of any plans to transfer real property known or suspected to contain MEC from DoD control.

2.2.2 U.S. Army

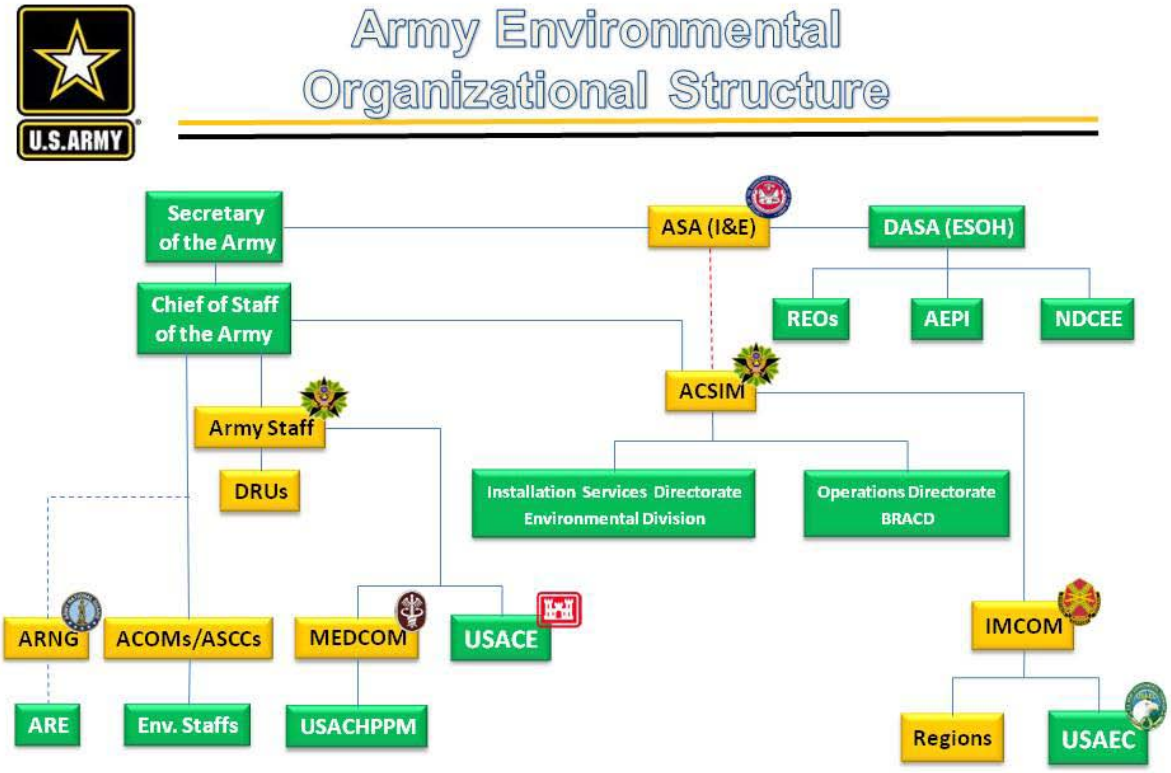
The Assistant Secretary of the Army (Installations and Environment) (ASA (I&E)), through the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health (DASA-ESOH), provides overall policy concerning all Army environmental programs, including the MMRP and is DOD's Executive Agent for FUDS. DASA-ESOH is also responsible for providing explosives safety policy and guidance for munitions response to MEC, including for CWM responses. Figure 2-1 shows the organizational structure of the Army's Environmental Program.

2.2.2.1 Installation Management Command and the Assistant Chief of Staff for Installation Management

The Installation Management Command (IMCOM) is a direct reporting unit (DRU). IMCOM oversees Army-wide installation management, except for BRAC closing and special installations and Army National Guard (ARNG) installations. Headquarters, IMCOM monitors installation cleanup programs, to include the MMRP. IMCOM regions monitor responses within their regions and coordinate with installations on issues of regional, regulatory, and public concern (U.S.

Army, 2004b). The IMCOM commander is dual-hatted as the Assistant Chief of Staff for Installation Management (ACSIM).

The Installation Services Directorate, Environmental Division (ISE) and the BRAC Division (BRACD) support the ACSIM. ISE, the Army Staff proponent for Army environmental programs, provides environmental implementing guidance, execution authority, and program management on all matters relating to management and resourcing of Army installations. BRACD is the program manager for the BRAC cleanup program, develops Army BRAC-related policy, and is responsible for the MMRP on BRAC installations.



Notes:
ACOM/ASCCs = Army Commands / Army Service Component Commands
AEPI = Army Environmental Policy Institute
ARE = Chief, NGB Environmental Programs Division
MEDCOM = U.S. Army Medical Command
NDCEE = National Defense Center for Energy and Environment
USACHPPM + United States Army Center for Health Promotion and Preventive Medicine
REO = Regional Environmental Offices
USACHPPM = United States Army Center for Health Promotion and Preventive Medicine

Figure 2-1: Army environmental organization

2.2.2.2 Chief, National Guard Bureau and the Army National Guard

The National Guard Bureau (NGB) is a joint bureau of the DA and the Department of the Air Force and is the channel of communications on all matters pertaining to the National Guard and the ARNG of the United States between the DA and the several States. Pertinent to the environmental programs, the Chief,

NGB is responsible for developing and administering policies and programs affecting the ARNG. The Director, ARNG is responsible for assisting in carrying out the following functions of the NGB as they relate to the ARNG environmental programs:

- Participating with the Army Staff in the formulation, development, and coordination of all environmental programs, policies, principles, concepts, and plans pertaining to or affecting the ARNG.

- Developing and administering such detailed environmental programs as are required to operate the ARNG based on approved programs, policies, and guidance from ASA (I&E) and ACSIM.

- Planning and administering the budgets for the ARNG.

- Supervising the accountability of the States for Federal property issued to the ARNG.

As part of the ARNG directorate, the Chief, NGB ARNG Environmental Division is responsible for establishing the ARNG's program priorities and coordinating the execution of the ARNG's DERP within the 54 States and Territories with the USAEC.

2.2.2.3 U.S. Army Environmental Command

USAEC is a subordinate command of IMCOM and is the current program execution manager at active installations. Through assigned Environmental Restoration Managers (ERMs), the USAEC Cleanup Division is responsible for establishing implementing processes, procedures, or guidelines with the installations, Army Commands for special installations, the National Guard Bureau, and the BRAC Division for non-BRAC excess installations (U.S. Army, 2004a). Figure 2-2 shows USAEC's organizational structure.

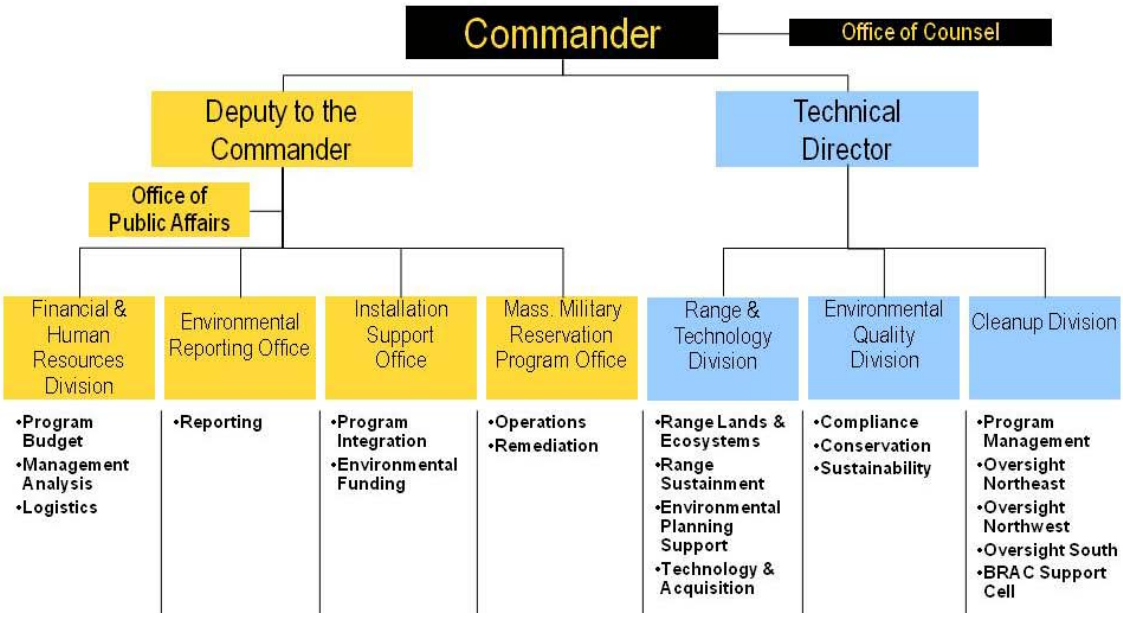


Figure 2-2: USAEC organizational structure

2.2.2.4 U.S. Army Technical Center for Explosives Safety

USATCES, on behalf of the Army Safety Office and DASA-ESOH, develops draft Army guidance, procedures, and regulations to ensure compliance with DoD 6055.09-STD, *DoD Ammunition and Explosives Safety Standards* (DDESB, 2008). USATCES also recommends explosives safety policy for the management and cleanup of real property known or suspected to contain MEC. It also provides explosives safety technical assistance and advises on munitions responses to MEC and other explosives safety–related matters to installation garrison commanders and others. In addition, USATCES reviews and provides Army approval of DDESB-required safety submissions.

Through its review of explosives safety submissions, USATCES also reviews and provides Army approval for the explosives safety provisions, such as LUC and UXO Safety Education that are selected via the decision document that follows the RI/FS. USATCES also reviews and forwards to DDESB for review and concurrence Finding Of Suitability to Transfer (FOST), Finding of Suitability for Lease (FOSL), and Finding Of Suitability for Early Transfer (FOSET) (DDESB, 2008).

2.2.2.5 U.S. Army Center for Health Promotion and Preventive Medicine

The U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) provides medical- and health-related oversight of restoration activities. For the MMRP, USACHPPM focuses on the human health and environmental effects of MC. These activities include the preparation of public

health assessments, health consultations, health studies, responses to citizens' petitions, and health education activities. USACHPPM reviews and concurs on human health and ecological risk assessments during the RI/FS for the Army Surgeon General.

2.2.2.6 U.S. Army Corps of Engineers and the Environmental and Munitions Center of Expertise

USACE executes the FUDS program for DASA-ESOH, who is DoD's Executive Agent for the program. USACE also routinely serves as the project manager for munitions responses to MEC that are conducted at MRSs located on BRAC and active Army installations.

The Headquarters, USACE (HQUSACE) DoD Environmental Support Team is responsible for budgeting, programming, and developing USACE guidance for the FUDS program. The Regional Business Center and Project Management District is responsible for FUDS project management and execution. Support for MMRP remedial investigations and remedial action contracting is provided by the five military design centers. Four of these design centers are military munitions design centers located in the Baltimore and Omaha Districts, Huntsville Center, and in the South Pacific Division Range Support Center. The fifth, the CWM Design Center in Huntsville, Alabama, is the only design center authorized to perform CWM response. Execution or assistance on MR remediation is performed by one of USACE's 10 munitions remedial action districts: Baltimore, Omaha, Fort Worth, Honolulu, Louisville, Savannah, Mobile, Los Angeles, Sacramento, and Huntsville. A USACE district commander serves as installation commander for each FUDS. In this capacity, district commanders execute environmental restoration projects and fulfill associated responsibilities. The Environmental and Munitions Center of Expertise (EM CX) provides technical support to HQUSACE and design centers.

2.2.3 Installations

Army, Army Reserve, special installations, and the NGB are responsible for execution of the MMRP. The garrison commander (GC) for Army, Army Reserve and special installations are responsible for executing the environmental programs for installations under their control. The Chief, NGB-ARE, is responsible for execution of environmental programs on behalf of the ARNG in the 54 States and Territories.

The GC is responsible for tasking the installation's DERP Executors, reporting to their USAEC ERM, coordinating regulatory and community involvement, and ensuring compliance with applicable DoD and Army policies and federal and state laws and regulations (U.S. Army, 2004b). As such, installations have the following responsibilities.

- ***MRS Project Management (Management of a Munitions Response)*** – The Army uses the TPP process to plan the CERCLA response process, including the RI/FS for an MRS. The TPP process, further described in Section 3,

provides a phased approach to planning that produces the type and quality of results needed for site-specific decision-making. Using the TPP, installations:
  - develop and submit work plans for regulatory review and
  - develop and submit DDESB-required safety submissions to USATCES for review and Army approval and to be forwarded to the DDESB for its review and approval.

- ***Regulatory Interface and Stakeholder Involvement*** – Installations:
  - establish a collaborative working relationship with environmental regulators and safety officials to attempt to achieve mutual agreement (consensus), particularly at critical decision points, and
  - seek early and continuous stakeholder involvement throughout the DERP process, ensuring that stakeholders, including property owners, are offered opportunities as early as possible to participate in the RI/FS process.

- ***Technical Review Committee (TRC) and Restoration Advisory Board (RAB)*** – In the mid-1980s, the DoD established TRCs, where practicable, to enable community representatives to review and comment on technical documents pertaining to environmental restoration activities. Current DoD policy is to convert existing TRCs or similar advisory groups into RABs, provided there is sufficient interest within the community. No additional TRCs will be formed. RABs shall operate within the guidelines of the OSD RAB Rule (OSD Restoration Advisory Board Rule Handbook, 2007).

  Restoration Advisory Board: Establishing a RAB, expanding an existing RAB, or soliciting interest in a RAB is required within three months of the start of the MMRP RI/FS.

  For munitions responses under the MMRP, interest in establishing a RAB will be evaluated within three months of initiation of the RI/FS, if the installation does not have an existing RAB. Formation of a RAB meets the requirement for a TRC. RABs complement other community involvement efforts by providing a forum for expression of diverse points of view (USACE, 2004c). If a RAB exists for an installation and it identifies MRSs, the installation may expand the RAB to consider issues related to the MMRP.

  It is important that installations communicate with and educate the local community about the potential hazards associated with UXO, DMM, and MC and the method by which the Army is addressing these hazards.

- ***Federal Facility Agreements (FFAs) and Interagency Agreements (IAGs)*** – Federal facilities are required, under the SARA provisions codified as the CERCLA §120(e)(2), to enter into an IAG or FFA within 180 days of completing the RI/FS at an NPL installation. These agreements outline the roles and responsibilities of the DoD components, the EPA and, frequently, the state in the cleanup process.

- ***Defense and State Memorandums of Agreement (DSMOAs)*** – The DSMOA program funds state environmental regulatory agencies for technical services provided in support of the Army DERP. The goals of the DSMOA program are to expedite the cleanup process, to comply with state regulations, and to improve coordination and cooperation between the DoD and state/territorial regulatory communities. The Army is the lead agent for the DSMOA program, and USACE provides day-to-day management of the DSMOA program.

2.2.4 Regulatory Agencies Jurisdiction Overview

The Army coordinates with regulatory agencies and local Native American or Native Alaskan tribal governments with jurisdiction, as stakeholders. Records of these notifications are placed in the Administrative Record and Information Repository for the MRS.

2.2.4.1 U.S. Environmental Protection Agency

The EPA develops and enforces regulations that implement environmental laws enacted by the Congress. The EPA provides its own RPMs to oversee munitions responses at DoD installations on the NPL. The EPA RPM's primary responsibilities are to ensure statutory compliance with federal environmental laws governing CERCLA cleanups and to provide assistance to the DoD in its MMRP efforts. The EPA and the DoD seek to operate under the partnering concept. This concept facilitates open communication and information sharing among EPA, state, and federal facilities.

Although the DoD is the lead agent at DoD installations, the EPA plays a key role in the remedial decision-making process at NPL installations. The EPA is the lead regulator for NPL installations and a regulatory team member for BRAC installations. The EPA is the signatory agency and is asked to concur with FFAs and RODs for NPL installations. Ultimately, if the DoD and the EPA cannot agree on the remedy for an NPL site and dispute resolution fails, the EPA has the right to select the remedy. Therefore, it is important for the DoD to work together with the EPA throughout the CERCLA response process.

2.2.4.2 State Regulatory Agencies

Federal facilities should coordinate response activities with federal, state, and local authorities to implement CERCLA and NCP requirements for NPL sites. CERCLA requires the DoD to ensure the EPA and appropriate state and local authorities have adequate opportunity to participate in the planning and selection of remedial actions. Although state regulatory agencies may sign FFAs, RODs, and remedial DDs, their signature is not required for RODs and DDs at NPL sites. Nevertheless, they should be afforded an opportunity to review such documents. The state normally serves as the lead regulator for non-NPL installations and is a regulatory team member at BRAC installations.

States also have a role in defining ARARs for both NPL and non-NPL sites. CERCLA Section 121(d) requires that, with some exceptions, federal facility remedial actions shall comply with state laws if they are determined to be applicable or relevant and appropriate in the RI process. CERCLA specifies that state laws "concerning removal and remedial actions, including state laws regarding enforcement, shall apply to removal and remedial actions at facilities owned or operated by [the federal government] when such facilities are not included on the NPL" (42 U.S.C. 9620(a)(4)(2001)).

In some cases, munitions responses to MEC at an MRS can be addressed under the RCRA Corrective Action Program or the Army may agree with RCRA regulators to address RCRA Corrective Action sites as part of an ongoing CERCLA response. The RCRA Corrective Action Program also requires that active and BRAC installations conduct investigations and cleanup actions as necessary. RCRA Corrective Action is not normally undertaken at FUDS because the DoD is neither the owner nor operator at the property. Personnel within state cleanup programs are typically the lead regulators for overseeing corrective actions when the EPA has authorized the State Corrective Action Program or an EPA Regional Office has entered into a work sharing agreement with a state program.

It is critical that RPMs understand the statutory requirements as specified in CERCLA and RCRA regarding state regulatory agency involvement in federal facility remedial actions. State regulatory agencies may participate at varying levels, including information review, project consultation, and remedial decision-making. It is beneficial to have open and honest communications with regulatory agencies regarding federal facility cleanup activities. If there is any doubt about the required level of participation, RPMs are advised to consult Army Program Management and/or Army environmental counsel.

2.2.5 Department of Defense and Regulatory Partnerships

The DoD relies on partnerships with state and federal agencies to facilitate planning and implementation of the DERP by providing the insight necessary to efficiently execute restoration requirements and expedite the cleanup process. These agreements include IAGs, FFAs, DSMOAs, and Cooperative Agreements (CAs). The DoD uses IAGs and FFAs to involve the EPA and states in the environmental restoration process by detailing the agencies' roles at an installation. DSMOAs are agreements between the DoD and the state specifying that the DoD will reimburse the state for specific services the state will provide in support of DERP activities at DoD installations. After signing a DSMOA with the DoD, a state may obtain a CA. CAs are agreements detailing the work plan and funding for DERP activities at DoD installations.

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3 MANAGEMENT OF AN RI/FS DURING A MUNITIONS RESPONSE

Management of an RI/FS requires a collaborative working relationship with regulators, stakeholder involvement, teamwork, and diligent planning to ensure the collection of site-specific data needed to design an effective munitions response, avoid the collection of unneeded data, and manage uncertainty.

USACE's TPP process, which mirrors the EPA's Systematic Planning and is widely accepted by Army installations, is the Army's recommended planning framework for use during the RI/FS.

Using the TPP process, the MR Project Team will:

- develop a problem statement;
- outline the available alternatives;
- determine the basic and optimum data needs while managing uncertainty; and
- focus on the collection of the site-specific data needed to determine the appropriate remedial alternative instead of attempting to resolve all uncertainty.

The following sections discuss the general management of an RI/FS, including identifying and managing MRAs and MRSs, implementing the TPP process, and managing uncertainty during a munitions response.

3.1 Management of MRAs and MRSs

During development of the Munitions Response Site Prioritization Protocol (MRSPP) (32 CFR Part 179, 2005), the DoD developed two new terms, MRA and MRS. An MRA is any area on a defense site that is known or suspected to contain UXO, DMM, or MC. An MRA is composed of one or more MRSs." An MRS is a discrete location within an MRA that is known to require a munitions response." If an MRA contains multiple MRSs, the sum total of the MRS acreages must equal the MRA acreage. After an investigation, an MRS may require a munitions response or NAA. It should be noted that the MRSPP is applied at the MRS level.

Because an MRA is often a large geographic area that may encompass an entire former military range with thousands of acres, the MR Project Team may, after development of a CSM for the installation or MRA, subdivide an MRA into one or more MRSs. Understanding the munitions-related activities that occurred at different areas within the MRA provides a better understanding of how each area was used. Because an MRS's use greatly impacts the munitions response requirements, particularly when addressing MEC, different response actions (e.g., surface removal, subsurface removal, no removal, LUCs) may be appropriate for different portions of an MRA. This would allow for subdivision to

MRSs. Management of MRAs and MRSs is similar to the management of operable units and exposure areas during a Hazardous Toxic Radioactive Waste (HTRW) RI/FS.

Figure 3-1 depicts the relationship between an MRA and an MRS at a typical installation. In Figure 3-1, the green area represents an operational range and, therefore, is excluded from the MMRP. Of the remaining installation areas potentially subject to the MMRP, only those areas known or suspected to contain UXO, DMM, or MC should be considered as an MRA. In Figure 3-1, only MRA 1 and MRA 2 (colored orange) are known or suspected to contain UXO, DMM, or MC. Please note that MRA 1 has been further delineated into two discrete MRSs (MRS 1A and MRS 1B), while MRA 2 is composed of only one MRS (MRS 2).All three MRSs (1A, 1B, and 2) require characterization due to their history of munitions use and require a munitions response (e.g., no action, LUCs, or MEC removal). .

This management approach ensures every acre of an MRA is addressed under the MMRP. Subdivision of an MRA into multiple MRSs can be very useful for managing a complex MRA. As previously mentioned, MRSs typically are based on munitions-related activity that occurred at a given area and may include a related group of exposure pathways, involving common receptors, that can easily be presented in the preliminary CSM. Additionally, overlapping temporal and spatial impact areas or ranges can be combined into one MRS, but MRS boundaries should not overlap. Acreage that falls into multiple range features is to be placed into a single MRS. By subdividing an MRA into multiple MRSs, the MR Project Team can focus the design of munitions response activities on those needed to allow the property's safe use and accelerate an MRS's closeout.

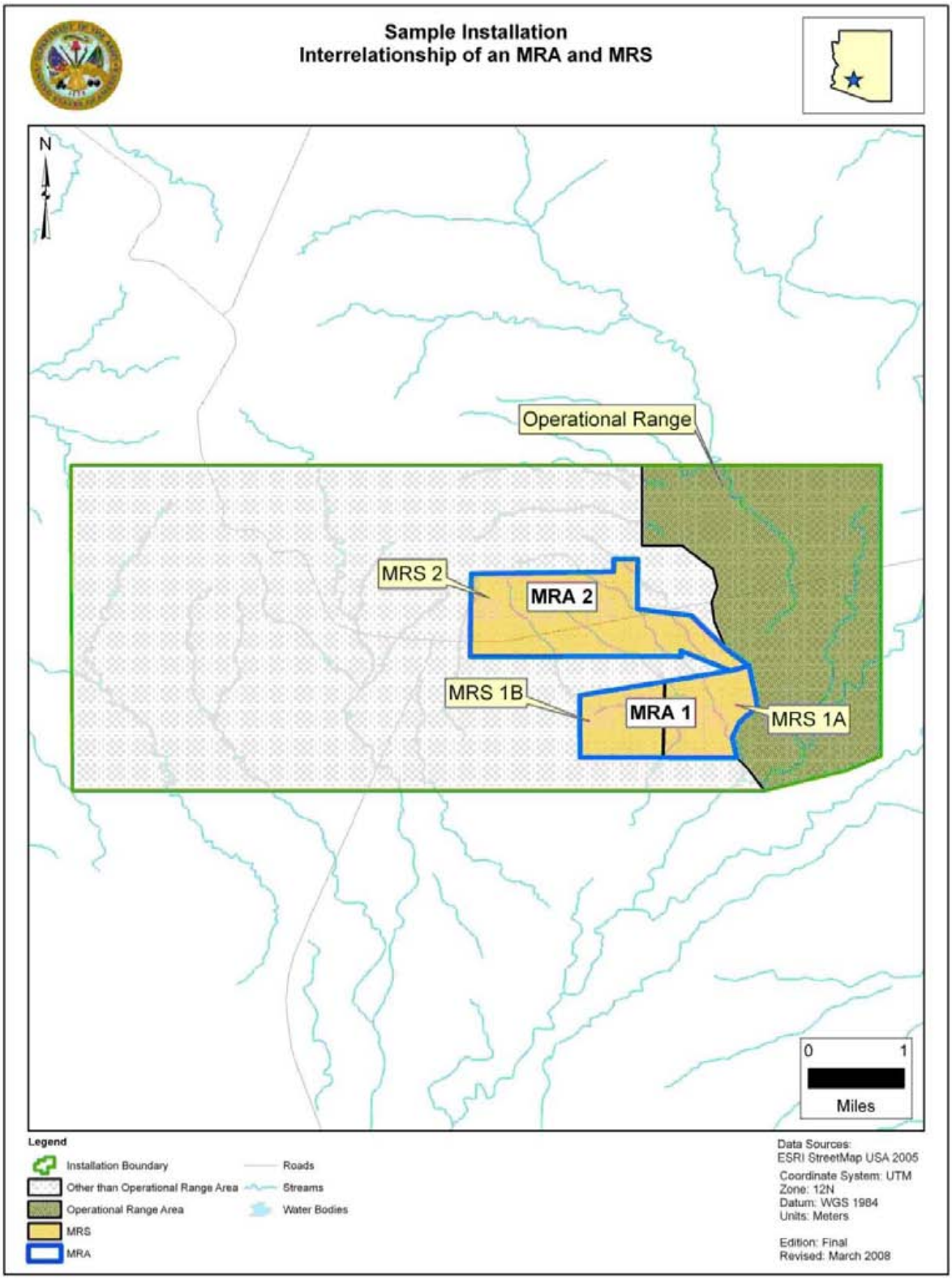


Figure 3-1: Relationship between MRA and MRS

3.2 Technical Project Planning Process

USACE developed the TPP process, shown in Figure 3-2, for identifying project objectives and designing data collection programs for HTRW sites (USACE, 1998a). As a general rule, the Army uses the TPP process framework. Use of the TPP process is consistent with the philosophy of taking a phased approach to planning that produces the type and quality of results needed for site-specific decision-making.

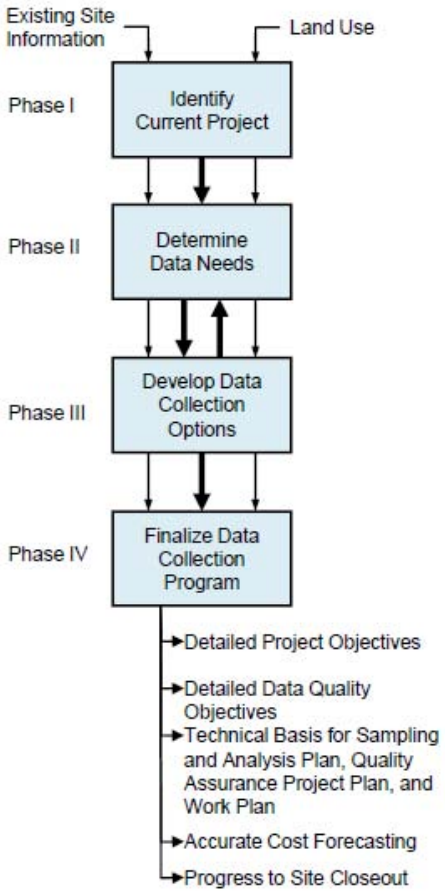


Figure 3-2: TPP Process

Using a team approach and employing the TPP process should facilitate the drafting and finalization of an RI/FS work plan that will allow the decision makers to use the data collected the first time without having to collect phase after phase of additional sampling efforts. The TPP framework provides the MR Project Team the project understanding and documentation to develop and analyze the response alternatives through the feasibility study and implement the chosen alternative to site closeout.

The four-phase TPP process helps to ensure that the requisite type, quality, and quantity of data are obtained to satisfy project objectives that lead to informed decisions and site closeout. The TPP process allows for effective and efficient progress to site closeout within all project constraints. The TPP process saves resources by reducing both the project duration and the project expenditures.

The TPP process develops DQOs as required by the EPA's Systematic Planning process for environmental investigations. The DQO process establishes performance or acceptance criteria that serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study.

The Army RPM should lead the TPP with support from the organizations discussed in Section 2. This section describes the TPP process framework and highlights

RI/FS TPP Process Framework: TPP is the Army's recommended framework for RI/FS project execution. Each RI/FS project execution is unique, directly affecting actual TPP phase execution versus the TPP model described in this guidance. The RPM's overall objective is to execute the RI/FS project within the TPP framework, ensuring collaborative decision-making with all project stakeholders.

the concepts necessary for the RPM to implement the process. Steps for each of the four phases are provided here and are further defined in Chapters 4 through 7.

3.2.1 Phase I – Identify Current Munitions Response Site Project

Phase I activities include bringing decision makers and technical personnel together, identifying the MRS, and documenting the munitions response's objectives. Phase I is designed to "front-load" conflicts and decision-making before field activities commence. The MR Project Team that implements the TPP, including decision makers, data users, and data implementers (see Table 3-1), should be involved during Phase I to create a common understanding of the current response.

Phase I of the TPP process framework includes the following three steps:

1 Identify TPP team members.
2 Prepare a team information package. (Gather existing site data, such as previous studies [e.g., PA, SI].)
   - Identify project goals.
   - Identify the approach for the MRS being addressed.
3 Complete Phase I activities.

Table 3-1: MR Project Team

Planning Perspective	Description	RI/FS TPP Team Members
Decision makers	Individuals with specific interest in the outcome of site-related activities	• Army RPM and USAEC ERM • Federal and state regulators • Property owner, particularly for FUDS and other areas not under DoD control • Other stakeholders
Data users	Technical personnel responsible for evaluations that are the basis for site decision	• Risk assessment perspective – explosive safety experts (e.g., UXO-qualified and explosive safety personnel), human health risk assessors to address MC and incidental environmental contaminants • Compliance perspective – RPM, regulators, legal counsel • Remedy perspective – UXO-qualified and explosives safety personnel, geophysicists, engineers, geologists • Responsibility perspective – legal counsel (as appropriate)
Data implementers	Technical personnel responsible for identifying data collection methods suitable for satisfying the users' data needs	• UXO-qualified personnel • Field team leaders

The outcome of Phase I is a Memorandum for Record (MFR) (For FUDS, referred to as the Phase I Planning Memorandum) documenting the MR Project Team's findings and decisions during Phase I. Section 4.1 further describes the information collection for Phase I, and Appendix D provides example Phase I TPP worksheets.

3.2.2 Phase II – Determine Data Needs

Phase II activities involve an evaluation to determine if additional data are needed to satisfy the MRS-specific munitions response objectives. It is critical to document the data needed for the decision about required munitions response activities and to tie those requirements directly to specific objectives. It is equally important to avoid collecting unneeded information. These data needs are used in Phase IV to create appropriate DQOs for the munitions response.

Phase II of the TPP process includes the following three steps:

1 Review Phase I MFR.
2 Determine Phase II information.
   - Establish data users' roles (risk and hazard, compliance, remedy, and responsibility).
   - Evaluate use of existing data.
   - Define data needs by data user role.
   - Evaluate the relevance of the data need to the current project objectives (basic, optimum, and excessive data needs).
   - Determine data collection approaches.
3 Complete Phase II activities.

When developing data requirements, it is helpful to determine whether the desired data will support decisions about the munitions response activities needed to allow the MRS's safe use for its intended purpose. Categorizing the intended data needs as basic, optimum, and excessive is a powerful way to prioritize collection efforts to meet the munitions response's objectives developed in Phase I and avoid collecting unnecessary data. Basic data provide information to select from among response alternatives and are required to complete the current executable stage. Optimum data help refine the cost of each response alternative and scope the response with the lowest implementation risk. Optimum data are needed to complete future executable stages. Excessive data are not needed to complete either of these stages. As such, their collection should be avoided. Table 3-2 provides possible examples of basic, optimum, and excessive data needs. However, it is critical that the RPM keep in mind that each MRS is unique and the data needs will vary based on multiple considerations. For example, for a large site (e.g., 500 acres), it may not be reasonable to excavate 100% of the site; however, if you have a small site (e.g., 1–2 acres), it may be reasonable to do 100% excavation.

Table 3-2: Example Data Needs Categorization

Data Needs Category	Basic	Optimum[a]	Excessive
Description	Required to select from among response alternatives	Helps refine the cost of each response alternative. Scopes the response with the lowest implementation risk.	Not required to support a decision
MRS characterization	Define the MRS boundary.	Conduct appropriate digital geophysical mapping to refine MRS boundary delineation.	Conduct digital geophysical mapping (DGM) of 100% of the MRS.
	Identify the munitions related activates, types and penetration depths involved through an archives search.	Identify the munitions types by surveying a small percentage of the site with geophysical methods and removing all selected anomalies. Determine the mobility of MC.	Identify the munitions types by removing all detected anomalies.
	Identify the MC present and extent of MC.		Sample groundwater for immobile MC (e.g., sampling for lead when groundwater is greater than 50 feet below ground surface)

[a] Optimum data needs require a strong rationale for a percentage of inspection of anomalies, preferably one with which regulators agree to the significance.

The outcomes of Phase II are the data needs worksheets documenting any potential hazards and risks, compliance, remedy, and responsibility data perspectives. Section 4.2 further describes the information collection for Phase II, and Appendix D provides Phase II TPP data needs worksheet examples.

3.2.3 Phase III – Develop Data Collection Options

During Phase III, investigation approaches are planned and data collection options are developed and documented. Phase III is designed to support planning field investigations that satisfy the data needs for munitions response. Data implementers and data users are the primary MR Project Team members needed to complete Phase III. Phase III includes three steps:

1 Review Phase I MFR and Phase II data needs.
2 Plan data collection options.
3 Document data collection options.

The outcomes of Phase III are the data collection options available to fill the data needs identified in Phase II. Section 4.3 further describes the decisions for Phase III, and Appendix D provides Phase III TPP data collection options worksheet examples.

3.2.4 Phase IV – Finalize Data Collection Program

Phase IV activities challenge the MR Project Team to discuss data collection options and finalize a data collection program that best meets the short- and long-term goals for an MRS. Phase IV is designed to provide guidance for documenting data collection programs with munitions response–specific DQO statements for the MRS being addressed. DQOs and example DQO statements are discussed in detail in Section 4.4.1. The decision makers should be involved with the data users and data implementers in the selection of the data collection program. The data implementers and data users should be responsible for developing DQOs. Phase IV includes the following three steps:

1 Review Phase I MFR, Phase II data needs, and Phase III data collection options.
2 Choose data collection options.
3 Finalize Phase IV.
   - Document DQOs.
   - Prepare work plan (see Section 4.4.2).
   - Prepare fact sheets.

The following elements are compiled from the first three phases to create a DQO statement:

- Data user perspective
- Munitions-related activities
- MC contaminant of interest or categories of munitions (UXO, DMM) by type
- Media of interest
- Data collection method for UXO and DMM
    - Determination of geophysical requirements (e.g., transects, thresholds)
    - Selection of anomalies for investigation (discrimination)
    - Determination of number of anomalies that require investigation
    - Excavation of subsurface anomalies identified for investigation
- Data collection method for MC, to include the following:
    - Required sampling areas or locations and depths identified
    - Number of samples required
    - Reference concentration of interest or other performance criteria identified
    - Sampling method
    - Sampling media
    - Analytical method

The MRS RPM and technical personnel must document the decisions made during TPP efforts to contribute to the institutional knowledge of an MRS and for presentation in required MRS-specific plans (sampling and analysis plans, work plans). Documentation should, as appropriate, include specific DQOs, the RI/FS work plan, and a fact sheet. Section 4.4 further describes the finalization in Phase IV, and Appendix D provides DQO worksheet examples.

3.3 Managing Uncertainty

It is important to realize that the level of uncertainty about the distribution and quantity of MEC present may be high for a munitions response prior to conducting the RI. This is less true when only MC, even when in concentrations high enough to pose an explosive hazard, are being addressed because the extent of MC, like for other HTRWs, is easier to quantify (i.e., determine the average residual concentration). However, the level of uncertainty about the distribution and quantity of MC should still be considered and managed in project planning.

Each MRS may have a different history with many unknown factors. For example, the period of use may only be known to the nearest decade. The number of soldiers trained and the types and quantity of munitions used (e.g., per soldier, per training event) may only be estimated from historical information about the training requirements of the period or by using current training requirements. UXO resulting from use may be estimated based on dud rates for each munitions, which may not exist, or an accepted dud rate for the period. Dud rates vary among munitions items. The number of munitions disposed of by burial (DMM) may only be determined from historical records (if any specific information can be found) or by excavation.

Additional uncertainty is expected with the available MEC remedial alternatives. Given the limitations in current detection technologies, some MEC might not be detected or removed during a munitions response. Although any residual risks can be managed (e.g., by use of agreed upon LUCs, to include safety education, 5-year reviews, and construction support), residual explosive hazards might still exist. The potential explosive hazards associated with any residual MEC present at an MRS pose a different hazard (acute) than does low concentrations of MC or other environmental contaminants.

The EPA understands the level of uncertainty during the RI/FS. According to the EPA RI/FS guidance (1988):

> *The objective of the RI/FS process is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given MRS.*

In addition to developing data needs based on specific project objectives and data user perspectives through the TPP process, the MR Project Team should seek to document any uncertainty identified during planning.

An uncertainty categorization matrix can be a useful tool in documenting and achieving consensus on uncertainty management. A categorization matrix clearly outlines the remaining uncertainties and the basis for selecting the management technique applied. Uncertainty can be reduced through focused data collection or mitigated through contingency plans. Table 3-3 provides the details of the factors

used in an uncertainty categorization matrix and examples of managing uncertainty using this method.

Both examples provided in Table 3 refer to an MRA with two MRSs—a rifle range from the 1960s and a grenade range from the 1940s located near each other. In our examples, uncertainty arises during Phase I of the TPP because a historical map brings into question the location of the grenade range and whether the boundaries of the two ranges overlap.

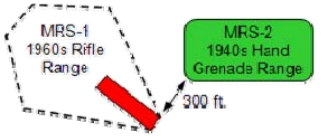
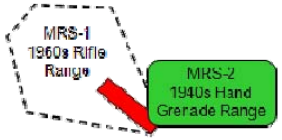
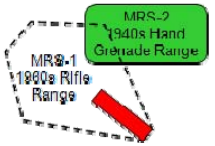
In Example 1, the consequence of the grenade range boundary overlapping the firing point portion of the rifle range is assessed. If an MRS that is suspected of only containing MC (MRS 1) is found to contain UXO, the scope of the investigation changes significantly, as do procedures for protecting on-site workers.

In Example 2, the consequence of the safety fan from the rifle range overlapping the grenade range is assessed. If an MRS that is suspected of containing MEC (MRS 2) is also found to contain MC in the form of lead, the required response may need to be changed to address any health hazards present. However, the impact of such changes is less significant. The MR Project Team would need to consider scoping additional MC sampling in the event that this uncertainty is found to be true.

3.4 Project Management Summary

Application of the TPP process is the recommended framework for the Army's MMRP RI/FS. The TPP process provides the Army's project manager with a method to achieve concurrence among the TPP participants. Section 4 describes the various information and options applicable to the TPP process, and Appendix D should be used as a resource for the TPP process.

Table 3-3: Uncertainty Categorization Matrix

Characterization	Description	Example 1	Example 2
Probable condition	This is the assumed value for the unknown parameter or condition, given all available data.	MRS-1 (1960s rifle range in red with white safety fan) is suspected to contain only small arms ammunition (< .50-caliber).	MRS-2 (1940s hand grenade range, in green) is suspected to contain only grenades.  **Probable Condition**
Reasonable deviation	This includes all reasonable deviations from the expected condition.	MRS-2 (1940s grenade range) boundary overlaps with MRS-1.  **Example 1 Reasonable Deviation**	MRS-1 (1960s rifle range) safety fan overlaps with MRS-2.  **Example 2 Reasonable Deviation**
Probability of occurrence	This is a qualitative statement of the likelihood that the assumed condition is incorrect (i.e., high, medium, or low).	Low – Historical maps and photograph analysis indicate that ranges were separated by 300 feet.	Low – Historical maps and photograph analysis indicate that ranges were separated by 300 feet.
Time to respond	This is an estimate of how long the project team would have to correct for a deviation if the assumed condition is incorrect.	Long	Short
Potential impact	This is an indication of how the deviation would impact response effectiveness or attainment of remedial action objectives.	High – • Threat to worker safety • Delay of investigation schedule • May require change in MRESS.	Low – • Easy to add lead media sampling • No impact to worker safety • Lead shot stabilization or removal will be considered in FS.
Monitoring/ investigation	This identifies the means by which the uncertain parameter or condition could be monitored to detect deviations from the assumed condition.	Investigate MRS 2 prior to MRS 1 to determine whether MRS 2 boundary is clear.	Identify lead shot if found during investigation and be prepared to collect additional lead samples.
Contingency plan	This identifies the course of action to be taken if monitoring indicates that a significant deviation does exist.	Develop contingency plans for investigation of MRS 1; analyze cost impacts to ensure available funding.	Minimal impact on investigation

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4 SCOPING THE RI/FS

During the scoping stage, the TPP process guides collection of existing data and other available information to develop the RI/FS work plan. The work plan describes the tasks required to conduct the RI/FS. The activities conducted during the scoping step of the RI/FS process are shown in Figure 4-1 and described in the following sections.

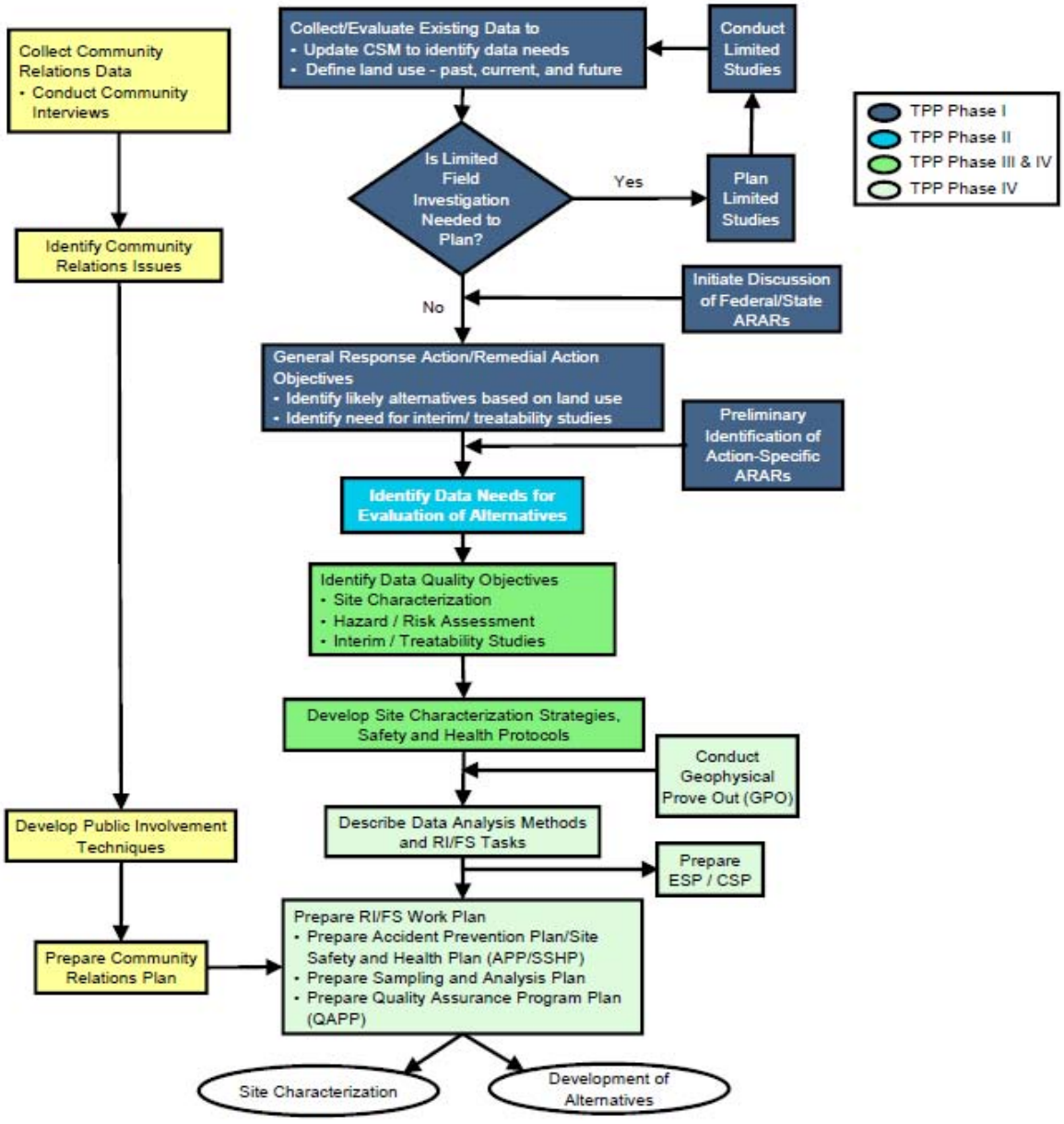

Figure 4-1: Scoping the RI/FS

4.1 Site Understanding and Initial Evaluation – TPP Phase I

To determine the need for additional site characterization, the MR Project Team must understand the available information for the MRS. Based on the evaluation of available data, additional site characterization may or may not be necessary to complete the RI/FS. TPP Phase I allows the MR Project Team to develop a common understanding and come to consensus on the need for further investigation by completing the Phase I MFR worksheets.

TPP PHASE I – IDENTIFY CURRENT PROJECT

1. Identify TPP team members.
2. Prepare a team information package.
3. Complete Phase I activities.

TPP PHASE II – DETERMINE DATA NEEDS

TPP PHASE III – DEVELOP DATA COLLECTION OPTIONS

TPP PHASE IV – FINALIZE DATA COLLECTION PROGRAM. PUBLISH THE RI/FS WORK PLAN.

In TPP Phase I, the RPM first identifies the key members of the TPP team in terms of decision makers, regulatory participants, and data users or implementers. Once the TPP team is identified, the RPM prepares and distributes a team information package to the key project team members. The following information is the minimum suggested content for the team information package:

- Team members – List team members by name and their role for the project
- Goals for the project – Present the general understanding of the current executable stage (for example, “Complete an RI/FS for MRA 1.”)
- Project schedule and budget
- Index of the Administrative Record and relevant correspondence to date
- Summary of the existing CSM and available site data

At the RI stage, much information may be available for the MRS. The previous studies at the MRS could include Archive Search Reports or Historical Records Reviews (HRRs), Wide Area Assessments (WAAs), PAs, SIs, and Engineering Evaluation/Cost Analysis’. Response actions that may have occurred could include explosives or munitions emergency, a WAA, a PA, an SI, a removal action (TCRA or NTCRA), or a remedial action. Reports from these studies or responses provide valuable information on the background of the MRS.

The TPP team is brought together to discuss the project goals and objectives and identify an approach to the MRS or for the planned response. The working relationships established at this time can make or break the investigation, so a great deal of careful planning and coordination should be conducted. Using the Phase I MFR worksheets facilitates information collection. Table 4-1 provides MFR required information and a MFR example is included in Appendix D.

Table 4-1: Phase I MFR Components

MFR Component	Subcomponents	Examples
TPP team	Decision makers	• Army • EPA • State regulatory agencies • Property owners
	Data users – risk, compliance, remedy, and responsibility	• Army • Consultants
	Data implementer – data collection, sampling, and analysis	Consultants
TPP team goals	Future land use	• Residential • Industrial • Open space
	Regulatory compliance	• Ecological MEC hazard not well defined • Identify potential ARARs • Understanding level of uncertainty and potential human health or ecological risks from UXO, DMM, and MC • Risk acceptance
	Interim site closeout goal (if applicable)	Restrict public access to the site.
	Site closeout statement	Reduce the risk at an MRS to a level that allows safe use.
	Schedule requirements	Project milestones
	Site budget	Current budget
Identify site approach	Existing site information and data – attachments to the MFR, Administrative Record, preliminary CSM	• Listing of available documents • Summary of the CSM
	Potential points of compliance	Interface of groundwater to surface water discharge of MC
	Media of potential concern	• Surface soil • Subsurface soil • Groundwater • Surface water • Sediment
	Project objectives (attach worksheets)	See Table 4-2
	Regulators perspectives	• Safety • Regulatory compliance • ARARs
	Community interests	• Revenue • Safe use of property • Safety

MFR Component	Subcomponents	Examples
Identify site approach (continued)	Other interests	• Agency for Toxic Substances and Disease Registry • USACHPPM • USAEC • EM CX • USATCES • DDESB
	Probable remedies	• No action • LUCs • Surface MEC removal • Subsurface MEC removal • Excavation or stabilization of MC
	Executable stages to site closeout	• RI/FS • Proposed plan • ROD/DD • Remedial design • Remedial action • Restoration complete • Five-year reviews
Identify current project	Site Constraints and dependencies Administrative constraints and dependencies	• Budget limitations • Rights of entry • MRESS exclusion zone (EZ) and evacuation requirements • Ability to manage uncertainty
	Technical constraints and dependencies	Technology limitations
	Legal and regulatory milestones and requirements	• Regulatory threshold for MEC • ARARs • Rights of entry
	Current executable stage	RI/FS
	Basic project objectives	Insert numbers from project objectives worksheet
	Optimum project objectives	Insert numbers from project objectives worksheet
	Excessive project objectives	Insert numbers from project objectives worksheet

The project objectives worksheet and the completion of an example project objective are shown in Table 4-2. An example project objectives worksheet is included in Appendix D, RPM Guide.

Effective collection and discussion of worksheet information is crucial to the project moving forward. The RPM should use display media wisely. The project objective worksheets easily can be displayed via a projector with someone filling in the forms real-time during the group discussion.

The preparation of the Phase I MFR using the information gathered during MR Project Team discussions is the final step. The following sections provide in-depth discussion of the specific RI/FS project components.

Table 4-2: Example Project Objective Worksheet

Project Objective					Data User(s)	Project Objective Classification
#	Executable Stage		Description	Source		
	Current	Future				
Ex. 1	X		Eliminate from further consideration those areas that pose no significant threat to public health or the environment.	CERCLA 40 CFR 300.420	☒ Risk ☐ Compliance ☐ Remedy ☐ Responsibility	☒ Basic ☐ Optimum ☐ Excessive

4.1.1 Evaluation of Land Use and Potential Receptors

A goal of a CERCLA response is to return the property to allow for its safe use. Therefore, the property's end use is a critical factor in selecting a response alternative. The RI is implemented to sufficiently fill the data needs for comparing remedial alternatives. Agreement on land use and the level of control the Army will have over the property is key to developing the data needs. As discussed previously, the Army is conducting munitions responses on MRSs that are under Army control, transferring from Army control, or outside of Army control. Therefore, the MR Project Teams will need to consider the level of authority the Army will have over land use.

4.1.2 U.S. EPA's Reuse Assessment

The EPA's Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-06P Reuse Assessments: A Tool To Implement the Superfund Land Use Directive (2001) reaffirms OSWER Directive 9355.7-04 Land Use in the CERCLA Remedy Selection Process (1995) (the Superfund Land Use Directive) and introduces the "Reuse Assessment" as a tool to help implement the Superfund Land Use Directive.

The Superfund Land Use Directive provides basic information on developing and using assumptions about land use to support remedial actions. Integrating realistic assumptions of future land use into remedial actions is an important step toward facilitating the reuse of sites following cleanup. Information obtained from the reuse assessment can be particularly useful during the planning stages of a remedial action. The resulting assumptions of reasonably anticipated future use can be considered as part of the following:

- The baseline risk assessment when estimating potential future risks
- The development of remedial/removal action objectives and the development and evaluation of remedial alternatives
- The selection of the appropriate remedial action required for the protection of human health and the environment

4.1.3 Conceptual Site Model Evaluation

A CSM is a description of a site and its environment based on current knowledge. It describes the source of UXO, DMM, or MC; the potential receptors based on land use; and exposure pathways. At active Army installation and FUDS MRSs, an initial CSM was created during the SI. For BRAC properties, a CSM, if not already prepared, should be developed with available information using the USACE's EM 1110-1-1200 *Engineering and Design - Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Waste (HTRW) Projects* (2003k).

CSMs contain information on the profiles shown in Table 4-3 Examples of potential revisions at the scoping stage are included.

Table 4-3: CSM Profiles, Information Needs, and Revisions

Profile Type	Typical Information Needs	Potential Changes at RI Scoping Stage
Facility profile	• All structures, sewer systems, process lines, underground utilities • Physical boundaries (past and current), fencing, administrative controls • Current and historical process and manufacturing areas • Military munitions activity areas (firing points, impact areas, storage areas, munitions manufacturing, or disposal areas) • Storage and waste disposal • Historical features that indicate potential source areas (landfills or lagoons, ground scars, impact craters)	• Facility changes • Ownership changes • Property owner changes land use • New boundaries in place • New historical data found
Physical profile	• Topographic and vegetative features or other natural barriers • Surface water features and drainage pathways • Surface and subsurface geology, including soil type and properties • Meteorological data • Geophysical data • Hydrogeological data for depth to groundwater and aquifer characteristics • Other physical site factors that affect site activities • Soil boring or monitoring well logs and locations	• Floods • Fires • Frost heave • Property owner changes land use • Soil borings or monitoring wells installed near the MRS
Release profile	• Determination of contaminant movement from source areas • Contaminants and media of potential concern • Munitions types • Impact of chemical mixtures and collocated waste on transport mechanisms • Locations and delineation of confirmed releases with sampling locations • Migration routes and mechanisms (HTRW and MC) • Modeling results	• Floods • Fires • Frost heave • Erosion

Profile Type	Typical Information Needs	Potential Changes at RI Scoping Stage
Land use and exposure profile	• Receptors associated with existing and reasonable future land use on and near the facility (residential, recreational, commercial, agricultural, industrial, public forest, etc.) • Zoning (applicable to transferred sites within the active program, BRAC sites, and FUDS) • Types of existing or future activities at the facility, including frequency and nature of activity (intrusive or nonintrusive) • Beneficial resource determination (aquifer classification, natural resources, wetlands, cultural resources, etc.) • Resource use locations (water supply wells; recreational swimming, boating, or fishing areas; hiking trails; grazing lands; historical burial grounds; etc.) • Demographics, including subpopulation types and locations (schools, hospitals, day care centers, site workers, etc.)	• Property owner changes land use • Better understanding of land use activities • Demographic changes • New facilities in or around MRS
Ecological profile	• Description of the property at the facility, including habitat type (wetland, forest, desert, pond, etc.) • Primary use of the property and degree of disturbance, if any • Identification of any ecological receptors in relation to habitat type (endangered or threatened species, migratory animals, fish, etc.) • Relationship of Army releases of hazardous substances to potential habitat areas (locations, sampling data, migration pathways, etc.)	• Floods • Fires • Frost heave • Ecological studies performed in surrounding areas

Graphical representations of the exposure pathway explain the completeness of a given pathway. The exposure pathway between a source and a receptor for UXO and DMM requires access to MEC and an activity (e.g., moving, touching) allowing contact with these categories of MEC. Exposure pathways for MC, regardless of concentrations, require an exposure medium (e.g., soil) and an exposure route (e.g., dermal contact) with a release mechanism and a transport medium sometimes being present. Examples of a CSM are provided in Figures 4-2 (wire frame) and 4-3 (three dimensional [3D]).

The CSM provides an organized approach to identifying data needs. Figure 4-2 and Figure 4-3 show complete, potentially complete, and incomplete pathways. The data needs for an MRS depend on this evaluation. The pathways should be considered as follows:

- Incomplete pathways: No risk or hazard is associated with the pathway. No further data are required to confirm the pathway is incomplete.

- Potentially complete pathways: Data needs determine if pathway is complete. If the pathway is determined to be incomplete, there is no risk or hazard. If the pathway is determined to be complete, a potential risk or hazard exists.

- Complete pathways: Complete pathways imply potential risks or hazards that may exist and need to be addressed by managing the pathway. Examples of data needs for complete pathways include GPOs or the institutional analysis to determine the effectiveness of LUCs.

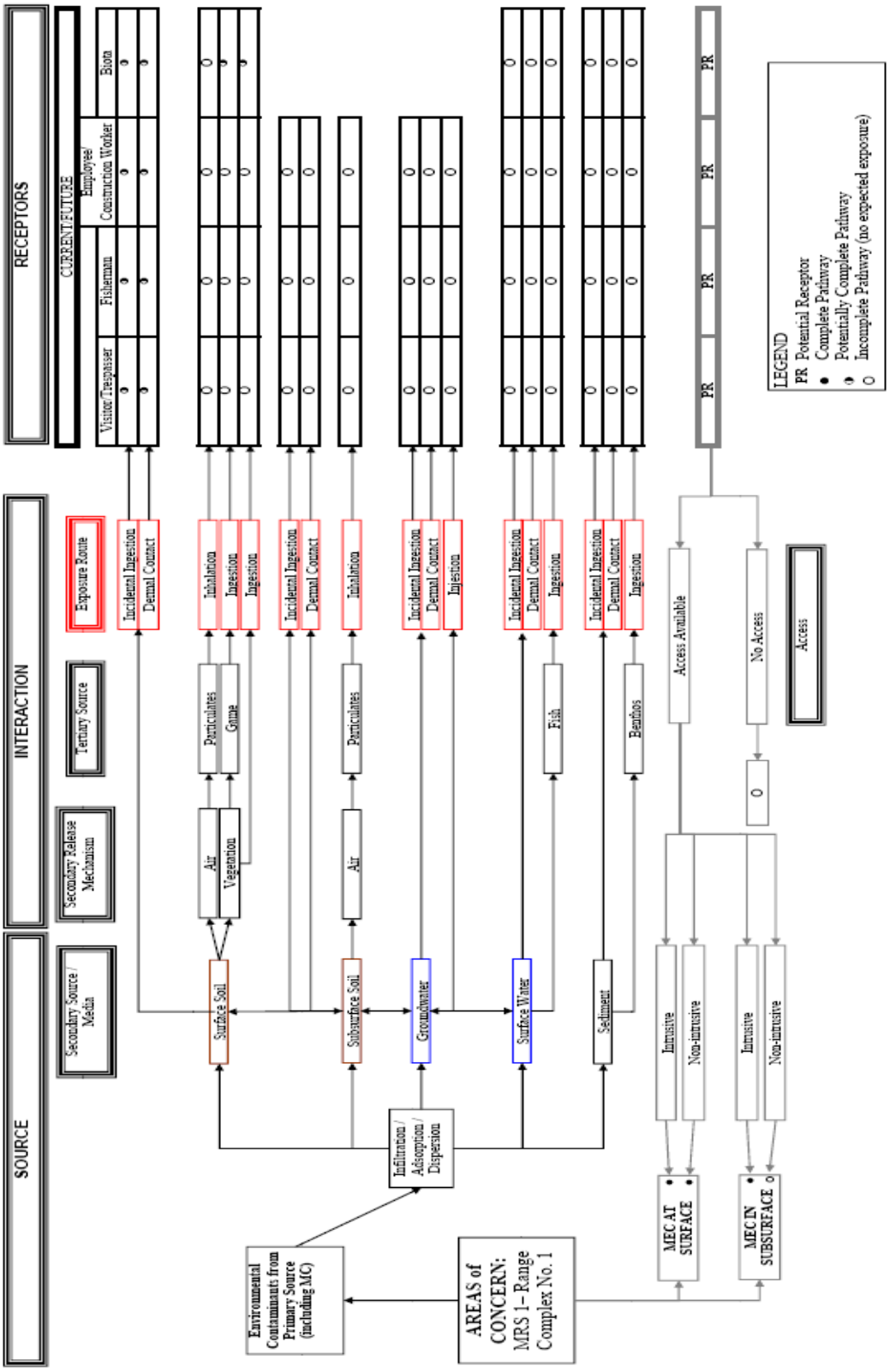

Figure 4-2: Wire-frame graphical representation of CSM

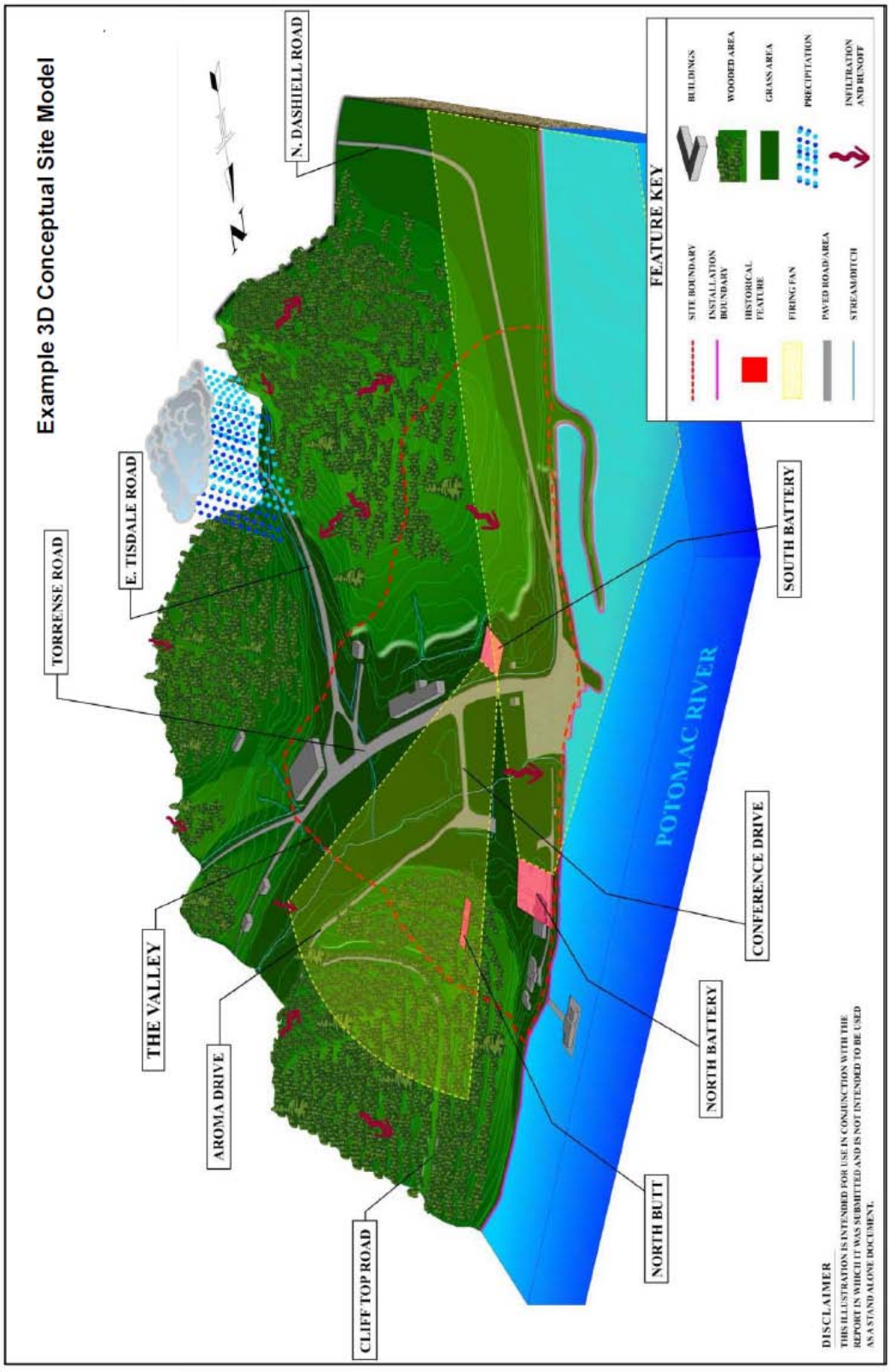

Figure 4-3: 3D graphical representation of CSM

4.1.4 Initial Response Alternative Evaluation

The potential remedial alternatives for an MRS containing MEC include, but are not limited to, a remedial action (e.g., surface or subsurface removal, stabilization, in situ capping), use of LUCs, or a combination of these responses. In most cases, some form of LUCs will be required to manage risk posed by any residual MEC present. No Further Action (NFA) or No Department of Defense Action Indicated (NDAI) (FUDS program only) are also options for sites. In addition, CERCLA requires the evaluation of the no action alternative in the FS (EPA, 1988).

In the FS, the potential alternatives are evaluated based on the NCP nine criteria, shown in Table 4-4.

Table 4-4: NCP Nine Criteria

Category	Criterion	Description
Threshold criteria	Overall protection of human health and the environment	Addresses whether specific alternative will achieve adequate protection and describes how UXO, DMM, or MC at the site will be eliminated, reduced, or controlled through treatment, engineering, and/or LUCs. For MC, meeting this criterion is related to the calculated risk reduction achieved through the chosen response and the short- and long-term effectiveness of the response. Because there is not an established threshold for MEC hazard, the goal is to effectively minimize or eliminate the exposure pathway between the MEC and receptor.
	Compliance with ARARs	Addresses whether a remedial alternative meets all selected federal and state environmental statutes and regulations. To be acceptable, an alternative shall comply with ARARs or be covered by a waiver.
Primary balancing criteria	Long-term effectiveness and permanence	Addresses the ability of a remedial alternative to maintain reliable protection of human health and the environment over time. Considers the magnitude of residual risk/hazard, the adequacy of the response in limiting the risk/hazard, and whether LUCs and long-term maintenance are required.
	Reduction in toxicity, mobility, or volume through treatment	Addresses the preference for remedial actions that use treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of any MC-related contaminants or removing any MEC reasonably possible to detect. The achievement of this criterion depends on the irreversibility of the response and the amount of UXO, DMM, and MC removed from the MRS.
	Short-term effectiveness	Addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during implementation. MEC removal poses risks to workers and the public that are not associated with environmental contaminants that must be considered and controlled.

Category	Criterion	Description
Primary balancing criteria (continued)	Implementability	Addresses the technical and administrative feasibility of implementing a remedial alternative from design through completion. Factors such as availability of services, materials, and operational reliability are considered. A significant factor of this criterion is the ability to attain rights of entry for FUDS and off-post active Army MRSs.
	Cost	Addresses the total cost of a remedial alternative, including consideration of the capital costs, annual operation and maintenance (O&M) costs, and net present value of these costs.
Modifying criteria	State acceptance	Addresses the acceptability of a remedial alternative to state regulatory agencies.
	Community acceptance	Addresses the acceptability of a remedial alternative to the public.

The overall criterion for the protection of human health and the environment is evaluated differently for MC and MEC, particularly UXO and DMM. For MC, this criterion typically is evaluated based on a threshold value (e.g., action level). Threshold values do not exist for MEC; therefore, the criterion typically is considered in terms of reduction in explosive hazard.

4.1.5 Initial ARARs Evaluation

Cleanup standards are determined by ARARs of any federal and state promulgated laws or regulations that are determined to apply to the MRS. Section 121 of CERCLA states that the following may be ARARs for the hazardous substance, pollutant, or contaminant concerned:

- Any standard, requirement, criteria, or limitation promulgated under any federal environmental law

- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility siting law that is more stringent than any federal standard, requirement, criterion, or limitation and that has been identified to the Army by the state in a timely manner.

ARARs constitute only those substantive requirements promulgated in environmental or facility citing laws. Administrative requirements, such as permits and procedural requirements, are not, by definition, ARARs. Any questions about ARARs that can be answered by the investigation should be included in the study (e.g., endangered species—if no threatened or endangered species are found during the RI, threatened and

ARAR Summary:
The RPM should consult legal counsel, who should work closely with the EPA and the states to ensure each is notified of the requirements the others have determined to be applicable or relevant and appropriate and to ensure appropriate ARARs are identified and considered at critical steps in the remedial planning process (USAEC, 1998).

endangered species would not be an applicable requirement). Because this is an initial evaluation, ARARs are not defined during this stage but are fully defined during the FS.

Compliance with ARARs is a threshold criterion in remedy selection; therefore, determining the ARARs and whether a remedy will comply with them is of critical importance to the remedial action. The NCP states an applicable requirement is one specifically addressing a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site. If it is determined that a requirement is not applicable to a specific release site, then the requirement is examined to determine if it is relevant and appropriate to the circumstances of the release. A requirement must be both relevant and appropriate in order to be an ARAR. A requirement may be relevant but not appropriate. Section 300.400(g)(2) of the NCP is used to evaluate the relevance and appropriateness of requirements.

To be considered requirements (TBCs) are nonpromulgated advisories (such as reference doses or potency factors), criteria, and guidance issued by federal and state governments. TBCs do not have the same status of ARARs; however, Section 300.400 of the NCP specifies that TBCs may be identified, as appropriate, to supplement ARARs where they do not exist or where it has been determined that the ARARs are insufficient to ensure protection of human health and the environment at that particular release (USAEC, 1998).

4.1.6 Preliminary Remediation Goals

In developing an RI/FS work plan, preliminary remediation goals (PRGs) for UXO, DMM, and MC are identified to determine the effectiveness of remedial actions. There are no established PRGs for MEC, particularly UXO and DMM. Rather, the property's use and pathways for exposure to MEC drive the design of the munitions response. In general, the remediation goals for MEC focus on removing or limiting the exposure pathways.

For MRSs with MC or other incidental contamination, medium-specific goals are identified, providing a clear and concise description of what the remedial action should accomplish. When establishing medium-specific goals for MC, background concentrations and whether the goals are analytically achievable should be taken into account. PRGs focus on protecting human health and the environment while allowing for the variation in remedial alternatives—treatment, containment, and removal. Discussion of MC PRGs with the TPP team members is important in order to collect appropriate data.

The EPA published the Regional Screening Table developed by Oak Ridge National Laboratory under an Interagency Agreement with the EPA. The new screening tables, as well as the user's guide and "master" screening table, are online at http://epa-prgs.ornl.gov/chemicals/. The online calculator can be used to

generate "site-specific" screening levels (http://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search).

4.2 Determining Data Needs – TPP Phase II

Evaluating existing site data, determining the data needed to make appropriate and supportable decisions about the site, and identifying methods for collecting that data are the components of the second phase in the TPP process. Phase II can occur in conjunction with Phase I. As the current project is identified, data needs may become apparent to the team. Otherwise, the data needs can be developed following a more thorough review of the Phase I MFR either by teleconference or through electronic communications.

One of the first actions during this phase is to review the Phase I MFR. The key participants are the decision makers and the data users. If any corrections or changes in project information are identified, the RPM should redistribute the revised Phase I MFR to the team. The RPM should then determine the Phase II TPP information required in the following manner.

TPP PHASE I – IDENTIFY CURRENT PROJECT

TPP PHASE II – DETERMINE DATA NEEDS

1. Review Phase I MFR.
2. Determine Phase II TPP information.
3. Complete Phase II activities.

TPP PHASE III – DEVELOP DATA COLLECTION OPTIONS

TPP PHASE IV – FINALIZE DATA COLLECTION PROGRAM

- Establish data user's roles. Data users in the TPP process are technical and other personnel responsible for engineering, scientific, and legal evaluations that are the basis for site decisions. The TPP process identifies four data user perspectives—risk, compliance, remedy, and responsibility. For MMRP projects an additional data user perspective "MEC Hazard" is recommended. The majority of the Army's MMRP RI/FS program does not have a responsibility data user because the Army is responsible for the munitions response.

- Evaluate use of existing data. Existing data were gathered during Phase I and included as part of the CSM. Before defining data needs for the project, existing data usability evaluation occurs. Existing data may be suitable for qualitative and quantitative uses. The team must be aware that some existing data may be of an unacceptable quality for one use, but of acceptable quality for another use. For example, a site reconnaissance may be enough to indicate a removal action is required in a given area; however, it may not provide enough information to evaluate the costs of conducting the removal action. More data may be required to develop accurate cost estimates for planning purposes.

- Define data needs. The team must identify specific data needs for collection in order to support the potential decisions to be made. Data needs are to be documented for each area of concern. The team should:
    - consider the consequences of incorrect decisions or decision errors;
    - consider how much data is required and for what the data will be used;
    - consider data collection approaches, including field screening approaches;
    - consider the cost of additional data collection in dollars and time; and then
    - decide how data needs can be balanced within project cost and schedule constraints.

The following are the four general data sets for characterizing an MRS and analyzing potential remedial alternatives:

Physical nature of the site – the natural, environmental, and cultural features and resources of a site that may affect or be affected by remedial alternatives requiring the use, detection, recovery, or disposal of UXO, DMM, or MC

MRS Characterization:
The RPM should consider the following four general data sets for MRS characterization and analyzing remedy alternatives:
1. Physical nature of the site
2. Characterization of DMM, UXO and MC
3. Regulatory framework
4. Demographics and land use

Characterization of UXO, DMM, or MC – the distribution and characteristics of UXO, DMM, or MC at the site (e.g., ferrous or nonferrous material) that will help determine the applicability of remedial alternatives; the type of UXO, DMM or MC, media concentration, MRS boundary, and any UXO, DMM, or MC present that are needed to determine remedial alternatives

Regulatory framework – the laws, regulations, and guidance that affect the remedial alternatives, to include no action and the use, detection, recovery or treatment, or disposal of any UXO, DMM or MC present at an MRS

Demographics and land use – the distribution, density, characteristics, and changes of the human population and their influences on the way land is used at the site (current and future land use is identified in TPP Phase I). Knowing the property's end use (existing, determined, or reasonably anticipated) is critical to determining appropriate remedial alternatives. The property's end use should be identified as early in the process as possible to determine the appropriate DQOs for site characterization. A full discussion of DQOs can be found in Section 4.4.1.

- Generally, only data needed to support potential decisions, project objectives, and site closeout should be gathered. Each requirement should be labeled as a basic data need, an optimal data need, or an excessive data need. The following six basic questions may help the team members determine the amount of data needed:
  - How much data do I need to determine that an area warrants a no action alternative?
  - How much data do I need to determine that an area requires an accelerated response — TCRA or NTCRA?
  - How much data do I need to determine the potential hazards posed by UXO, DMM, or MC and the relative risk posed?
  - How much data do I need to evaluate a response alternative and develop a realistic cost estimate?
  - How much data do I need to gain regulator and stakeholder concurrence with potential decisions to be made?
  - How much data do I need to develop a LUC plan?

The final step is documentation of the data needs. For MC, the worksheets provided in Appendix D are used to document the risk, compliance, and remedy data needs. For MEC data needs, a tabular or narrative format of each data need and the required specifics is created.

Sections 4.2.1 - 4.2.6 provide in-depth discussion of additional project components. The following types of MRSs are unique in the approach for the RI/FS process. These MRSs require a different level of effort than a more traditional MRS.

4.2.1 Small Arms Ranges

Small arms ranges are military ranges that were used exclusively for live-fire training or testing using only small arms ammunition (see Section 1.2). Small arms ammunition that is unfired and intact or misfired and ejected on any range is considered MEC even though it is not considered to present an explosive hazard. Used small arms ammunition is considered munitions debris, a potential source of MC hazard (e.g., potential lead hazard associated with bullets). Skeet and trap ranges used solely for recreational purposes are not normally designated as MRSs or addressed under the MMRP.

Small Arms Ranges:
The Army has extensive experience in closing small arms ranges. As such, there is substantial information available on the relatively few technical options that should be considered: excavations with screening and/or treatment, in-situ stabilization, or containment.

Typically, the key MC contaminant at small arms ranges is lead. Small arms ranges may also contain antimony, copper, tungsten, and

zinc. Tungsten is included in this list because it was a planned replacement or substitute for lead in some small arms ammunition. Polycyclic aromatic hydrocarbons (PAHs) from nonexploding (nonenergetic) bullets and fragments, bullet jackets, and related sporting material (e.g., clay targets) also pose a problem. For such ranges, the response does not need to consider any munitions present (i.e., small arms ammunition) as posing an explosives safety risk requiring a munitions response. In other words, munitions responses are done on small arms ranges to address MC such as lead, and in the conduct of such, any small arms ammunition found incident to such a response is removed. Traditional RI/FS guidance likely is applicable to small arms ranges if it is confirmed that no other munitions were used on the range.

The Interstate Technology and Regulatory Council (ITRC) has prepared a document discussing the investigation and response to small arms ranges entitled Characterization and Remediation of Soils at Closed Small Arms Firing Ranges (2003). Additional guidance for small arms ranges can be found in the EPA documents Best Management Practices for Lead at Small Arms Ranges, EPA/902/B-01/001, June 2005 and Technical Review Workgroup for Lead (TRW) Recommendations for Performing Human Health Risk Analysis on Small Arms Shooting Ranges, OSWER #9285.7-37, March 2003.

4.2.2 Chemical Warfare Materiel (CWM) Sites

A CWM response is a munitions response that addresses the chemical safety; explosives safety, when applicable; human health; or environmental risks presented by chemical agent–filled munitions or chemical agents in other than munitions configurations (collectively referred to as CWM) at an MRS known or suspected to contain CWM (referred to as a CWM site).

Only a limited number of CWM sites are in the Army's MRS inventory. CWM sites are on active Army and BRAC installations and FUDS. Although an RI/FS for a CWM site is similar to one for an IRP site or an MRS that does not contain CWM, a multitude of challenges make the RI/FS at CWM sites unique. These include the potential for exposure to toxic chemical agents that are designed to rapidly induce acute health effects. This potential necessitates stringent safety procedures; requires compliance with a complex web of regulations; mandates additional coordination with emergency response providers (e.g., medical personnel, hospitals) and planning; and can heighten regulatory and public scrutiny. Additionally, an RI/FS at a CWM site may require the use of specialized monitoring equipment or a need to comply with U.S. treaty obligations.

CWM Sites:
Due to complexity and to ensure consistency, the USACE's Huntsville Engineering and Support Center's Recovered Chemical Warfare Materiel (RCWM) Design Center manages all CWM responses, including support requirements for the Army.

The 20th Support Command, Chemical, Biological, Radiological, Nuclear, High-Yield Explosives Analytical and Readiness Activity is responsible for responding to explosives or munitions emergencies that involve munitions with an unknown liquid fill or CWM and for supporting CWM responses.

Due to the limited number of sites and the complexity of addressing the technical, safety, regulatory, and public relations issues, work at these sites is only managed and executed by a small cadre within the Army. The Huntsville EM CX is USACE's Center of Excellence for RCWM. There is also a separate RCWM Design Center located within the Huntsville Center. The U.S. Army Engineering and Support Center, Huntsville (USAESCH) is the only USACE command authorized to execute CWM remedial actions (USACE, 1999c). Typically, USACE manages RCWM investigations and is supported by the Project Manager for Non-Stockpile Chemical Materiel who is responsible for the destruction of CWM.

4.2.3 Munitions with an Unknown Liquid Fill

For explosives and chemical safety reasons, the positive identification of recovered munitions is required before demilitarization, destruction, or disposal. This is particularly true with regard to munitions that can be filled with chemical agent and could present both an explosive and a downwind chemical vapor hazard. Should a munitions item with an unknown liquid fill be encountered at other than a CWM site, all intrusive activities must stop, and the munitions or explosives emergency response procedures must be initiated. Prior to resumption of intrusive activities, the plan of action and procedures for the site must be reviewed and changes should be made as necessary to assure workers and the public are adequately protected.

Although many munitions have sufficient physical properties (for example, design characteristics, marking) that allow technically qualified personnel to positively identify the munitions and the filler, the design or physical condition of some munitions may not allow their positive identification by visual inspection. Munitions whose external design does not always allow positive identification of their filler include, but may not be limited to, 4.2-inch mortars (M1, M2, and the M2A1 models), the Livens projectiles (MK II [M1] and MKIIAI), and foreign chemical munitions.

Chemical Agent Identification Sets (CAIS): Actions at MR or IRP sites that involve K951/2 to K955 CAIS will be addressed as potential Hazardous Waste under the provisions of 29 CFR 1910.120 and not CWM. CWM site plan and Chemical Safety Submission (CSS) are not required.

The identification of the filler of some munitions is very difficult, if not impossible, through visual inspection when a munitions item has been used or otherwise impacted (for example, after attempted demilitarization using ineffective

methods) or exposed to the environment (e.g., buried as a means of disposal) for years. Therefore, when a munitions item contains or is suspected to contain an unknown liquid fill, it will be assessed using nondestructive testing (such as X-ray or portable isotopic neutron spectroscopy system), with the assessment provided to the U.S. Army's Materiel Assessment Review Board for determination of most likely fill.

4.2.4 Radiological/Depleted Uranium

The armed forces have only tested or used military munitions that contain a depleted uranium (DU) penetrator at a relatively small number of ranges. The Nuclear Regulatory Commission (NRC) licenses these ranges, including former ranges, for the activities conducted at them (e.g., live fire, live fire at targets with DU armor, possession of DU in any form). There are also industrial areas that were used by the armed forces that may have processed DU. Like ranges, the NRC licenses these areas.

Recently, the Army became aware that, in the 1960s, several infantry units assigned a nuclear mission using the Davy Crockett Nuclear Weapon System (a recoilless rifle) used the M101 spotting round. The M101 was a 20-millimeter (mm) round that was approximately 7 inches long and contained about 6.7 ounces of DU. The DU in this round was used for additional weight to allow the round to mirror the trajectory of a training warhead that contained high explosives. This round was used between 1962 and 1968. The Army currently is conducting research, including on-site inspection, to determine the ranges on which the M101 was used and to get these ranges appropriately licensed by the NRC.

DU has been used in military munitions in several ways: as a kinetic energy penetrator to defeat armored targets, as ballast in the M101 spotting round, and in minute quantities as a catalyst in epoxy. Epoxy that contains minute amounts of DU is only used in the M86 Pursuit Deterrent Munitions and the Area Denial Artillery Munitions. DU also has other military (e.g., protective armor for tanks) and civilian applications.

DU, which is only weakly radioactive, is a heavy metal that is dense, strong, and hard. When used as a penetrator, DU becomes pyrophoric on impact with hard targets (e.g., armored tanks). Unlike modern DU penetrators that can aerosolize and ignite on impact with a hard target, the M101 was a low velocity round that normally would break apart upon impact, depositing DU as relatively large fragments on a range.

For munitions response, DU is addressed as an MC. DU is relatively harmless unless inhaled, ingested or absorbed into the bloodstream through open cuts. DU dust may pose a potential inhalation hazard to response workers. The hazard is related more to the toxicity of the dust than its radioactivity.

DU that may be found on ranges, including those at which the M101 spotting round was used, is:

- nonmagnetic,
- extremely heavy (about 50% more dense than lead), and
- jet-black lumps or bright yellow-green lumps or small particles.

In many cases, it may not be possible to identify areas containing DU with a visual inspection. The radiation detection instruments used on site walks may not be sensitive enough to detect small deposits (quantities) of DU. Therefore, information regarding the potential for DU generally comes from the HRR or occasionally through the observation of the bright yellow oxide while on site. Table 4-5 lists current munitions that may contain DU.

Table 4-5: Examples of Military Munitions that May Contain DU

DoD Identification Code	Munitions Nomenclature
A675	CARTRIDGE, 20-mm LINKED, DS, MK 159-1,
A676	CARTRIDGE, 20-mm LINKED, DS, MK 149-2
A983	CARTRIDGE, 25-mm, API, PGU-20/U
A986	CARTRIDGE, 25-mm, APFSDS-T, M919
B103	CARTRIDGE, 30-mm, API-T/HEI, PGU-14/B & PGU-13/B
C380	CARTRIDGE, 120-mm, APFSDS-T, M829A1
C523	CARTRIDGE, 105-mm APFSDS-T M774, W/M13 TRACER
C524	CARTRIDGE, 105-mm, APFSDS-T, M833
C543	CARTRIDGE, 105-mm, APFSDS-T, M900
C786	CARTRIDGE, 120-mm, APFSDS-T, M829
D501	PROJECTILE, 155-mm APERS, M692, W/O FZ, W/M67 APERS MINES ADAM-L
D502	PROJECTILE, 155-mm APERS, M692, W/O FZ, W/M67 APERS MINES ADAM-L
K152	MINE, AP, PDM M86

4.2.5 Water Sites (Inland and Ocean)

Military ranges also include bodies of water located within the boundaries of a military range (e.g., stream, lake, pond) or are themselves a range (e.g., an off-shore range in the Atlantic or Pacific Ocean). Such water areas include all waters of the United States (as defined under the Clean Water Act) and those ocean waters extending up to 200 nautical miles from the U.S. coast (DoD, 2001a). Addressing water sites requires equipment modifications for littoral areas, further described in Section 5.

4.2.6 Improved Conventional Munitions (ICM) and Submunitions

Prior to entering an MRS that is known or suspected to contain ICMs or submunitions (collectively referred to a ICM), a waiver is obtained by the affected installation or the executing Military Munitions Remedial Action District for some FUDS properties. RPMs should verify the requirements for their MRSs. If a waiver is needed, the waiver is obtained in accordance with the requirements listed in DA PAM 385-63 for FUDS and USACE-managed projects; the waiver is routed through the EM CX for concurrence. If an ICM is found on an MRS that was not previously known to contain ICMs, all intrusive munitions response activities in the immediate and adjacent areas should cease and the approved work plan's explosives or munitions emergency response procedures will be implemented. If the item is found during a munitions response to MEC, the procedures in the approved work plan and DDESB-approved munitions response explosives safety submission will be implemented. The discovered munitions item should be secured and identified and properly disposed of with work resuming once an ICM waiver has been obtained (USACE, 2003m).

ICM:
MRSs that are known or suspected to contain ICMs are not all the same, nor do all ICMs have the same waiver requirements; RPMs should verify the requirements for their MRS. RPMs can obtain a waiver for MRSs containing ICMs per DA PAM 385-63.

4.3 Develop Data Collection Options – TPP Phase III

The third phase in the TPP process is to develop and document the field methods used based on a review of all the information gathered in Phases I and II. There are numerous resources/ methods to gather data; some are:

- historical documents,
- personal interviews,
- aerial photographic analysis,
- WAAs,
- geophysical mapping,
- ground reconnaissance, and
- anomaly investigations.

TPP PHASE I – IDENTIFY CURRENT PROJECT

TPP PHASE II – DETERMINE DATA NEEDS

TPP PHASE III – DEVELOP DATA COLLECTION OPTIONS

1. Review Phase I MFR and Phase II data needs.
2. Determine data collection options.
3. Document data collection options.

TPP PHASE IV – FINALIZE DATA COLLECTION PROGRAM

During this phase, the MR Project Team reviews the Phase I MFR and the Phase II data needs. The key participants are the decision makers, the data users, and the data implementers. If any corrections or changes in project information are identified, the RPM should redistribute the revised information to the team. The Phase III activities can occur during a teleconference or a meeting.

The MR Project Team then reviews suitable data collection methods. The MR Project Team must decide what tools are most appropriate in determining data collection methods at a site. One of the major considerations in this decision is ensuring the health and safety of personnel during data collection at the site. It is critical to fully understand the intent of the methods and tools selected and their limitations and to communicate precisely how any resulting data will be incorporated into the decision-making process. Section 5 provides detail on the various data collection methods for the MMRP.

The final step of Phase III is documentation of the data collection options. Data collection options worksheets and sampling and analysis worksheets are provided in Appendix D.

TPP PHASE I – IDENTIFY CURRENT PROJECT

TPP PHASE II – DETERMINE DATA NEEDS

TPP PHASE III – DEVELOP DATA COLLECTION OPTIONS

TPP PHASE IV – FINALIZE DATA COLLECTION PROGRAM

1. Review Phase I MFR, Phase II data needs, and Phase III data collection options.
2. Choose data collection options.
3. Finalize Phase IV.

4.4 Finalizing the Data Collection Program – TPP Phase IV

The final phase of the TPP process is finalization and documentation of the data collection options and decisions. The team now prepares DQO statements. These are project-specific statements describing the intended data use, the data need requirements, and the means to achieve acceptable data quality for the intended use.

The MR Project Team reviews the outcomes of Phases I, II, and III. For Phase IV, the key participants are the decision makers, the data users, and the data implementers. If any corrections or changes in project information are identified, the RPM should redistribute the revised information to the team. Typically, the activities will be conducted through the preparation and review of the RI/FS work plan.

The objectives of the Phase IV effort are to develop consensus on the data collection methods to be used and to prepare the DQOs, the RI/FS work plan, and associated plans for review and approval by the MR Project Team. The following sections provide discussion of the documentation requirements.

4.4.1 Data Quality Objectives

The DQO process is a systematic planning process approach optimizing data collection activities and defining the criteria the data collection design satisfies. The results generate a scientific and resource-effective data collection design. The DQOs selected are qualitative and quantitative statements that:

- clarify the study objectives,
- define the appropriate types and amount of data to collect,

- determine the appropriate conditions (e.g., location, time) for data collection, and
- specify the tolerable limits on decision errors.

Using the DQO process to plan field activities ensures that the type, quantity, and quality of data used in decision-making are appropriate for their intended use. The EPA Data Quality Objectives Process for Hazardous Waste Site Investigations is documented in Systematic Planning: A Case Study for Hazardous Waste Site Investigations, EPA/240/B-06/004, dated February 2006 (2006a). Further guidance for applying the DQO process is given in Section 4.4.2.1.2 describing the Uniform Federal Policy (UFP) –QAPP.

The following is a sample of possible DQO statements for a typical RI/FS project. In addition, a DQO development example is provided in Appendix D.

Data Quality Objectives

The following is a listing of possible DQO statements for an RI/FS project that has DGM and environmental sampling components.

DGM:

- Determine appropriate boundaries for the MRS.
- Determine if the MRS historically was used as an artillery range.
- Operate the EM61-MK2 at a velocity less than an average of 1.25 meters (m)/second.
- Locate all GPO seed items to the maximum detection depth of the approved geophysical instrument.
- Locate quality control (QC) nails within 20 centimeters (cm) of their surveyed location to verify positioning capability of the navigation method.
- Minimize the number of non-MEC geophysical anomalies.

Environmental sampling:

- Ensure laboratory quantitation limits for the selected methods and analytes are below the selected screening criteria (e.g., background levels, risk-based concentrations, action levels).
- Collect sufficient number of samples to conduct human health and ecological risk assessments.

4.4.2 Work Plan Preparation

Depending on the outcome of the TPP process, the Army MMRP RI/FS work plan provides a detailed definition of the RI and the FS tasks. Typically, the outline for an MMRP RI/FS work plan is similar to that for an HTRW work plan. Previously prepared work plans for the project property should be used as much as possible in the preparation of the plan. The EPA's RI/FS guidance (1988) lists five elements to be included in the work plan:

Example Work Plan:
RPMs should refer to the example Work Plan Outline in Appendix D for more information.

- Introduction: A general explanation of the reasons for the RI/FS and the expected results or goals of the RI/FS process are presented.

- Site background and physical setting: The current understanding of the physical setting, the site history, and the existing information on the condition of the site are described.

- Initial evaluation: The CSM developed during scoping is presented, describing the potential migration and exposure pathways and the preliminary assessment of human health and environmental impacts. Outcome of the TPP process is presented.

- Work plan rationale: Data requirements for both the risk assessment and the alternatives evaluation identified during the formulation of the DQOs are documented, and the work plan approach is presented to illustrate how the data collection options will satisfy data needs.

- RI/FS tasks: The tasks to be performed during the RI/FS are presented. This description incorporates RI site characterization tasks identified in the QAPP, the field plans, the data evaluation methods identified during scoping, and the preliminary determination of tasks to be conducted after site characterization.

The Phase I MFR, Phase II data needs analysis, and Phase III data collection options worksheets are attached to the work plan. Additional standard attachments to the project work plan, described below, provide details of the specific data collection activities designed to support the objectives of the project, as set forth in the work plan. Information in the project work plan and the attachments should not be redundant (USACE, 2004c). The format of the Work Plan and the sub-plans should be determined on a site specific basis.

4.4.2.1 Sampling and Analysis Plan

When sampling and analysis are required, Sampling and Analysis Plans (SAPs) are prepared, ensuring the data obtained are of the quantity and quality necessary to support the decisions to be made (EPA, 1988). The SAP for RI/FS activities must be reviewed and approved by the EPA in accordance with NCP Section 300.430(b)(8) for all NPL sites in the Army inventory.

4.4.2.1.1 Field Plans

The field plans should contain specific procedures for the proposed geophysical and any intrusive investigations to be performed. They should specifically address the protective measures that will be taken to ensure explosives safety during intrusive investigation of anomalies and removal actions that involve MEC. The following munitions response elements are required:

- GPO Plan: The GPO Plan is used to provide details of the approach, methods, and operational procedures to be (1) employed to perform GPOs for munitions response or other munitions responses and (2) documented as part of the Geophysical Investigation Plan and QC methods.

- Geophysical Investigation Plan: The Geophysical Investigation Plan is used to provide details of the approach, methods, and operational procedures employed in performing geophysical investigations.

- Geospatial Information and Electronic Submittals Plan: The Geospatial Information and Electronic Submittals are used to describe methods, equipment, and accuracy for conducting location surveys and mapping of munitions response or other munitions-related projects and the subsequent development of geographic information system databases to support the mapping and document (paper and electronic) production process.

- Intrusive Investigation Plan: The Intrusive Investigation Plan documents:
    - locations for investigating anomalies or sampling for MC;
    - procedures for sampling and investigating anomalies;
    - personnel qualifications;
    - procedures for MEC accountability and records management;
    - the munitions with the greatest fragmentation distance (MGFD) for each MRS;
    - minimum safety distance based on the MGFD;
    - identification;
    - procedures for MEC removal, storage and disposal; and
    - procedures for processing Material Potentially Presenting an Explosive Hazard (MPPEH) and material documented as either safe or hazardous.

- Investigation-Derived Waste Plan: The Investigative-Derived Waste Plan is used to detail requirements for handling and disposing of investigation-derived waste.

4.4.2.1.2 Quality Assurance Project Plan

The QAPP is intended to integrate all technical and quality aspects for the life cycle of the project, including planning, implementation, and assessment. The QAPP documents how quality assurance and quality control are applied to an environmental data collection operation to ensure that the results obtained will satisfy the stated performance criteria. Current implementation by the Army focuses primarily on the methods and Quality Assurance / Quality Control (QA/QC) procedures used to collect and analyze environmental samples and manage environmental sampling data and will be used in place of SAPs for new projects. (The Navy has developed a MEC QAPP template for use on MMRP projects and can be found at http://www.ert2.org/T2MRPortal/pages/mrqa.html.) The DoD is voluntarily adopting the requirements of the UFP-QAPP Manual. Use of the UFP-QAPP Manual is being phased in over time as new and substantially revised QAPPs are developed. On 7 June 2005, the EPA issued OSWER Directive 9272.0-17 *Implementation of the Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) at Federal Facility Hazardous Waste Sites. This has been implemented by DoD Instruction 4715.5 *Environmental Quality Systems* (DoD, 2006). This directive requests EPA Regions to immediately begin implementation (as appropriate) of the UFP-QAPP and its associated documents. The UFP-QAPP is designated for use in federal facility projects where environmental data are collected. Designed to be applicable for all environmental data collection related to hazardous waste investigations (e.g., cleanup under CERCLA, RCRA, BRAC), compliance with the UFP-QAPP (form, content, and minimum QA/QC specifications) is considered adequate conformance with the EPA QA/G-5 Guidance (2002) and any regional guidance on the preparation of QAPPs. The UFP-QAPP manual, templates, and examples are available at http://www.epa.gov/fedfac/documents/qualityassurance.htm. The UFP-QAPP supersedes existing region-specific QAPP guidance for federal facility hazardous waste activities (EPA, 2005b). Additional guidance for chemistry requirements for for MC can be found in EM 1110-1-4009 (USACE, 2007). Chemistry requirements for CWM projects shall be according to Engineer Pamphlet (EP) 75-1-3 (USACE, 2004).

4.4.2.2 Accident Prevention Plan / Site Safety and Health Plan

An approved APP and SSHP, an appendix to the APP, with an Activities Hazard Analysis is required when conducting on-site munitions response activities (e.g., soil sampling, construction of a geophysical test plot, geophysical mapping, anomaly investigation). The APP/SSHP shall address all occupational safety and health hazards associated with site investigation, as required by the Occupational Safety and Health Administration. The USACE has multiple guidance documents on preparing APP/SSHPs, including ER 385-1-92, ER 385-

1-95, EP 75-1-2, EP 75-1-3, EM 385-1-97, and EM 385-1-1 (USACE, 2000c, 2006b, 2000a, 2004a, 2003l, and 2003j). For FUDS and USACE-managed projects, the APP/SSHP must be coordinated with the EM CX before on-site work begins (USACE, 2000a).

4.4.2.3 Department of Defense Explosives Safety Board Required Safety Submissions and Site Plans

An explosives or, when appropriate, a CWM site plan (ESP or CSP) is required for MRS investigations or characterizations that involve the intentional physical contact with MEC or CA, regardless of configuration. Such site plans will address areas (e.g., magazines) used for the storage of commercial or military demolition explosives, MEC or CA, regardless of configuration; planned or established demolition or disposal areas; and the MRA, MRS, or response area boundaries. MRS investigation and characterization are used to collect the information needed to design the required munitions response and to prepare, as appropriate, an Explosives Safety Submission (ESS) or CSS for the selected response (DoD, 2005a). See DoD 6055.09-STD, Chapter 12 for complete details concerning ESP/CSP and ESS/CSS requirements. These requirements are summarized in Table 4-6 below.

The GC, or designated authority, is responsible for execution of the installation's Army DERP and approval of the DDESB-required s site plan submitted through the DRU and USATCES to the DDESB for approval with DoD *Ammunition and Explosives Safety Standards* (DoD 6055.09-STD; DDESB, 2008) and with DoD and Army explosives safety policies. The RPM should start the submittal review process as early in the investigative phase as possible due to the length of time required to obtain DDESB approval for the required submittal (i.e., 4 to 6 months). For FUDS, the EM CX will provide the mandatory DRU approval memorandum for HQUSACE per EP 385-1-95 (USACE, 2006b). The DRU may request an interim Army approval from USATCES if the situation or schedule warrants such a request.

Table 4-6: DDESB Required Explosives Safety Submissions Requirements (RESS)[1]

Munitions Response Activity	Quantity Distance Safety Submissions[1]	MRESS[1] or MRCSS[1] required	Reference[3]
MRS investigation or characterization (e.g., RI/FS) that involves intentional physical contact with MEC or CA, regardless of CA configuration.[2]	**Yes**	No	C12.5.4.; C12.5.8.3.7.
Placement of explosives (e.g., donor charges) on an MRS.	**Yes**	No	C12.5.1.1.
Munitions response (removal, remedial) actions that involve the intentional physical contact with MEC or CA, regardless of configuration, or conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC.	No	**Yes**	C12.5.4; C12.5.8. (for MRESS); and C12.5.9. (for MRCSS)
Construction support (On Site) where the probability of encountering MEC or CA, regardless of CA configuration is considered moderately or highly probable.	No	**Yes**	C12.5.7.; C12.4.3.2.2
A determination of NDAI or NFA.	No	**Yes**	C12.5.2.2.; C12.5.5.
Time Critical Removal Action (TCRA) that involve the intentional physical contact with MEC or CA, regardless of configuration, or conduct of ground-disturbing or other intrusive activities in areas known or suspected to contain MEC.	No	**Yes**	C12.5.2.3.; C12.5.6.
Munitions or explosives emergency responses	No	No	C12.5.3.1
Preliminary assessments or site inspections (e.g., site visits in conjunction with an archival search) when intentional physical contact with MEC or CA, regardless of CA configuration, or the conduct of ground-disturbing or other intrusive activities are not are not intended.	No	No	C12.5.3.2
Clearance activities on operational ranges. (Responding to a military munition burial site on an operational range is not a clearance activity.)	No	No	C12.5.3.3
Munitions responses on former ranges used exclusively for training with small arms ammunition.	No	No	*C12.5.3.4
Construction support (On Call) where the probability of encountering MEC or CA, regardless of CA configuration, is considered low.	No	No	C12.5.5.; C12.4.3.2.1
Anomaly avoidance activities.	No	No	C12.5.3.6.; C12.4.4.

1. See DoDI 6055.16, Explosives Safety Management Program, Enclosure 10, July 29, 2009. (Currently, DoD 6055.9-STD refers to RESS as ESS (explosive safety submissions), QD Safety Submissions as either an explosives site plan or a chemical warfare material site plan, and MRESS and MRCSS as an explosives safety submission (ESS) and a chemical safety submission (CSS) respectively.)
2. Normally the only RESS required is a QD Safety Submission (i.e., an Explosives Site Plan or a Chemical Agent Site Plan).
3. See DoD 6055.09-STD, Ammunition and Explosives Safety Standards, February 29, 2009, with Change 2, August 21, 2009; DoDI 6055.16, Explosives Safety Management Program; and AR 385-10, The Army Safety Program, 3 September 2009; and related issuances.

4.4.2.4 Additional Planning Documents

Based on the characteristics of the MRS, additional planning documents may be required. The following sections summarize the various planning documents that may apply to the RI/FS at an MRS.

4.4.2.4.1 Environmental Protection Plan

The Environmental Protection Plan (EPP) is used to describe the approach, methods, and operational procedures employed to protect the natural environment during performance of all tasks. The EPP is coordinated with the installation for all active installations. Example components of an EPP can be found in Data Item Description (DID) MR-005-12 (USACE, 2003f).

Note - DID Revisions: It is highly recommended that the RPM contact the EM CX to ensure most current DID as requirements are they often revised.

4.4.2.4.2 Institutional Analysis Plan

An Institutional Analysis identifies and analyzes the institutional framework necessary to support the development of institutional controls (ICs), if any, required to help ensure the remedy is protective. The purpose of this analysis is to gather background information and document which stakeholders have jurisdiction over the MRS in question and to assess the capability and willingness of these entities to assert ICs that would protect the public from any hazards potentially present within the limits of the MRSs. The Institutional Analysis is conducted, and an IC Plan is prepared as part of the RI/FS for munitions response projects. The Institutional Analysis Plan, developed as part of the characterization effort (EP 1110-1-24; USACE, 2000b), is reported in the RI. This will aid in early identification of LUC coordination issues. Example components of an Institutional Analysis Plan can be found in DID MR-100, and an example has been included in Appendix D.

4.4.2.4.3 Explosives Management Plan

The Explosives Management Plan provides details for management of explosives in accordance with applicable regulations. Example components of an Explosives Management Plan can be found in DID MR-005-03 (USACE, 2003a).

4.5 Public Involvement in the RI/FS

Although not unique to the MMRP, it is important throughout the RI/FS process to engage community stakeholders continuously and effectively regarding significant decisions, unforeseen developments, and project milestones. The TPP process is used to facilitate community relations. The NCP has specific

RI/FS Public Involvement:
RPMs should refer to the Public Involvement Guidance and the FUDS Public Involvement Toolkit compact disc provided in Appendix D for more information on how to effectively engage the public about their Army MMRP RI/FS project.

requirements for community relations at the RI/FS stage as described below.

- RAB: The RPM and the MR Project Team should identify whether a RAB or TRC with community members has been formed and when the RAB/TRC was formed. The Army strongly encourages local community involvement during investigations and cleanup actions at all Army sites. The Restoration Advisory Board Rule Handbook (OSD, 2007) supplements the RAB Rule issued on 12 May 2006 (71 Federal Register 27610). This handbook is intended to guide the RPM and the individual RAB in addressing their own unique concerns of their project site. This handbook is available at http://aec.army.mil/usaec/cleanup/rab-rule.pdf.

- Community Relations Plan (CRP): The NCP requires a CRP be in place before RI field activities start. For FUDS projects, EP 1110-3-8 Public Participation in the DERP for FUDS should be consulted to guide public involvement (USACE, 2004b). The level of public involvement may differ for removal actions. These can include explosives or munitions emergencies where prior public involvement would likely be minimal compared with NTCRAs. The CRP is updated to address community concerns throughout the RI/FS process.

- Administrative Record: The NCP 40 CFR 300.805(a) requires the Administrative Record file be initiated at the start of the RI phase for a remedial action, upon signature of the Engineering Evaluation/Cost Analysis Approval Memorandum for an NTCRA or within 60 days of beginning on-site activities for a TCRA. Notification of the availability of the Administrative Record file shall be made, at a minimum, in a major local newspaper of general circulation (USACE, 2004c).

  For munitions responses under the MMRP, installations shall have a permanent record of the data gathered to characterize a site and a clear audit trail of pertinent data analysis and resulting decisions and actions. To the maximum extent practicable, the permanent record shall include geophysical sensor data that are digitally recorded and georeferenced. When digitally recording and georeferencing the geophysical sensor data is impractical, ACSIM approval will be required. These data shall be included in the Administrative Record (U.S. Army, 2004a).

4.5.1 Rights of Entry

To fulfill its CERCLA responsibilities per EO 12580, the Army has the authority to conduct remedial actions outside of the installation boundaries, where the installation is reasonably considered to be the sole or the major source of the CERCLA release. Off-site actions can be complex and often require a right of entry (ROE) from the property owner and extensive coordination with the property owner and community because of the lack of Army control over the

property. By DoD policy, only EOD units may respond to a request for support of an explosives or munitions emergency (US Army, 2004a).

The USACE District Chief of Real Estate must obtain all ROEs, regardless of their purpose. There are no cases where installations can obtain ROEs without USACE participation. The RPM is responsible for obtaining access agreements to limit government and contractor liabilities. The USACE District Chief of Real Estate and/or the HQUSACE Deputy Chief of Staff for Real Estate shall be consulted for additional information and project-specific issues.

The initial step in obtaining property access is the preparation of the landowner notification letter. The project manager should coordinate preparation of the Landowner Notification Letter with their Public Affairs Office. It is necessary to recognize the potential effects of entry, including traverse of other properties, upon a parcel of land. Routes should be selected to avoid or minimize such disturbances.

In some cases, property owners may not allow the Army access to their properties. For projects or properties where MEC are reasonably believed to be present and access is denied, the Army will notify the Office of the DUSD(I&E) of the circumstances surrounding the denial of ROE. The Army shall make appropriate referral to the Attorney General of the United States per CERCLA §104(e)(5)(B) (DoD, 2001a).

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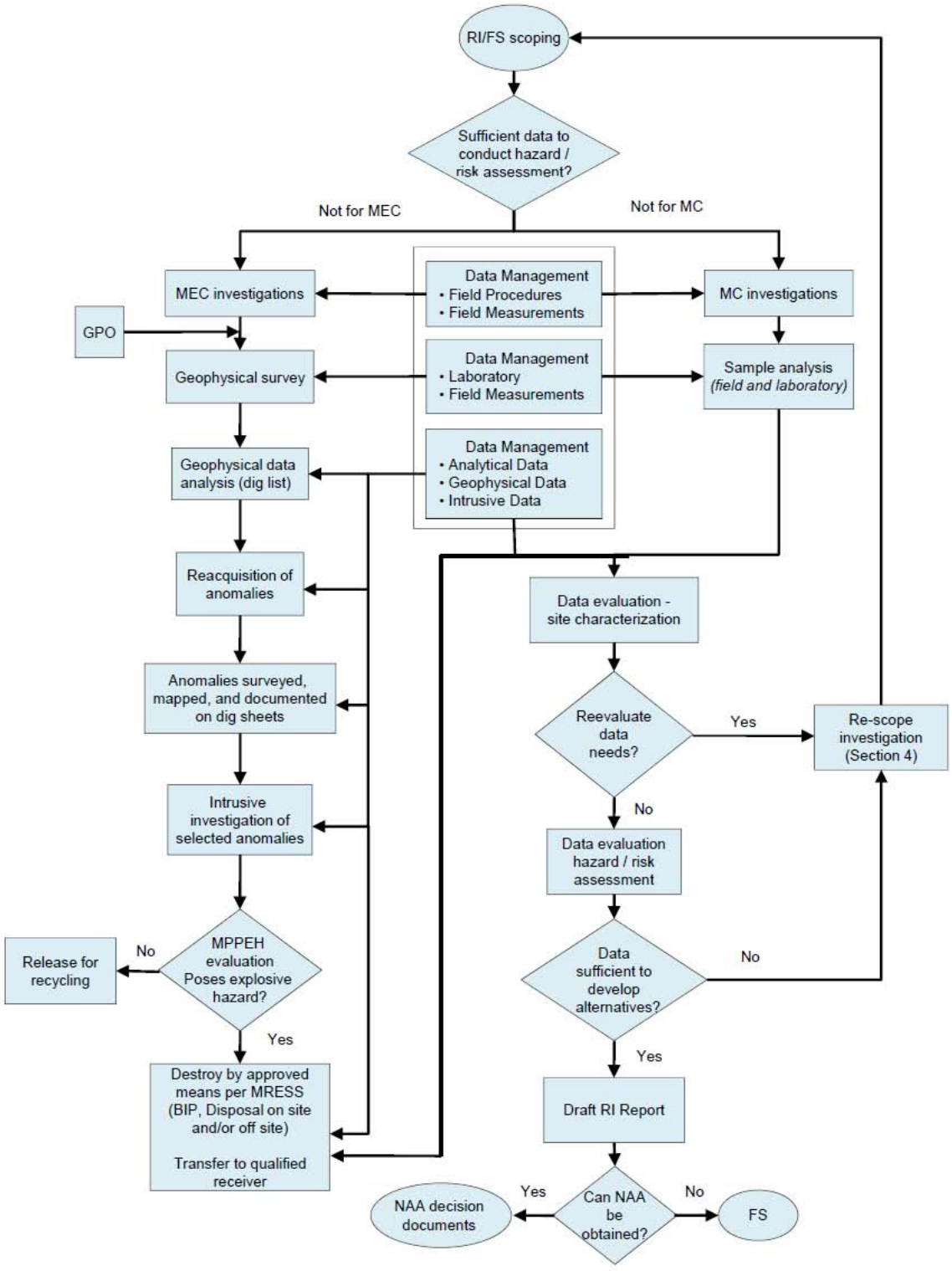
5 REMEDIAL INVESTIGATION

The RI includes performing field investigation (Sections 5.1 to 5.4), developing an explosive MEC hazard and health risk assessment (Section 5.5), and conducting treatability studies (Section 6). Major differences between an RI for an MRS and an RI for an HTRW site are described in Table 5-1. Figure 5-1 details the process flow diagram involved in an MMRP RI.

Table 5-1: Comparison of RI Components

RI Component	MEC	HTRW
Nature of the hazard/ risk	Acute explosive hazard	Acute or chronic toxic risk
Distribution of the hazards	Higher potential for heterogeneity – distribution patterns vary based on munitions-related activities that occurred, the type of munitions involved, and human actions. Homogeneity may be possible within target areas and disposal areas.	Higher potential for homogeneity in contaminate distribution (e.g., groundwater plumes with a Gaussian distribution and soil contamination from spills or disposal techniques)
Level of characterization needed to compare alternatives	Based on available knowledge about the MRS proposed response alternatives (e.g., fencing vs. subsurface removal) and the current anticipated future land use (e.g., DoD control vs. public/private control; potential construction activities vs. no potential construction activities)	Based on nature and extent evaluation
Nature of the ability to assess the hazard/risk	The MRSPP, MEC HA, and Ordnance and Explosives Risk Impact Assessment (OERIA) provide tools for use in making such assessments.	Well-established methods of performing risk assessments resulting in a quantitative value of risk and reduction in risk
Characterization techniques	Primary information is available from historical documentation, aerial photographs, and previous investigations. This information is used to design and conduct geophysical investigations.	Widely applied and accepted sampling and analysis techniques



Note: The need for interim measures (TCRA, NTCRA, or interim remedial action) is assessed throughout the process. See Section 5.7.

BIP = blow in place

Figure 5-1: Flow diagram for the RI

5.1 Site Characterization

Through the RI, the MR Project Team characterizes the nature and threat posed by UXO, DMM, and MC and gathers data necessary to assess the potential threat to human health or the environment. As a key aspect of the RI, the team gathers data to support the analysis and design of potential response actions by assessing the following factors (40 CFR 300.430(d)(2)):

- Physical characteristics of the property
- Characteristics/classification of air, soil, surface water, and groundwater
- Characteristics of the UXO and DMM (e.g., type munitions, quantities) or MC (e.g., concentration, toxicity)
- The extent to which the source can be characterized
- Actual and potential exposure pathways through environmental media
- For MEC, actual and potential exposure routes (e.g., access to MRS) and location (i.e., surface or subsurface) of UXO or DMM; for MC, actual or potential exposure routes (inhalation or ingestion)
- Other factors, such as sensitive populations, that pertain to the characterization of the site or support the analysis of potential remedial action alternatives

The RI requires the assessment of potential hazard/risk to human health and the environment to determine if such is unacceptable. The RI for MC and incidental nonmunitions contamination also includes the conduct of treatability studies; for MEC, it includes destruction options to evaluate the potential performance and cost of likely technologies (see Section 6).

Data Collection:
Depending on available data and the DQOs established during the TPP process, additional data may not be necessary to assess the most appropriate response action.

The data needs of the munitions response will determine whether the MRS requires additional characterization for UXO, DMM, or MC during the RI. It will also identify actions needed to address MPPEH. General steps in the site characterization phase of the RI/FS include the following:

- Site reconnaissance and area preparation
- MEC characterization
    - Geophysical investigation for UXO or DMM
    - Intrusive investigation
    - Disposal of MEC.

    - Management, processing and disposition of MPPEH, Material Documented as an Explosive Hazard (MDEH) and Material Documented As Safe (MDAS).
- MC characterization
    - Sampling
    - Analysis
- Data collection and recording
- Baseline explosive hazard and health risk assessments

5.2 MRS Characterization for Certain Categories of MEC

The data needs for an MRS are determined during the scoping phase of RI/FS through the TPP process as described in Section 4. Data needs are directly linked to the decisions to be made at the MRS. Therefore, the level of characterization for each MRS may vary from no additional investigation for two common categories of MEC (i.e., UXO and DMM) to extensive geophysical investigation. Again, the purpose of the RI is not to eliminate all uncertainty, but to sufficiently characterize the MRS for response alternative selection.

As discussed previously, the main variation in an MRS RI/FS is the potential need to use geophysical technology to characterize the site. However, on a case-by-case basis, the MR Project Team must evaluate whether conducting a geophysical investigation is the best way to fill the data needs for an MRS (see Case Study). Although geophysical data provide a great deal of information about a site, they are not required for all response alternatives (i.e., no action, LUCs, and surface removal). The applicability of geophysical investigations depends on the information known about the site (e.g., presence of MEC, historical use), property ownership (e.g., DoD, federal, state), current, determined, or reasonably anticipated future land use, the likely response alternative, and MR Project Team criteria.

Geophysical investigations provide data about the potential for MEC, specifically UXO and DMM, to be present in the subsurface. Geophysical investigations typically involve three phases. The first phase is the GPO, allowing for the selection of the most appropriate technology based on the site conditions and anticipated MEC targets. The second phase is the geophysical survey; geophysical instrumentation is used to survey the area. Geophysical data are analyzed and interpreted to identify anomalies for intrusive investigation. The third phase is the reacquiring of target anomalies for intrusive investigation. During this third phase, all anomalies selected for excavation are physically reestablished by precise survey methods, mapped, documented on dig sheets, and intrusively investigated. The exception to this is when the selected data collection approach consists of using a magnetometer and digging the anomalies (“mag-and-dig”) or using a magnetometer and flagging the anomalies for later excavation (“mag-and-flag”) (USACE, 2002).

Prior to a geophysical survey, the site will need to be prepared for the use of geophysical instruments. Site preparation activities typically consist of evaluating safety hazards, clearing at least some vegetation, and removing surface munitions and surface metallic clutter. Vegetation removal and removal clearance help to ensure that a munitions response can be safely and effectively conducted. Performing a surface clearance removal and clearing the MRS of as much vegetation and surface debris as possible helps ensure the safety of munitions response personnel, allows a better view of the area being worked, improves access, and reduces any metallic clutter present to optimize the performance of geophysical instruments in a given environment.

When geophysically surveying a site, there are two choices: either survey the entire site or survey a representative portion of the site and infer the results across the whole. On relatively small sites, it can be efficient in terms of cost, schedule, and environmental impact to map the entire area. However, large sites can present significant cost, schedule, access, and environmental impact challenges that preclude geophysically mapping large areas as a method of site characterization. Various site sampling methodologies are discussed in Section 5.3.2.

After a site has been geophysically mapped, multiple anomalies are likely to have been located. Figure 5-2 shows the results of geophysical mapping. When using mag-and-flag, anomalies are marked as flags at the location of each subsurface anomaly. For munitions responses where digital geophysical methods are used, the geophysicist evaluates and selects anomalies to be investigated, or dug, with the help of analytical software. In either case, a portion of the anomalies must be excavated by qualified UXO personnel to determine if an anomaly is MEC (UXO or DMM) or some other feature. However, depending on historical munitions-related uses (e.g., impact area, OD site) or the current uses (e.g., developed areas), the number of anomalies detected on some MRSs may range from several dozen to several thousand per acre, most of which may be small metallic fragments. When this occurs, a clear understanding of the geological background and consideration of use of statistical investigation methods at the MRS may be necessary. A clear anomaly selection criteria based on anticipated MEC can help reduce the number of anomalies investigated. Section 5.3.3 discusses available statistical sampling techniques.

Computer-based evaluation is an important tool for interpreting geophysical data. The MR Project Team must consider which geophysical tool (digital vs. analog, see Section 5.2.1) to use during the discrimination and anomaly selection process. The MR Project Team must ensure that it develops a transparent and inclusive process of analyzing the geophysical data and provides hard copy of the data and the list of anomalies selected for investigation (i.e., digital dig sheets) to stakeholders. The process, assumptions, and procedures for interpreting geophysical data should be clearly outlined in the work plan, and any deviations should be discussed with the MR Project Team prior to finalizing the “dig list.”

Case Study: Applicability of Geophysics to Close Data Gaps
Fort Somewhere - Artillery Range MRS

MRS Description: The Artillery Range MRS is a partially developed DoD owned 290-acre parcel located within the installation boundary. Historical documents, including a map, indicate the potential presence of a portion of a pre–World War II era artillery range. Expected munitions usage included medium and large caliber projectiles. However, to date no EOD responses have been known to occur on the MRS. The current land use includes a golf course on a portion of the installation and a developed area with several installation tenant organizations.

Site Inspection Results: The Artillery Range SI Report indicates that no MEC or munitions debris was observed. Sampling results showed no Target Analyte List (TAL) metals or explosives above regulatory limits. It should be noted that a previous investigation at an adjacent site indicated the presence of subsurface anomalies. The MRS was recommended for an RI/FS due to the potential for MEC to be present.

Proposed Future Land Use: According to the installation Master Plan, the area that this MRS occupies would be further developed to support installation tenant expansion activities. A portion of the MRS would remain open space for recreational activities.

Data Gap Discussion: The MR Project Team did not know if the MRS was an actual portion of the historical artillery range. Based on the SI results and the apparent lack of surface MEC presence, it seemed reasonable to conclude that the MRS was probably part of the artillery range safety danger zone. The MR Project Team needed to determine an approach to help determine the historical use of the MRS and the actual presence of UXO, DMM, and/or MC.

RI MEC Approach - Use of Geophysics: The MR Project Team evaluated a number of statistical tools to determine the most applicable fieldwork approach and sampling program to achieve the Artillery Range MRS RI goals. The MR Project Team, in conjunction with the stakeholders, determined that a geophysical survey of the Artillery Range MRS would be the most appropriate method to help close existing data gaps. The MR Project Team also decided to employ a Visual Sampling Plan (VSP) to develop the geophysical transects based on the characteristics and expected distribution of any munitions (i.e., UXO or DMM) known or suspected to be present.

Geophysics Results: The results of the geophysical fieldwork data indicated multiple anomalies present within the MRS that met the threshold values established by the GPO. Dig results indicated the presence of several medium and large caliber MEC items. Therefore, the MR Project Team was able to reasonably conclude that the MRS was part of the impact area of the artillery range and not part of the safety danger zone.

Lessons Learned: The MR Project Team's selection of geophysics and VSP to help resolve existing data gaps proved to be the most appropriate methodology. Surface MEC were not present probably due to prior construction and development. However, the use of geophysics helped the team locate potential subsurface MEC items, and dig results helped prove that the MRS was, in fact, part of the artillery range impact area and identify the presence of MEC.

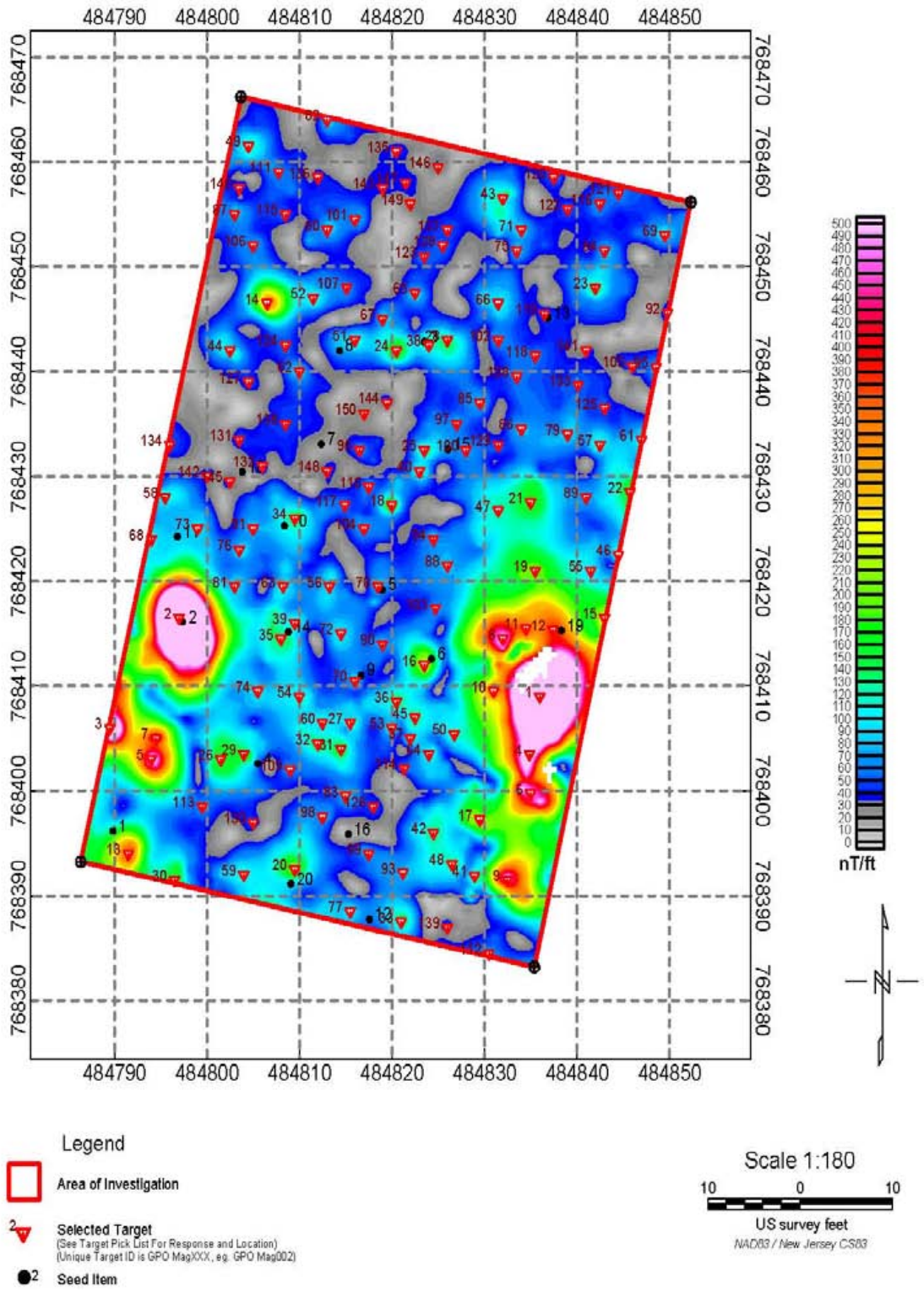


Figure 5-2: Example of Geophysical data

Anomaly reacquisition and marking is an extremely important aspect of a geophysical survey. Errors in positioning during a survey, data analysis adjustments, or positioning errors during reacquisition can result in an inability to reacquire anomalies. Ideally, reacquisition should be performed with the same instrument used in the original survey to enable comparison of reacquired target amplitude to the original amplitude (USACE, 2003c). For example, if different technologies are used to conduct reacquisition, the reacquisition may not meet DQOs and project teams should understand the limitations of this approach. Further information on interpreting data and anomaly reacquisition is provided in Section 5.3.4.

After the location of a subsurface anomaly has been marked by the reacquisition team, the anomaly is excavated, identified, and properly disposed. This can be an extremely hazardous activity and should only be undertaken by qualified UXO personnel working under a DDESB-approved ESP and an approved work plan. The excavation team must collect pertinent information regarding each anomaly and provide it to the geophysical team. Section 5.2.6 describes the intrusive investigation of subsurface anomalies and disposal.

It is important to build a feedback loop between the geophysicists mapping and analyzing site data and the individuals excavating anomalies and performing field QC. Comparison of the types of items found in the field to the original data allows the geophysicists to adjust the processing methodology and reduce the number of false selections. Information such as size, depth, weight, and metallic nature (i.e., ferrous vs. nonferrous) of items found can be useful to geophysicists in directing intrusive teams to the anomalies most likely resembling a military munitions (i.e., UXO or DMM).

Establishing a Feedback Loop: A feedback loop between the geophysicists mapping and analyzing site data and the individuals excavating anomalies and performing field QC allows the geophysicists to adjust the processing methodology and reduce the number of false selections.

5.2.1 Technology Selection

This section provides a brief overview of the application and limitations of available detection technologies and includes a recommended approach for technology selection. For additional information, refer to the 2005 USACE MEC Detection, Recovery, and Disposal Technology Assessment Report (2005b) and the 2006 Environmental Security Technology Certification Program, ITRC, and Strategic Environmental Research and Development Program Survey of Munitions Response Technologies.

The components of the geophysical data acquisition platform include the:

- geophysical sensor,
- positioning system,
- data-recording devices,
- electronic and power cables, and
- mode of transport.

Some of these components may be integrated into a single unit by the manufacturer or the contractor during the design of the platform. Important design considerations for the data acquisition platform include the munitions response objectives, ergonomic design, safety, reduction or removal of metal components that are near the geophysical sensor (or the use of nonferrous metals, such as aluminum, for magnetometers), and minimization of the movement of any metal with respect to the geophysical sensor (USACE, 2005b).

Portable Detection Systems

A common method for conducting geophysical surveys is the use of man-portable technologies. The production rate for this method is lower than other systems (1–5 acres per day), but man-portable systems are useful in certain terrain (e.g., rough terrain, wooded areas) and under certain circumstances (e.g., small areas). Towed arrays have become popular in open areas and have a higher production rate (5–20 acres per day) based on the speed with which data are collected and the use of multiple detectors (larger footprint). The quality of data and detection depth of ground-based systems are generally superior to other platforms due to the proximity of the detection systems to the ground.

Airborne Systems / Wide Area Assessments

Although not all MRSs are suitable for use of airborne WAA technologies, WAA systems have been evaluated as a regional footprint reduction tool (300–500 acres per day), but have limitations due to the inability of the systems to detect small anomalies (e.g., small munitions) from a safe operating altitude. There are also considerably advanced processing procedures required to remove the effects of the fixed-wing or rotary-wing aircraft on the detection system. Many of these technologies need to be flown close to the ground; this can be limited by vegetation (e.g., forests) and extreme topography. Another factor that has limited the popularity of airborne methods is the cost associated with maintaining and operating the aircraft.

Marine Investigations

Perhaps the most challenging aspect of marine investigations is accurately determining the position of one or more submerged detectors. Typically, the conditions in the marine environment (e.g., silt or sand, wave and current action) support burial (i.e., covering) of munitions or their deep penetration and, in many cases, lateral movement of underwater munitions. Analog systems, specifically magnetometers, are preferred for underwater geophysical surveys because the geophysical sensors must be near the bottom of the water to accurately detect deep into the sediments. Positioning is mandatory due to the cost of location

identification and recovery of suspect anomalies in the marine environment. To avoid the potential for movement of detected anomalies, any required removal of underwater munitions should be performed soon after geophysical data acquisition.

Significant advancement in geophysical equipment and its data evaluation procedures is expected. To monitor and track emerging technologies from the research programs, the MR Project Team should utilize the numerous resources and program offices referenced in this guidance document (http://aec.army.mil/usace/technology/eqt00.html; http://www.serdp.org; http://www.estcp.org).

5.2.1.1 Geophysical Sensors

Many different geophysical sensors are available for use in detecting UXO and DMM at an MRS. USACE (2005b) provides a detailed comparison of available technologies. Table 5-2 provides a summary of this information.

The two main categories of instruments used to detect UXO and DMM are electromagnetic induction (EMI) sensors and magnetometers. EMI sensors induce electrical currents in surface and subsurface conductive objects. The electrical currents in both ferrous (e.g., steel) and nonferrous (e.g., brass, aluminum) objects generate a secondary magnetic field measured by the EMI sensor to detect the object. The signal induced by the EMI sensor may be either time-domain or frequency-domain. Table 5-2 outlines the advantages and limitations of EMI sensors.

Magnetometers are passive sensors that measure the total magnetic field at a location, including both the Earth's ambient field and any magnetic field caused by ferrous items. There are several types of total field magnetometers used in environmental remediation. However, the two magnetometers most used during munitions responses to MEC are optically pumped alkali-vapor (usually Cesium vapor) magnetometers and fluxgate magnetometers. Whereas EMI sensors can detect both ferrous and nonferrous metals, magnetometers can only detect ferrous metals. Table 5 2 outlines the advantages and limitations of magnetometers. Many different geophysical sensors are available for use in detecting UXO and DMM at an MRS. USACE (2005b) provides a detailed comparison of available technologies. Table 5-2 provides a summary of this information.

The two main categories of instruments used to detect UXO and DMM are EMI sensors and magnetometers. EMI sensors induce electrical currents in surface and subsurface conductive objects. The electrical currents in both ferrous (e.g., steel) and nonferrous (e.g., brass, aluminum) objects generate a secondary magnetic field measured by the EMI sensor to detect the object. The signal induced by the EMI sensor may be either time-domain or frequency-domain. Table 5-2 outlines the advantages and limitations of EMI sensors.

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Geophysical Sensors Overview: Table 5-2 provides the MR Project Team with an overview/comparison of available geophysical sensors. It should assist the team in selecting the best possible geophysical technology solution given the unique requirements at an MRS. As stated in Section 5.2.1, more information is available to guide in this decision process.

5.2.1.2 Positioning Systems

Data location is important for almost all detection technologies. Detection technologies that require data processing require that the location of detected anomalies be accurate and precise so that selected targets can be relocated in a time effective manner. Accurate and precise positions for the geophysical data are necessary to extract the maximum value from the data. The Global Positioning System (GPS) has been popular for years; however, this system may have limited application in some areas (e.g., wooded areas with thick canopy). For this reason, a number of other existing positioning systems have been introduced for use during munitions response to MEC. Table 5-3 provides a summary of the detailed analysis of various positioning systems presented by USACE (2005b).

5.2.1.3 Data Analysis and Processing

In recent years, survey data analysis and processing techniques for use with commercial sensors have been developed that improve detection capabilities and discrimination between MEC (UXO or DMM) and other metallic clutter. These developments have been demonstrated for use with magnetometer data and EMI sensor data. The procedures rely on physics-based models in which estimated model parameters are correlated with target features from actual geophysical sensor data. Those target features include the target's spatial parameters, such as their location, orientation and depth; the target's physical parameters, such as their size, shape and density; and the target's magnetic and electromagnetic properties (USACE, 2005b).

5.2.1.3.1 Geophysical Prove-Out

Currently, the GPO process consists of designing and planning a GPO, constructing the GPO plot, implementing the prove-out, and reporting the GPO

results. This process is under review to increase efficiency, eliminate unnecessary steps, and reduce costs.

The purposes of a GPO include the following:

- Determine if a particular geophysical system works at a particular site.
- Determine the optimum geophysical system configuration and standard operating procedures (SOPs) for a particular MRS.
- Can prove detection depth capabilities. Note: A large population of data from national test sites and other GPO sites is available.
- Demonstrate that the system is meeting typical detection performance capabilities for a given target of interest.
- Assure contractor compliance with the contract.
- Evaluate the MR Project Team's data collection, data transfer methods, and data transfer rates.
- Establish MRS-specific geophysical data needs and MRS-specific data quality measures and protocols for all work tasks involving geophysics and all work tasks that use geophysical data.
- Establish MRS-specific anomaly characteristics for selection criteria.
- Demonstrate anomaly resolution procedures to ensure contractor SOPs achieve both munitions response requirements and QA/QC requirements.

EM 1110-1-4009 (USACE, 2007) and Geophysical Prove-Outs for Munitions Response Projects (ITRC, 2004) provide additional information regarding planning and implementing a GPO. Internet hyperlinks to publications that contain discussions on selecting the appropriate geophysical instrument are provided in Appendix D.

Table 5-2: Comparison of Detection Technologies

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Flux-gate magnetometers	Almost all flux-gate magnetometers measure the vertical component of the geomagnetic field along the axis of the sensor and not the total intensity of the geomagnetic field.	**Medium–High:** Has been used as the primary detector in some highly ranked systems. Has high industry familiarization. Detects ferrous objects only. Due to gradiometer design, is most adept at detecting smaller, shallow items as opposed to relatively large, deeper items.	**High:** Costs, transportation, and logistics requirements are equal to or less than other systems. Is light and compact. Can be used in any traversable terrain. Is widely available from a variety of sources.	**Low:** A number of the flux-gate magnetometers have a low cost for purchase and operation compared to other detection systems. Digital units are more costly than analog units.	Schonstedt 52-CX Schonstedt 72-CX Foerster FEREX 4.032 Ebinger MAGNEX 120 LW Foerster Ferex 4.032 Vallon EL1302D1	Analog systems are not usually coregistered with navigational data. Digital output should be coregistered with navigational data.
Proton precession magnetometers	Proton precession magnetometers measure the total intensity of the geomagnetic field, and multiple sensors sometimes are arranged in proximity to measure horizontal and vertical gradients of the geomagnetic field.	**Medium:** Proton precession systems have similar sensitivities as flux-gate systems, but with a relatively slow sampling rate. Detects ferrous objects only.	**Low–Medium:** Systems are similar to flux-gate systems in terms of operation and support. Generally is heavier and requires more battery power than flux-gate sensor. Sampling rate is low. Can be used in any traversable terrain. Is widely available from a variety of sources.	**Medium:** Costs are comparable to flux-gate systems that acquire digital data.	Geometrics G856AX GEM Systems GSM-19T	Typically used as a base station.
Overhauser magnetometers	Overhauser magnetometers measure the total intensity of the geomagnetic field, and multiple sensors sometimes are arranged in proximity to measure horizontal and vertical gradients of the geomagnetic field.	**High:** Sensitivity is on the order of 0.02, which is almost equal to the most sensitive magnetic technology. Not susceptible to “heading error.”	**Low–Medium:** Systems are digital, ruggedized, and weatherproof. Weighs more than most flux-gate systems. Is only available from two manufacturers, one specializing in land-based and the other marine.	**Medium–High:** Purchase and operating costs are higher than analog flux-gate systems and proton precession technology.	GEM Systems GSM-19	Primarily used for land-based and marine applications. Can be susceptible to magnetic noise.
Atomic-vapor magnetometers	Atomic-vapor technology is based on the theory of optical pumping and operates at the atomic level as opposed to the nuclear level (as in proton precession magnetometers).	**High:** Used in several highly ranked systems. Has high industry familiarization. Detects ferrous objects only.	**High:** Equipment is digital, ruggedized, and weatherproof. Common systems weigh more than most flux-gate systems and are affected by “heading error.” Can be used in most traversable terrain. Is widely available from a variety of sources. Processing and interpretation require trained specialists. Discrimination possibilities are limited to magnetic susceptibility / magnetic moment estimates and depth estimates. Detection capabilities are influenced by iron-bearing soils.	**High:** Has high purchase cost compared to other discussed technologies. Costs less when arrays of multiple detectors are used.	Geometrics G-858 Geometrics G-822 Geometrics 880 Geometrics 882 GEM Systems GSMP-40 Scintrex Smart Mag G-tek TM4	Digital signal should be coregistered with navigational data.

Table 5-2: Comparison of Detection Technologies (continued)

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Time-domain electromagnetic induction (TDEMI) metal detectors	TDEMI is a technology used to induce a pulsed magnetic field beneath the Earth's surface with a transmitter coil, which in turn causes a secondary magnetic field to emanate from nearby objects that have conductive properties.	**High:** Used in several highly ranked systems. Has high industry familiarization. Developed to detect small, metal objects. Detects both ferrous and nonferrous metallic objects.	**High:** Equipment is portable and ruggedized for use in various terrain and weather conditions. Some systems are heavier and consume more power than magnetometers. Typically utilize transceiver coil that is 1 m wide, but smaller versions are also available. Most commonly used instrument is widely available. Processing and interpretation are relatively straightforward. Discrimination possibilities exist for multichannel systems.	**Medium–High:** Common analog metal detectors are comparable in cost to analog flux-gate magnetometers. Digital systems are comparable in cost to Overhauser and atomic-vapor magnetometers. Costs less when arrays of multiple detectors are used.	Geonics EM61-MK1 and EM61-MK2 Geonics EM63 Zonge Nanotem G-tek TM5-EMU Vallon VMH3	Digital signal should be coregistered with navigational data. Detection depths are highly dependent on coil size and power.
Frequency-domain electromagnetic induction (FDEMI) metal detectors	FDEMI sensors generate one or more defined frequencies in a continuous mode of operation.	**Medium–High:** Some digital units are the primary detector in highly ranked systems. Demonstrates capability for detecting small items using handheld unit. Is not optimum for detecting deeply buried objects. Has high industry familiarization. Detects both ferrous and nonferrous metallic objects.	**High:** Handheld detectors are generally light, compact, and ergonomic. Most are handheld. Is widely available from a variety of sources. Discrimination possibilities exist among some multichannel systems and some handheld systems.	**Medium–High:** Costs less when arrays of multiple detectors are used. Common handheld metal detectors are much lower cost than digital systems.	Schiebel ANPSS-12 White's All Metals Detector Fisher 1266X Geophex GEM 2 and 3 Geonics EM31 and EM34 Apex Max-Min	Analog systems are not usually coregistered with navigational data. Digital output should be coregistered with navigational data.
Ground penetrating radar (GPR)	GPR works by propagating electromagnetic waves into the ground via an antenna. These transmitted signals are reflected by objects and features that possess contrasts in electrical properties with the surrounding medium.	**Low:** Is extremely sensitive system that responds to changes in the magnetic, conductive, and dielectric properties of the subsurface. Has a very low success rate as a stand-alone MEC detection system. Detects both metallic and nonmetallic objects, but is susceptible to numerous environmental/geological conditions. Has medium industry familiarization.	**Low:** Man-portable systems are cumbersome to operate in varying terrain with thick vegetation. Power requirements are higher than most magnetometer and EMI systems. System requires skilled operators.	**High:** GPR systems are approximately 1.5 to two times the cost of comparable magnetometer and EMI systems.	GSSI SIR2, SIR3, SIR8, SIR10 Sensors and Software Pulse Ekko and Noggin RAMAC Mala	Data output is usually viewed in either transects or two-dimensional time slices. These have not been demonstrated to be as successful as profile outputs.
Sub audio magnetics (SAM)	SAM is a patented methodology by which a total field magnetic sensor is used to simultaneously acquire both magnetic and electromagnetic response of subsurface MEC.	**Medium–High:** Detects both ferrous and nonferrous metallic objects. Is capable tool for detection of deep MEC. Has low industry familiarization.	**Low:** Has high data processing requirements. Is only available from one source. Has high power requirements. Has longer than average setup times.	**High:** Has higher than average operating costs and very low availability.	G-tek SAM	Is not commercially available. Has no established track record.

Table 5-2: Comparison of Detection Technologies (continued)

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Magnetometer-electromagnetic detection dual sensor systems	These dual sensor systems are expected to be effective in detecting all types of MEC, as magnetometers respond to large deep ferrous targets and EMI sensors respond to nonferrous metallic targets.	**High:** Detects both ferrous and nonferrous metallic objects. Has medium industry familiarization. Has higher potential for discrimination.	**Medium–High:** Has high data processing requirements. Is available from few sources.	**High:** Lower costs can be obtained by using a towed array platform. Has low availability.	GEOCENTERS AETC MTADS	Is available from only a few sources.
Marine side-scan sonar	Side-scan sonar technology uses acoustic (i.e., sound) waves to locate objects and record water bottom structure in a swath on one or both sides of its sensors.	**Low:** Visualizes shapes of both metallic and nonmetallic objects. Only detects items on surface of water body floor. Has low industry familiarization.	**Medium:** Requires trained operator, experienced field crew; calm water may be needed. Vegetation can hinder acoustic signal propagation.	**High** for marine investigations	Klein 5500, EdgeTech DF-1000, Triton Elics Sonar Suite, GeoAcoustics, Fishers SSS-100K/600K, Marin Sonic Technologies	Few have applied this technology to the MEC problem.
Airborne multi- or hyper-spectral imagery	This airborne method utilizes unique spectral signatures produced by an item to determine the item composition and size. Multispectral techniques can be used since they provide more information than images from common broadband cameras.	**Low:** Detects both metallic and nonmetallic objects. Only detects largest MEC. Requires line of sight. Has low industry familiarization. Effectiveness increases when used for WAA in conjunction with other airborne technologies.	**Low:** Requires aircraft and an experienced pilot. Also requires substantial data processing and management. Is available from few sources.	**High:** Requires aircraft operation and has high maintenance and data processing costs.	There are many multi-/hyper-spectral imagery providers.	Few have applied these technologies to the MEC problem.
Airborne synthetic aperture radar (SAR)	Airborne SAR is a technology applicable to the detection of MEC via airborne data acquisition platforms. Typical radar measures the strength and roundtrip time of the microwave signals that are emitted by a radar antenna and reflected off a distant surface or object.	**Low:** Detects both metallic and nonmetallic objects. Only detects largest MEC. Requires line of sight. Has medium industry familiarization. Effectiveness increases when used for WAA in conjunction with other airborne technologies.	**Low:** Requires aircraft platform, increased power, and robust data recording systems. Also requires substantial data processing and management. Is available from few sources.	**High:** Requires aircraft operation and has high maintenance and data processing costs.	--	Few have applied these technologies to the MEC problem.
Airborne laser and infrared (IR) sensors	IR and laser sensor technologies can be used to identify objects by measuring their thermal energy signatures. MEC on or near the soil surface may possess different heat capacities or heat transfer properties than the surrounding soil, and this temperature difference theoretically can be detected and used to identify MEC.	**Low:** Detects both metallic and nonmetallic objects. Has low industry familiarization. Effectiveness increases when used for WAA in conjunction with other airborne technologies.	**Low:** Requires aircraft and an experienced pilot. Also requires substantial data processing and management. Is available from few sources.	**High:** Requires aircraft operation and has high maintenance and data processing costs.	--	Few have applied these technologies to the MEC problem.

Table 5-3: Comparison of Positioning Systems

Technology	Detection	Effectiveness	Implementability	Cost	Representative Systems	Notes
Differential Global Positioning System (DGPS)	GPS is a worldwide positioning and navigation system that uses a constellation of 29 satellites orbiting the Earth. GPS uses these "man-made stars" as reference points to calculate positions on the Earth's surface. Advanced forms of GPS, like DGPS, can provide locations to centimeter accuracy.	**Medium**: Is very effective in open areas for both digital mapping and reacquiring anomalies. Is very accurate when differentially corrected. Is not effective in wooded areas or near large buildings. Commonly achieves accuracy to a few centimeters, but degrades when minimum satellites are available.	**High**: Easy to operate and set up. Requires trained operators. Is available from a number of vendors. Better systems are typically ruggedized and very durable. Some work time is lost when insufficient satellites are available.	**Low**: High-end system is available for $100–200 per day.	Leica GPS 1200 Trimble Model 5800 Thales Ashtech Series 6500	Is recommended in open areas.
RANGER	RANGER is a radio frequency system that uses four to eight fixed radio transponders and a mobile radio integrated to the geophysical detector system.	**Medium–High:** Can effectively survey open, vegetated, or cluttered areas with varying degrees of position accuracy. Can be set up over a 5-acre area.	**Medium:** Technique has not been successfully demonstrated on numerous MEC projects.	**Medium–High:** Purchase price is estimated to be $20,000–30,000**.**	Ensco	There is only one manufacturer and limited supply at this time.
Robotic Total Station (RTS)	RTS is a laser-based survey station that derives its position from survey methodology and includes a servo-operated mechanism that tracks a prism mounted on the geophysical sensor.	**Medium**: Is very effective in open areas for both digital mapping and reacquiring anomalies. Is effective near buildings and sparse trees. Commonly achieves accuracy to a few centimeters.	**Medium**: Easy to operate. Requires existing control.	**Low**: System is available for $150–200 per day.	Leica TRS 1100 Trimble Model 5600	Is recommended near houses or in open areas that have a high tree line.
Laser	The ArcSecond constellation system calculates locations by triangulating the signals of stationary lasers placed on the edge of a grid. The system uses four laser transmitters, although only two are required to calculate the position in three dimensions.	**High**: Is very effective in wooded areas. Can be used in open areas, though is limited due to range of transmitters. Is extremely accurate positioning system. Commonly achieves accuracy to a few centimeters.	**Low**: Technology has a time-consuming setup due to numerous parts and connections. Equipment is not ruggedized.	**Medium**: System is available for less than $200 per day.	ArcSecond "In-door GPS" (Constellation)	Is recommended in wooded areas.
Fiducial method	The fiducial method consists of digitally marking a data string (data set) with an indicator of a known position. Typically, lines or markers are placed on the ground at known positions (e.g., 25 feet).	**Medium**: Has medium effectiveness when performed by experienced personnel. Has low effectiveness when used by inexperienced personnel. Commonly achieves accuracy of 15–30 cm.	**Low**: Is difficult to use and requires constant pace, detailed field notes, and elaborate setup.	**Low**: Minimal direct costs are associated with this method. Is similar to fiducial method.	Not available (N/A)	Requires very capable operators. Is a useful method if digital positioning systems are unavailable.
Odometer method	This method utilizes an odometer, which physically measures the distance traveled.	**Medium**: Has medium effectiveness when performed by experienced personnel. Has low effectiveness when used by inexperienced personnel. Commonly achieves accuracy of 15–30 cm	**Low**: Setup and operation are affected by terrain/environment. Requires detailed field notes and lengthy setup. Is similar to fiducial method.	**Low**: Very little costs are associated with this technology.	N/A	--
Acoustic	This navigation system utilizes ultrasonic techniques to determine the location of a geophysical instrument each second. It consists of three basic elements, a data pack, up to 15 stationary receivers, and a master control center.	**Medium–Low**: Is not very efficient in open areas due to substantial calibration setup time. Is reasonably effective in wooded areas, although less accurate than other methods. Commonly achieves accuracy of 10–30 cm.	**Low**: This technology is difficult to set up, and there is minimal available support. Is negatively affected by certain aspects of environment.	**Medium**: System is available for around $200 per day.	USRADS	Has been used extensively in wooded areas with success.
Inertial navigation	An inertial navigation system measures the acceleration of an object in all three directions and calculates the location relative to a starting point. The starting point is input and periodically refreshed using another navigation system, typically DGPS.	**Low–Medium**: Is very time consuming with below average accuracy. Accuracy of 4–6 cm (open area) is commonly achieved shortly after refreshing baseline data, but degrades quickly with time. Required frequency of refreshing baseline significantly reduces production rates.	**Low**: Is difficult to operate and has limited support.	**High**: Is expensive to purchase or rent.	Ranger	This technology is still under development.

5.2.2 Survey Approach Decisions

Different survey approaches can be used depending on the goals of the RI/FS. Review of the previous studies may provide adequate geophysical information to make appropriate decisions in the FS. If further geophysical investigation is needed, probabilistic survey approaches can be used when the goals are to investigate for UXO or DMM or to look for large objects (e.g., target areas, disposal trenches). Figure 5-3 shows several different survey design approaches that can be used for DGM surveys. Additional guidance for selecting probabilistic survey method of investigation can be found in EM 1110-1-4009. Probabilistic survey designs include the following (USACE, 2007):

- Fixed pattern grid method
  - In the fixed pattern grid method, grids are laid out in a pattern on a fixed percentage (often 10%) of an area.
  - Other more random patterns can provide statistically valid results using fewer grids, so the fixed pattern grid method is not normally used.

- Random pattern grid method
  - In the random pattern grid method, a statistical approach is used to randomly locate grids throughout an area. The total area to be investigated must first be determined using a statistical tool, such as the UXO Estimator (see Section 5.2.3). Grid size and shape are then determined using the site terrain, vegetation, and geophysical instrument that will be used. Grids are typically square or rectangular and may be as small as 2,500 square feet or as large as 1 hectare. The size and shape of the grids may vary.
  - Use of a purely random pattern is not recommended because it leaves the possibility that large areas that were not investigated may contain UXO or DMM.

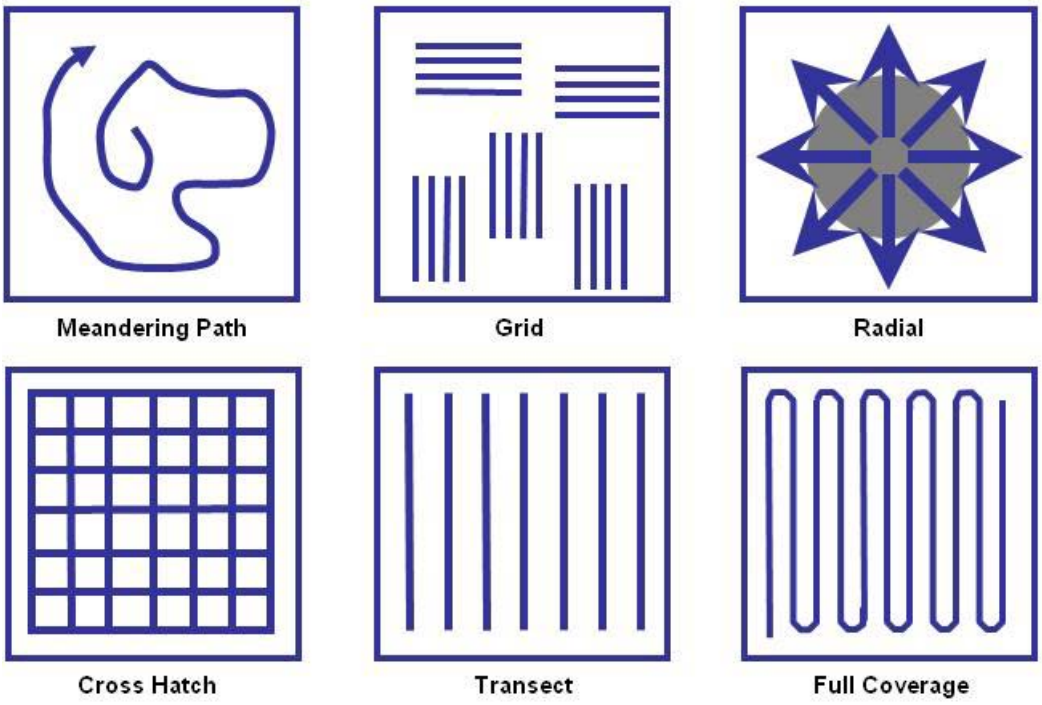
- Hybrid pattern grid method
  - In the hybrid pattern grid method, method grids to be investigated are placed randomly (as in the random pattern grid method). However, approximately 20% more grids are added in biased locations to fill in data gaps.
  - The hybrid pattern grid method approach ensures that an area known to contain MEC receives more thorough coverage.

- Radial
  - In a radial path, a grid pattern is walked radiating out from a single point.
  - The radial path approach ensures that an area known to contain MEC receives more thorough coverage.

- Transects
  - During a geophysical transect investigation, a geophysical sensor is walked over lines that are typically evenly spaced apart. This is similar to a 100% design, but the line spacing is often much greater with a transect design.
  - Use of transects is a good approach to characterize areas and begin to define the boundaries of areas where MEC (UXO or DMM) may be present. Transects can be considered as very narrow, fixed pattern grids. Typically, transects are used at sites with easy terrain and vegetation.

- Cross hatch transects
  - Like a transect investigation, a geophysical sensor is walked in straight lines across a site and then repeated at a 90-degree angle from the original transects.
  - Full coverage
  - Like a transect investigation, a geophysical sensor is walked over lines that are typically evenly spaced apart. These are spaced closely together to obtain 100% coverage.

- Meandering paths
  - When using meandering paths, a geophysical instrument is integrated with a navigation instrument, typically Differential Global Positioning System (DGPS), and the geophysical team walks a “meandering” path across an MRS. The team records geophysical data until the total area geophysically mapped equals the area that would have been required if sampling grids were used.
  - Use of meandering paths is a good survey approach at MRSs with difficult vegetation and terrain because it does not require vegetation removal and the geophysical survey cost is greatly reduced.



(Source: ITRC, 2004a)

Figure 5-3: Types of geophysical survey designs

5.2.3 Use of Statistical Tools

This section contains a brief discussion of the applicability of statistical tools for the characterization. Because 100% coverage of the MRS typically is not required to fulfill the basic or optimum RI/FS data needs, statistical tools can be used to characterize an MRS. There are two statistical tools that are commonly used:

- The UXO Estimator may be used to develop an investigation plan for an MRS and to estimate the amount of MEC (UXO or DMM) potentially present in an area. The following are some key features of the UXO Estimator (USACE, 2007):
  - It assumes homogeneous distribution of UXO within an identified area.
  - It can be used to determine statistical confidence levels for UXO density and to perform statistical tests concerning such densities.

- VSP is a statistical tool that can be used to determine the appropriate transect spacing of geophysical surveys to achieve specific levels of confidence in the search for target areas. VSP allows the user to perform the following functions:
  - Determine the required transect spacing to guarantee that transects traverse circular or elliptical target areas of a specific size and shape with a specific high probability.
  - Compute the probability that a target area may exist even though it was not found using a geophysical survey of the area.

- Approximate the probability that a target area of a specific size and shape would have been found during a geophysical survey if straight-line or meandering transects were used.
- VSP is also a useful statistical tool to evaluate MC (e.g., to quantify the uncertainty for MC, make inferences about MC to support decisions, quantify number of MC samples to be collected).

VSP may be used on MRSs that are known to contain areas with a high density of UXO whose locations may not be known, while the UXO Estimator may be used on MRSs assumed to have a homogeneous MEC distribution. Additional guidance on statistical investigation (sampling) approaches is available in EM 1110-1-4009 (USACE, 2007). The UXO Estimator is available from the USACE EM CX. VSP can be downloaded from http://dqo.pnl.gov/vsp/vspdesc.htm.

5.2.4 Phenomenological Geophysical Analysis

Phenomenological evaluation of an MRS can provide valuable information about the appropriate technology and survey design for use at an MRS. Background geophysical surveys can be used to determine the level of background noise common at an MRS for use in evaluating and selecting anomalies for investigation. Phenomenological factors include:

- munitions type, orientation, and potential depth;
- topography;
- soil and rock types;
- vegetation; and
- cultural features (e.g., overhead power lines, underground utilities, buildings).

The basic premise for considering phenomenology is that the geologic and cultural makeup of the MRS are primary influences on what the geophysical sensor measures. The phenomenological evaluation considers a variety of factors during the sensor selection process, including physical characteristics of the MRS, geophysical properties of the soil or rock, types of munitions, and potential depth of subsurface munitions (Simms et al., 2004).

The USACE's Engineering Research and Development Center (ERDC) Geotechnical and Structures Laboratory has developed a six-step process to evaluate phenomenological aspects of a site (Simms et al., 2004). Although this evaluation is not routine procedure for an RI due to cost constraints and data availability, it could provide valuable information if data are available and cost constraints are removed.

5.2.5 Anomaly Discrimination and Data Interpretation

In recent years, survey data analysis and processing techniques for use with commercial sensors have been developed that improve detection capabilities and discrimination between MEC (UXO or DMM) and other metallic clutter.

These developments have been demonstrated for use with magnetometer data and EMI sensor data. The procedures rely on physics-based models in which estimated model parameters are correlated with target (anomaly) features from actual geophysical sensor data. Those target features include the target's spatial parameters, such as location, orientation, and depth; the target's physical parameters, such as size, shape, and density; and the target's magnetic and electromagnetic properties.

Discrimination specifically is defined for munitions responses to MEC as the ability to distinguish between hazardous MEC and other pieces of metal (e.g., munitions debris, nails, horseshoes, cans, pipes). This process is performed by determining (or measuring) the geophysical characteristics of a subsurface item (anomaly) and comparing those characteristics to modeled or actual results (e.g., the GPO). The primary variables defining the geophysical characteristics are the shape, orientation, distance and direction, and material composition of an item, as well as the ambient magnetic and/or electromagnetic field. Variations in these parameters have the potential to change the geophysical signature. Additionally, a detected anomaly that is large and deep can have a similar signal intensity to one that is small and shallow. The primary objective of discrimination is to reduce the number of unnecessary intrusive investigations and, thus, the cost of investigating an MRS.

Anomaly Discrimination:
The accuracy of discrimination is the focus of many ongoing technology demonstration projects. Regulatory support of this is limited, and site-specific demonstrations of discrimination likely are required to gain stakeholder acceptance of discrimination.

5.2.6 Anomaly Investigation

Once anomalies are selected, intrusive investigations are conducted to identify the source of selected anomalies. Anomalies may be excavated using mechanical or manual methods. Table 5-4 provides a summary of the detailed analysis of various anomaly investigation systems presented by the USACE (2005b).

Evacuations of portions of a surrounding community may be necessary to minimize risk during intrusive investigations. As outlined in the ESP and work plan, an EZ is established to ensure that nonessential personnel are protected from both intentional and unintentional detonations. The design of EZs is detailed in DDESB TP Number 16 (2007). DDESB-approved engineering controls (ECs) can often be used to decrease the size of the EZ and DoD 6055.09-STD, Chapter 12. EM 1110-1-4009 details the application of these controls (USACE, 2007). Evacuations involving residents or nearby workers are coordinated with state or local relocation officials, as required by NCP Section 300.415(f).

Recovered MEC are normally destroyed in place or on site. Under certain and limited conditions, MEC may be transported off site for destruction. The risk associated with the disposal operation, as determined by MRS site-specific characteristics and the nature of the MEC recovered, guides the disposition decision. Technical Manual (TM) 60A-1-1-31 Explosive Ordnance Disposal (U.S. Army, 1999) provides additional information on MEC disposal operations.

Although, EOD will respond to explosives or munitions emergencies that may occur during a munitions response to MEC, EOD units do not normally support such planned responses. Coordination with the responsible EOD unit prior to initiating activities munitions response actions that require an DDESB-required submission is recommended.

Additional considerations include the management MPPEH (see DoD Instruction 4140.62 and EM 1110-1-4009) and determination of its explosives safety status as either MDEH or MDAS.

Excavation/Disposal Technologies:
Table 5-4 and Table 5-5 provide the RPM and MR Project Team with an overview/comparison of available excavation and disposal technologies. These tables should assist the team in selecting the best possible excavation/disposal technology solution given the unique requirements of a munitions response.

Table 5-5 provides disposal options for MEC and MDEH, as well as for removing explosives residues or deforming MDAS (see USACE 2005b). This table is divided in two sections, one addresses MEC and MDEH, while the other addresses technologies that may be used to address explosives residues or deform MDAS.

5.3 Munitions Constituents Characterization

Characterization of MC-related contamination is similar to characterization of environmental contamination (i.e., HTRW) because it involves analytical sampling of soil, vadose zone, sediment, groundwater, and surface water to evaluate the nature and extent of MC. As with HTRW, the nature and extent of MC are used to refine location-specific ARARs, define the risk to human health and the environment through the preparation of a baseline risk assessment, and aid in the development of remedial alternatives. MC may be found in concentrations high enough to pose an explosive hazard. When MC are determined to pose an explosive hazard, they are considered to be MEC, and protective measures, including alternate sampling approaches, must be implemented to ensure the safety of personnel. High concentrations of MC are not expected to be encountered on ranges. Such concentrations could be found at munitions operating facilities (e.g., a melt-out facility, production facility), including in settling ponds and drains.

MC contamination can result from corrosion of munitions (e.g., UXO, DMM) or from low-order detonations. In a low-order detonation, a munitions item's filler

may be scattered over portions of a firing range as constituents or partially encased in the remains of the delivery system. This results in a complex source term that is not amenable to simple evaluation (Brannon et al., 1999).

Specific MC sampling requirements for an RI/FS are determined on a MRS-specific basis by the MR Project Team through the TPP process and the development of a CSM in close coordination with MEC characterization planning. While not the focus of an MMRP RI/FS, the sampling and characterization of incidental non-munitions related contaminants may be a component of a munitions response action. For additional information on MC characterization requirements, see the EPA's 1988 Guidance on Conducting Remedial Investigations and Feasibility Studies under CERCLA, USACE's 1994 Engineering and Design - Technical Guidelines for Hazardous and Toxic Waste Treatment and Cleanup Activities (EM 1110-1-502), Military Munitions Response Process (EP 1110-1-18) (USACE, 2002), and Engineering and Design – Military Munitions Response Actions (EM 1110-1-4009) (USACE, 2007). MC characterization sampling approaches are addressed in the following sections.

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Table 5-4: Comparison of Excavation Technologies

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Hand excavation	Hand excavation consists of digging individual anomalies using commonly available hand tools.	**Medium**: It can be very thorough and provides good data on any munitions collected.	**High**: Can be accomplished in almost any terrain and climate. Is limited only by the number of people available.	**Average**: Is the standard by which all others are measured.	Probe, trowel, shovel, pick axe	Are locally available and easily replaced tools.
Mechanized removal of individual anomalies	This method uses commonly available mechanical excavating equipment, such as a backhoe or excavator.	**Medium**: Used in conjunction with hand excavation when soil is so hard it causes time delays. Method works well for the excavation of single anomalies 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 clearing of 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	Equipment is easy to rent and to operate.
Mass excavation and sifting	Armored excavation and transportation is earth moving equipment that has been armored to protect the operator and equipment from unintentional detonation.	**High**: Process works very well in areas of heavy concentration of UXO or DMM. Can separate several different sizes of material, allowing for large quantities 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 insure and has the added expense of high maintenance cost.	**Earth moving equipment**: Many brands of heavy earth moving equipment, including excavators, off-road dump trucks, and front-end loaders, are available. **Sifting equipment**: Trommel, shaker, rotary screen from varying manufacturers	Can be rented, armor installed, and delivered almost anywhere. Significant maintenance costs.
Mechanized soil processing	Once the soil has been excavated and transported to the processing area, it is then processed through a series of screening devices and conveyors to produce segregated soils of different grain sizes.	**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	The most promising application of magnetic technology is in scrap and soil processing.	**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 eliminate the need to inspect the smaller size soil spoils. Magnetic systems are also potentially useful to help with surface clearance of fragmentation 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	Remotely operated equipment is excavating equipment that has had additional control equipment added that allows the equipment to be operated remotely.	**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 have been tested for MEC applications.

Table 5-5: Comparison of Disposal Technologies

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Treatment of MEC						
Blow in Place (BIP)	BIP is the destruction of MEC for which the risk of movement beyond the immediate vicinity of discovery is not considered acceptable. Normally, this is accomplished by placing an explosive charge alongside the item.	**High:** Munitions are individually or collectively destroyed with the destruction verified (QC/QA).	**High:** Uses field-proven techniques, transportable tools, and equipment and is suited to most environments. Public exposure can limit viability of this option. ECs can further improve implementation.	**Low:** Is manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled.	Electric demolition procedures; nonelectric demolition procedures	Disposition of resultant waste streams must be addressed in planning. Any stream produced by BIP is not contained. Increased regulatory involvement may result in higher life cycle cost for waste (for characterization, treatment, and disposal) than for technologies that do contain the waste streams. The DoD has committed to reducing its reliance on the use of OD.
Consolidate detonations	Consolidate detonations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC for which the risk of movement has been determined to be acceptable either within a current working sector or at an established demolition ground.	**High:** Techniques recently developed and refined in Iraq are providing documented successes. Use of donor munitions is also proving effective. Is limited in use to munitions that are “safe to move.”	**Medium–High:** Generally employs same techniques, tools, and equipment as BIP. Requires larger area and greater controls. Most ECs not completely effective/applicable for these operations.	**Medium:** Is manpower intensive; may require material handling equipment for large-scale operations.	Electric demolition procedures; nonelectric 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 consolidate detonations are not contained. As regulatory agencies become more involved in munitions responses, this may yield higher life cycle costs for waste (for characterization, treatment, and disposal) than for 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.
Laser initiation	Portable (vehicle-mounted) lasers are used from a safe distance to heat MEC laying on the surface, resulting in high- or low-order detonation of the munitions.	**Low–Medium:** Is still in development, though currently is deployed in Iraq for testing. Tests show positive results for 81 mm and smaller munitions, with reported success on munitions up to 155 mm. 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 100 m. GATOR system does require approach and placement of fiber-optic cable at appropriate position of MEC. Laser systems are still addressing power, configuration, transportability, and logistics issues.	**Low–Medium:** Requires greatly reduced manpower. Has added equipment, transportability, and logistics concerns. No explosives are required by the system.	ZEUS-HLONS GATOR LASER	Offers added safety through significant standoff (up to 300 m). (Note: Acceptable safety standoffs must be evaluated for specific MEC and scenarios.) ZEUS prototype was deployed/employed in Afghanistan (2003). Waste streams produced by laser initiation are not contained. As regulatory agencies become more involved in munitions responses, 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 yield greater environmental contamination than successful BIP operations.

Table 5-5: Comparison of Disposal Technologies (continued)

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Treatment of MEC						
Contained detonation chambers - stationary	Contained detonation chambers involve destruction of certain types of munitions in a chamber, vessel, or facility designed and constructed specifically for the purpose of containing blast and fragments. Contained detonation chambers can only be employed for munitions for which the risk of movement has been determined acceptable.	**High:** Chambers successfully contain hazardous components. Current literature reviewed shows containment up to 40 pounds (lb) (net explosives weight [NEW]).	**Low–Medium:** Stationary facilities typically must meet regulatory and construction standard for permanent/semipermanent waste disposal facilities. Service life and maintenance are issues. Such facilities are not commonly used in support of munitions responses. Produces additional hazardous waste streams.	**High:** Sitting and construction required. Low feed rates lead more hours on site. Has significant requirements for maintenance of system.	Typically is designed on case-by-case basis.	System cleaning and maintenance usually require personal protective equipment (PPE) and worker training. Have probable permitting issues with employment of technology.
Contained detonation chambers – mobile	Contained detonation chambers involve destruction of certain munitions in a chamber, vessel, or facility designed and constructed specifically for the purpose of containing blast and fragments. Contained detonation chambers can only be employed for munitions for which the risk of movement has been determined acceptable for transport over public highways.	**High:** Chambers successfully contain hazardous components. Current literature reviewed shows containment up to 40 lb NEW.	**Medium–High:** Designed to be deployed at the MRS. Has greatly reduced footprint compared to stationary facilities. Service life and maintenance are issues. Requires additional handling of MEC. Produces additional hazardous waste streams.	**Medium–High:** Possible construction required (e.g., berms, pads). Low feed rates leads to more hours on site. Significant requirements f maintenance of system.	Transportable Detonation Chambers (T-10) Kobe Blast Chamber	System cleaning and maintenance usually require PPE and worker training. Have 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 in terms of public perception and in life cycle cost.
Disassembly or RSPs	Disassembly or RSPs are the procedures that enable the neutralization or disarming of mines and munitions to occur in a recognized and safe manner. RSPs are executed by EOD personnel.	**Low:** Hazardous components may remain intact after procedure. Some procedures may expose hazardous materials inadvertently or intentionally. Have lower probability of success compared to other methods. Present significant danger to personnel conducting disposal operations. DoD policy allows RSP at MRSs only in cases of extreme emergency. RSPs are not allowed for the mere purpose of rendering a munitions item acceptable to move.	**Low:** Have significant personnel exposure in implementation. Specialized tools and equipment commonly are required.	**Medium–High:** Is manpower intensive. Specialized tools and equipment are required.	Manual disassembly Mechanical disassembly Explosive de-armer Cryofracture	Procedures are not commonly applied even by authorized military EOD personnel, except in rare circumstances.

Table 5-5: Comparison of Disposal Technologies (continued)

Technology	Description	Effectiveness	Implementability	Cost	Representative Systems	Notes
Treatment of Munitions Debris						
Chemical decontamination	Such decontamination should only be used when there is a requirement to eliminate all explosives residues from munitions or range-related debris.	**Low–Medium** Great variety of chemicals. Difficult to test for effectiveness of many methods. May generate additional waste streams (some hazardous).	**Low** Requires containment of multiple hazardous materials. May require emissions controls. Worker training and PPE typically required. No mobile systems deployable to MRSs exist. National Defense Center for Energy and Environment is working on a mobile system, but it only treats scrap metal not MEC.	**High** Requires specialized manpower, containment requirements, and additional waste stream processing.	Supercritical water oxidation Photocatalysis Molten salt oxidation	--
Thermal treatment	Decontamination is achieved by exposing the debris to high temperatures (between 600 and 1400 degrees Fahrenheit) for specified periods of time.	**High** Methods are proven means of attaining high degrees (five times) of decontamination.	**Medium** Typically stationary; however, mobile processes exist. Service life and maintenance are issues. May have low feed rates due to safety concerns. Produce additional hazardous waste streams.	**High** Possible construction required. Low feed rates lead to more hours on site. Requires greater maintenance of system.	Rotary kiln incinerator Explosive waste incinerator Transportable flashing furnace	System cleaning and maintenance usually require PPE and worker training. May require permit to deploy technology.
Shredders and crushers	These technologies use large machines to deform metal components. This results in unusable remnants and overall reduced volume of scrap.	**Medium** Shredders are mostly used to render inert munitions debris unrecognizable as munitions. Very limited use to date to shred MEC. Shredding MEC presents heightened probability of accidental detonation. Residue typically still requires additional treatment to achieve higher decontamination levels.	**Low–Medium** Typically are stationary facilities. Service life and very high maintenance are expected.	**Medium–High** Requires specialized equipment and operators. Has high maintenance. Requires additional waste stream processing.	Shred Tech ST-100H Roll-Off (vehicle mounted)	Disposition of resultant waste streams must be addressed.

5.3.1 Representative Soil Sampling Methods

The environmental characteristics of MC in soil indicate that they are extremely heterogeneous in spatial distribution. Secondary MC contamination on testing and training ranges is generally the result of releasing a low-order detonation that exposes a munitions filler. The distribution of MC in soil depends on the degree of combustion and the condition of the munitions item that experienced a low-order detonation. Concentrations may range from nondetectable levels (less than 0.5 parts per million [ppm]) to percent levels (greater than 10,000 ppm) for samples collected within several feet of each other. At locations used for OB/OD, MC-related contamination can vary greatly (from nonexistent to the presence of chunks of explosive filler). Analysis of the concentration of explosive MC-related contamination is needed to determine whether MC pose an explosive hazard because the type and level of MC-related contamination that can pose an explosive hazard vary greatly. When operating in areas known to pose an explosive hazard, a safety analysis is needed for materials handling equipment to prevent initiating forces that could propagate a detonation throughout the soil mass (Crockett et al., 1998).

One key aspect to characterizing soils for lead or other MC at a small arms range is reaching consensus on whether to sieve the soil samples prior to analysis. One of the primary reasons to sieve is to remove bullet fragments. Retaining bullet fragments yields a higher concentration of lead; however, the lead in the fragments is not readily available to receptors.

In some locations, native or anthropogenic background concentrations of metals, perchlorate, or PAHs may exceed non-site-specific risk-based screening levels or regulatory limits that are used commonly for screening purposes or response action decision-making. If these parameters are analyzed and no appropriate regional or MRS-specific background data are available for the MRS, background samples should be collected and analyzed. Some available resources for background condition evaluation include the following (USACE, 2007):

- *Guidance for Environmental Background Concentration Analysis Volume I: Soil* (NAVFAC UG-2049-ENV, April 2002) https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NFESC_PP/ENVIRONMENTAL/ERB/DOCUMENTS-N/BG_SOIL_GUIDE_0.PDF

- *Guidance for Environmental Background Concentration Analysis Volume II: Sediment* (NAVFAC UG-2054-ENV, April 2003) https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NFESC_PP/ENVIRONMENTAL/ERB/DOCUMENTS-N/UG-2054-SED-GUIDE_0.PDF *Guidance for Environmental Background Concentration Analysis Volume III: Groundwater* (NAVFAC UG-2059-ENV, April 2004) https://portal.navfac.navy.mil/pls/portal/docs/PAGE/NAVFAC/NAVFAC_WW_PP/NAVFAC_NFESC_PP/ENVIRONM

ENTAL/ERB/DOCUMENTS-N/UG-2059-BKGRND-ANALYSIS_0.PDF
Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (EPA 540-R-01-003 OSWER 9285.7-41, September 2002) http://www.epa.gov/oswer/riskassessment/pdf/background.pdf

- *Environmental Quality – Environmental Statistics.* (USACE EM 1110-1-4014, January 2008) http://www.usace.army.mil/publications/eng-manuals/em1110-1-4014/entire.pdf

- *Data Quality Assessment: Statistical Methods for Practitioners*. (EPA QA/G-9S, February 2006) http://www.epa.gov/quality1/qs-docs/g9s-final.pdf

The Cold Regions Research Engineering Laboratory (CRREL), a USACE ERDC laboratory, has conducted numerous studies to determine the best means to collect a representative sample. These studies have been conducted at primarily active and BRAC sites as part of a research and development (R&D) effort (Jenkins et al., 1996; Thiboutot et al., 2002). Their current recommendations are documented in full in Appendix A of SW8330B located at http://www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

5.3.2 Analytical Methods

Analytical methods for MC should be based on the munitions-related activities, including the types of munitions involved and their fills, conducted at an MRS. Some of the more common MC include nitrogen-based explosives, perchlorate, white phosphorus, agent breakdown products, CWM agents, and heavy metals. Metals at some quantity are found in all cased military munitions. Metal analyses should be based on the type(s) of ordnance known or reasonably assumed to have been present or used on the MRS. If not, it is recommended to analyze for the 23 Total Analyte List (TAL) metals. Although it is recommended to analyze for the TAL metals, it may be beneficial to analyze for additional metals. Background data should be used to determine additional metals to analyze and metal concentrations not due to DoD activities. Choosing additional analytes, if needed, will be discussed during the TPP process. Information on the composition of most military munitions is available from the Munitions Item Disposition Action System database (available at https://midas.dac.army.mil). Access requires registration and is restricted to DoD personnel, DoD contractors, and various TMs. Many

MC Sampling:
In many cases, it would be advantageous to only sample for the MC expected from the munitions items used at the site rather than for the full suite of analytes (e.g., TAL metals). Analytical methods should be coordinated with the stakeholders prior to any fieldwork.

types of filler used in munitions are composition explosives, consisting of two or more explosive compounds mixed together. Compositions vary and are documented in *Military Explosives* (TM 9-1300-214) (U.S. Army, 1990; USACE, 2005b). Table 5-6 provides a list of commonly evaluated MC and the analytical method used to detect the MC. The analytical methods described in Table 5-6 include laboratory and field tests for nitrogen-based explosives, co-contaminants, and breakdown products.

Field efforts should use anomaly avoidance techniques. Sampling and analysis should be discussed as part of the TPP process.

Table 5-7 provides fixed laboratory test methods for commonly evaluated MC. Laboratories should have experience in handling MC samples and must demonstrate compliance with the latest version of the DoD Quality Systems Manual for Environmental Laboratories (QSM) through the DoD Environmental Laboratory Accreditation Program (DoD ELAP). The DoD QSM can be found at http://www.navylabs.navy.mil/. A fact sheet about the DoD ELAP can be found at http://www.navylabs.navy.mil/DoD%20ELAP%20fact%20sheet021809.pdf. For USACE-managed munitions responses, laboratories must meet the requirements of *Chemical Data Quality Management For Hazardous, Toxic, Radioactive Waste Remedial Activities* (ER 1110-1-263; 1998b).

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Table 5-6: Commonly Evaluated MC

Compound (Abbreviation)	Description[a]	CAS Number[b]	Fate and Transport (Soil)[c]	Method No.[d]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	Nitramine explosive; also Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) co-contaminant	2691-41-0	HMX has high adsorption in clay. HMX has low adsorption in other soils. There is little to no degradation.	SW8330B, SW8095, SW8321A, SW8510
RDX	Nitramine explosive; also HMX co-contaminant	121-82-4	RDX has high adsorption in clay with no transformation or degradation. RDX has low adsorption or some transformation in other soils.	SW8330A, SW8330B, SW8095, SW8321B, SW8510, SW 4051 or EPA 529
1,3,5-Trinitrobenzene (1,3,5-TNB)	Trinitrotoluene (TNT) co-contaminant and breakdown product	99-35-4	1,3,5-TNB is readily degraded and strongly adsorbed in surface soils, but is relatively mobile once in aquifer soils.	SW8330B, SW8095, SW8321A, or EPA 529
1,3-Dinitrobenzene (1,3-DNB)	Dinitrotoluene (DNT) breakdown product and TNT co-contaminant	99-65-0	1,3-DNB is readily degraded and strongly adsorbed in surface soils, but is relatively mobile once in aquifer soils.	SW8330B, SW8095, SW8321A, or EPA 529
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	Nitramine explosive	479-45-8	Solution phase concentrations of tetryl decline rapidly, mostly due to transformation or decay. When these mechanisms are not present, as in certain soils, transport will occur easily.	SW8330B, SW8095, SW8321A, or EPA 529
Nitrobenzene (NB)	DNT co-contaminant	98-95-3	NB is readily degraded in surface soils, but is relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW 8095, SW8321B, or EPA 529
2,4,6-Trinitrotoluene (2,4,6-TNT)	Nitroaromatic explosive	118-96-7	2,4,6-TNT is strongly adsorbed in surface soils, but is relatively mobile once in aquifer soils. Readily degrades in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, SW4050, SW8515, or EPA 529
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	TNT breakdown product	1946-51-0	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	TNT breakdown product	355-72-78-2	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
2,4-Dinitrotoluene (2,4-DNT)	Nitroaromatic explosive/ propellant; also TNT co-contaminant	121-14-2	2,4-DNT is very readily degraded and strongly adsorbed in surface soils, but is relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
2,6-Dinitrotoluene (2,6-DNT)	Nitroaromatic explosive/ propellant; also TNT co-contaminant	606-20-2	2,6-DNT is strongly adsorbed in surface soils, but is relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
2-Nitrotoluene (o-Nitrotoluene) (2-NT)	DNT co-contaminant	88-72-2	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
3-Nitrotoluene (m-Nitrotoluene) (3-NT)	DNT co-contaminant	99-08-1	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
4-Nitrotoluene (p-Nitrotoluene) (4-NT)	DNT co-contaminant	99-99-0	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8330A, SW8330B, SW8095, SW8321B, or EPA 529
Nitroglycerin (NG)	Nitrate ester explosive/ propellant	55-63-0	Solution phase concentrations of NG decline rapidly, mostly due to transformation or adsorption in surface or aquifer soils.	SW8330B, SW8095, or SW8321B
Ammonium picrate (AP)	Nitroaromatic explosive	131-74-8	AP in soil has limited mobility and degradation.[e]	SW8321B

Table 5-6: Commonly Evaluated MC (continued)

Compound (Abbreviation)	Description[a]	CAS Number[b]	Fate and Transport (Soil)[c]	Method No.[d]
Picric acid (PA)	Nitroaromatic explosive	88-89-1	PA in soil has limited mobility and degradation.[e]	SW8321B
Pentaerythritol tetranitrate (PETN)	Nitrate ester explosive	78-11-5	PETN rapidly degrades in surface soils and slightly slower in aquifer soils.	SW8330B, SW8095, or SW8321B
Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (MNX)	RDX breakdown product	5755-27-1	MNX is very stable and relatively mobile in all soils.	SW8321B
Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine (DNX)	RDX breakdown product	80251-29-2	DNX is very stable and relatively mobile in all soils.	SW8321B
Hexahydro-1,3,5-trinitroso-1,3,5-triazine (TNX)	RDX breakdown product	13980-04-6	TNX is very stable and relatively mobile in all soils.	SW8321B
Nitroguanidine (NQ)	Nitroaromatic/nitramine explosive/propellant	556-88-7	Partition coefficients are very low for NQ, remaining mostly in solution. This propellant will not be attenuated by sorption or degradation.	SW8321B
3,5-Dinitroaniline (3,5-DNA)	TNB breakdown product	618-87-1	TNT-related compounds are readily degraded and/or strongly adsorbed in surface soils, but are relatively mobile once in aquifer soils.	SW8321B, SW8330B, or EPA 529
Ammonium perchlorate[f] (NH_4ClO_4)	Propellant	7790-98-9	Perchlorate is very stable and needs a very active perchlorate-degrading microbial population for any degradation to occur. No sorption to soil occurs.	SW6850, SW6860, EPA 331.0, EPA 332.0
Potassium perchlorate[f] ($KClO_4$)	Propellant	7778-74-7	Perchlorate is very stable and needs a very active perchlorate-degrading microbial population for any degradation to occur. No sorption to soil occurs.	SW6850, SW6860, EPA 331.0, or EPA 332.0
Lead	Metal	7439-92-1	Lead is relatively constant because it does not degrade, volatilize, or migrate extensively through soil.[g]	SW6010B or SW6020
Copper	Metal	7440-50-8	Absorption/solubility of copper will depend on pH, redox, and the presence of other compounds (e.g.,humic material, sulfide) to form complexes	SW6010B or SW6020
Antimony	Metal	7440-36-0	Mobility of antimony will depend on pH and redox of surrounding environment.	SW6010B or SW6020
Zinc	Metal	7440-66-6	Absorption/solubility of zinc will depend on pH, redox, and the presence of other compounds (e.g.,humic material, sulfide) to form complexes	SW6010B or SW6020
Aluminum	Metal	7429-90-5	Mobility of aluminum will depend on pH and redox of surrounding environment.	SW6010B or SW6020

[a] Information gathered from TM 9-1300-214, *Military Explosives*; ATSDR Toxicological Profiles for 2,4- and 2,6-DNT and for 2,4,6-TNT (located at http://www.atsdr.cdc.gov/toxpro2.html), and the Hazardous Substances Database.
[b] Chemical Abstracts Service (CAS) registry number
[c] USACE ERDC, 2006
[d] Each specific method has advantages and disadvantages. Before choosing an analytical method, research the analytical method to assure its appropriate for your particular site. Methods referenced are from EPA 1994, Test Methods for Evaluating Solid Waste (SW-846), EPA/600/R-05/052, EPA 815/R-05/007, and EPA/600/R-05/049.
[e] USACHPPM, 2005
[f] The latest DoD perchlorate policies and guidance can be found at http://www.dodperchlorateinfo.net/.
[g] EPA, 2008

Table 5-7: Fixed Laboratory Analytical Methods for MC

Method No.	Title
SW6010C	Trace Metals Analysis by Inductively Coupled Plasma Atomic Emissions Spectrography (ICP-AES)
SW6020A	Inductively Coupled Plasma - Mass Spectrometry
SW6850	Perchlorate in Water, Soils and Solid Wastes using High Performance Liquid Chromatography / Electrospray Ionization / Mass Spectrometry or Chromatography-Electrospray Ionization Tandem Mass Spectrometry (HPLC/ESI/MS OR HPLC/ESI/MS/MS)
SW6860	Ion Chromatography / Electrospray Ionization / Mass Spectrometry
SW7470A	Mercury in Liquid Wastes (Manual Cold-Vapor Technique)
SW7471B	Digestion and Analysis of Solid Samples for Mercury by USEPA
SW8330B	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)
SW8332	Nitroglycerin by HPLC
SW8095	Explosives by Gas Chromatography (GC)
SW8321A[a]	Explosives by HPLC / Mass Spectrometry (MS)
EPA 529	Determination of Explosives and Related Compounds in Drinking Water by Solid Phase Extraction and Capillary Column GC/MS

[a] This method typically is cited for HPLC/MS of explosives. However, no published version includes explosives.

Because of the extremely heterogeneous distribution of MC (e.g., explosives) in soils, on-site analytical methods are a valuable, cost-effective tool to assess the nature and extent of MC-related contamination. Field analytical methods also provide for quicker analytical result turnaround times. Limitations to the methods include detection limits for MC that are not as low or refined as laboratory methods. Field methods are provided in Table 5-8. All field methods must be conducted by personnel with documented training and experience performing the planned methodology (USACE, 2007).

Table 5-8: Field Tests for Munitions Constituents

Method No.	Title
SW4050	Trinitrotoluene (TNT) Explosives in Soil by Immunoassay
SW4051	Royal Demolition Explosive (RDX) in Soil by Immunoassay
SW6200	Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment
SW8515	Colorimetric Screening Method for TNT in Soil
SW8510	Colorimetric Screening Procedure for RDX and Octahydro-1,3,5,7-Tetranitro-1,3,7-Tetrazocine (HMX) in Soil
N/A	Expray™

5.3.3 Sample Depth and Processing

5.3.3.1 Sample Depth

For surface soil sampling at former or operational ranges, research data have shown that most secondary MC (e.g., explosives) are found in the top 2 inches of soil and that sampling should be performed no deeper than 6 to 12 inches below ground surface. Sampling depth should be agreed on during the TPP process.

Alternate depths would be appropriate in conditions of shifting sands, erosion, grading, etc. If MEC items are expected or found in the subsurface, initial sampling should also be taken from subsurface soil near the identified MEC or munitions debris location. Subsurface MEC avoidance techniques need to be followed (USACE, 2007).

If significant releases of MC are believed to have occurred, groundwater sampling should be considered. The decision to sample groundwater should be made based on depth to groundwater, its susceptibility from surface releases, potential receptors, the magnitude of the suspected MC release, and the type of MC suspected at the site. If surface water is located on or near the MRS and receives runoff from suspected MC source areas, surface water / sediment sampling should be considered.

5.3.3.2 Sampling Schemes

For MC sampling during the RI/FS, the available methods for sample collection include discrete sampling, composite sampling (spoke and hub), and multi-incremental sampling. These collection methods have been used and documented during CRREL's R&D efforts. The types of sample collection to be used are decided by the MR Project Team during the TPP process.

Discrete soil samples provide point concentrations. However, because of the distribution of explosives on live-fire ranges, discrete samples are not reproducible and can give concentrations of an order of magnitude difference in adjacent samples. Due to the extreme heterogeneity and limited areal distribution of contaminants associated with low-order detonations and blow-in-place operations, multi-increment sampling, using a small sampling unit/decision unit (perhaps only a few square meters) may be the preferred method as decided by stakeholders during the TPP process.

Sampling Considerations for Various Range Types:
Table 5-9 provides the RPM and MR Project Team with an overview of sampling considerations based on range type. This table should assist the team in selecting the best possible sampling solution given the unique requirements of its MRS.

Composite sampling was developed by CRREL as a way to show the differences in discrete sampling compared to composite sampling. A spoke and hub template of seven samples was used. The findings from this sampling technique led to the development of the multi-increment (MI) sampling approach. This seven spoke sampling template will not be used for MC sampling, as the MI sampling approach will produce significantly more representative data.

MI sampling involves the collection of 30 or more individual subsamples over a defined decision unit at a specific depth interval. These subsamples are combined to form a single sample that is representative of the decision unit at the

specified depth. The recent update of SW8330B (http://www.epa.gov/epaoswer/hazwaste/test/new-meth.htm) includes specific guidance on multi-incremental sampling.

SW8330B recommends collecting 1000 grams (g) of soil and sieving and grinding the entire sample prior to subsampling. The sieving and grinding may occur in the field or in the laboratory. For additional information on laboratory subsampling, see *Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples* (EPA, 2003a at http://www.clu-in.org/download/char/epa_subsampling_guidance.pdf).

Typically, vegetation (e.g., grass, sticks, leaves) is removed from soil samples prior to laboratory processing; it is often conducted during actual field sampling. SW8330B recommends retaining the vegetation within the processed sample in order to account for any particles that may cling to the vegetation. Depending upon the concentrations of concern and the laboratory's chromatographic separation, this may be problematic for the analysis. For most site characterization projects, including all FUDS, this is not recommended, given the time elapsed between the distribution of the explosives and the characterization. For post-BIP samples, this would be appropriate. Sample preparation should be determined on a site specific basis.

SW8330B also recommends sieving samples with #10 (2 mm) sieves rather than the #30 mesh sieves specified in SW8330. It also recommends processing 10 g of soil rather than 2 g. This portion of the method should be implemented even if SW8330B is not implemented in full.

The sample collection method, degree of processing, vegetation inclusion/ exclusion, and sieve size must be discussed by the TPP team members and the laboratory to ensure acceptance of data to the data users. The regulatory acceptance based on previous agreement and quality of the data should be documented to ensure future acceptance of the data.

Method SW8330B:
Because Method SW8330B is new and has not yet been used extensively by DoD, a number of drawbacks remain. No decision has been reached with regard to testing for metals within the samples due to the grinding process. Their use in risk assessments and data validation may be compromised due to a limited number of samples, the sizing of decision units, and the number of sample increments within a decision unit. Decision unit for MRS sampling should be decided during the TPP.

Decision units for sampling at an MRS will depend on the site layout and the end use of the data. For a former or operational range, decision units could include the target area, the overshot and the undershot areas around the target, the firing point(s), and the range fan area. Table 5-9 summarizes information on sampling protocols or various MRSs from CRREL's Protocols for Collection of Surface Soil Samples at Military

Training and Testing Ranges for the Characterization of Energetic Munitions Constituents (2007).

5.3.4 Data Management and Validation

Analytical data management and validation guidance should follow CERCLA and RI/FS hazardous waste site investigation guidance (USACE, 2005a). Review procedures should be based on EM 200-1-10 Environmental Quality - Guidance for Evaluating Performance-Based Chemical Data (USACE, 2005a); the latest versions of the EPA Contractor Laboratory Program National Functional Guidelines (available at http://www.epa.gov/oerrpage/superfund/programs/clp/guidance.htm); and any applicable state or regional requirements. After an MRS undergoes sampling and analysis, it is necessary to carefully interpret all data and determine if the munitions response objectives have been met. If numeric DQOs have been identified for the munitions response, a comparison to those DQOs must take place.

Environmental Data Management System (EDMS) software is available to USACE personnel and contractors for DQO comparison. Data gaps may exist and should be identified and explained. Data gaps may require additional action as part of the remedial response (USACE, 2007). Staged Electronic Data Deliverables will be generated, and these electronic deliverables will be reviewed (at least in part) using Automated Data Review software (from Laboratory Data Consultants, Inc and available to USACE and Contractors). After this is done, the data may be compiled into EDMS or a similar system.

Regulators should also perform a review of project objectives and data quality. The solid development and adherence to DQOs is essential for the data collected to be in accordance with the work plan and meet the remedial goals and specific DQOs.

5.4 Data Evaluation

Data should be reviewed for potential additional data needs. In addition, determination of the need for a removal action should be reviewed at this point. Updating the CSM allows the project team to determine if basic and optimal data needs are met. Again, the purpose of the RI is not to answer all data gaps, but to fill the data needs for determining a baseline risk/hazard and comparing remedial alternatives. The purpose is also to identify if the investigation resulted in additional data needs required to select among or to refine response alternatives.

Table 5-9: MI Sampling Considerations for Various Range Types

Range Type	Description	Typical Weapons Used	Typical Energetic MC	Sampling Design[a]	Additional Considerations
Hand grenade range	Hand grenade ranges are small throwing bays, sometimes divided into several courts. Practice is to throw grenade from behind a fortified earthen wall into an impact area.	• M67 fragmentation grenade	• Composition B (RDX, TNT) • MC should include degradation products and impurities of RDX and TNT.	• MI samples will target the area between the front bay to the impact area, all along the impact area's width. Sample depth is dependent on the depth of penetration for a hand grenade; the sample depth should reflect this depth of penetration. For areas < 100 square meters (m^2), recommend 30 increments to prepare MI sample along a systematic grid. For areas $\geq$ 100 m^2, recommend 30–100 increments, depending on site size. Number of samples will be agreed to during the TPP process. Depth profiles are recommended as a single five-increment sample.	• When courts are not separated by barriers, sample as single decision unit. • Deposition is normally at surface; however, with cratering and range management, this will vary.
Anti-tank rocket range	Rocket projectiles are fired from shoulder-mounted tubes.	• 66 mm M72 Light Anti-armor Weapon (LAW) • AT4 rockets	• Practice rounds include propellant, but no high explosive warhead. • LAW rocket warheads include Octol (HMX, TNT) with a tetryl or RDX booster, M7 double-base (nitrocellulose [NC]/NG) propellant, potassium perchlorate, and carbon black.	• For the target area, MI sample should be taken in areas where most munitions residues are expected to be found (near targets, etc). Increments should be determined based on the size of the decision unit, as indicated above. A segmented halo design can establish MI samples within the individual segment areas. • For the firing point, determine where subsurface accumulation of energetic residue is likely to occur and collect the MI sample at the depth of penetration.	• Explosive and propellant residues are present in front of and behind the firing line and around targets.
Artillery/Tank/Mortar range	These range types are the largest Army training ranges.	• 155 mm howitzer • 105 mm artillery projectiles • 120 mm tank projectiles • 81 mm, 60 mm, and 120 mm mortar rounds • Various smaller munitions	• High explosive components include TNT, Composition B, tetryl, octyl, etc. • Single-based (NC; 2,4-DNT), double-based (NC/NG), and triple-based (NC/NG/NQ) gun propellants were used.	• For impact areas, use a square grid centered on each target, with an MI sample from top using a systematic grid pattern. • Point source samples may be taken near low-order detonations. Recommend a small grid centered around low-order detonations taking MI sample from top portion of soil. • Depth profile samples of these areas are taken as a single increment MI sample at several separate depths to establish the depth at which residues have mixed into the soil profile. • Other areas outside may be chosen for sampling and should follow the impact area grid, collecting MI sample from top.	• Low-order detonations of rockets/mortars pose the greatest risk for contaminant point sources in impact and target areas. • Propellant residues at firing points are often found downrange where excess propellant was burned.
Bombing range	Various	Various	• Apply same principles for artillery impact ranges.		
Demolition range	Various	Various	• Apply a grid within the OB area, collecting an MI sample from the top.		
Small arms range	Various	Various	• Apply similar principles for hand grenade range. Soil samples should not include intact or fragmented bullets and lead shot. When samples are ground and analyzed, these can falsely indicate high bioavailability of lead in soil.		

Source: USACE ERDC, 2007

Note: This is not a comprehensive table for MRSs, as there may be other types of sites and munitions that may need to be considered.

[a] Detailed information is not included in this table. For detailed information regarding MI sampling, refer to USACE ERDC, 2007.

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5.5 Baseline Risk/Hazard Assessment

The National Academy of Sciences (NAS) defines risk as the potential for adverse effects to an exposed population (NAS, 1983). It is a function of the probability of an accident (or adverse situation) occurring within a certain period of time and resulting in consequences to people, property, or the environment. The intent of these documents is discussed in Sections 5.5.1 through 5.5.3. The following definition of risk from the Presidential/Congressional Commission on Risk Assessment and Risk Management (1997) gives a clearer understanding of risk as it relates to the MMRP:

> *Risk is the probability that a substance or situation will produce harm under specified conditions and is a combination of two factors: (1) the probability that an adverse event will occur and (2) the consequences of an adverse event.*

The EPA has developed general risk assessment methods for evaluating human health and environmental risks at hazardous and toxic waste sites that follow the basic relationship established by the NAS. These general risk assessment methods are conducted through four basic steps: (1) hazard identification, (2) exposure assessment, (3) dose response modeling, and (4) risk characterization (NAS, 1983; EPA, 1988). These methods typically are used to quantify risk from long-term, chronic exposure to varying levels of chemical contamination.

Army Trial Use of Munitions and Explosives of Concern Hazard Assessment (MEC HA):
The Army has authorized and encouraged the use of the MEC HA as a tool in conducting hazard assessments and in alternatives analyses. However, this approval is for a 2-year trial period and will expire at the end of 2010 if not extended (2008a).

As the potential hazards posed by MEC, and MC are different, the MEC HA attempts to differentiate them by use of the terms “hazard” and “risk.” A MEC hazard assessment evaluates the risk of injury or death from any explosive hazard present. An MC risk assessment evaluates the potential threat of carcinogenic risk or noncarcinogenic hazard to human health and the environment through exposure to MC.

Explosive hazards may exist when MEC are known or suspected to be present at an MRS. The exposure to MEC can occur if a receptor has access to an MRS, MEC are present on the surface or may be exposed from the subsurface as a result of the activity to be conducted, and the receptor makes physical contact with any MEC encountered. An encounter with MEC may have one of three outcomes: no effect, injury, or death. The MRSPP is used to assign a relative priority for response activities at MRSs, taking into consideration various factors related to safety and environmental hazards. The EPA, working with the DoD

and the states, has developed a risk/hazard assessment tool, the MEC HA methodology to assess potential explosive hazards to human receptors at MRSs. This MEC HA tool describes and estimates the likelihood of adverse outcomes from an encounter with MEC. Several methods have been developed for performing a risk/hazard assessment on an MRS; however, no single methodology has been widely accepted, tested, and fully implemented. Both quantitative and qualitative methods evaluate MEC hazards. Information on available risk tools is on the USACE Ordnance and Explosives Directorate Web site (http://www.hnd.usace.army.mil/oew/index.aspx).

Without a quantitative risk assessment model, the exit criteria for a munitions response at an MRS must be determined on a site-by-site basis in collaboration with environmental regulators and Army explosive safety officials and consistent with future land use. The risk/hazard assessment and other qualitative methods are tools for qualitatively describing the explosive hazard and are not meant to be the decision makers.

Exit Criteria for MRA/MRS:
The RPM and MR Project Team should develop an exit strategy for an MRA/MRS in conjunction with the stakeholders. This task is complicated by the lack of an accepted risk assessment model. A key element of the exit strategy for the subject MRA/MRS is the accepted future land use!

If the risk/hazard assessment tool is not available to the MR Project Team during implementation of the RI and the MR Project Team does not accept other methods, a qualitative discussion of the hazard at the MRS should be developed by the MR Project Team. If the risk/hazard assessment tool is available to the MR Project Team, it should be augmented with a qualitative discussion of risk in relation to current and reasonably anticipated future users of the property.

5.5.1 U.S. EPA MEC HA

A multiagency (EPA, OSD, Army, Navy, states, Department of Interior, and Tribes) workgroup has developed the MEC HA (2008) to promote mutual understanding of technical issues of an MRS through a collaborative, team-based MEC HA process. The EPA risk/hazard assessment is designed to enhance communication of hazards within an MR Project Team and between project teams and external stakeholders. Use of the MEC HA should facilitate evaluation of removal and remedial alternatives and evaluation of determined or reasonably anticipated future land use activities.

The EPA MEC HA reflects the fundamental difference between assessing chronic chemical exposure risk and assessing acute MEC explosive hazards. An explosive hazard can result in immediate injury or death. Risks from UXO explosive hazards are evaluated as being either present or not present. If the potential for an encounter with MEC exists, the potential that the encounter could result in death or injury also exists. According to the risk/hazard assessment, if

MEC are known or suspected to be present, a munitions response (e.g., investigation) will normally be a removal or remedial action. As a general rule, munitions responses (i.e., removal or remedial) will include implementation of LUCs. In some cases, LUCs alone may suffice.

The EPA MEC HA addresses human health and safety concerns associated with potential exposure to MEC at land-based sites. It does not address underwater sites, nor does it address the chemical agent hazards associated with CWM sites, nor does it directly address environmental or ecological concerns that might be associated with MEC.

5.5.2 USACE Ordnance and Explosives Risk Impact Assessment

The OERIA provides a qualitative risk assessment tool that aids in risk communication. The OERIA provides a table to compile information and rank an MRS using the following factors: munitions type, sensitivity, estimated density and depth, site accessibility and stability, human activities, and population. A baseline score is developed based on best professional judgment. Actions (e.g., ICs, clearance to a detectable depth) are evaluated, and relative scores are given for each of the resulting site conditions. The table acts as a tool to compare the results of response action alternatives and relies heavily on the MR Project Team to analyze the results and select an alternative. The baseline risk assessment is used to assess the relative impact that response alternatives may have on reducing unacceptable risk of MC. The output of the method is a table with each response alternative ranked with a letter grade (A being the highest) for all risk factors identified. Although the MR Project Team may refer to USAESCH's 2001 Interim Guidance Ordnance and Explosives Risk Impact Assessment, for information on its use, the Army encourages the MEC HA's use.

5.5.3 Munitions Constituents Risk Assessment

Risks posed by MC are assessed through a baseline risk assessment that adheres to the requirements of CERCLA and the NCP. The following documents provide the guidance for conducting risk assessments:

- EM 200-1-4 Environmental Quality - Risk Assessment Handbook - Volume I: Human Health Evaluation and Volume 2: Environmental Evaluation (USACE, 1999a and 1996)

- EM 1110-1-4009 Military Munitions Response Actions (USACE, 2007)

- EPA 540/1-89/002 Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A), Interim Final (1989b)

- EPA 540/G-89/004 Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final (1988)

- EPA 540-R-97-006 Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments (1997)

State risk assessment protocols should also be considered, keeping in mind that MR Project Team approval is required prior to following any state-specific cleanup plan.

5.6 Assessment of Required Interim Measures

In general, the Army expects the remedial process to be the most effective solution for the majority of MRSs. If, during the course of an RI/FS, site characterization indicates the need for a more immediate removal action, the MR Project Team can and should switch actions. However, following the removal action, the munitions response should transition back to the RI/FS process. Therefore, it is preferable to limit removal actions and perform interim remedial actions that are determined based on the overall remedial action instead of performing removal actions that require additional documentation and assessment.

Removal Actions:
When a removal action is conducted within or in conjunction with the remedial response, the removal action will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action. When the removal action is completed, the munitions response normally will transition back to the RI/FS process.

If either before the RI/FS begins or during the course of the investigation an immediate threat is found, a removal action or interim remedial action may be required. Removal actions are an integral part of the overall CERCLA process for the MMRP, and an MRS can enter the removal action phase from any point in the CERCLA process, if deemed necessary. Section 300.415(b)(2) of the NCP describes the factors that shall be considered in determining the appropriateness of a removal action. These factors include property conditions, potential receptors, migration pathways, and risk/hazard assessments. Removal actions generally have limited objectives and typically are short term to mitigate the threat posed by a release or threatened release of UXO, DMM, or MC.

5.6.1 Remedial Actions and Removal Actions

The EPA, consistent with section §300.415 of the NCP, established three categories of removal actions: emergency, time-critical, and non-time-critical based upon the situation, the urgency and threat of release or potential release, and the subsequent timeframe in which the action must be initiated. Each type of removal action is discussed in detail below. When appropriate, removal actions can be conducted as part of a munitions response. Such responses normally reduce risks and may reduce the total cost. Removals are normally expedited

response actions, as opposed to final remedial actions, which are usually intended to provide permanent remedies.

- Emergency removal actions: Emergency removal actions address immediate, unacceptable hazards or risks and must commence within hours of discovery. Due to the exigency of an emergency removal, an Action Memorandum (AM) is not required prior to performing the emergency removal. Emergency removal actions include EOD response to an immediate identification of MEC. Emergency removal actions are described in ER 200-3-1 (USACE, 2004c).

- TCRA: A TCRA is an expedited removal action for which less than 6 months of planning time is available before on-site activities must begin. TCRAs may be initiated at any phase of the munitions response. An AM is required prior to performing the TCRA. TCRAs may be conducted for situations that involve UXO, DMM, or MC alone or in combination. While time may be limited, the TPP process should still be followed.

- NTCRA: The general difference between a TCRA and an NTCRA is the amount of planning time that exists before on-site activities must be initiated. For an NTRCA, a planning period of at least 6 months exists before on-site activities must be initiated, and it has been determined that a removal action is appropriate. An Engineering Evaluation/Cost Analysis will be conducted. An AM is required prior to performing the NTCRA. Additional guidance for NTCRAs is available in EPA 540-R-93-057 (1993). While time may be limited, the TPP process should still be followed.

In addition to TCRAs and NTCRAs, the RI/FS may recommend Interim or Contingent Remedial Actions to accomplish a mission similar to NTCRAs. The Interim Remedial Action is implemented as a partial CERCLA response process.

For a removal action, an Engineering Evaluation/Cost Analysis is typically conducted. Typically, removal actions are initiated in response to situations to abate, prevent, minimize, stabilize, mitigate, or eliminate circumstances that pose an immediate and serious threat to human health or the environment (EPA, 1988). Removal actions at MRSs on active Army installations are usually the result of what the NCP characterizes as an imminent “threat of fire or explosion.”

Remedial and removal actions are not mutually exclusive. For example, an MRA with very complex conditions involving several MRSs with multiple sources and types of UXO, DMM, or MC is addressed through a munitions response under the remedial process. These MRSs may also involve individual removal actions. When a removal action is conducted within or in conjunction with the remedial response, the removal action will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action. Following any removal action (emergency, time-critical, or non-time-critical), the effort transitions to the previous point in the remedial process to determine what

additional remedial action, if any, may be necessary to achieve the response in place or response complete milestones or closeout (USACE, 2002).

5.7 Remedial Investigation Reporting

The RI portion of the RI/FS report should include the MRS background, a description of the physical characteristics, a description of the data collection and analysis, the updated CSM, the baseline risk/hazard assessment, and the recommended remedial action objectives. Development of RI objectives is discussed in Section 4.1. An example RI/FS report outline is included in Appendix D.

5.7.1 Update Conceptual Site Model

The CSM is refined with information collected during the RI. Given the results of the RI, the MRS may become an MRA containing more than one MRS with similar characteristics and corresponding response alternatives. A CSM would be required for each MRS.

5.7.2 Update Munitions Response Site Prioritization Protocol

The MRSPP requires the DoD in consultation with representatives of the states and Indian tribes, to assign each MRS a relative priority for response actions. The MRSPP evaluates the potential explosive, chemical agents, and environmental hazards at an MRS. A full description of the MRSPP process is described in 32 CFR Section 179.

The MRS's initial MRSPP score was developed during the SI phase. These scores must be reviewed annually and must be revised whenever new data are obtained, such as in the RI/FS.

6 TREATABILITY STUDIES

Bench and/or pilot studies are conducted, as necessary, to determine the suitability of remedial technologies to address MRS conditions and problems. Technologies suitable to the site should be identified as early as possible to help the MR Project Team decide if there is a need to conduct treatability studies to better estimate costs and performance capabilities. Treatability testing of technologies to support remedy implementation may begin during the scoping phase or the initial phases of site characterization and technology screening and continue through the RI/FS and into the Remedial Design / Remedial Action.

Figure 6-1 provides a decision diagram for determining when treatability studies are needed to support the evaluation of and selection of an alternative.

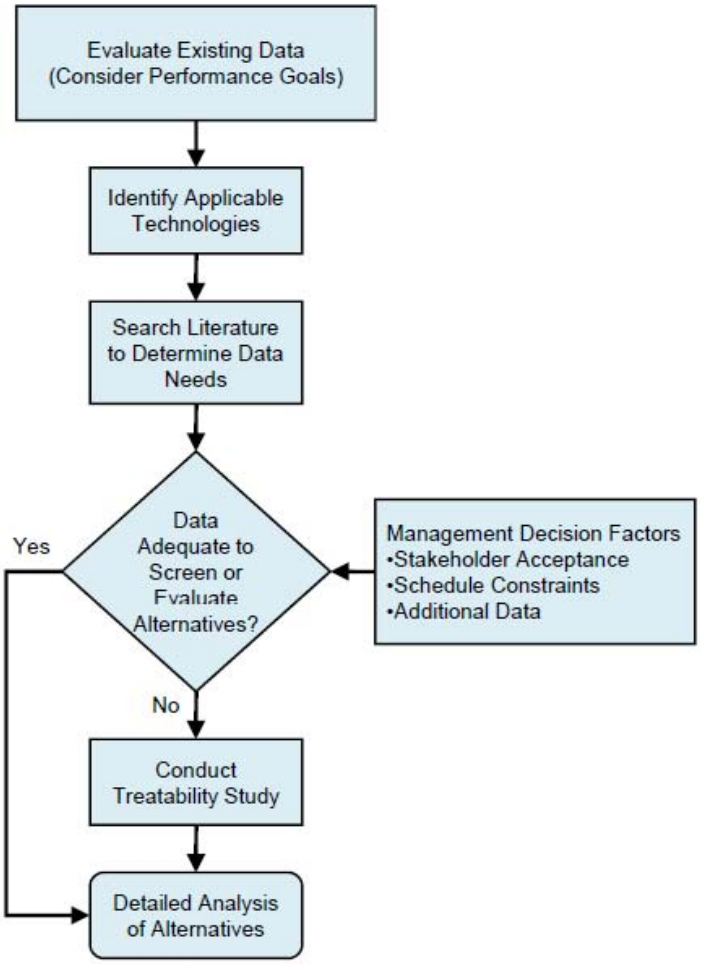

Figure 6-1: Treatability study decision diagram

If treatability studies are deemed necessary, a testing plan identifying the types and goals of the studies, the level of effort needed, a schedule for completion, and the data management guidelines is submitted to the state and/or the EPA for review. The testing plan also addresses the limitations of the proposed technology relative to field application and expected cost, time, and implementability issues associated with the technology at this site. Treatability studies are MRS- or munitions response–specific and short term. Care must be exercised to ensure the treatability study is representative of material to be treated (MC or munitions) to minimize uncertainty in the decision. Upon review completion, a test facility and any necessary equipment, vendors, and analytical services are procured by the contractor.

Treatability studies for an MMRP RI/FS may include the following:

- Vegetation removal studies – As detection technology is more effective with less vegetative cover, techniques to facilitate vegetation removal are possible treatability options. The type of vegetation at the site determines the best method for its removal. Options for vegetation removal include cutting, controlled burns, and biological methods.

- MEC treatability studies – Continued technology advancements will provide the RPM a variety of technological solutions for disposing of MEC with the necessary tools and information required for FS decision-making. Technological advancements and “real life” and “field tested” applications will also provide a platform for future studies.

- MC treatability studies – Treatability studies for MC address technologies and bench-scale tests for soil and groundwater contamination (e.g., biodegradation, pump and treat, composting).

7 FEASIBILITY STUDY

"The primary objective of the FS is ensuring appropriate remedial alternatives are developed and evaluated...and an appropriate remedy selected" (NCP, 40 CFR 300.430[e]). The FS process includes the development and screening of alternatives and detailed analysis of alternatives. This section focuses on the development of alternatives for MEC. The process for developing and screening response action alternatives for MEC differ from that used for MC or other environmental contaminants, as detailed in Chapter 4 of the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (OSWER Directive 9355-01, 1988).

7.1 Development of Response Actions and Process Options

For the majority of MRAs/MRSs the below RI/FS alternatives are normally evaluated:

- NAA
- LUCs / risk management (ICs such as ECs, educational programs, legal mechanisms, and construction support)
- Active treatment alternative (surface and subsurface removal response combined with risk management)
- Active treatment and disposal plus LUCs

There are several technologies used during munitions responses, including remedial actions, to MEC: detection technologies, recovery technologies, and disposal technologies. Table 7-1 provides an example of the process options for MEC remedial actions.

7.1.1 No Further Action

The NCP requires a "no action" alternative be developed for the FS. This alternative provides a baseline for comparison against the other alternatives. The NAA is not discussed to any great extent if it is clear there is risk and some kind of cleanup action must be considered. However, the NAA must be evaluated against the threshold criteria and balancing factors, as must all alternatives at this phase of the process.

7.1.2 Risk Management or Land Use Controls

LUCs are physical, legal, and other mechanisms restricting access and property use. LUCs can be used to mitigate risks associated with the potential exposure to any hazards prior to, during,

LUC Selection:
The selected LUC must be compatible with the agreed upon future land use. It must be clearly defined, established in coordination with affected parties, and enforceable.

Table 7-1: Example Process Options for MEC Remedial Alternatives

Potential MEC Response Actions	Remedial Action	Site Preparation	Detection Technologies	Recovery Technologies	Disposal Technologies	Munitions Debris
No DoD action	None	N/A	N/A	N/A	N/A	N/A
LUCs	ECs (e.g., fencing, signage, guard posts)	N/A	N/A	N/A	N/A	N/A
	ICs (e.g., legal, education)	N/A	N/A	N/A	N/A	N/A
Surface removal	Excavation and disposal (and associated LUCs)	Site Prep "A"	Various	N/A	BIP	Debris removal
					Consolidated shot	Debris removal
					Contained detonations	Debris removal
Subsurface removal to a specified depth	Excavation and disposal (and associated LUCs)	Site Prep "A"	System A	Excavation System A	BIP	Debris removal
					Consolidated shot	Debris removal
					Contained detonations	Debris removal
Subsurface removal to a detected depth	Excavation and disposal (and associated LUCs)	Site Prep "B"	System B	Excavation System B	BIP	Debris removal
					Consolidated shot	Debris removal
					Contained detonations	Debris removal
Subsurface removal to a given depth	Excavation and disposal (and associated LUCs)	Site Prep "B"	System A	Excavation System A	BIP	Debris removal
					Consolidated shot	Debris removal
					Contained detonations	Debris removal
Construction support	On-site or on-call construction support	N/A	N/A	Excavation System B	BIP	Debris removal
					Consolidated shot	Debris removal
					Contained detonations	Debris removal

or after a response when cleanup to a level that allows for either unrestricted use is not possible. Because some MEC might not be detected or removed during a response, some form of LUC is normally required to address any residual hazards that might exist. LUCs may be a component of other remedial actions, unless leaving MEC in place proves to be the most favorable risk management decision (e.g., due to technical or economic limitations, concerns regarding worker safety, to prevent collateral ecological injuries) (U.S. Army, 2004a). The DoD Policy on Land Use Controls Associated with Environmental Restoration Activities (2001b) provides additional information concerning LUCs and discusses the evaluation of unrestricted land use and unlimited access versus LUCs during an FS.

The primary LUC mechanisms for MEC are defined below:

- Physical mechanisms encompass a variety of engineered remedies that reduce or eliminate potential exposure to MEC known or suspected to be present. Such controls are intended to limit or prohibit access to an MRS, warn people of the potential dangers known or suspected to be present at an MRS, or prevent the potential for MEC to migrate from the MRS. These mechanisms are also known as physical controls or ECs.

- Legal mechanisms used for LUCs may be the same as those used for ICs, as discussed in the NCP. These mechanisms are imposed primarily to ensure that restrictions on land use, developed as part of a remedy decision, stay in place. Examples of legal mechanisms include updates to the Real Property Master Plan and restrictive covenants, equitable servitudes, and deed restrictions for transfer properties.

A primary objective of LUCs is to help manage risks/hazards present at the site during the implementation of remedial actions, as well as any residual risks/hazards after the completion of active remedial actions. LUCs also ensure that current and future land use is compatible with the agreed upon land use that was the basis for the evaluation, selection, and implementation of the response action alternative. Because current technologies do not allow for complete removal of all MEC, LUCs are a component of nearly all munitions responses to MEC. At active installations, the Army is responsible for maintaining LUCs.

At MRS where a use restriction is part of munitions response to MEC, the LUC must be clearly defined, established in coordination with affected parties, and enforceable. Implementing LUCs through established real estate and land use management mechanisms provides a means to help ensure LUCs remain associated with the land upon transfer of ownership. Use of a system of mutually reinforcing controls is often a necessary component in a LUC strategy. When considering LUCs as part of the response alternatives, the unrestricted use alternative must also be considered.

7.1.2.1 Active Installations

In the case of an active installation, risk management responsibility is a command responsibility and installations should incorporate LUC into the installation's Master Plan (part of the environmental overlay and an annex with descriptions of both ECs and ICs) (AR 210-20). In addition, if appropriate, installations should develop written management procedures for maintenance and inspection of ECs and review of proposed actions that may impact the LUCs (e.g., construction projects, excavations).

Long-Term Remedy Effectiveness: When evaluating LUCs, the MR Project Team should consider the long-term effectiveness and efficiency of the remedy. Therefore, clear plans and procedures to ensure the LUCs remain in effect and are enforced are important considerations for regulatory and stakeholder review.

7.1.2.2 Transferring Properties

When a property is transferring from federal control, the transfer documents should specify the responsibility of the transferee and any subsequent property owners with regard to maintenance and enforcement of LUCs. At properties transferring from federal control, the Army should use state LUC registries where available. The Army may, upon transfer, grant a property interest to the relevant state or local agency, allowing the state or local agency to maintain and enforce the LUC. Most LUCs at transfer sites would also be memorialized as deed restrictions or in other publicly available legal instruments. The Army may work together with state or local government agencies or with other appropriate authorities (e.g., zoning boards) to assist in LUC management and enforcement, ensuring compliance with remedial LUCs by a transferee. It is essential the Army consult state property law and state environmental law when drafting the restriction because state law may require the use of a particular type of instrument or operative language.

7.1.2.3 Transferred Properties

Approaches to LUC documentation differ for property the Army owns or controls and private property. The Army cannot impose or enforce restrictive covenants or negative easements on private property. The Army can, however, work with the property owner and/or state or local governments to ensure needed restrictions (e.g., zoning restrictions) or other forms of restrictions are implemented and maintained. The real property laws of the state in which the property is located should be considered when addressing the need for LUCs because some state laws may allow restrictions to be recorded in some manner. In cases where a LUC was included in a transfer deed or contract at the time the property was transferred, proprietary controls (e.g., a covenant or easements) may be used to restrict land use. Under their police-power authority, a state or local government may supplement such proprietary controls. This

supplementation may include zoning, permitting, and local redevelopment ordinances.

For property transferred with some type of LUC, proprietary mechanisms may be used to restrict land use. Proprietary controls are contractual or real estate mechanisms, usually established in a transfer deed or contract for sale in the form of covenants or easements. Such proprietary LUCs may be supplemented with existing forms of control imposed by a state or local government originating from their police power authorities. This may include zoning, permitting, and local redevelopment ordinances.

7.1.3 Remedial Action with LTM (Excavation and Disposal)

7.1.3.1 Surface Removal and Disposal

A surface removal is the removal of any MEC visible in part or whole on the surface. A surface removal may be based on a visible survey of an MRS or may be technology aided. During a surface removal, qualified personnel mark, identify, and record the approximate locations of all MEC found on the surface for subsequent destruction. In addition, all munitions debris and other materials interfering with the geophysical investigation should be collected and stored for later disposal (USACE, 2006a).

7.1.3.2 Subsurface Removal and Disposal

Geophysical investigations are performed to acquire data and identify anomalies beneath the surface. The data gathered is processed using discrimination techniques to determine a dig list of those anomalies selected for investigation. Whereas RI geophysical investigations are aimed at identifying the presence or absence of MEC and, if present, the extent of the MEC, remedial action geophysical investigations aim to identify all potential MEC-like geophysical anomalies. The geophysical investigation phases are the same during both the RI and the remedial action, but remedial action investigations typically cover the entire site, while RIs typically only investigate a portion of the site using one of the sampling strategies outlined in Section 5.2.2. Geophysical investigations typically are performed in three phases.

- Phase 1: GPO (See Section 5.2)
- Phase 2: Geophysical survey – Employ geophysical instrumentation to survey the MRS. Geophysical data are then analyzed and interpreted to identify potential MEC for intrusive investigation.
- Phase 3: Reacquisition of target anomalies for intrusive investigation – All anomalies selected for excavation are physically reestablished by precise survey methods, mapped, documented on dig sheets, and intrusively investigated (USACE, 2000a).

Subsurface excavations and disposal methods for any MEC found are also described in AR 385-10 *Army Safety Program* (2007b), and DA PAM 385-65 *Explosive and Chemical Site Plan Development and Submission* (2008).

The design of remedial alternatives are based on land use and the potential depth of any MEC that may be present. Potential interaction between receptors and MEC are considered when designing a munitions response for MEC. Currently, most anomalies selected for investigation are investigated to detection depth. Other aspects that may be considered include the ability to store, destroy or transport any MEC recovered. Storage and transport are discussed in EM 385-1-97, EP 75-1-3 RCWM, and EM 1110-1-4009 (USACE, 2003l, 2004a, 2007).

Recovered MEC is normally destroyed on site, either at the location of discovery or at the location on the MRS that has been sited and approved under Service and DoD policy. In some cases, recovered MEC may be transported of the MRS for destruction. The decision regarding the disposition of any MEC recovered is based on the risk associated with the disposal operation, as determined by site-specific characteristics and the nature of the MEC recovered. Additional information on MEC disposal operations can be found in TM 60A-1-1-31 *Explosive Ordnance Disposal* (U.S. Army, 1999). The MEC contractor shall comply with the provisions of DoD 6055.09-STD, DoD Instruction 4140.62 (DDESB, 2008), EM 1110-1-4009, and EM 385-1-97 (USACE, 2007, 2008) for managing, processing and disposition of MPPEH.

7.1.3.3 Long-Term Management

LTM of an MRS where a munitions response to MEC will normally require some level of LUCs, as described in Section 7.1.2, and 5-Year reviews of the effectiveness of the response. CERCLA 5-year reviews may be conducted at intervals less than 5 years if conditions at the MRS have changed significantly (e.g., reasonably anticipated land use changes from open space to residential).

7.2 Development and Screening of Alternatives

Alternatives identified in the FS are screened initially for effectiveness, cost, and implementability. While the initial screening with regard to a munitions response that only involves MEC (i.e., is not also addressing environmental contaminants, including MC) may have limited utility, it may prove to be beneficial. This initial screening is preliminary and is not equivalent to the detailed analysis of alternatives discussed below.

- Effectiveness: The demonstrated ability of component technologies to achieve design goals is addressed in evaluating effectiveness. Adverse environmental impacts predictable at this stage are also being considered in evaluating effectiveness.

- Cost: At this stage, costs are order-of-magnitude, but include remedial action-operations and LTM costs, as appropriate. It is important to capture life-cycle costs and use this information in the decision-making analysis of the alternatives.

- Implementability: Factors such as safety; constructability; regulatory and public support; compatibility with planned land uses; and availability of material, equipment, technical expertise, or off-site treatment and disposal facilities may be considered in evaluating implementability.

Calculations, assumptions, and references supporting these evaluations should be documented in the FS. The results of the initial screening should be provided to the state so they can refine state ARARs. Tables 5-1 through 5-4 provide the initial screening for effectiveness, cost, and implementability of detection; processing; and disposal technologies.

7.3 Detailed Analysis of Alternatives

The purpose of this step is to evaluate and compare the alternatives remaining after the initial screening. Section 300.430 (e)(9)(iii) of the NCP describes the nine criteria for evaluating and comparing alternatives during the detailed analysis. Based upon the criteria, the alternatives are evaluated against each of the nine criteria and the alternatives are then compared to one another to identify their relative performance against the nine criteria. The results are placed in a table (preferred) within the draft FS report.

FS Comparison of Alternatives: In developing the comparison of FS alternatives, the RPM must ensure that each potential alternative is evaluated and compared against the nine criteria listed in Section 300.430(e)(9)(iii) of the NCP. The results of this comparison should be placed in a table (preferred) within the draft FS report.

7.3.1 Threshold Criteria

Threshold criteria are requirements each alternative must meet or have specifically waived to be eligible for selection. In the absence of thresholds for MEC, the primary objective of the response is to reduce hazards while meeting ARARs. In the event a response is available that meets ARARs, the goal of the response is to reduce MEC hazard.

7.3.1.1 Criterion for Protectiveness of Human Health and the Environment

The overall protectiveness is a combination of the magnitude of residual risk / hazard following the action and the short- and long-term effectiveness of the alternative.

The hazard/risk assessment tool (upon DoD and Army acceptance) and the USACE OERIA, as discussed in Section 5.5, provide input to the threshold criteria of protection of human health and the environment. These tools can be

used qualitatively to evaluate the relative protection allowed by the remedial alternatives.

7.3.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

See Section 4.1.4 for a discussion of ARARs. RPMs should consult their organization's legal counsel for guidance on ARARs.

7.3.2 Balancing Criteria

Balancing criteria are those that form the basis for comparison among alternatives that meet the threshold criteria.

7.3.2.1 Long-Term Effectiveness and Permanence

Long-term effectiveness considers the magnitude of residual risk/hazard, the adequacy of the response in limiting the risk/hazard, the required LUCs, and LTM.

7.3.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This is a balancing criterion and assesses the degree to which response alternatives employ recycling or treatment, reducing toxicity, mobility, and volume. Toxicity, mobility, and volume are factors that can be addressed for MC. For MEC, the toxicity and mobility factors are not specifically relevant. Therefore, the reduction of volume, or removal of MEC, is the primary factor for MEC. Remedial alternatives, at a minimum, address the principal potential threats posed by the site to the local environment. Considerations for the evaluation of this criterion are as follows:

- Disposal processes for MEC
- Amount of UXO, DMM OR MC to be destroyed, treated, or recycled. The management of the MPPEH, and the disposal of MDEH or MDAS
- Degree of expected reduction in toxicity, mobility, and volume, including the means by which the principal threat is addressed
- Degree to which the alternative is irreversible
- Type, quantity, or volume of residuals that will remain, considering the persistence, toxicity, mobility, and propensity to bioaccumulate
- The degree to which the alternative reduces the inherent hazards posed by the principal threat

When conducting these analyses, decision makers need to consider the multiple sources possibly generating waste during a munitions response (removal or remedial) and prioritize the associated concerns (i.e., UXO, DMM or MC) for (a) MEC (explosives safety), (b) MC and incidental non-munitions contaminants; and, (c) MPPEH (explosives safety). When evaluating response alternatives against the reduction in toxicity, mobility, and volume criterion, consider the degree to which the response alternative will address any MEC present and treat

any environmental contaminants, including MC, present. In certain situations, the removal of MEC may effectively remove any MC contamination present. Confirmation sampling following the removal of MEC will help determine where any additional MC treatment is required.

7.3.2.3 Short-Term Effectiveness

Short-term effectiveness considers worker and community safety, as well as ecological impacts, socioeconomic impacts, and cultural impacts. Worker and community safety is addressed through ECs and ICs established during the remedial action (e.g., EZs, Personal Protective Equipment [PPE]). Ecological impacts vary with site-specific conditions and alternatives (e.g., surface vs. subsurface removal). For example, alternatives requiring a high level of vegetation removal have a larger impact than those not requiring such removal. The evaluation of socioeconomic impacts requires decision makers to conduct an analysis to determine if environmental justice is a concern or potential concern. To conduct this analysis, decision makers should evaluate impacts or potential impacts of each alternative on minority and low-income communities living on or near the MRS. Examples include how a response alternative would impact low-income communities versus affluent communities or how subsistence farming or fishing patterns relate to the response alternatives.

7.3.2.4 Implementability

Implementability can include technology and administrative requirements. Examples of each are given below:

- Technical requirements
  - Access due to terrain, vegetation, soils, water, hazards
  - Availability of technology
  - Availability of equipment
  - Meteorological/climatological concerns
  - Available technology
  - Ability to determine effectiveness
  - The ability or inability to integrate munitions responses with other environmental responses

- Administrative requirements
  - Legal considerations
  - Coordination and time requirements
  - Access due to ownership
  - Personnel/equipment shortages
  - Funding availability

7.3.2.5 Cost

This is a balancing criterion used to evaluate the capital cost, annual O&M cost, and net present value costs associated with implementing each alternative with

consideration of discount rates over a 30-year period. The 30-year period adopted in this document is consistent with the NCP and does not represent a limitation on the length of response implementation (EPA, 1991a). It is used in this context for subsequent use during the comparative analysis to evaluate the differences in costs among alternatives. As such, the cost estimates need to be revised prior to the end of the original O&M period.

When conducting the analysis of individual response alternatives, decision makers should compare net present value costs associated with implementing each alternative. In addition, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988 and 1990) indicates that order-of-magnitude cost estimates having a desired accuracy of -30% to +50% should suffice for the more detailed analysis of response alternatives for this criterion.

7.3.3 Modifying Criteria

Modifying criteria are criteria considered in remedy selection.

7.3.3.1 Regulatory Acceptance

Dialogue among members of the MR Project Team should be maintained throughout the process. However, formal evaluation of this criterion should precede remedy selection, which is the final step in the detailed analysis of response alternatives.

7.3.3.2 Community Acceptance

Community acceptance may be estimated based on community outreach efforts, but this criterion should be the last phase of the process prior to remedy selection and cannot be fully evaluated in the RI/FS phase. Community outreach efforts include, but are not limited to, the development of the CRP, RAB meetings, public meetings, and other widely accepted mechanisms.

The detailed analysis provides the means by which facts are assembled and evaluated to develop the rationale for a remedy selection. Therefore, it is necessary to understand the requirements of the remedy selection process to ensure that the FS analysis provides the sufficient quantity and quality of information to simplify the transition between the FS report and the actual selection of a remedy (USACE, 2006b).

Final community acceptance is evaluated when the Proposed Plan has been issued and the public meeting / comment period for the Proposed Plan has been conducted. Public/community concerns are then addressed in the selection of the remedy in the final ROD/DD, and responses are provided in the responsiveness summary section of the ROD/DD.

7.4 Reporting

The FS portion of the RI/FS report should summarize the results of the RI, detail the development of ARARs and resulting PRGs and remedial action-operations, identify and screen the general response alternatives, provide detailed alternative descriptions, and provide a comparative analysis of the response alternatives. Appendix D provides an outline of the RI/FS report and example presentations of the content.

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Appendix A – References

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Appendix B – Acronyms and Glossary

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Acronyms

Acronym	Description
3D	Three Dimensional
ACOM/ASCCs	Army Commands / Army Service Component Commands
ACSIM	Assistant Chief of Staff for Installation Management
AEPI	Army Environmental Policy Institute
AM	Action Memorandum
AP	Ammonium Picrate
APP	Accident Prevention Plan
AR	Army Regulation
ARAR	Applicable or Relevant and Appropriate Requirement
ARE	Chief, NGB Environmental Programs Division
ARNG	Army National Guard
ASA (I&E)	Assistant Secretary of the Army (Installations and Environment)
BIP	Blow-In-Place
BRAC	Base Realignment and Closure
BRACD	Base Realignment and Closure Division
CA	Cooperative Agreement
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CAIS	Chemical Agent Identification Sets
CFR	Code of Federal Regulations
cm	Centimeter
CRP	Community Relations Plan
CRREL	Cold Regions Research Engineering Laboratory
CSM	Conceptual Site Model
CSP	Chemical Site Plan
CSS	Chemical Safety Submission
CWM	Chemical Warfare Materiel
DA	Department of the Army
DASA-ESOH	Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health
DD	Decision Document
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DID	Data Item Description
DMM	Discarded Military Munitions
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DNX	Hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DoD	Department of Defense
DQO	Data Quality Objective
DRU	Direct Reporting Unit
DSMOA	Defense and State Memorandum of Agreement
DU	Depleted Uranium

Acronym	Description
DUSD(I&E)	Deputy Under Secretary of Defense for Installations and Environment
EC	Engineering Control
EDMS	Environmental Data Management System
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EM CX	Environmental and Munitions Center of Expertise
EMI	Electromagnetic Induction
EO	Executive Order
EOD	Explosive Ordnance Disposal
EP	Engineer Pamphlet
EPA	United States Environmental Protection Agency
EPP	Environmental Protection Plan
ER	Engineer Regulation
ERDC	Engineering Research and Development Center
ERM	Environmental Restoration Manager
ESP	Explosive Site Plan
ESS	Explosives Safety Submission
EZ	Exclusion Zone
FOSET	Finding Of Suitability for Early Transfer
FOSL	Finding of Suitability for Lease
FOST	Finding Of Suitability to Transfer
FDEMI	Frequency-Domain Electromagnetic Induction
FFA	Federal Facility Agreement
FS	Feasibility Study
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Sites
FY	Fiscal Year
g	Gram
GC	Garrison Commander or Gas Chromatography
GPO	Geophysical Prove-Out
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High Performance Liquid Chromatography
HPLC/ESI/MS	High Performance Liquid Chromatography / Electrospray Ionization / Mass Spectrometry
HPLC/ESI/MS/MS	High Performance Liquid Chromatography / Electrospray Ionization Tandem Mass Spectrometry
HQUSACE	Headquarters, United States Army Corps of Engineers
HRR	Historical Records Review
HRS	Hazard Ranking System
HTRW	Hazardous, Toxic, and Radioactive Waste
IAG	Interagency Agreement
IC	Institutional Control
ICM	Improved Conventional Munitions
ICP-AES	Inductively Coupled Plasma-Atomic Emissions Spectrography
IMCOM	Installation Management Command
IR	Infrared

Acronym	Description
IRP	Installation Restoration Program
ISE	Installation Services Directorate, Environmental Division
ITRC	Interstate Technology and Regulatory Council
LAW	Light Anti-Armor Weapon
lb	Pound
LTM	Long-Term Management
LUC	Land Use Control
m^2	Square Meter
m	Meter
MC	Munitions Constituents
MDAS	Material Documented As Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MEC HA	Munitions and Explosives of Concern Hazard Assessment
MEDCOM	U.S. Army Medical Command
MFR	Memorandum for Record
MGFD	Munitions with the Greatest Fragmentation Distance
MI	Multi-Increment
mm	Millimeter
MMRP	Military Munitions Response Program
MNX	Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
MPPEH	Material Potentially Presenting an Explosive Hazard
MR	Munitions Response
MRA	Munitions Response Area
MRCSS	Munitions Response Chemical Safety Submission
MRESS	Munitions Response Explosives Safety Submission
MR Project Team	Munitions Response Project Team
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS	Mass Spectrometry
NAA	No Action Alternative
N/A	Not Applicable
NAS	National Academy of Science
NB	Nitrobenzene
NC	Nitrocellulose
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAA	National Defense Authorization Act
NDAI	No Department of Defense Action Indicated
NDCEE	National Defense Center for Energy and Environment
NELAP	National Environmental Laboratory Accreditation Program
NEW	Net Explosives Weight
NFA	No Further Action
NG	Nitroglycerin
NGB	National Guard Bureau
NPL	National Priorities List
NQ	Nitroguanidine
NRC	Nuclear Regulatory Commission

Acronym	Description
NTCRA	Non-Time-Critical Removal Action
O&M	Operation and Maintenance
OB	Open Burn
OD	Open Detonation
OERIA	Ordnance and Explosives Risk Impact Assessment
OSD	Office of the Secretary of Defense
OSWER	Office of Solid Waste and Emergency Response
PA	Preliminary Assessment
PA (picric)	Picric Acid
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Pamphlet
PETN	Pentaerythritol tetranitrate
PPE	Personal Protection Equipment
ppm	Parts Per Million
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
QC	Quality Control
QSM	Quality Systems Manual
R&D	Research and Development
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RCWM	Recovered Chemical Warfare Materiel
RDX	Royal Demolition Explosive
REO	Regional Environmental Offices
RESS	Required Explosives Safety Submissions Requirements
RI	Remedial Investigation
ROD	Record of Decision
ROE	Right of Entry
RPM	Remedial Project Manager
RSP	Render Safe Procedure
RTS	Robotic Total Station
SAM	Sub Audio Magnetics
SAP	Sampling and Analysis Plan
SAR	Synthetic Aperture Radar
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
STD	Standard
TAL	Total Analyte List
TBC	To Be Considered
TNB	Trinitrobenzene
TCRA	Time-Critical Removal Action
TDEMI	Time-Domain Electromagnetic Induction
TM	Technical Manual

Acronym	Description
TNT	Trinitrotoluene
TNX	Hexahydro-1,3,5-trinitroso-1,3,5-triazine
TP	Technical Paper
TPP	Technical Project Planning
TRC	Technical Review Committee
TRW	Technical Review Workgroup
UFP	Uniform Federal Policy
U.S.	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEC	United States Army Environmental Command
USAESCH	United States Army Engineering and Support Center, Huntsville
USATCES	United States Army Technical Center for Explosives Safety
U.S.C.	United States Code
UXO	Unexploded Ordnance
VSP	Visual Sampling Plan
WAA	Wide Area Assessment

Glossary

Active Installation
An active installation is an installation under the custody and control of the Department of Defense (DoD), to include operating installations, installations in a standby or layaway status, and installations awaiting closure. Examples include, but are not limited to, posts, camps (including National Guard camps), forts, depots, activities, ports, ammunition supply points, basic load ammunition storage areas, and ammunition plants.

Anomaly
An anomaly is any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site (pipes, power lines, etc.).

Anomaly Avoidance
This is a technique employed on property known or suspected to contain unexploded ordnance (UXO), other munitions that may have experienced abnormal environments (e.g., discarded military munitions [DMM]), munitions constituents (MC) in high enough concentrations to pose an explosive hazard, or chemical agents, regardless of configuration, to avoid contact with potential surface or subsurface explosive or chemical agent hazards, to allow entry to the area for the performance of required operations.

Archives Search Report (ASR)
An ASR is a detailed investigation report on past munitions activities conducted on an installation. The principal purpose of the archives search is to assemble historical records and available field data, assess potential ordnance presence, and recommend follow-up actions at a Defense Environmental Restoration Program (DERP) Formerly Used Defense Site (FUDS). There are four general steps in an archives search: records search phase, Site Safety and Health Plan, site survey, and ASR, including risk assessment (USAEC, 2004a). The ASR has since been replaced in the Military Munitions Response Program process by the Historical Records Review.

Base Realignment and Closure (BRAC)
BRAC is a program governing the scheduled closing of DoD sites (Base Closure and Realignment Act of 1988, Public Law 100-526, 02 Stat. 2623, the Defense Base Closure and Realignment Act of 1990, Public Law 101-510, 104 Stat. 1808, etc.).

Building Demolition / Debris Removal Program
The Building Demolition / Debris Removal Program provides funds for the demolition and removal of unsafe buildings or structures at installations and formerly owned or used properties.

Chemical Warfare Materiel (CWM)
CWM is an item generally configured as a munitions containing a chemical compound that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM includes V- and G-series nerve agents or H-series (mustard) and L-series (lewisite) blister agents in other-than-munitions configurations and certain industrial chemicals (e.g., hydrogen cyanide [AC], cyanogens chloride [CK], or carbonyl dichloride [called phosgene or CG]) configured as a military munitions.

Due to their hazards, prevalence, and military-unique application, chemical agent identification sets are also considered CWM. CWM does not include riot control devices, chemical defoliants, and herbicides; industrial chemicals (e.g., AC, CK, CG) not configured as a munitions; smoke and other obscuration producing items; flame and incendiary producing items; or soil, water, debris, or other media contaminated with low concentrations of chemical agents where no chemical agent hazards exist.

Chemical Warfare Materiel (CWM) Response
CWM response includes munitions responses and other responses to address the chemical safety; explosives safety, when applicable; human health; or environmental risks presented by CWM regardless of configuration.

Chemical Warfare Materiel Site Plan (CSP)
A CSP is required when an area is known or suspected to contain CWM to address requirements for an interim holding facility and, when the use of on-site CWM destruction technology is planned, for the site at which those destruction activities will occur.

Closed Range
A closed range is a military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a DoD component. Closed ranges cannot occupy an area that has been identified as an active/inactive range. Closed ranges are those areas of land that used to be operational and are still owned by the United States (U.S.) Army, but are now used for nonrange purposes.

Community Relations Plan (CRP)
The CRP serves as the framework for establishing a successful information exchange with the public for munitions responses. The CRP follows guidelines set forth under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA). Each CRP must be tailored to fit the individual site and situation and should also accommodate any site-specific agreements between the U.S. Army and U.S. Environmental Protection Agency or state

environmental agencies. The CRP is not a static document and should be revised to reflect the project's development/progress.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA authorizes federal action to respond to the release or threatened release of hazardous substances into the environment or a release or threat of release of a pollutant or contaminant into the environment that may present an imminent or substantial danger to public health or welfare.

Cost to Complete (CTC)
The DoD requires that all services develop a comprehensive estimate, by site, of the total cost for completing environmental cleanup under the Installation Restoration Program (IRP)/BRAC. The Army effort, the CTC Study and Analysis, was completed for all Army installations with ongoing or planned restoration activities (HQDA ACISM, 2004).

Data Quality Objective (DQO)
DQOs are project-specific statements that clarify the study objective, define the most appropriate type of data to collect, determine the most appropriate conditions from which to collect the data, and specify tolerable limits on decision errors (used in establishing the quantity and quality of data needed).

Decision Document (DD)
DDs serve to provide the reasoning for the choice of or changes to a Superfund site cleanup plan. DDs include Proposed Plans (PPs), Records of Decision (RODs), ROD Amendments, and Explanations of Significant Differences, along with other associated memoranda and files. DDs are required by Section 117 of CERCLA, as amended by SARA, for remedial actions taken pursuant to Sections 104, 106, 120, and 122. Sections 300.430(f)(2), 300.430(f)(4), and 300.435(c)(2) of the National Contingency Plan (NCP) establish the regulatory requirements for these DDs.

Defense Environmental Restoration Program (DERP)
Established in 1984, DERP promotes and coordinates efforts for the evaluation and cleanup of contamination at DoD installations.

Defense Site
Any locations that is or was owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. [10 USC 2710(e)(1)] (DoD refers to such sites as Munitions Response Site or MRS).

Department of Defense Explosives Safety Board (DDESB)
The DDESB is the DoD organization charged with promulgating ammunition and explosives safety policy and standards and reporting on the effectiveness of the implementation of such policy and standards.

Discarded Military Munitions (DMM)
DMM includes military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include UXO, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations (DoD, 2000; 10 USC 2710(e)(2)).

Engineering Evaluation / Cost Analysis (EE/CA)
An EE/CA is prepared for all non-time-critical removal actions (NTCRAs) as required by the NCP. The goals of the EE/CA are to identify the extent of a hazard, identify the objectives of the removal action, and analyze the various alternatives that may be used to satisfy these objectives for cost, effectiveness, and implementability.

Explosive Ordnance Disposal (EOD)
The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration.

Explosive Ordnance Disposal (EOD) Personnel
Military personnel who have graduated from the Naval School, Explosive Ordnance Disposal; are assigned to a military unit with a service-defined EOD mission; and meet service and assigned unit requirements to perform EOD duties. EOD personnel have received specialized training to address explosive and certain chemical agent hazards during both peacetime and wartime. EOD personnel are trained and equipped to perform render safe procedures on nuclear, biological, chemical, and conventional munitions and on improvised explosive devices.

Explosive Ordnance Disposal (EOD) Unit
A military organization constituted by proper authority; manned with EOD personnel; outfitted with equipment required to perform EOD functions; and assigned an EOD mission.

Explosive Soil
Explosive soil refers to mixtures of explosives MC in soil, sand, clay, or other solid media at concentrations such that the mixture itself presents an explosive hazard.

Explosives or Munitions Emergency Response
Explosives or munitions emergency response includes all immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at Resource Conservation and Recovery Act (RCRA) facilities (Military Munitions Rule).

Federal Facilities Compliance Act (FFCA)
The FFCA (Public Law 102-386 [106 Stat. 1505]) provides for a waiver of sovereign immunity with respect to federal, state, and local procedural and substantive requirements relating to RCRA solid and hazardous waste laws and regulations at federal facilities. Additionally, it defines hazardous waste in relation to public vessels, expands the definition of mixed waste, and discusses waste discharges to federally owned treatment works (FFCA, 1992).

Former Ranges (Closed, Transferred, or Transferring [CTT] Ranges)
Former ranges are ranges for which a formal decision has been made to close the range or that have been put to a use that is incompatible with continued use as a military range. Former ranges include closed ranges, transferred ranges, and transferring ranges.

Formerly Used Defense Sites (FUDS)
FUDS include those properties previously owned, leased, or otherwise possessed by the United States and under the jurisdiction of the Secretary of Defense, or manufacturing facilities for which real property accountability rested with the DoD but were operated by contractors (government owned, contractor operated) and that were later legally disposed of. FUDS is a subprogram of the DERP.

Geographic Information System (GIS)
GIS combines layers of information about a place to provide a better understanding of that place. What layers of information are combined depend on the purpose—finding the best location for a new store, analyzing environmental damage, viewing similar crimes in a city to detect a pattern, and so on (www.gis.com/whatisgis/).

Installation Restoration Program (IRP)
The IRP for active (nonclosing) Army installations is authorized by the DERP, codified in 10 United States Code (USC) 2701–2708 and 2810. It is implemented subject to and in a manner consistent with CERCLA, as amended by SARA, and CERCLA's implementing regulation, the NCP, codified in 40 Code of Federal Regulations (CFR) 300. Although CERCLA drives the IRP, RCRA is applicable to numerous IRP projects.

Institutional Control (IC)
See Land Use Control.

Land Use Control (LUC)
LUCs are legal, physical, or administrative mechanisms that restrict the use of, or limit access to, real property to manage risks to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to real property, such as fences or signs.

Material Potentially Presenting an Explosive Hazard (MPPEH)
Material owned or controlled by the Department of Defense that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are munitions within the DoD-established munitions management system and other items that may present explosion hazards (e.g., gasoline cans and compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Material Documented As Safe (MDAS)
MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

Material Documented as an Explosive Hazard (MDEH)
MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

Military Munitions
Military munitions are all ammunition products and components produced for or used by armed forces for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the

U.S. Department of Energy, and the National Guard. The term military munitions includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smokes and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions; rockets; guided and ballistic missiles; bombs; warheads; mortar rounds; artillery ammunition; small arms ammunition; grenades; mines; torpedoes; depth charges; cluster munitions and dispensers; demolition charges; and devices and components of the above.

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components other than nonnuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.), as amended, have been completed. (10 USC 101(e)(4)(A) through (C))

Military Range (or "Range")
A military range, as used in the Military Munitions Rule (40 CFR 266.201), is "Designated land and water areas set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, other ordnance or weapons systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas."

Munitions and Explosives of Concern (MEC)
This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means UXO, as defined in 10 USC 101(e)(5)(A) through (C); DMM, as defined in 10 USC 2710(e)(2); or MC (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC)
MC include any material originating from UXO, DMM, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 USC 2710(e)(3))

Munitions Debris
Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

Munitions Response
Response actions, including investigation, removal actions, and remedial actions to address the explosives safety, human health, or environmental risks presented by UXO, DMM, or MC, or to support a determination that no removal or remedial action is required.

Munitions Response Area (MRA)
Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. An MRA is composed of one or more munitions response sites (MRSs).

Munitions Response Chemical Safety Submission (MRCSS)
A CSS provides specifications for conducting work activities during a chemical warfare materiel (CWM) response. It details the scope of the project, planned work activities, potential site hazards, and methods of controlling the hazards. A CSS is required when removal activities (e.g., surface removal of recovered CWM [RCWM] or excavations when the intent is to uncover, characterize, and remove geophysical anomalies that have the potential to be RCWM items) will be performed (USACE, 2002a).

Munitions Response Explosives Safety Submission (MRESS)
An ESS is a document that serves as the specification for conducting munitions response activities involving munitions and explosives of concern (MEC). The ESS details the scope of the project, planned response activities, potential hazards (including the maximum credible event), and methods for their control.

Munitions Response Site (MRS)
A discrete location within an MRA that is known to require a munitions response.

National Oil and Hazardous Substance Pollution Contingency Plan (NCP)
Revised in 1990, the NCP provides the regulatory framework for responses under CERCLA. The NCP designates the DoD as the removal response authority for explosive hazards associated with military munitions.

Non-Time-Critical Removal Action (NTCRA)
NTCRAs are actions initiated in response to a release or threat of a release that poses a risk to human health, welfare, or the environment. Initiation of removal cleanup actions may be delayed for 6 months or more (USACE, 2000b).

Office of Solid Waste and Emergency Response (OSWER)
OSWER provides policy, guidance and direction for:

- safely managing waste;
- preparing for and preventing chemical and oil spills, accidents, and emergencies; and
- cleaning up and reusing contaminated property.

Operational Range
An operational range is a range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities or, although not currently being used for range activities, is still considered by the Secretary to be

a range and has not been put to a new use that is incompatible with range activities. (10 USC 101(e)(3)(A) and (B)) Also includes "military range," "active range," and "inactive range" as those terms are defined in 40 CFR 266.20.

Ordnance and Explosives
See Munitions and Explosives of Concern.

Other Debris
Debris found on operational ranges or MRSs, which may be removed to facilitate a range clearance or munitions response that is not related to munitions or range operations. Such debris includes, but is not limited to, rebar, household items (refrigerators, washing machines, etc.), automobile parts and automobiles that were not associated with range targets, fence posts, and fence wire.

Preliminary Assessment (PA)
A PA is an assessment of information about a site and its surrounding area. A PA is designed to determine whether a site poses little or no threat to human health and the environment or, if it does pose a threat, whether the threat requires further investigation. PA investigations collect readily available information about a site and its surrounding area. The PA is designed to distinguish, based on limited data, between sites that pose little or no threat to human health and the environment and sites that may pose a threat and require further investigation. The PA also identifies sites requiring assessment for possible emergency response actions. If the PA results in a recommendation for further investigation, a Site Inspection (SI) is performed.

Proposed Plan (PP)
PPs document the preferred alternative. The PP briefly summarizes the alternatives studied in the detailed analysis phase of the remedial investigation / feasibility study (RI/FS), highlighting the key factors that led to identifying the preferred alternative. The PP, as well as the RI/FS and the other information that forms the basis for the lead agency's response selection, is made available for public comment in the Administrative Record file.

Qualified Receiver
A qualified receiver includes entities that have personnel who are (or individuals who are) trained and experienced in the identification and safe handling of used and unused military munitions and any known or potential explosive hazards that may be associated with the MPPEH they receive and are licensed and permitted or otherwise qualified to receive, manage, and process MPPEH.

Quantity-Distance
Quantity-distance is defined as the quantity of explosives material and distance separation relationships that provided defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate quantity-distance tables provided

in DoD 6055.09, *DoD Explosives Safety Board (DDESB) and DoD Component Explosives Safety Responsibilities*. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the quantity-distance tables should be used whenever possible.

Range
A range is a designated land or water area that is set aside, managed, and used for range activities of the DoD. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 USC 101(e)(1)(A) and (B))

Range-Related Debris
Range-related debris is debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., targets, target debris, military munitions packaging and crating material).

Real Property
Real property consists of land, bodies of water, and improvements on the land (such as access roads, buildings, and other structures). Equipment or fixtures (such as plumbing, electrical work, and elevators) installed in a permanent manner or essential for the purpose of an improvement are part of the real property.

Record of Decision (ROD)
RODs are used to select and document the remedy selection decision. The ROD documents the remedial action plan for a site or operable unit and serves the following three basic functions: (1) certifies that the remedy selection process was carried out in accordance with CERCLA and, to the extent practicable, with the NCP; (2) describes the technical parameters of the remedy, specifying the methods selected to protect human health and the environment, including treatment, engineering, and IC components, as well as cleanup levels; and (3) provides the public with a consolidated summary of information about the site and the chosen remedy, including the rationale behind the selection (EPA, 1999).

Recovered Chemical Warfare Materiel (RCWM)
CWM used for its intended purpose or previously disposed of as waste, which has been discovered during a CWM response or by chance (e.g., accidental discovery by a member of the public), that the Department of Defense has either secured in place or placed under DoD control, normally in a DDESB-approved storage location or interim holding facility, pending final disposition (DoD, 2005a).

Recovered Chemical Warfare Materiel (RCWM) Conceptual Site Plan

This plan describes the background and proposed general approach and procedures to address the scope of a CWM response.

Remedial Action Cost Engineering and Requirements (RACER)
RACER is the primary tool for preparing programming cost estimates for environmental remediation.

Remedial Investigation / Feasibility Study (RI/FS)
An RI/FS is performed to collect data to characterize site conditions, assess risk/hazard to human health and the environment, and conduct interim/treatability testing to evaluate the potential performance and cost of the treatment technologies that are being considered. The FS is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions.

The RI/FS process includes scoping, site characterization, screening of remedial alternatives, interim/treatability studies, and detailed analysis. The RI and FS are conducted concurrently—data collected in the RI influence the development of remedial alternatives in the FS, which in turn affect the data needs and scope of interim/treatability studies and additional field investigations. This phased approach encourages the continual scoping of the site characterization effort, which minimizes the collection of unnecessary data and maximizes data quality (EPA, 1989).

Remedial Project Manager (RPM)
An RPM is the official designated by the lead agency to coordinate, monitor, and direct remedial or other response actions (DoD, 2000).

Removal Action
A removal action is the cleanup or removal of released hazardous substances from the environment; such actions as may be taken in the event of a threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare of the United States or to the environment, which may otherwise result from a release or threat of release. The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for, action taken under Section 104 (b) of CERCLA, post-removal site control, where appropriate, and any emergency assistance that may be provided under the Disaster Relief Act of 1974. For the purpose of the NCP, the term also includes enforcement activities related thereto.

Resource Conservation and Recovery Act (RCRA)

RCRA is the federal statute that governs the management of all hazardous waste from cradle to grave. RCRA covers requirements regarding identification, management, and cleanup of waste, including (1) identification of when a waste is solid or hazardous; (2) management of waste—transportation, storage, treatment, and disposal; and (3) corrective action, including investigation and cleanup, of old solid waste management units (DoD, 2000).

Response Action
Respond or response, as defined by Section 101(25) of CERCLA, means remove, removal, remedy, or remedial action, including enforcement activities related thereto.

Site Inspection (SI)
An SI identifies sites that enter the National Priorities List Site Listing Process and provides the data needed for Hazard Ranking System (HRS) scoring (Introduction to the HRS) and documentation. SI investigators typically collect environmental and waste samples to determine what hazardous substances are present at a site. They determine if these substances are being released to the environment and assess if they have reached nearby targets. The SI can be conducted in one stage or two. The first stage, or focused SI, tests hypotheses developed during the PA and can yield information sufficient to prepare an HRS scoring package. If further information is necessary to document an HRS score, an expanded SI is conducted.

Small Arms Ammunition
Small arms ammunition includes ammunition, without projectiles that contain explosives (other than tracers), that is .50-caliber or smaller or for shotguns.

Stakeholders
Stakeholders include federal, state, and local elected or appointed officials, community organizations, property owners, and others directly or indirectly impacted by the potential hazards present, munitions response activities, or the sufficiency and/or protectiveness of the response.

Superfund Amendments and Reauthorization Act (SARA)
Enacted in 1986, this legislation establishes standards for cleanup activities, requires federal facility compliance with CERCLA, and clarifies public involvement requirements.

Technical Escort Unit (TEU)
The TEU is a DoD organization manned with specially trained personnel that provide verification, sampling, detection, mitigation, render safe, decontamination, packaging, escort, and remediation of chemical, biological, and industrial devices or hazardous material.

Time-Critical Removal Action (TCRA)

TCRA is a removal action where, based on the site evaluation, a determination is made that removal is appropriate and that less than 6 months exist before on-site removal activity must begin. (40 CFR 300.5)

Transferred Range
A transferred range is a military range that is no longer under military control and has been leased by the DoD, transferred, or returned by the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was once used by the U.S. Army. This includes use under the terms of an executive order, special use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager.

Transferring Range
A transferring range is a military range that is proposed to be leased, transferred, or returned by the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An active range is not be considered a "transferring range" until the transfer is imminent.

Unexploded Ordnance (UXO)
UXO includes military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. (10 USC 101(e)(5)(A) through (C) and 40 CFR 266.201)

Unexploded Ordnance (UXO)-Qualified Personnel
UXO-qualified personnel have performed successfully in military EOD positions or are qualified to perform in the following Department of Labor, Service Contract Act, Directory of Occupations, and contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, or Senior UXO Supervisor.

Unexploded Ordnance (UXO) Technicians
UXO technicians are qualified for filling Department of Labor, Service Contract Act, Directory of Occupations, and contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III.

Waste Military Munitions (WMM)
A military munition is a WMM if it has been identified as (1) solid waste per the Military Munitions Rule (as described in the RCRA regulations at 40 CFR 266.202 Subpart M) or (2) hazardous waste per the RCRA regulations at 40 CFR 261 Subpart C or D (i.e., either listed as hazardous or fulfilling the criteria for one or more of the hazardous characteristics—ignitability, corrosivity, reactivity, or toxicity).

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Appendix C – Regulatory Considerations: State Adoption of the Federal Military Munitions Rule

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Military Munitions Rule	Federal Adoption	Specific State Rule Developed	State Law/Regulation
Alabama	Yes	Yes	ADEM 335-14-7.13, 355-14-6.31
Alaska	Yes	No	ADEC, AAC Title 18, Chapter 62, Article 1-5 and 7
American Samoa	Yes	No	AS Administrative Code Title 25, Chapter 5
Arizona	Yes	No	ADEQ, AAC Title 18, Chapter 8, Parts 260–266 and 270
Arkansas	Yes	No	APCEC, Hazardous Waste Division, Regulation 23
California*	No	No	CCR, Title 22, Division 4.5
Colorado	Yes	Yes	CDPHE, 6 CCR, Sections 1007-3, Parts 260–265, Part 267, and Part 100
Connecticut*	No	No	RCSA Section 22a-449(c)-100–106 and 110
Delaware	Yes	No	DRGHW Parts 122, 260–266 (Subpart M), and 268
District of Columbia	Yes	No	DCMR, Title 20, Chapters 4260 – 4266 and 4270
Florida	Yes	No	FDEP Waste Management Division, Chapter 62-730
Georgia	Yes	No	GDNR EPD, Chapter 391-3-11
Guam*	No	No	GCA Title 10, Chapter 51
Hawaii	Yes	No	HDOH, HAC, Title 11, Chapters 260–266 and 270
Idaho	Yes	No	IDEQ, IDAC, Chapter 58.01.05
Illinois	Yes	Yes	ILEPA, IAC, Title 35, Subtitle G: Waste Disposal
Indiana	Yes	Yes	IDEM, IAC, Title 329, Article 3.1
Iowa	Yes	No	IDNR, IAC, Title 567, Chapter 141.1–6, .8, and .14
Kansas	Yes	No	KDHE, Bureau of Waste Management, Chapter 28-31-1–4, -6, -8, and -9
Kentucky*	No	Yes	KDEP, KAR, Title 401, Chapters 30–36 and 38
Louisiana	Yes	Yes	LDEQ, LAC, Title 33 Part V, Chapter 53
Maine*	No	No	MDEP, BRWM Rules, Title 38, Chapters 400 and 850–857
Maryland*	No	No	MDE, COMAR, Title 26, Subtitle 13, Chapters 1–7 and 10
Massachusetts*	No	No	MDEP, Bureau of Waste Prevention, CMR, Title 310, Section 30.000
Michigan	Yes	Yes	MDEQ, MAR, Part 111, R299
Minnesota*	No	No	MPCA, Hazardous Waste and Tanks Rules, Chapter 7045
Mississippi	Yes	No	MDEQ, Parts 260-266,and 270

Military Munitions Rule	Federal Adoption	Specific State Rule Developed	State Law/Regulation
Missouri	Yes	Yes	MDNR, Hazardous Waste Regulations Title 10, Chapter 3-7
Montana	Yes	No	MDEQ, ARM Title 17, Chapter 53 – Hazardous Waste
Nebraska*	No	No	NDEQ, Title 128, Chapter 1-3, 6-13, and 14
Nevada	Yes	No	NDEP, Bureau of Waste Management, NAC Chapter 459
New Hampshire*	No	No	HWCS, Part Env-Wm, Chapters 110, 211, 353, 400, 500, 600, 700, and 900
New Jersey	Yes	No	NJDEP, NJAC Section 7:26G-4.1-10.1, and 12.1
New Mexico	Yes	No	NMED, 20 NMAC 4.1
New York	Yes	Yes	NYDEC, DSHM Title 6 Parts 371-374 and 364
North Carolina	Yes	No	NCDENR 15A NCAC 13A Parts .0102, .0106-0111, and .0113
North Dakota	Yes	No	North Dakota DOH, Division of Waste, NDCC Chapter 33-24-01 - 33-24-07
Ohio	Yes	No	OEPA, OAC Section 3745, Parts 50-54, 65, 205,248, 256, and 266
Oklahoma	Yes	No	ODEQ, OEDC Title 252, Chapter 205
Oregon	Yes	Yes	ODEQ, OAR Chapter 340, Division 100-105
Pennsylvania	Yes	Yes	PADEP, Title 25, Part I, Subpart D, Article VII
Puerto Rico	Yes	No	EQB (Environmental Quality Board), Governor's Office, Regulation for the Control of Hazardous Solid Waste (1998 edition)
Rhode Island	Yes	Yes	Rhode Island Hazardous Waste Mgmt Rules & Regulations, Sections1.00–13.00
South Carolina	Yes	No	SCCR,Chapter 61, Department of Health and Environmental Control
South Dakota	Yes	No	SDDENR, SDAR Article 74:28:21–34
Tennessee	Yes	No	TDEC, Chapter 1200-1-11, Sections .01-.09
Texas	Yes	Yes	TCEQ Rules, Chapter 335, Subparagraph A-H,
Utah*	No	No	Utah Hazardous Waste Rules 315-1–R315-9 and R315-12–R315-14
Vermont	Yes	No	VANR, VEPR, Chapter 7, Subchapters 1-7

Military Munitions Rule	Federal Adoption	Specific State Rule Developed	State Law/Regulation
Virgin Islands	No	No	TITLE 19 VIRGIN ISLAND RULES & REGULATIONS, Part VI: Regulatory Provisions Concerning Public Health, Chapter 56: Solid and Hazardous Waste Management Rules and Regulations
Virginia	Yes	Yes	VDEQ, Waste Management Division, VAC Title 9, Chapter 60
Washington	Yes	Yes	WDEC, Dangerous Waste Regulation, WAC Chapter 173-303
West Virginia	Yes	No	WVDEP, Office of Waste Management, Title 33, Series 20
Wisconsin*	No	No	WDNR, WAC Chapter NR 600-690
Wyoming*	No	No	Wyoming Hazardous Waste Rules, Chapters 1–14

*For those states that have not adopted the federal rule or enacted their own state-specific rules, the State Law/Regulation column identifies the citation for the state's general hazardous waste rules.

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Appendix D – Remedial Project Manager's Guide

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The purpose of the Remedial Project Manager's (RPM) Guide is to provide the RPM with the necessary Remedial Investigation / Feasibility Study (RI/FS) management tools to support the successful planning and execution of an RI/FS at sites on active installations and Base Realignment and Closure properties and Formerly Used Defense Sites properties. The following are included in this RPM Guide.

Appendix D Contents

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Example USAEC Remedial Investigation / Feasibility Study Statement of Work

As of 6 April 2009, this is the current example of USAEC/USACE Statement of Work. For more current information, please contact your USAEC/USACE project manager.

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EXAMPLE ACTIVE ARMY SCOPE OF WORK FOR MILITARY MUNITIONS RESPONSE PROGRAM REMEDIAL INVESTIGATION / FEASIBILITY STUDY AT INSTALLATION, COUNTY, STATE

1.0 BACKGROUND AND INTRODUCTION

This requirement is for environmental remediation services for [XX] Military Munitions Response Program (MMRP) sites (Munitions Response Sites or MRSs) at [installation name] located at [city & state]. The Department of Defense (DoD) established the MMRP under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations.

[Briefly describe the installation in one or more paragraphs here]

The Contractor shall be responsible for fully executing the Firm Fixed Price Remediation (FFPR) approach under a Performance-Based Acquisition (PBA), by: conducting required environmental restoration services for which the United States Department of the Army (the "Army") is statutorily responsible; addressing any and all unforeseen environmental, explosive safety, scheduling, and regulatory issues; and, assuming contractual liability and responsibility for the achievement of the performance objectives for the cleanup sites at the [Installation] (the "Installation") identified in this Performance Work Statement (PWS), including any sites with off-installation contamination for which the Army is responsible. Contractors should not treat "Unforeseen environmental issues" include unknown and/or varied concentrations of contaminants at cleanup sites (off-installation areas included) identified in this PWS, but not unknown sites (e.g., sites not identified in this PWS).

[The following list of required capabilities will be installation-specific and may require revision of the "following note" and Section 2.0.] The contractor must possess all the required expertise, knowledge, equipment and tools required to meet or exceed the government's objectives identified in this PWS in accordance with established industry standards. The Contractor must have the capability and experience to perform, or provide, a wide range of investigative, remedial design, remedial construction, and remediation services required for hazardous substance and waste sites, munitions and explosives of concern (MEC), and chemical warfare materiel (CWM).

Under this contract, the contractor will perform munitions response actions for military munitions (MM) and munitions debris (MD). Activities may involve munitions and explosives of concern (MEC), which includes UXO, DMM, and MC if found in high enough concentrations to cause an explosive threat, non-explosive concentrations of MC and incidental contaminants not related to MM.

[The following note will be installation-specific] Work will include, for example, site investigation, site characterization, evaluation of remedial alternatives, remedial design, remedial construction, remediation of contaminated sites, remedial action (operations), and long-term management.

It is the Contractor's responsibility to comply with all applicable federal, state and local laws and regulations and to fulfill the performance objectives of this PWS in a manner that is consistent with any applicable orders or permits, all existing and future cleanup agreements or guidance for the Installation, and relevant Department of Defense (DoD) and Army policy, for the duration of the contract.

[The following paragraph will be installation-specific.]The Contractor must perform all the necessary environmental remediation work as required to meet the performance objectives of this PWS. Remediation is being conducted pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and National Oil and Hazardous Substances Contingency Plan (NCP) requirements, with regulatory coordination, as appropriate, of the [State Agency] and the United States Environmental Protection Agency (USEPA) Region [Number].

[The following paragraph will be installation-specific.]The Installation was proposed for the National Priorities List (NPL) in [Date] due to [Reason]. The Installation was placed on the NPL in [Date]. [Regulatory Agencies] and the Army signed a Federal Facilities Agreement (FFA) on [Date].

[The following paragraph will be included for installations with unregulated contaminants and CERCLA as the regulatory driver.]Certain pollutants or contaminants (P/C) may be an issue at sites covered by this PWS. Cleanup of P/C may be warranted if the P/C present an imminent and substantial endangerment to the public health or welfare that result in an unacceptable risk. P/C, as defined in CERCLA, typically do not have a federally promulgated maximum contaminant limit (MCL). For any such P/C, or any other chemical, that does not have a federally promulgated MCL, but does have a finalized reference dose (RfD) or slope factor listed in USEPA's Integrated Risk Information System (IRIS) database, that RfD or slope factors should be incorporated in the NCP risk assessment process. However, funding will not be provided for responses that are not in full compliance with CERCLA, the DERP, and DoD and Army policy. Additionally, state standards will only be analyzed through the CERCLA applicable or relevant and appropriate requirement (ARAR) process.

To perform munitions responses, the DoD primarily uses CERCLA. However, CERCLA has no special provisions for dealing with explosive safety. The DoD recently revised its Ammunition and Explosives Safety Standards (DoD 6055.09-

STD) (Feb 08) and this document must be adhered to in the investigation and remediation of sites with MEC.

2.0 TYPES OF SERVICES REQUIRED

[The following paragraph will be PWS and contract-specific. This section also ties to Section 1.0, paragraph 2] This PWS includes broad-spectrum environmental services. These services may include, but are not limited to, remedial study and incidental construction associated with environmental remediation activities.

3.0 PERFORMANCE OBJECTIVES AND STANDARDS

The Contractor shall be required to furnish all plant, labor, materials and equipment necessary to meet the performance objectives and standards identified in Table 1 below.

Table 1: Performance Requirements Summary.

Performance Objective	*Performance Standards*
Approved Project Management Plan (PMP) and Quality Assurance Surveillance Plan (QASP): • Draft PMP and QASP within 30 calendar days of contract award, • Final PMP within 30 calendar days of receipt of COR comments on the drafts.	Army approval through the Contracting Officer's Representative (COR).
Achieve Site Investigation (SI) at the following sites by [Date]: • [List of SI Sites]	Department of Defense Explosives Safety Board (DDESB) approval of contractor prepared Explosives Safety Submission (ESS) or Explosives Site Plan (ESP). Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming approval of SI Report).
Achieve Remedial Investigation (RI) at the following sites by [Date]: • [List of RI Sites]	DDESB approval of contractor prepared ESS or ESP. Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming approval of RI Report).

Performance Objective	*Performance Standards*
Achieve Remedy in Place (RIP) at the following sites by [Date]: • [List of RIP Sites] Upon achievement of RIP, perform Remedial Action (Operations) (RA(O)) at the above sites for the duration of the contract or until achievement of Response Complete (RC), whichever comes first. Upon achievement of RC, perform any necessary Long-Term Management (LTM) at the above sites for the duration of the contract.	DDESB approval of contractor prepared ESS or ESP. Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming RIP/RC; RA(O)/LTM exit or ramp down strategy; RA(O)/LTM reports incorporating requirements of the exit or ramp down strategy).
Perform RA(O) at the following sites for the duration of the contract or until achievement of RC, whichever comes first: • [List of RA(O) Sites] Upon achievement of RC, perform any necessary Long-Term Management (LTM) at the above sites for the duration of the contract.	Army approval through the COR and Regulator concurrence (e.g., RA(O)/LTM exit or ramp down strategy; RA(O)/LTM reports incorporating requirements of the exit or ramp down strategy).
Achieve RC at the following sites by [Date]: • [List of RC Sites] Upon achievement of RC, perform any necessary Long-Term Management (LTM) at the above sites for the duration of the contract.	DDESB approval of contractor prepared ESS or ESP. Army approval through the COR and Regulator concurrence (e.g., RA(O)/LTM exit or ramp down strategy; RA(O)/LTM reports incorporating requirements of the exit or ramp down strategy)
Perform any necessary LTM at the following sites for the duration of the contract: • [List of LTM Sites]	Army approval through the COR and Regulator concurrence (e.g., RA(O)/LTM exit or ramp down strategy; RA(O)/LTM reports incorporating requirements of the exit or ramp down strategy)
For all remedies, optimize capital and long-term costs.	Acceptance by the COR that the Contractor has demonstrated that the proposed remedy represents the lowest 30-year present worth cost to the Army, and is acceptable to the regulators.

Performance Objective	*Performance Standards*
Complete all CERCLA 121(c) Reviews required for the sites identified above, for the duration of the contract. Correct any deficiencies noted in the CERCLA 121(c) Reviews. Consolidate CERCLA 121(c) Reviews into a single installation-wide review conducted at the conclusion of the contract.	Army approval through the COR and Regulator concurrence (e.g., formal documentation accepting the reviews and any corrections).
[Additional installation-specific performance objectives, such as "Achieve levels of <2ppb RDX at the identified point of compliance."]	Army approval through the COR and Regulator concurrence (e.g., documentation acknowledging that objective was achieved in a manner acceptable to Army and Regulators).

[if going RI only, then this section should be deleted] Contractors should note that Remedy in Place, Remedial Action (Operations), Response Complete, and Long-Term Management are terms used for Defense Environmental Restoration Program. These terms are defined in Attachment C.

[if going RI only, then this section should be deleted] RIP or RC will be attained upon the finalization of appropriate written documentation certifying that site remediation has met identified response objectives and no further action is necessary, subject to any requirement for RA(O) and/or LTM. Contractors should note that when RA(O), LTM and/or a CERCLA 121(c) review is necessary as a result of the Contractor's remediation activities at a site, the Contractor shall be responsible for the following:

- Performing the required RA(O) and/or LTM at that site for the duration of the contract.
- Conducting any CERCLA 121(c) reviews required at that site for the duration of the contract.
- CERCLA 121(c) reviews conducted during the duration of the contract constitute a Government Inspection of Services. The Contractor will correct any problems and/or deficiencies noted within CERCLA 121(c) reviews or any Contractor furnished service or submittal. Any service or submittal performed that does not meet contract requirements shall be corrected or re-performed by the Contractor and at no additional cost to the Government. Corrective action must be certified and approved by the COR. If the Contractor performs any task unsatisfactorily and all defects are not corrected, the Government reserves the right to terminate the contract for default. In addition, the Government reserves its rights under Federal Acquisition Regulation (FAR) clause 52.246-4, "Inspection of Services – Fixed Price, for further remedies

concerning a Contractor's failure to perform in conformance with contract requirements. If the Contractor is conducting RA(O) or LTM, or completing a CERCLA 121(c) review, for a remedy that they did not implement or modify (i.e., an on-going pump and treat system inherited as part of the PBA scope), correction of substantive remedy deficiencies noted during RA(O), LTM or within a CERCLA 121(c) review which may require modification of that remedy are considered outside the scope of this contract effort.

There may be multiple milestones and/or deliverables for each performance objective (see Section 4.3). Payments will be based on successful completion of the milestones. Final decisions regarding the adequacy of milestone and deliverable completion resides with the [Installation]'s COR (see Section 7.3), with appropriate acceptance and approval of necessary site remediation documentation by regulators, consistent with applicable regulatory drivers listed in Section 1.0 of this PWS. For the duration of the contract, the Contractor shall remain responsible for correction of remedy deficiencies noted during RA(O), LTM, and CERCLA 121(c) reviews.

4.0 PROJECT MANAGEMENT

The PBA approach requires careful coordination of project activities to ensure that all stakeholders are kept informed of the project status, existing or potential problems, and any changes required to prudently manage the project and meet the needs of the Installation's project stakeholders and decision-makers. The Contractor shall be responsible for the following project management activities:

4.1 Project Management Plan

The Contractor shall develop and maintain a detailed Project Management Plan (PMP). The PMP, based on the schedule prepared as part of the Contractor proposal, shall specify the schedule, technical approach and resources required for the planning, execution, and completion of the performance objectives. The first draft of the PMP shall be due within thirty (30) calendar days of contract award and shall include a payment milestone plan. Elements of this draft PMP shall be part of the offeror's proposal submittal. The draft PMP, proposed payment milestones, and subsequent revisions shall be subject to Army review and approval, through the COR. The final PMP shall be due within 30 calendar days of receipt of COR comments on the draft PMP. A payment milestone will be established for Army approval of the final PMP through the COR.

4.2 Project Schedule

As part of the PMP, the Contractor shall develop and maintain an Activity-Based Schedule that fully supports the technical approach and outlines activities and milestones defined at the appropriate detail level and logically sequenced to support and manage completion of the performance objectives in this PWS. Additionally, the due dates for all payable deliverables shall be identified. A payment plan shall be included with the schedule that may allow for payments to

the Contractor based on successful completion of interim milestones proposed by the Contractor. Activities identified in the QASP should be appropriately coded in the project schedule to allow for planning of QA inspections. It is the Army's intent to make all payments after verification of milestone completion in accordance with this schedule. Unless otherwise noted in Table 1, all performance objectives must be completed within the allowable contract period of performance provided all contract options have been exercised. The Contractor shall need to take into account the existing or future schedules developed under the applicable regulatory drivers listed in Section 1.0 of this PWS. The Contractor shall also need to coordinate activities with the COR to ensure that the proposed project schedule does not conflict with other contractor activities on site, or interrupt Installation mission activities.

As part of the PMP, the Contractor shall identify and implement a means for providing project status reports to the COR. The PMP shall address the frequency and content of status reports.

The Contractor shall update the PMP to reflect progress towards achievement of the performance objectives and delineate proposed actions to accomplish future project milestones.

4.3 Milestone Presentations

Milestone presentations shall be made to the COR at the completion of each milestone below to provide analysis and lessons learned, and to present approaches for completion of future milestones. At the COR's request, the Contractor may also make milestone presentations to the other project stakeholders, consistent with the applicable regulatory drivers listed in Section 1.0 of this PWS, to show achievement of the performance objectives. This includes participation in annual Installation Action Plan (IAP) meetings, if requested by the COR.

The Contractor may propose a revision of the milestones below to reflect their PMP and provide for interim milestones. Interim milestones will only be accepted if they represent significant progress toward milestone completion, and completion of these interim steps can be measured and demonstrated. As noted in Section 3.0, payments will be tied to the successful completion of the following milestones or an interim milestone plan approved by the Army, through the COR. To that end, all proposed interim milestones should be associated with easily demonstrated metrics tied to performance measurements (e.g., final acceptance of a report rather than submission of a draft). All milestones must have a defined means for demonstrating completion in order to facilitate certification and approval (see Section 7.4, *Certification and Approval of Project Milestones and Deliverables*).

Major Milestones

- Approval of the Project Management Plan
- Achievement of (acceptance/approval of) SI at [Site] by [Date]
- Achievement of (acceptance/approval of) RI at [Site] by [Date]
- Achievement of (acceptance/approval of) RIP at [Site] by [Date]
- Approval of annual RA(O) reports
- Approval of an exit or ramp-down strategy for RA(O)
- Achievement of (acceptance/approval of) RC at [Site] by [Date]
- Approval of annual LTM reports
- Approval of an exit or ramp-down strategy for LTM
- Approval of the CERCLA 121(c) review(s)
- Successful correction of deficiencies noted in the CERCLA 121(c) review(s)

4.4 Environmental Requirements

The Contractor shall identify applicable federal, state and local laws and regulations; applicable Installation-specific orders, agreements, or rules; and perform its work in accordance with said authorities. The Contractor shall ensure that all activities performed by its personnel, subcontractors and suppliers are executed in accordance with said authorities. Any incident of noncompliance noted by the Contractor shall immediately be brought to the attention of the COR and Installation [or "facility operator" if applicable] telephonically and then by written notice. Nothing in this contract shall relieve the Contractor of its responsibility to comply with applicable laws and regulations. The Contractor shall obtain all permits, licenses, approvals, and/or certificates required or necessary to accomplish the work. When the work to be performed requires facility clearances, such as digging or drilling permits, the Contractor shall obtain such clearances and/or permits, with the assistance of the installation point of contact, prior to any drilling or excavating operations. The Contractor shall coordinate all such work with Installation maintenance personnel prior to performing work. Contractors on environmental sites are required to perform their own utility checks based on Installation-supplied utility maps. The Contractor shall comply with all Installation- or site-specific time and procedural requirements (federal, state, and local) described in the permits obtained. The Army technical experts will also independently review Contractor work to ensure compliance with all applicable requirements.

[The following paragraph will be installation-specific.]The Army is in the process of establishing a Geographic Information System (GIS)-based tracking system to ensure the Land Use Controls (LUCs) are enforced. The LUCs will/have been incorporated into the post-wide Master Plan and compliance with LUCs will/shall be reported in the Monitoring Reports for each site. The LUC policy applies to all units and activities, Military and Civilian Support Activities, tenant organizations and agencies and Government and Civilian Contractors. The Contractor is

required to comply with the LUC policy in all RA(O), LTM and CERCLA 121(c) review activities.

The Contractor shall adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this PWS. Spatial data shall conform to the Federal Geographic Data Committee (FGDC) National Standard for Spatial Data Accuracy (NSSDA). In addition, each Geographic Information System (GIS) data set shall be accompanied by metadata conforming to FGDC's Content Standard for Digital Geospatial Metadata (CSDGM) and be provided in a geodatabase that is compliant with the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE). The horizontal accuracy of any GIS data created by the contractor shall be tested in accordance with the NSSDA and the results shall be recorded in the metadata. All data shall be provided in the Universal Transverse Mercator (UTM) project in the appropriate zone, and shall have a datum of WGS84.

The Contractor shall review and fully understand "Executive Order 13423 -- Strengthening Federal Environmental, Energy, and Transportation Management," in particular those requirements pertaining to environmental management system (EMS). The Contractor shall also be required to review and adhere to the installation's environmental management system, including the environmental policy and significant aspects / impacts.

4.4.1 MEC Related Guidance

MEC related guidance includes, but may not be limited to, the following:

- MEC includes UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); or Munitions Constituents (MC), as defined in 10 U.S.C. 2710 (e)(3) (Reference (ai)), present in high enough concentrations to pose an explosive hazard.
- MEC distinguishes specific categories of military munitions that may pose unique explosives safety risks. Because MEC being actively managed may be determined to be hazardous waste, 29 Code of Federal Regulations (CFR), Hazardous Waste Operations and Emergency Response, Section 1910.120 may apply.
- Per the guidelines set forth in DoDI 4140.62 and DDESB Technical Paper 18, UXO qualified personnel will be responsible for determining the explosive safety status of any material recovered that may pose an explosive hazard (i.e., material potentially presenting an explosive hazard (MPPEH)).
- *[This paragraph will be installation-specific]* Should MEC be encountered during this response, UXO-qualified personnel will evaluate the explosive hazard and remove it, including by open detonation in place. This response will be conducted per the CERCLA

and the NCP, applicable state and federal regulation, and applicable DoD, U.S. Army policies and procedures.

4.5 Health and Safety Requirements

Prior to beginning any fieldwork, the Contractor shall implement a written Safety and Health Program compliant with federal, state, and local laws and regulations and approved by the COR. The Contractor shall ensure that its subcontractors, suppliers and support personnel comply with the approved Site Safety and Health Plan (SSHP). The Army reserves the right to stop work under this contract for any violations of the SSHP at no additional cost to the Army. Once the Army verifies through the COR that the violation has been corrected, the Contractor shall be able to continue work. As a minimum, the SSHP shall contain the following elements: site description and contaminant characterization, safety and health hazard(s) assessment and risk analysis, safety and health staff organization and responsibilities, site specific training and medical surveillance parameters, personal protective equipment (PPE) and decontamination facilities and procedures to be used, monitoring and sampling required, safety and health work precautions and procedures, site control measures, on-site first aid and emergency equipment, emergency response plans and contingency procedures (on-site and off-site), logs, reports, and record keeping. Training and medical screening per 29 CFR 1910.120(e) is required for the contract.

Additionally, the Contractor must adhere to all DoD and DA policies, procedures and regulations for munitions response. This includes but is not limited to DOD 6055.09-STD, Ammunition and Explosives Safety Standards; Army Regulation 385-10, the Army Safety Program; Department of the Army Pamphlet 385-63, Range Safety; and Department of the Army Pamphlet 385-64, Ammunition and Explosives Safety Standards.

[revise accordingly on PWS specific basis] The site is not suspected to contain CWM; however, if suspect CWM is encountered during any phase of site activities the Contractor shall immediately halt operations and contact the COR for assistance and guidance.

All activities involving work in areas potentially containing MEC hazards shall be conducted in full compliance with Department of Army, state, and local requirements regarding personnel, equipment and procedures, and DoD Standard Operating Procedures and safety regulations.

4.5.1 Safety Documentation and Reporting

Engineer Manual (EM) 385-1-1, part 01.D "Accident Reporting and Recordkeeping" is required for the work identified in this PWS.

4.6 Quality Management

The Contractor must ensure that the quality of all work performed or produced under this contract meets Army approval, through the COR. Quality control/assurance plans must be prepared and approved by the COR prior to performance of physical work.

Since the technical approach for this PBA shall be developed by the Contractor, the Contractor shall also develop a proposed Quality Assurance Surveillance Plan (QASP) for use by the Army. A Draft QASP using the template provided in Attachment D shall be submitted with the PMP deliverables within thirty (30) calendar days of award. The Final QASP will be prepared by the Army.

The QASP should highlight key quality control activities or events that the COR will use to determine when Army (COR or Contracting Officer (KO)) inspections can be conducted to assess progress toward and/or completion of milestones. Activities identified in the QASP should be appropriately coded in the project schedule to allow for planning of QA inspections.

4.7 Quality Control Testing

Chemical Quality Control shall be provided whenever sampling or analysis for chemical constituents is required in order to achieve milestones. Quality control for traditional soils or geotechnical testing shall also be included. The laboratory(ies) to be used by the Contractor shall demonstrate compliance with the latest version of the DoD QSM through the DoD Environmental Laboratory Accreditation Program (DoD ELAP). The Contractor may establish an on-site testing laboratory at the project site if determined necessary by the Contractor. However, on-site testing shall meet the requirements of USEPA, specific state regulator requirements, and all requirements of the most recently approved DoD Quality Systems Manual.

4.8 Project Repository and Administrative Record

The Contractor shall update at least monthly a multimedia (i.e., both paper and electronic format) project repository of all project-related information to ensure that pertinent documentation and data are available for project reviews, and to provide a clear record of the PBA approach to support final decisions and remediation completion. This repository is the property of the Army and available to the Army upon request by the COR or KO. A project repository is currently maintained at [Location].

"Project-related information" includes all previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors for the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS. Documents generated prior to the PBA are not expected

to be stored in electronic format; however, all documents generated by the Contractor shall be maintained in multi-media form.

The Contractor shall also update the repositories for the Administrative Record for CERCLA activities established at [Location], as needed. The project repository and Administrative Record shall be updated by the Contractor, and made available to the public, for the duration of the contract. Final electronic document files must be in text-searchable PDF format and be accompanied by defined metadata for upload into the Army Repository of Environmental Documents (READ). The Army, through the COR, will provide the metadata field requirements for READ to the Contractor.

4.8.1 Army Environmental Database and Environmental Restoration Information System

If a site identified in this PWS has achieved Response Complete (i.e., appropriate documentation is finalized), the Contractor shall be responsible for providing the COR with the data and documentation necessary for the closeout of each site in the Army Environmental Database - Restoration Module (AEDB-R). In addition, the Contractor shall upload all generated analytical data into the Environmental Restoration Information System (ERIS) on a quarterly basis. The Army, through the COR, will provide data specifications for AEDB-R and ERIS to the Contractor. The Contractor shall comply with all applicable requirements for data validation and submission.

4.9 Additional Site Plans

Prior to beginning any field work the Contractor shall prepare any additional plans or documents (e.g., sampling and analysis plans, quality assurance project plan, waste minimization plans, health and safety plans) consistent with the applicable regulatory drivers listed in Section 1.0 of this PWS, and any other agreements, orders, or regulations that apply to the Installation and sites. These plans and documents shall be subject to Army review and approval, through the COR.

4.10 Protection of Property

The Contractor shall be responsible for any damage caused to property of the United States (Federal property) by the activities of the Contractor under this contract and shall exercise due diligence in the protection of all property located on the premises against fire or damage from any and all other causes. Any property of the United States damaged or destroyed by the Contractor incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the Contractor to a condition satisfactory to the COR or reimbursement is made by the Contractor sufficient to restore or replace the property to a condition satisfactory to the COR in accordance with FAR Clause 52.245-2.

4.11 Project Stakeholders

For the purposes of this PWS, project stakeholders include the Army, [Regulatory Agencies], and the Restoration Advisory Board (RAB) [If applicable]. Required level of involvement may differ from site to site and the Contractor shall be responsible for obtaining comments with appropriate approval or concurrence on project deliverables consistent with applicable regulatory drivers and agreements for each site.

4.12 Regulatory Involvement

All regulatory coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all regulatory aspects of the project (e.g., organizing discussions with regulators concerning site response objectives and completion requirements, obtaining regulator comments on site documents and appropriately addressing them, and obtaining written documentation of remediation completion from the regulators for all of the sites identified in this PWS). The COR, or designee, will attend and represent the Army at all meetings with the regulators. With approval of the COR, the contractor may also informally discuss remediation issues with regulators and provide an after-action report back to the COR. The Army will be the signature authority for all regulatory agreements and remediation documentation.

4.13 Public Involvement

All public participation coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, articles/public notices to news media, and notifications to RAB members). The Contractor shall be responsible for requesting and addressing all public comments consistent with the applicable regulatory drivers listed in Section 1.0 of this PWS. The COR, or designee, will attend and represent the Army at all meetings with the public.

[The following paragraph will be installation-specific.] Contractors should note that the Installation has an active RAB and detailed information concerning the RAB's organization and activities will be provided to the Contractor. Activities that are required to support the RAB meetings are included in this effort. The Contractor shall be responsible for the minutes of all RAB meetings and shall submit these minutes to the COR for approval. The Contractor shall also secure a location for each scheduled meeting and shall provide all equipment to support these meetings.

[The following paragraph will be installation-specific – delete if CRP already in place.] The Contractor is responsible for developing an approved Community Relations Plan (CRP) for the Installation.

4.13.1 Communications

The Contractor shall not make available or publicly disclose any data or report generated under this contract unless specifically authorized by the COR. If any person or entity requests information from the Contractor about the subject of this scope of work or work being conducted hereunder, the Contractor shall refer them to the COR. All reports and other information generated under this scope of work shall become the property of the Government, and distribution to any other source by the Contractor is prohibited unless authorized by the COR.

4.14 Deliverable Requirements

All documents must be produced with at least draft, draft-final, and final versions. With Army concurrence, the Contractor may coordinate with appropriate regulatory agencies to determine if fewer versions of each deliverable are sufficient for review. The Army, through the COR, will receive initial draft documents and will provide comments to the Contractor within thirty (30) calendar [confirm duration with installation] days. Once initial comments are addressed, the Army will review draft documents before submission to appropriate regulatory agencies. The Contractor shall ensure that review periods are consistent with the applicable regulatory drivers noted in Section 1.0 of this PWS. All documents shall be identified as draft until completion of stakeholder coordination, when they will be signed and finalized. One copy of the final document shall be placed in both the project repository and Administrative Record (for CERCLA documents).

The Contractor shall follow the substantive requirements for all subject areas of the U S Army Corps of Engineers (USACE) guidance applicable to deliverables required for achievement of performance objectives identified in this PWS. If versions of Engineer Manuals, Data Item Description (DID), etc. are updated, the substantive requirements of the most recently approved version will apply to this PWS. The requirements can be found at http://www.hnd.usace.army.mil/oew/CX_mission.aspx.

In addition, the Munitions Response Site Prioritization Protocol (MRSPP) requirements in 32 CFR Section 179 require the DoD in consultation with representatives of the states and Indian tribes, to assign each MRS a relative priority for response actions. The initial MRSPP score for MRSs is developed during the SI phase. These MRSPP scores must be reviewed annually and must be revised whenever new data are obtained. Pursuant to this requirement, the Contractor shall annually review, revise MRSPP scores based on new information, and submit to the Army. In addition, the Contractor shall also include any information that may have influenced the MRS priority or MRS sequencing decision in the Administrative Record and the Information Repository.

Furthermore, the FY02 Defense Authorization Act creating the MMRP requires DoD to develop and maintain an inventory of defense sites that are known or suspected to contain UXO, DMM or MC. Pursuant to this requirement, the Contractor shall submit annual updates to the Installation Munitions Response (MR) map that reflect changes to the location, boundaries and/or extent of the MMRP sites in .pdf format.

The Contractor shall propose deliverables and payment milestones as part of its proposal, and if approved by the Army, included as part of the PMP. Final decisions regarding the adequacy of milestone and deliverable completion resides with the COR (see *Section 4.3, Milestone Presentations*) and will be based on the appropriate acceptance and approval of required documentation by Regulatory Agencies, consistent with CERCLA and the NCP. Note that the two annual deliverables above will not be accepted as interim payment milestones.

5.0 EXPERTISE AND NECESSARY PERSONNEL

The Contractor shall provide the necessary personnel and equipment to execute this PWS successfully. The Contractor is responsible for determining the requirements for licensed professionals and certifications.

The Contractor shall furnish all plant, labor, materials and equipment necessary to meet the performance objectives. The Contractor shall provide personnel trained as required by the Occupational Safety and Health Administration (OSHA) and all other applicable federal and state regulations. The Contractor shall provide all support activities necessary to ensure the safe and effective accomplishment of all work. For all work performed under this contract, the Contractor shall also develop and implement quality control measures consistent with all applicable federal and state regulatory requirements and standards.

5.1 Key Personnel

[The following paragraph will be contract-specific] The Army requires that the following positions, at a minimum, be designated as "key personnel," subject to the terms and conditions for such set forth in the basic contract. Contact the KO for available selections if the contract vehicle is not listed below]

POSITION	PERSONNEL	
Project Manager	[TBD]	
Senior Scientist/Engineer	[TBD]	
Senior UXO Supervisor	[TBD]	
UXO Safety Officer	[TBD]	
UXO Quality Control Specialist	[TBD]	
Regulatory Specialist		[TBD]
Risk Assessor		[TBD]
Certified Industrial Hygienist		[TBD]

The Contractor shall notify the COR of any changes in key personnel. The change of key personnel is subject to approval by the KO, although such approval will not be unreasonably withheld provided replacement personnel are of the same quality as originally proposed.

6.0 PERFORMANCE

6.1 Place of Performance

Work will be performed at the Installation and off-site Contractor offices as agreed to by both parties for proper performance of this contract.

6.2 *Period of Performance*

The period of performance will be the date of task order award through [Day/Month/Year]

7.0 ADDITIONAL REQUIREMENTS

7.1 Resources

7.1.a Army Furnished Resources

The Army, through the COR, shall make available the following resources to the Contractor:

- Records, reports, data, analyses, and information, in their current format (e.g., paper copy, electronic, tape, disks, CDs), to facilitate development of an accurate assessment of current, former, and historical site activities and operations; waste generation and contaminant characteristics; parameters of interest; and site environmental conditions.
- Access to personnel to conduct interviews on Installation operations and activities.
- Access to DoD and Army policy and guidance documents.
- All Army owned property used for remediation purposes must be maintained by the Contractor in accordance with applicable maintenance requirements, and may not be replaced by the Army should new equipment be required.
- [list any and all government furnished property and resources, see below for examples]
- Rights of Entry (ROEs) for sites included in this Task Order.
- The cost for evacuations, compensation, and temporary housing for displaced residents during intrusive activities and MEC destruction will be the responsibility of the Government.
- GIS database resources from the SI reports will be provided by the COR following Task order award.

7.1.b Contractor Furnished Resources

The Contractor must possess all the required expertise, knowledge, equipment and tools required to meet or exceed the Army's objectives identified in this PWS in accordance with established industry standards.

In addition, the Contractor shall be responsible for the following:

- Coordination with the Army/COR and the Installation for access to the Installation, to execute this PWS and comply with the procedures described during the Contractors' meeting at the Installation.
- Coordination with the Army/COR and the Installation in order to gain access to available infrastructure (e.g., buildings, roadways, waste management units, other Installation facilities) and utilities (e.g., electric power and telephone lines, natural gas and water supply distribution pipelines, and wastewater discharge conveyances), to execute this PWS.
- [The following bullet will be installation-specific.] The provision and cost of the utilities associated with implementation of remedies, including installation of individual meters for necessary utilities.
- [The following bullet will be installation-specific.] All waste generated under this contract shall be the responsibility of the Contractor.
- Any other necessary resources needed to achieve the performance objectives.

7.2 Contractor's Guarantee [N/A in USACE contracts/task orders]

The following definitions apply to this PWS: [Note: The following definitions may be changed to remove site-specific guarantees for RA(O)/LTM activities.]

- "Project Price" for each site identified in the PWS will be equal to the approved proposed price for achieving completion of remediation services in accordance with the PWS, the payment of which will be tied to one or more project milestones. The Project Price does not include the cost of the PMP, insurance premiums or surplus line taxes, if applicable.
- "Guarantee Limit" is equal to [define on PWS specific basis, if applicable. For example, "Guarantee Limit" is equal to one and one half (1.5) times the sum of all of the Project Prices for the sites identified in this PWS.] provided the contractor maintains a COR assigned performance rating of acceptable or higher in accordance with the QASP performance standards throughout the life of the contract.
- "Contractor's Project Costs" are defined as those costs incurred by the Contractor (including costs covered by insurance and PMP) in executing the work required to achieve the performance objectives identified in the PWS for all sites identified in this contract.

The Contractor guarantees to complete and meet all of the performance objectives, subject to the Guarantee Limit. This guarantee by the Contractor shall not exceed the Guarantee Limit. In the event the Contractor's Project Costs reach 80% of the Guarantee Limit, the KO, COR and the Contractor shall enter into discussions to determine if completion can be accomplished within the Guarantee Limit. If it is determined that completion will not be accomplished within the Guarantee Limit, work on the contract will stop when 100% of the Guarantee Limit is reached; unless and until there is agreement by modification

to the contract to continue and U.S. Army Environmental Command (USAEC) has committed adequate funding.

7.X Insurance Specifications [Optional]

If the Contractor chooses to use environmental insurance as part of their risk management approach on this PWS and will request a separate contract line item for environmental insurance, the following requirements apply:

The Contractor shall procure Environmental Insurance (EI) in the form of Remediation Stop Loss Insurance (Clean Cost Cap or CCC) and thereafter carry and maintain the EI coverage in full force and effect over the duration of the contract, to include options, at all sites identified in this PWS as requiring EI. The EI shall meet or exceed the following objectives:

1. Provides coverage applicable to the sites, performance objectives, and performance standards identified in Table 1 of this PWS as requiring insurance, and confirms that all the obligations assumed under this PWS are incorporated into the definition of the insured "remedial plan" as specified in the insurance endorsements.
2. Provides coverage at a minimum, equal to the Guarantee Limit of the PWS, minus insurance, travel, and PMP costs and costs for any site locations excluded from the award or not requiring insurance.
3. Coverage to include a Waiver of Subrogation, as applicable, for claims associated with matters and scope items addressed in this PWS that the Contractor or insurance company may have against the Army.
4. Coverage provided from a carrier rated A.M. Best's A- (Excellent) and Financial Size Category (FSC) IX or better.
5. Requires that technical and schedule progress reports to be provided to the Army on the same schedule that they are provided to the insurance carrier.
6. Contains no "War Exclusion" or contains a limited war exclusion that excludes cleanup costs caused solely by a hostile or violent act of war after the inception date.
7. Provides the Army the primary right to assign the policy to a replacement contractor acceptable to the insurance company should the Contractor default or otherwise be unable to meet the PWS requirements.

The Contractor must provide proof of insurability with the submitted proposal. Proof of insurability will be in the form of a draft policy specifying terms and conditions (e.g., all endorsements) in sufficient detail to allow evaluation of:

- The identity of the insurance companies offering to insure the contractor;
- The limits of liability for each coverage part;
- The premium for each policy or coverage part;
- The amount of the self-insured retention, buffer layer (if applicable), and /or co-insurance;

- The policy length (term) for each policy;
- The policy forms, and proposed endorsements;
- The insured scope of work or definition of the insured remedial plan;
- A list of the documents provided to the underwriter as part of the application for insurance;
- The name of the insurance broker and the full compensation of the insurance broker including any and all commissions, fees, incentive payments, reinsurance commissions or wholesale brokerage commissions earned by any firm within the insurance brokers economic family disclosed as a separate cost item, even if these costs are incorporated into the premiums of the insurance policies being provided;
- How, in the event of Contractor default, its provisions will ensure that this PWS is completed to the satisfaction of the Army.
- Any exclusions to be added to these polices by endorsement along with an explanation of the rationale behind attaching the exclusion; and
- Any deviations from these insurance specifications with explanation using a checklist as to why the specification was not met, or why the deficiency in question is not material to the CCC coverage to be provided.

Within ten (10) business days of contract award, the Contractor shall provide a quote letter containing a policy with endorsements to KO/COR. The KO and COR shall have the right to review the quote letter to ensure consistency with the objectives as listed above. The Government reserves the right to withhold or adjust payment for the insurance policy if the final bound policy terms and conditions are changed from the draft policy terms and conditions presented in the Contractor's proposal submittals. The Contractor is responsible for paying the costs associated with all insurance requirements, including but not limited to the self-insured retention and co-pays. Contractors should note that the Army will allow the first payment milestone to include necessary insurance costs (e.g., insurance premium).

A Certificate of Insurance shall be furnished to the contracting officer (KO) on an annual basis evidencing the above insurance coverage is bound.

7.3 Certification and Approval of Project Milestones and Deliverables

The COR will be responsible for contract management, inspection, oversight, review, and approval activities. Certification and approval of project milestones by the COR is necessary before distribution of payments. Final acceptance of milestone completion shall include appropriate acceptance of site remediation documentation by regulators. For the duration of the contract, the Contractor shall remain responsible for correction of remedy deficiencies noted during [adjust according to scope] RA(O), LTM, and CERCLA 121(c) reviews.

Certification by the Army is contingent upon the Contractor performing in accordance with the terms and conditions of the contract, this PWS, and all amendments/options.

Representatives of USAEC, USACE, the installation, and the Contractor shall meet with the COR at a site and time designated by the COR after receipt of each status report to:

- Formally review the quantity and quality of services;
- Inspect work for compliance with this PWS, the associated Contractor's final proposal, and project documentation;
- Accept or reject milestones and deliverables completed since the previous review; and
- Prepare, approve and submit DD Form 250 "Material Inspection and Receiving Report" for milestone payments in accordance with milestone completions and approvals at the COR level.

7.4 Government Rights

The Army has unlimited rights to all documents/material produced under this contract. All documents and materials, to include the source codes of any software, produced under this contract shall be Army owned and are the property of the Army with all rights and privileges of ownership/copyright belonging exclusively to the Army. These documents and materials cannot be used or sold by the Contractor without written permission from the KO. All materials supplied to the Army shall be the sole property of the Army and cannot be used for any other purpose. This right does not abrogate any other Army rights under the applicable Data Rights clause(s).

7.5 Stop Work

The Contractor, authorized Installation personnel, and the COR have the responsibility to stop work immediately if the work is considered to be a serious threat to the safety or health of workers, other personnel, or to the environment. Authorized Installation personnel include Installation safety officers, Environmental Division personnel, and command personnel with responsibility for overall Installation operations. When work is stopped due to a hazard/threat to worker safety, health, or the environment, the situation and resolution must be documented and submitted to the KO. Work must be stopped whenever chemical and biological warfare agents are encountered.

7.6 Environmental Responsibility Considerations

- The Army will retain responsibility for any assessed natural resource damages that are attributed to historic releases of hazardous substances (prior to contract with the Contractor) and any injuries that are necessary and incidental to the reasonable implementation of a selected response or remedial action. The Contractor shall be responsible for any/all additional natural resource injuries and associated Natural Resource Damages claims

brought as a result of its actions (e.g. release of hazardous substance or unreasonable disturbance of natural resources as a result of construction activities).

- [The following bullet will be installation-specific.]The Army will retain all responsibility for third party liability for CWM, MEC, or radiological material that are either targeted for or may be discovered during the course of remediation.
- Response cost claims, property damage and personal injury claims brought due to contamination and hazardous substance releases that have occurred historically (prior to contract with the Contractor) and are not due to Contractor remediation activities are excluded from Contractor responsibility. The Contractor shall be responsible for and indemnify the Army for:
    - Any response cost claims for any environmental remediation services which the Contractor has assumed responsibility for under this PWS;
    - All costs associated with correction of a failure of any remedy implemented or operated and maintained by the Contractor to the extent such failure was caused by the willful or negligent acts or omissions of the Contractor in the course of performing the environmental services;
    - All personal injury or property damage claims to the extent caused by the acts or omissions of the Contractor in the course of performing the environmental services;
    - All natural resource damages pursuant to 42 U.S.C. Section 9607(a)(4)(C), to the extent that such damages were caused or contributed to by the actions of the Contractor or its successors in interest; and
    - All costs associated with or arising from any negligent acts or omissions or willful misconduct of the Contractor in the course of performing the environmental services or implementing remedial actions.

7.7 Organizational Conflicts of Interest

7.7.1 **Disclosure.**

The Contractor shall provide a disclosure statement with its proposal, which concisely describes all relevant facts concerning any past or present organizational conflicts of interest relating to the work in each PWS. In the same statement, the Contractor shall provide the information required in the following paragraph to assure the Government that the conflicts of interest have been mitigated and/or neutralized to the maximum extent possible. If a conflict of interest is discovered after contract award, the Contracting Officer will make a decision whether to terminate or rescind the PWS and/or contract at that time.

7.7.2 **Potential Conflicts of Interest.**

This request for proposals is open to any of feror to compete as a prime contractor, subcontractor or in any teaming arrangement. In order to avoid any

organizational conflicts of interest, or even the appearance of any organizational conflicts of interest, any contractor performing environmental services work at the follow-on installation(s) under each contract will need to avoid, neutralize and/or mitigate - prior to contract award - significant potential conflicts of interest that may prejudice effective competition. The KO has determined that at a minimum contractors currently performing work on the identified installation(s) under each contract must ensure that all data pertaining to contamination at the sites compiled by or in the possession of such contractors shall be made available to all potential contractors in a timely fashion to the maximum extent possible by providing such data in to a data depository.

7.8 Privacy and Security

In order to ensure the security and orderly running of the Installation, any contractor personnel who wish to gain access to the Installation shall follow procedures established by the Installation. The Contractor should account for potential delays due to DoD security requirements in its pricing.

[include narrative explanation of installation access/security requirements or provide policy/procedure references and post documents on the webpage.

If something requires advance approval or arrangement for access (e.g. ROEs requiring a long lead time to execute), indicate approximate advance notice timeframes needed here]

7.9 Travel

Travel to/from the Installation and to other CONUS locations for such purposes as to attend meetings, briefings and/or presentations may be required incidental to this remedial action, the costs for which shall be included in the total price for the PWS.

7.10 Performance and Payment Bonds [Applicable only if the base contract allows for it. Review the base contract and proposed scope to determine if bonds are necessary]

In accordance with the base contract, the Contractor:

☐ is NOT required to furnish Performance and Payment Bonds on this PWS.

☐ is required to furnish Performance and Payment Bonds on this PWS in accordance with the following:

[List bonding requirements per the base contract here, e.g. in an amount equal to 100 percent of the original contract price]

7.11 Warranty [Applicable only if the base contract allows for it. Review the base contract and proposed scope to determine if warranty is necessary]
In accordance with the base contract, the Contractor:

☐ is NOT required to provide a 5-year warranty for each site as specified in this PWS.

☐ is required to provide a 5-year warranty for each site as specified in this PWS.

8.0 CONTRACTING OFFICER'S REPRESENTATIVE [to be inserted upon issuance of contract]

Name:
Organization:
Address:
Address:
City, State, Zip Code:
Telephone:
Facsimile:
Email:

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Attachment A: Reference Documents

The Army believes that documentation provided with the solicitation represents the most recent and appropriate documentation available for the Installation and sites identified in this contract. However, if there is a conflict between this information and other site documentation (the existing reports), the Contractor is solely responsible for reviewing all available information and forming their independent, professional conclusions/interpretation of site conditions and requirements to meet the objectives of this contract. This information is not intended as a substitute for complete analysis of technical data available, nor is it intended to be a guide on how the Contractor should address achievement of the performance objectives/standards.

Specific documents may be made available following a request to the Contracting Officer, if the documentation can be distributed in a timely manner. Electronic format is not guaranteed.

Table 2: Available Reference Documents.

Title	Author	Date
[Insert list of all available/key documents – in chronological order with newest first]		

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Attachment B: List of Acronyms

Acronym	Description
AEDB-R	Army Environmental Database - Restoration Module
APP	Accident Prevention Plan
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirement
CAIS	Chemical Agent Identification Sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLIN	Contract Line Item Number
CMS	Corrective Measures Study
COR	Contracting Officer's Representative
CPAR	Contractor Performance Assessment Report
CRP	Community Relations Plan
CSDGM	Content Standard for Digital Geospatial Metadata
CWM	Chemical Warfare Materiel
DA	Department of the Army
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DMM	Discarded Military Munitions
DoD	Department of Defense
EMS	Environmental Management System
ERIS	Environmental Restoration Information System
ESP	Explosive Site Plan
ESS	Explosives Safety Submission
FAR	Federal Acquisition Regulation
FFA	Federal Facility Agreement
FFPR	Firm Fixed Price Remediation
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
HRR	Historical Records Review
IAP	Installation Action Plan
IRIS	Integrated Risk Information System
KO	Contracting Officer
LUC	Land Use Control
LTM	Long-Term Management
MC	Munitions Constituents
MCL	Maximum Contaminant Level

Acronym	Description
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MM	Military Munitions
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Sites
MRSPP	Munitions Response Site Prioritization Protocol
NCP	National Oil and Hazardous Substances Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NPL	National Priorities List
NSSDA	National Standard for Spatial Data Accuracy
NTP	Notice to Proceed
OSHA	Occupational Safety and Health Administration
PBA	Performance-Based Acquisition
PMP	Project Management Plan
PWS	Performance Work Statement
QA	Quality Assurance
QASP	Quality Assurance Surveillance Plan
RAB	Restoration Advisory Board
RA(O)	Remedial Action (Operations)
RC	Response Complete
RCRA	Resource Conservation and Recovery Act
RCWM	Recovered Chemical Warfare Materiel
RDX	Cyclotrimethylenetrinitramine
READ	Repository of Environmental Army Documents
RfD	Reference Dose
RFI	RCRA Facility Investigation
RFP	Request for Proposal
RI	Remedial Investigation
RIP	Remedy In Place
ROD	Record of Decision
ROE	Right of Entry
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SC	Site Closeout
SDSFIE	Spatial Data Standards for Facilities, Infrastructure, and Environment
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TNT	Trinitrotoluene

MMRP Performance Based Acquisition Generic PWS Template
(as of 6 April 09)

Acronym	Description
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
USAEC	United States Army Environmental Command
USC	United States Code
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance

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Attachment C: Definitions

Activity-Based Schedule: Activities and milestones defined at the detail level and logically sequenced to support, and manage completion of the performance objectives.

Contractor's Project Costs: Costs incurred by the Contractor (including costs covered by insurance and the PMP) in executing the work required to achieve the performance objectives identified in the PWS for all sites identified in this contract/task order.

Chemical Warfare Materiel (CWM): An item configured as ammunitions containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM also includes V- and G- services nerve agent, H-series blister agent, and lewisite in other than munitions configurations. Due to their hazards, prevalence, and military-unique application, Chemical Agent Identification Sets (CAIS) are also considered CWM. CWM does not include riot control agency, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with chemical agent.

Deliverables: Documentation or data that support the completion of milestones or achievement of the performance objectives identified in this PWS.

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance that has become hazardous by damage or deterioration.

[*If using USACE contract vehicle, delete]* Guarantee Limit - is equal to [define on PWS specific basis, if applicable, and ensure consistent with Section 7.2]

[if going to RI for MMRP sites only, delete] Long-Term Management (LTM): The remedial phase including maintenance, monitoring, record keeping, remedy reviews, etc. initiated after response (removal or remedial) objectives have been met (i.e., after Response Complete). LTM includes development and implementation of an exit or ramp-down strategy for LTM activities at each site.

Milestones: Significant events or activities that occur in the course of the Contractor achieving the performance objectives identified in this PWS.

Military Munitions (MM) – All ammunition products and components produced or used by or for the DoD or the U.S. Armed Services for national defense and security, including MM under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, and National Guard personnel. The term military munitions includes: confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. MM do not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components thereof. However, the term does include non-nuclear components of nuclear devices, managed under DOE's nuclear weapons program, after all required sanitization operations under the Atomic Energy Act of 1954, as amended, have been completed.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means UXO, as defined in 10. SC 101(e)(5)(A) through (C); DMM, as defined in 10 USC 2710(e)(2); or MC (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions response – A response action, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, and/or environmental risks presented by munitions and explosives of concern (MEC) and/or MC.

PMP Documents: The original PMP (including project schedule), revisions, and status reports.

Project Documents (CERCLA): Documentation and data required by CERCLA remediation and RA(O) and/or LTM activities. These documents include the additional site plans referenced in Section 5.0 of this PWS.

[*If using USACE contract vehicle, delete] Project Price*: The approved proposed price for achieving completion of remediation services in accordance with the PWS, the payment of which will be tied to one or more project milestones. The Project Price does not include the cost of the PMP, insurance premiums or surplus line taxes, if applicable.

Project-related information: All previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors and subcontractors during their work at the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS.

[if going to RI for MMRP sites only, delete] Remedial Action (Operations) (RA(O)): The remedial phase during which the remedy is in place and operating to achieve the cleanup objective identified in the Record of Decision (ROD) or other formal decision document. Any system operation (long-term operations) or monitoring (long-term monitoring) requirements during this time are considered RA(O). RA(O) includes development and implementation of an exit or ramp-down strategy for LTM activities at each site.

[if going to RI for MMRP sites only, delete] Remedy In Place (RIP): A final remedial action has been constructed and implemented and is operating as planned in the remedial design. An example of a remedy in place is a pump-and-treat system that is installed, is operating as designed, and will continue to operate until cleanup levels have been attained. Because operation of the remedy is ongoing, the site cannot be considered Response Complete.

[if going to RI through RIP for MMRP sites only, delete] Response Complete (RC): The remedy is in place and the required remedial action-operations (RA-O) have been completed. If there is no RA(O) phase and all response action objectives have been achieved and documented, then the remedial action-construction end date will also be the RC date.

[if going to RI through RIP for MMRP sites only, delete] Site Close-Out: Site Close-Out signifies when the Army has completed active management and monitoring at an environmental cleanup site, no additional environmental cleanup funds will be expended at the site and the Army has obtained regulator concurrence. For practical purposes, Site Close-Out occurs when cleanup goals have been achieved that allow unrestricted use of the property (i.e., no further LTM, including institutional controls, is required). Site Close-Out may include, but not be limited to, the dismantling, removal, recycling, reclamation and/or

disposal of all remedial activity systems and ancillary equipment above and underground to return the site to its natural state.

Unforeseen environmental issues: include unknown and/or varied concentrations of contaminants at cleanup sites (off-installation areas included) identified in this PWS, but not unknown sites (e.g., sites not identified in this PWS).

Unexploded ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

EXAMPLE WORK BREAKDOWN STRUCTURE

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Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
1	**Project Award**			
2	**Project Management Plan (PMP)**		Prepare PMP for Government review	PMP should minimally include Project Overview, Technical Approach, Management Approach, Public Involvement Plan, Project Schedule, Quality Assurance Strategy, Reporting Procedures, and Payment Plan.
3	**Project Kickoff Meeting with Army Stakeholders**			Within 45 days of Project Award. Agenda to minimally include: Project Scope, Review of Existing Site Information (i.e., conceptual site model [CSM], Site Investigation Report, etc.), Customer Expectations, PMP Review, and Schedule.
4	**Project Kickoff Meeting Minutes**			
5	**Technical Project Planning (TPP) Phase 1 - Site Understanding and Initial Evaluation**			Sections 3.2.1 Identify Current Project and 4.1 Site Understanding and Evaluation
		Identify TPP Team Members	Identify key team members and establish their role for the project - (decision maker, data user, data implementer)	Refer to Table 3-1 for more information on TPP team member description and roles.
		Prepare a team information package	Team Information Package: Team members - Name and defined roles Stated goals for the project Project schedule Project budget Administrative Record Index and correspondence to date	Prepare and distribute team information package
			Public Involvement Plan	Section 4.5 Public Involvement in the RI/FS

Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
			Summary of existing CSM	Section 4.1.2 Conceptual Site Model, Figure 4-2 Graphical CSM Presentation
			Available site data and/or applicable reports	Examples - HTRW Data, Archive Search Reports, Historical Record Reviews, Wide Area Assessments, Preliminary Assessment, Site Inspection Report, etc.
		Conduct TPP meeting		TPP Team is brought together to discuss project goals, objectives, and identify a site approach.
			The Phase 1 Memorandum for Record (MFR) Worksheet can facilitate required information collection.	See Table 4-1: TPP Phase 1 MFR Components
			Meeting agenda should include:	Refer to Sample Agenda TPP Meeting 1 in Appendix D for more detailed information
			Purpose of meeting Project objectives and scope Site overview Initial Consideration of Data Needs and Data Collection Strategies Review proposed project activities	
			Geophysical prove-out	Section 5.2.1.3.1 Geophysical Prove-Out
			Site visit Project schedule Identify action items and deliverables	
		Complete TPP activities		Preparation of the Phase 1 MFR using the information gathered at the TPP meeting
			Activities include: Develop Phase 1 MFR Develop Meeting Minutes Complete Action Items	

Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
			Complete Project Objective Worksheets	See Table 4-2 - Project Objective Worksheet
		Finalize Phase 1 TPP 1 Documents/Activities	Gain Stakeholder Concurrence on meeting minutes, MFR, and project objective worksheets.	
6	**Geophysical Prove-Out**			
		Geophysical Prove-Out Process	**Activities include:**	Section 5.2.1.3.1 Geophysical Prove-Out
			Geophysical Prove-Out Planning and Design	
			Construction of Geophysical Prove-Out Plot	
			Geophysical Prove-Out Implementation	
			Geophysical Prove-Out Results	
7	**TPP Phase 2 - Determine Data Needs**			Sections 3.2.2 and 4.2 Determine Data Needs
		Team member review of Memorandum for Record prior to TPP Phase 2 Meeting		
		Conduct Phase 2 TPP Meeting	**Meeting agenda should include:**	Refer to Sample Agenda TPP Meeting 2 in Appendix D for more detailed information
			Purpose of Meeting	
			Site Overview	
			Data Quality Objectives	Section 4.4.1 Data Quality Objectives
			Geophysical Prove-Out Results	Section 5.2.1.3.1 Geophysical Prove-Out
			Geophysical Survey Approach	Section 5.2.2 Survey Approach Decisions
			Munitions Constituents Sampling Plan	Section 4.4.2.1.1 Field Sampling Plan
			Intrusive Investigation Plan	Section 5.2.6 Anomaly Investigation. Refer to Tables 5-5 Comparison of Excavation Technologies
			Rights of Entry	Section 4.2.1 Rights of Entry

Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
			Work Plan - Discussion includes requirements for QAPP, APP, SSHP, Field Sampling Plan, Safety Submissions, etc.	Section 4.4.2 Work Plan Preparation
			Project Schedule	
			Follow-On Phases	
			Identify Action Items and Deliverables	
		Complete Phase 2 TPP activities	**Activities include:**	
			Develop Meeting Minutes	
			Complete Action Items	
8	**RI/FS Work Plan**			
		Prepare Work Plan Document	Internal Army Stakeholder Review	Section 4.4.2 - Also refer to the Sample RI Work Plan Outline in Appendix D for more information
			Revise/Resubmit Draft Work Plan Document	
			Regulatory Review	
			Revise/Resubmit Final Work Plan Document	
9	**Field Activities**			
		Notice to Proceed	**Field Activity Components**	Section 5.0 Remedial Investigation
			Mobilization	
			Survey and Site Preparation	
			Geophysical Investigation	Section 5.2 Munitions Response Site Characterization for Munitions and Explosives of Concern
			Intrusive Investigation	Section 5.2.6 Anomaly Investigation. Refer to Tables 5-5 Comparison of Excavation Technologies
			MEC Destruction/Removal	See Table 5-6 Comparison of Disposal Technologies
			Munitions Constituents Sampling	Section 5.3 Munitions Constituents Characterization
			Demobilization	

Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
10	**Environmental Sampling and Analysis**			
		Laboratory Sample Analysis	Analysis	
			Analytical Data Submittal for Quality Data Evaluation	Section 5.3.4 Data Management and Validation
			Electronic laboratory data submittal	
11	**RI Report**			
		Prepare RI Report	Internal Army Stakeholder Review	Section 5.7 Remedial Investigation Reporting. Refer to the RI/FS Report Outline in Appendix D
			Revise/Resubmit Draft RI Report Document	
			Regulatory Review	
			Revise/Resubmit Final Work Plan Document	
		Conduct Phase 3 TPP Meeting	**Meeting agenda should include:**	Refer to Sample Agenda TPP Meeting 3 in Appendix D for more detailed information
			Purpose of Meeting	
			Site Overview	
			Data Quality Objectives	
			Geophysical Prove-Out Results	
			Geophysical Survey Results	
			Munitions Constituents Sampling Results	
			RI Report Review	
			Follow-On FS Phases	
			Identify Action Items and Deliverables	
			Revise/Resubmit Final RI Report Document	
12	**FS Report**	**Prepare FS Report**	Determine need for Treatability or Pilot Study	Section 7.0 Feasibility Study. Refer to the RI/FS Report Outline in Appendix D
			Internal Army Stakeholder Review	
			Revise/Resubmit Draft FS Report Document	
			Regulatory Review	

Number	Task Name	Activities	Sub Activity	Guidance Section Reference and Notes
		Conduct Phase 4 TPP Meeting	**Meeting agenda should include:**	Refer to Sample Agenda TPP Meeting 4 in Appendix D for more detailed information
			Purpose of Meeting	
			Site Overview	
			RI Report Results	
			Discussion of Site Alternatives	Section 7.2 Development and Screening of Alternatives
			FS Report Findings and Site Recommendations	
			Identify Action Items and Deliverables	
			Revise/Resubmit Final RI/FS Report Document	
13	**RI/FS Decision Document**			
		Prepare RI/FS Decision Document	Internal Army Stakeholder Review	
			Revise/Resubmit Draft Decision Document	
			Proposed Plan and Public Comment Period	
			Regulatory Review	
			Response to Comments	
			Revise/Resubmit Final Decision Document	
14	**Administrative Record**			
		Register of RI/FS Administrative Record	Register RI/FS Work Plan	Section 4.5 Public Involvement in the RI/FS
			Register RI/FS Report	
			Register of RI/FS Decision Document	
15	**Project Management**	**Job Opening**		
		Job Closeout		

SAMPLE TECHNICAL PROGRAM PLANNING MEETING AGENDAS

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Sample Agenda Technical Project Planning Meeting Phase I

Goals:

- Fostering of the Technical Project Planning (TPP) Team
- Common understanding of the conceptual site model
- Common understanding of overall site approach
- Consensus on Phase I project objectives
- Understand project constraints/dependencies
- Understand regulator/stakeholder perspectives
- Consensus on data needs
- Understanding of next steps

Agenda:

1. Opening Remarks
   - Statement of Purpose of Meeting
   - Introductions (Participants)
     - Name, Organization, Role on the Project
   - Expectations/Objectives for Today's Session
   - Overview of TPP Process
2. Site Overview
   - Site History
   - Site Status
   - Existing Data
   - Current and Future Uses
3. *Break*
4. Project Phases and Schedule
   - Executable Project Stages
   - Remedial Investigation / Feasibility Study (RI/FS) Phase I Goals
     - Biological Assessment
     - Geophysical Prove-Out
     - Geophysical Survey
5. Follow-On Project Executable Stages
   - Intrusive Investigation / Environmental Sampling
   - I - FS
   - Prepare RI/FS Report, Action Memorandum
6. Closing Remarks
   - Action Items/Deliverables
7. *Lunch*
8. Site Visit

Sample Agenda Technical Project Planning Meeting Phase II

Goals:

- Fostering of the Technical Project Planning Team
- Common understanding of the Statement of Principles
- Common understanding of overall site approach
- Consensus on project approach for Phase I of Remedial Investigation / Feasibility Study (RI/FS)
- Understand project constraints/dependencies
- Understand regulator/stakeholder perspectives
- Consensus on data needs
- Understanding of next steps

Agenda:

1. Opening Remarks
    - Purpose of Meeting
    - Statement of Principles
    - Introductions (Participants)
        - Name, Organization, Role on the Project
    - Expectations/Objectives for Today's Session
    - CERCLA Overview, RI/FS Review
2. Site Overview
    - Site History
    - Site Status
    - Existing Data
        - Physical Nature of the Site
        - Characterization of Munitions and Explosives of Concern and Munitions Constituents
        - Regulatory Framework
        - Demographics and Current and Future Land Uses
3. *Break*
4. Biological Assessment
5. Cultural Resource Investigation
6. Geophysical Prove-Out Review
7. *Lunch*
8. Geophysical Survey
    - Proposed Investigation Areas
    - Brush Clearing Considerations
9. Project Executable Stage II – Intrusive Investigation / Environmental Sampling / Dig Sheets
    - Artifact Discovery Procedures
10. Follow-On Project Executable Stages
    - FS
    - Prepare RI/FS Report, Action Memorandum
11. Closing Remarks
    - Action Items/Deliverables

Sample Agenda Technical Project Planning Meeting Phase III

Goals:

- Fostering of the Technical Project Planning Team
- Common understanding of the Statement of Principles
- Common understanding of overall Remedial Investigation / Feasibility Study (RI/FS)
- Consensus on project approach for Phase II of RI/FS
- Understand project constraints/dependencies
- Understand regulator/stakeholder perspectives
- Consensus on data needs
- Understanding of next steps

Agenda:

1. Opening Remarks
    - Purpose of Meeting
    - Statement of Principles
    - Introductions (Participants)
        - Name, Organization, Role on the Project
    - Expectations/Objectives for Today's Session
    - Site Status
2. Phase I RI/FS Overview
    - Review of Phase I
        - Archeological Screening
        - Sensitive Habitat Areas
        - Geophysical Prove-Out
        - Geophysical Site Inspection
        - Selection of Anomalies
        - Survey Areas
3. *Break*
4. Geophysical Results and Anomaly Selection
5. Phase II – Q&A
6. Next Steps
    - Concurrence on Anomaly Digs
    - Schedule Fieldwork
    - Deliverables/Action Items
7. Closing Remarks

Sample Agenda Technical Project Planning Meeting Phase IV

Goals:

- Fostering of the Technical Project Planning Team
- Common understanding of the Statement of Principles
- Common understanding of overall Remedial Investigation / Feasibility Study (RI/FS)
- Review objectives of RI/FS
- Review results/conclusions if RI/FS
- Identify concerns
- Review recommendations of RI/FS
- Achieve consensus on next actions (if any)

Agenda:

1. Opening Remarks
    - Purpose of Meeting
    - Statement of Principles
    - Introductions (Participants)
        - Name, Organization, Role on the Project
    - Expectations/Objectives for Today's Session
    - Site Status
2. Phase II RI/FS Overview – Intrusive Investigations
    - Results and Conclusions of Intrusive Investigations
3. *Break*
4. Project Executable Stage III RI/FS Overview - FS
    - Results of Remedial Alternative Development and Evaluation
5. *Lunch*
6. Discussion of RI/FS Results and Recommendations
7. Next Steps
    - Deliverables/Action Items
8. Closing Remarks

EXAMPLE MEMORANDUM FOR RECORD WORKSHEET

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Phase I MFR Worksheet

US Army Corps of Engineers®

Author(s) _____
Reviewer(s) _____
Latest Revision Date _____ Review Date _____

Location: _____
Site: _____
Project: _____

(Attach Phase I MFR to PMP)

TPP TEAM EM 200-1-2, Paragraph 1.1.1

Decision Makers	Data User Perspectives	Data Implementer Perspectives
Installation: List Installation CO Project Manager: Installation RPM USACE RPM Regulator(s): EPA State Stakeholders: RAB Other interest groups	Risk: List team member(s) Compliance: List team member(s) Remedy: List team member(s) Responsibility: List team member(s) (if needed)	Sampling: List team member(s) Analysis: List team member(s)

PROJECT GOALS EM 200-1-2, Paragraph 1.1.2

Future Land Use(s) at Site	Regulatory Compliance Status and Issues	Interim Site Closeout Goal (if applicable)
Example(s): MRA 1: Open Space MRA 2: Parking Lot MRA 3: Residential	Example(s): **Regulatory Compliance:** Comply with CERCLA Meet FFA schedule **Considerations/Regulatory Issues:** No regulatory threshold for MEC No approved MEC hazard assessment methodology	Example(s): Fence MRA 1 and MRA 3 Install signs on all MRAs

PROJECT GOALS (continued) EM 200-1-2, Paragraph 1.1.2

Site Closeout Statement
Example(s): Reduce the MEC hazard to return the site to its intended use.
Schedule Requirements
Example(s): FFA Contract period of performance
Site Budget
Example(s): RI/FS budget of $XXX.

IDENTIFY SITE APPROACH		
EXISTING SITE INFORMATION AND DATA EM 200-1-2, Paragraphs 1.1.3 and 1.2.1		
Attachment(s) to Phase I Memorandum For Record	Site Information Respository(ies)	Preliminary Conceptual Site Model
Example(s): PA/SI EE/CA HTRW reports	List location of Administrative Record	Example(s): MRA 1: Former aerial bombing range for practice bombs, current use open space, future use open space MRA 2: OB/OD in 1950s, current use open space, future use parking lot MRA 3: Mortar range in 1940s, current use residential, future use residential
POTENTIAL POINTS OF COMPLIANCE EM 200-1-2, Paragraph 1.2.1.3 Example(s): MC < PRGs therefore, no further action ROD for MC		
MEDIA OF POTENTIAL CONCERN EM 200-1-2, Paragraph 1.2.1.4 Example(s): Soil, etc.		

IDENTIFY SITE APPROACH (continued)

PROJECT OBJECTIVES EM 200-1-2, Paragraph 1.2.1.3

Attach project objectives worksheets.

REGULATOR AND STAKEHOLDERS PERSPECTIVES EM 200-1-2, Paragraph 1.2.3

Regulators	Community Interests	Others Agencies
Example(s): Potential receptors Phased closeout if possible QA/QC	Example(s): Land is safe for intended use	Example(s): Reporting procedures if MEC found

PROBABLE REMEDIES EM 200-1-2, Paragraph 1.2.4

Example(s):
Combination of surface or subsurface removal with LUCs.

EXECUTABLE STAGES TO SITE CLOSEOUT EM 200-1-2, Paragraph 1.2.5

RI/FS → Proposed Plan → Record of Decision → Response design → Response Action → Response Complete

IDENTIFY CURRENT PROJECT

SITE CONSTRAINTS AND DEPENDENCIES EM 200-1-2, Paragraph 1.3.1

Administrative Constraints and Dependencies:

Example(s):
Rights of Entry
Budget limitations

Technical Constraints and Dependencies:

Example(s):
Technology limitations

Legal and Regulatory Milestones and Requirements:

Example(s):
No regulatory threshold for MEC hazard
ARARs

CURRENT EXECUTABLE STAGE EM 200-1-2, Paragraph 1.2.1.3

RI/FS

(Also list project objective numbers and attach Project Objectives Worksheet with descriptions.)

Basic (current project)	Optimum (future project)	Excessive (objectives that do not lead to site closeout)

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EXAMPLE PROJECT OBJECTIVES WORKSHEET

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TECHNICAL PROJECT PLANNING
PROJECT OBJECTIVES WORKSHEET (EXAMPLE)

SITE:_____ Page ____ of ____
PROJECT:_____

Project Objective[1]					Data User(s)	Project Objective Classification[2]
#	Executable Stage[3] Current	Executable Stage[3] Future	Description	Source[4]		
1	X		Determine MRA boundary	CERCLA	☒ Risk ☐ Compliance ☒ Remedy ☐ Responsibility	☒ Basic ☐ Optimum ☐ Excessive
					☐ Risk ☐ Compliance ☐ Remedy ☐ Responsibility	☐ Basic ☐ Optimum ☐ Excessive
					☐ Risk ☐ Compliance ☐ Remedy ☐ Responsibility	☐ Basic ☐ Optimum ☐ Excessive
					☐ Risk ☐ Compliance ☐ Remedy ☐ Responsibility	☐ Basic ☐ Optimum ☐ Excessive
					☐ Risk ☐ Compliance ☐ Remedy ☐ Responsibility	☐ Basic ☐ Optimum ☐ Excessive

[1] Refer to EM 200-102, Paragraph 1.2.2.
[2] Classification of project objectives can only occur after the current project has been identified. Refer to EM 200-102, Paragraph 1.3.3.
[3] Refer to EM 200-102, Paragraph 1.2.5.
[4] For example, CERCLA _____, State Regulation _____, FFA Section _____, Meeting with regulator on MM/DD/YY.

EXAMPLE Project Objectives Worksheet

SITE: MRS Name
PROJECT: MRS Project Name

Site Objective [a]					Data Needs [d]	Data Collection Methods	Project Objective Classification [e]
Number	Executable Stage [b]		Description [c]	Source			
	Current	Future					
1	Yes		Presence/absence of MEC and MC	ASR, public	CR, LU, SC, MEC	MEC visual inspection, MC sampling	Basic
2	Yes		Eliminate from further consideration those releases that pose no significant threat to public health or the environment by collecting adequate samples to assess the presence or absence of MC at the site.	ASR, public	CR, LU, SC, MEC	MEC visual inspection, MC sampling	Basic
3	Yes		Determine the potential need for a TCRA by collecting data from previous investigations/ reports, site visits, and geophysics	ASR, public	CR, LU, SC, MEC	MEC visual inspection, MC sampling	Basic
4	Yes		Collect, or develop, additional data, as appropriate, for HRS scoring by the EPA	ASR, public	CR, LU, SC, MEC	MEC visual inspection, MC sampling	Basic
5	Yes		Collect data, as appropriate, to characterize the release for effective and rapid initiation of the RI/FS.	ASR, public	CR, LU, SC, MEC	MEC visual inspection, MC sampling	Basic
6	Yes		Collect the additional data necessary to the complete the MRSPP.	ASR, Public	CR, LU, SC, MEC	MEC Visual Inspection, MC Sampling	Basic

[a] Refer to EM 200-1-2, Paragraph 1.2.2
[b] Refer to EM 200-1-2, Paragraph 1.2.5
[c] For example, list the regulation title, or the date of the meeting with Customer/Stakeholder/Regulator where decision was made.
[d] Data Needs: CR – Compliance/Regulatory, LU-Land Use/Demographics, SC-Site Conditions, and MEC- MEC Conditions and Hazard
[e] Classification of project objectives can only occur after the current project has been identified. Refer to EM 200-1-2, Paragraph 1.3.3.

Acronyms
ASR – Archive Search Report
EM – Engineer Manual (see www.usace.army.mil/inet/usace-docs/)
EPA – United States Environmental Protection Agency
HRS – Hazard Ranking System
MEC- Munitions and Explosives of Concern
MC- Munitions Constituents
MRSPP – Munitions Response Site Prioritization Protocol
RI/FS – Remedial Investigation / Feasibility Study
TCRA – Time Critical Removal Action

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EXAMPLE DATA NEEDS WORKSHEETS

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DATA NEED WORKSHEET – RISK PERSPECTIVE (EXAMPLE)

SITE:_____ Page ____ of ____
PROJECT:_____

Data Need		Project Objective(s) & Data Need Group	Data Use			Number of Samples			Risk Action Level(s)		Exposure Area(s) / Sample Location(s) and Depth
Contaminant of Concern, or Characteristic of Interest	Media		Current or Future Use	Receptor Group(s)	Receptor's Exposure Route(s)	CL (%)	P (%)	MDRD (%)	Human Health	Ecological	
	Soil	Risk									

DATA NEED WORKSHEET – COMPLIANCE PERSPECTIVE

SITE:_____ Page ____ of ____
PROJECT:_____

Data Need		Project Objective(s) & Data Need Group	Data Use		Number of Samples	Compliance Reference Concentration	Point(s) of Compliance/Sample Location(s) and Depth
Contaminant of Concern, or Characteristic	Media		Regulatory Program or Statute, and Citation	Specific Use			

DATA NEED WORKSHEET – REMEDY PERSPECTIVE

SITE:_____ Page ____ of ____
PROJECT:_____

Data Need		Project Objective(s) & Data Need Group	Data Use		Number of Samples	Concentration of Interest or Sensitivity of Measurement(s)	Remediation Area(s) / Sample Location(s) and Depth
Contaminant of Concern, or Characteristic	Media		Remedy Method(s) of Interest	Criteria to be Considered			

SUMMARY TABLE OF DATA COLLECTION OPTIONS

SITE:_____ Page ____ of ____
PROJECT:_____ Date: _____

DATA IMPLEMENTERS
Sampling:_____
Analysis:_____

Data Collection Option	Description	Data Collection Method	Order-of-Magnitude Cost (dollars)	Comments
Excessive				
Optimum				
Basic				

EXAMPLE DATA QUALITY OBJECTIVES AND DATA QUALITY OBJECTIVES ATTAINMENT VERIFICATION WORKSHEETS

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DATA QUALITY OBJECTIVE (DQO) WORKSHEET

SITE:_____ Page ____ of ____

PROJECT:_____

DQO Statement Number:_____

DQO Element Number [a]	DQO Element Description	Site-Specific DQO Statement
Intended Data Use(s):		
1	Project Objective(s) Satisfied	
Data Needs Requirements:		
2	Data User Perspective(s)	
3	Contaminant or Characteristic of Interest	
4	Media of Interest	
5	Required S ampling L ocations or A reas and Depths	
6	Number of Samples Required	
7	Reference Concentration o f Interest or Other Performance Criteria:	
Appropriate Sampling and Analysis Methods:		
8	Sampling Method	
9	Analytical Method	

[a] Refer to EM 200-1-2, Paragraph 4.2.1

DATA QUALITY OBJECTIVE (DQO) ATTAINMENT VERIFICATION WORKSHEET

SITE:_____ Page ____ of ____

PROJECT:_____

DQO Statement Number:_____

DQO Element Number [a]	DQO Element Description [a]	Site-Specific DQO Statement [b]	Attained?	Required Corrective Action?
Intended Data Use(s):				
1	Project Objective(s) Satisfied		Yes ☐ No ☐	
Data Needs Requirements:				
2	Data User Perspective(s)		Yes ☐ No ☐	
3	Contaminant or Characteristic of Interest		Yes ☐ No ☐	
4	Media of Interest		Yes ☐ No ☐	
5	Required Sampling Locations or Areas and Depths		Yes ☐ No ☐	
6	Number of Samples Required		Yes ☐ No ☐	
7	Reference Concentration of Interest or Other Performance Criteria:		Yes ☐ No ☐	
Appropriate Sampling and Analysis Methods:				
8	Sampling Method		Yes ☐ No ☐	
9	Analytical Method		Yes ☐ No ☐	

[a] Refer to Paragraph 4.2.1, p 4-4 to 4-5.

[b] DQO statement should be taken directly from originating DQO worksheet or corresponding Statement of Work.

EXAMPLE DATA QUALITY OBJECTIVES DEVELOPMENT

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Example: Remedial Investigation / Feasibility Study Data Quality Objectives Development

Data Quality Objectives (DQOs) Overview:
The use of DQOs is a systematic approach for establishing the quality and quantity of data needed to support project decisions. To establish DQOs, the intended use of the data, possible consequences of incorrect decisions attributed to inadequate or invalid data, and an acceptable level of uncertainty must be considered. Guidelines followed in the preparation of DQOs are set out in the Guidance for the Data Quality Objectives Process EPA QA/G-4, Final *Guidance* (USEPA, 2000).

Example: Artillery Range Munitions Response Site (MRS) Description
The Artillery Range MRS is a partially developed Department of Defense (DoD_-owned 290-acre parcel located within the installation boundary. An SI has been performed to identify the potential for UXO, DMM or MC to be present. Historical documents including a map indicated the potential presence of a portion of a pre–World War II era artillery range. Expected munitions usage includes medium and large caliber projectiles. However, to date no explosive ordnance disposal (EOD) responses are known to have occurred on the MRS. The current land use includes a portion of the installation golf course and a developed area with several installation tenant organizations.

Problem:
The intent of the Remedial Investigation / Feasibility Study (RI/FS) at the Artillery Range MRS is to characterize potential explosive safety hazards, including munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) on the surface and in the subsurface, characterize munitions constituents (MC) contamination in soil, perform a hazard assessment for MEC, and perform a baseline risk assessment for MC. The RI/FS is being conducted to determine how the site can safely be reused and what, if any, actions are required to support its reuse (i.e., removal action prior to construction, construction support, or change in anticipated future use).

Identify the Decision:
The primary decision addressed by this project is to determine if sufficient data are available to support the conclusion that there is a strong likelihood of encountering MEC at the site. If the collected data support the strong likelihood, sufficient MEC and MC data are needed to support decisions regarding what actions will be needed for future safe use of the site.

Identify the Inputs to the Decision:
Multiple factors help identify inputs to the decision. Input factors include expected MEC type, MEC sensitivity, MEC density or quantity, MEC depth and location, site characteristics, site accessibility, site stability, and site activities.

Density, type, quantity, depth and location of munitions debris are also factors into the decision, especially if no MEC are identified. The risks established for MEC and MC with regard to human health and the environment will also be incorporated into the decision.

Define the Boundaries of the Study:
The Artillery Range MRS is a 290-acre parcel, bounded to the west by developed property and to the north, east, and south by roads. The investigation of the Artillery Range MRS may occur up to the distance of three step-out grids (90 meters [m]) outside of the established range boundary.

Develop a Decision Rule:
The decision rules developed through the Technical Program Planning (TPP) process for the Artillery Range MRS include the following.

- If MEC are found at the site, the unexploded ordnance (UXO) team will respond to the MEC find(s).
- If MEC or significant evidence of encountering MEC (i.e., high density of munitions debris) is identified, a removal action may be recommended for the site.
- If no MEC or no significant evidence of potentially encountering MEC is found, then construction support may be recommended for future development of the site.
- If a source of MC is identified that presents a risk to human health or the environment, further MC investigation or remediation may be recommended.

Specify Tolerable Limits on Decision Errors:
The probability of decision errors can be controlled by adopting a scientific approach. In this approach, the data are used to select between one condition of the environment (the null hypothesis, H_o) and an alternative condition (the alternative hypothesis, H_a). H_o is that there is no ordnance of any type present at the site. If H_o is rejected, then a removal action may be required prior to construction activities.

The null hypothesis is treated as the baseline condition that is presumed to be true in the absence of strong evidence to the contrary. This feature provides a way to guard against making the decision error that the decision maker considers to have the more undesirable consequences. A decision error occurs when the decision maker rejects the null hypothesis when the null hypothesis is true or fails to reject the null hypothesis when the null hypothesis is false. These decision errors are classified as false positive (Type I) and false negative (Type II) decision errors, respectively.

The two possible decision errors for this project are Type I, concluding that MEC and/or munitions debris is not present within the boundaries of the study when it

is, and Type II, concluding that the MEC and/or munitions debris is present within the boundaries of the study when it is not. The consequences of a Type I decision error could include harm to human health and/or the environment. The consequences of a Type II decision error could include unnecessarily incurred project costs associated with additional investigation and/or remediation. The Type II error is more tolerable than the Type I error in this case.

Optimize the Design for Obtaining Data:
For the Artillery Range MRS RI/FS, the geophysical team will conduct the geophysical investigation using the EM61-MK2, an electromagnetic induction sensor. The EM61-MK2 will collect data along transects spaced 34.5 m apart in both the north-south and east-west directions. The transect spacing was determined by using VSP to ensure that the transect design had a 100% chance of traversing a potential 60-millimeter mortar range impact area in the shape of an ellipse with a 46 m minor axis length. Prior to the investigation, a geophysical prove out (GPO) was constructed at the installation in a geologic environment similar to the Artillery Range MRS to evaluate the field methods utilized and multiple detectors (Figure 1, Appendix K). The purpose of the GPO was to evaluate and document the site-specific capabilities of the proposed geophysical survey instruments, navigation equipment, data analysis procedures, data management techniques, and associated equipment and personnel to operate as an integrated system capable of meeting DQOs for project performance goals. The results and recommendations of the GPO have been accepted by the United States Army Corps of Engineers (USACE); therefore, the digital geophysical mapping (DGM) can be implemented. A detailed explanation of the methods utilized during the GPO is presented in the GPO Plan and GPO Letter Report.

Anomaly Investigation:
The geophysical team will utilize the line and fiducial method to preliminarily reacquire each point anomaly to be investigated. When the location is identified, geophysical team personnel will survey around the point using the approved geophysical equipment to identify the exact location of the most intense anomaly within the area. This is the anomaly that will be excavated during the subsequent intrusive portion of the investigation. This procedure will insure that only the original anomaly will be excavated and will reduce “no-finds.”

The UXO team will excavate each identified target anomaly. The UXO team will locate each anomaly marked with a flag and carefully excavate it by hand using a combination of hand tools. Anomalies will be excavated by carefully removing the overburden using hand tools. Not all anomalies will be reacquired, only those selected to be dug.

In the event that MEC are identified, the UXO team will conduct demolition operations. A safe separation distance for all personnel will be established. Also, 30 m by 30 m step-out grids will be centered on the location of the MEC during the intrusive investigation. The grid will be mapped with the EM61-MK2 using

lines spaced 5 m apart. The anomaly identification, reacquisition, and excavation procedures used will be identical to those described above. This process will be repeated until the next transect is reached or three step-out grids have been located from the original MEC location. This procedure may be followed if MPPEH is discovered as well.

The DQOs established for this project are as follows:

DGM:

- Determine appropriate boundaries for the MRS.
- Determine if site was used historically as a mortar range.
- Operate the EM61-MK2 at a velocity less than an average of 1.25 m/second.
- Locate all MEC to the maximum detection depth of the approved geophysical instrument.
- Have no more than 15% false positives.
- Locate quality control nails within 20 centimeters of their surveyed location to verify positioning capability of the navigation method.
- Minimize the number of non-MEC geophysical anomalies.

Environmental sampling:

Ensure laboratory detection limits for the selected methods and analytes are below the selected screening criteria:

- Artillery Range MRS background levels
- USEPA Region Risk-Based Concentrations (hazard quotient of 10 applied to noncarcinogenic values)
- USEPA Action Level for Lead in Residential Soil
- USEPA Region Biological Technical Assistance Group values for ecological receptors

Collect sufficient number of samples to conduct human health and ecological risk assessments.

EXAMPLE WORK PLAN OUTLINE

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Example Work Plan Outline

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EXAMPLE ARMY REMEDIAL INVESTIGATION / FEASIBILITY STUDY INSTITUTIONAL ANALYSIS

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ARMY REMEDIAL INVESTIGATION / FEASIBILITY STUDY INSTITUTIONAL ANALYSIS EXAMPLE

INTRODUCTION

This Institutional Analysis identifies and analyzes the institutional framework necessary to support the development of institutional controls as an effective response action alternative for the Fort Sample munitions response sites (MRSs).

PURPOSE AND OBJECTIVES

The purpose of this analysis is to gather background information and document which stakeholder entities have jurisdiction over the MRSs and to assess the capability and willingness of these entities to assert institutional controls that would protect the public from explosive hazards potentially present within the limits of the sites. More specifically, this report:

- identifies entities that have jurisdiction over the land within the Fort Sample MRSs;
- defines authority, responsibility, capability, resources, and the willingness of each entity to participate in institutional controls to protect the public from explosive hazards;
- identifies potential institutional control strategies available to implement access controls and/or public safety awareness actions for the property; and
- defines and analyzes intergovernmental relationships, joint responsibilities, land use control functions, technical capabilities, funding sources, and recommendations.

REGULATORY BACKGROUND

The following paragraphs provide a brief summary on existing regulations that result in the implementation of an Institutional Analysis.

In 1986, Congress enacted the Superfund Amendments and Reauthorization Act (SARA), which amended certain aspects of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), some of which directly related to munitions and explosives of concern (MEC). Chapter 160 of the SARA established the Defense Environmental Restoration Program (DERP). One of the goals specified for the DERP is the "correction of environmental damage" (such as detection and disposal of MEC), which creates an imminent and substantial endangerment to public health/welfare or to the environment. The DERP requires that appropriate action consistent with CERCLA be undertaken whenever such "imminent and substantial endangerment" is found at a facility or site that is under the jurisdiction of the Secretary of Defense and is owned by, leased to, or otherwise possessed by the United States at the time of actions leading to contamination.

The National Contingency Plan (NCP) was established by the Clean Water Act of 1972 and has been revised and broadened several times since then. Its purpose is to provide the organizational structure and procedures for remedial actions to be taken in response to the presence of hazardous substances, pollutants, and contaminants at a site. Section 105 of the 1980 CERCLA states that the NCP shall apply to all response actions taken as a result of CERCLA requirements. The March 1990 NCP, given in 40 Code of Federal Regulations (CFR) Part 300, is the latest version of the NCP. Paragraph 300.120 states that the "Department of Defense (DOD) will be the removal response authority with respect to incidents involving DOD military weapons and munitions under the jurisdiction, custody, and control of DOD."

The NCP model requires that any government response be considered openly in coordination with all stakeholders. Further, federal decision-making requires development of alternative response strategies to ensure that the most cost-effective remedies that provide the best balance among the 9 criteria are implemented. MEC response action alternatives should be based on a variety of technologies or implementation strategies that are sufficiently different in effect to allow for technical discrimination in the assessment of plans and to allow for real choice on the part of the stakeholders. A strategy that engages the presence of ordnance is a removal action.

Removals of MEC are the traditional response action. In general, a plan of action involves developing and coordinating plans for worker and public safety during the action, site mobilization, operations, and site close-out, which may include continuing maintenance requirements. When a federal response action is complete, there is a natural tendency for stakeholders to assume that the site is clean. This happens no matter how clearly it is stated that no removal action is complete. Removal produces a condition of fewer ordnance items. If human behavior is the same before and after the removal, the assumption is that the risk has been substantially reduced. However, if, as a result of the removal, human access is facilitated and/or behavior is less cautious, an unknown situation arises that may pose greater risk. Institutional controls are alternative response plans that use governmental or other authorities in addition to the response authority under the DERP.

INSTITUTIONAL CONTROLS

Institutional controls in this Remedial Investigation / Feasibility Study (RI/FS) report were developed using U.S. Army Corps of Engineers (USACE) guidance (EP 1110 -1-24) for *Establishing and Maintaining Institutional Controls for Ordnance and Explosives (OE) Projects* (December 2000). Institutional controls protect property owners and the public from hazards present at a site by warning of the potential MEC hazard and/ or limiting the access or use of a site. Institutional controls include engineering controls, educational programs, legal mechanisms, and construction support. The overall effectiveness of institutional controls depends on the type of institutional controls being implemented and the

support, involvement, and willingness of local agencies and landowners to enforce and maintain institutional controls implemented to eliminate public interaction with MEC. For institutional controls to be successful, the stakeholders who have jurisdiction over and the authority to enforce institutional controls must coordinate and agree on the types of institutional controls to be implemented and who will be responsible for maintaining/enforcing them.

METHODOLOGY

Data used for this Institutional Analysis were collected from various sources, including site visits, record searches, and interaction with the various agencies during previous phases of this investigation.

Data collected during the processes included jurisdictional boundaries, authorities, responsibilities for land use and public safety, capabilities, resources, and the agencies' willingness to participate in institutional controls. Current and future capabilities for institutional controls, current and future responsibilities for land use, and public safety and capabilities in terms of authorities and resources were also investigated. The methods focused upon identification of institutional controls that would be protective, based upon legally constituted authority that would fit the areas of the Fort Sample MRSs to which the controls were applied. The analysis focused upon the identification of institutional controls that could be included in a comprehensive risk management strategy for areas within the Fort Sample MRSs contaminated with munitions debris and potentially MEC.

SCOPE OF EFFORT

Stakeholders that have jurisdiction over the Fort Sample MRSs include the State Department of Environment, the State Department of Natural Resources, the Department of the Army (Army), the USACE, and County. The land/water body owners include the Army and the State. The Army owns those portions of the MRSs that occur within the Fort Sample installation boundary. The State owns those portions of the MRSs outsides the Fort Sample installation boundary. The USACE hold jurisdictional rights over MRS water areas (as defined in 33 CFR Part 329 [Navigable Waters of the U.S.]).

State Legislative and regulatory jurisdiction of the water areas with ownership was verified in communications with personnel of the State Department of Environment. *The State Document*, dated XXX, clearly indicates that the State has ownership of the waterways "…unto the further Bank of the said River, and following the same on the West and South, unto a certain Place, situated near the mouth of the said River ...". Communication between the State Department of Environment and USACE verified the boundary between ownership by the State and the Army.

State Department of Environment The State Department of Environment was created in Date to protect and preserve the state's natural resources. In addition to restoring State environment and safeguarding the environmental health of

State citizens, the State Department of Environment duties encompass enforcement and regulation, long-term planning and research, and technical assistance to industry and communities for pollution, growth issues, and environmental emergencies. The mission of the agency is to protect and restore the quality of State air, water, and land resources, while fostering smart growth, economic development, healthy and safe communities, and quality environmental education for the benefit of the environment, public health, and future generations. The State Department of Environment is provided full authority to administer and enforce all of the environmental laws of the state, with this authority granted in the Code of State Regulations.

The State Department of Environment has been an active participant during all phases of investigation of the site under the Military Munitions Response Program (MMRP). The agency has reviewed all documents previously submitted under the program and provided technical feedback and shared regulatory expertise where appropriate. Funding for the agency's involvement during each phase of the investigation process has been provided by the USACE through the Defense-State Memorandum of Agreement (DSMOA). The agency will require additional DSMOA funding in order to continue engagement in on going investigation or implementation of remedial alternatives at Fort Sample MRSs.

The State Department of Environment maintains an active relationship with the U.S. Environmental Protection Agency (USEPA) Region, has worked closely with USEPA personnel, and has acted as the lead regulatory agency throughout the previous investigations completed at the installation. Additionally, the State Department of Environment is expected to be an invaluable resource in working with other state agencies that may be able to provide assistance and expertise during refinement and implementation of institutional controls at Fort Sample MRSs (such as the State Department of Natural Resources). The State Department of Environment is expected to be an invaluable and necessary partner during implementation of remedial alternatives within the Fort Sample MRSs.

State Department of Natural Resources In Date, five agencies, including the Department of Fisheries; the Department of Game and Inland Fish; the Department of State Forests and Parks; the Department of Geology, Mines, and Water Resources; and the Department of Research and Education, were consolidated to form the State Department of Natural Resources. The State Department of Natural Resources works to ensure the preservation, development, wise use, and enjoyment of State natural resources for the greatest benefit to the state and its citizens. The Department coordinates all natural resource activities within the state and reviews and evaluates all natural resources policies, plans, programs, and practices of county, state, regional, and federal agencies and institutions. The State Department of Natural Resources manages more than amount acres of public lands and amount miles of

waterways, along with State forests, fisheries, and wildlife for maximum environmental, economic, and quality of life benefits.

Since 2003, the State Department of Natural Resources has overseen five main functions: Waterway Programs; Forests, Parks, Fish, and Wildlife; Information Technology Service; Land and Water Conservation; and Management Services. The State Department of Natural Resources also is responsible for the State membership units of five interstate bodies: the States Marine Fisheries Commission, Coastal States Organization, State River Basin Commission, Interstate Commission on the River Basin, and River Fisheries Commission (Code Natural Resources Article, secs. 1-101 through 1-104).

It is anticipated that the State Department of Natural Resources may be able to provide assistance and expertise during refinement and implementation of institutional controls at Fort Sample MRSs. In particular, the State Department of Natural Resources may be able to assist in disseminating information to the public concerning potential hazards associated with munitions that may be encountered on the shoreline of Fort Sample or in the waters of the Fort Sample MRS waterways offshore from the installation. It is assumed that funding for this assistance would be required to be provided by the Army.

Department of the Army The USACE is the technical oversight agency for this project. The Army is also the landowner of the portions of the MRSs that occur shoreward of the mean high water mark. Funding for projects related to the MMRP is allocated to the U.S. Army Environmental Command, who uses the USACE as the contracting agency and as technical oversight for MMRP investigations.

National Oceanic and Atmospheric Administration The National Oceanic and Atmospheric Administration (NOAA) is responsible for Notice to Mariner chart updates. The Office of Coast Survey (OCS) produces NOAA Electronic Navigational Charts (NOAA ENC®) to support the marine transportation infrastructure and coastal management. NOAA ENCs® are in the International Hydrographic Office (IHO) S-57 international exchange format, comply with the IHO ENC Product Specification and are provided with incremental updates, which supply Notice to Mariners corrections and other critical changes. NOAA ENCs® are available for free download on the OCS Web site.

LAND USE

The Fort Sample MRS and the River MRS are undeveloped and are not used for any set purpose. Recreational users, fisherman, and hunters use the surrounding River. The State Department of Natural Resources has duck blind locations surrounding the installation. Hunters are required to stay at least 365 meters offshore as measured during mean low water, although there are no security controls that inhibit hunters from gaining access to the shoreline. During

the RI/FS field activities, there was evidence that boaters were trespassing on the shoreline. Additionally, the sites are accessible to installation personnel.

TECHNICAL CAPABILITY

Each of the agencies discussed above (with the exception of State Department of Natural Resources) has been involved in previous phases of this investigation. Each of the agencies is able to provide expertise that may be utilized in developing removal alternatives for Fort Sample designed to protect the public. Each of the agencies has been involved in various projects that protect the public from hazards contained on a site by warning of the hazard or limiting the access or use of a site. These mechanisms can reduce exposure to MEC by limiting public access to a site or limiting the extent of intrusive activities that may occur on a site. In addition, each of the agencies has experience disseminating information to large portions of the public.

EXISTING INSTITUTIONAL CONTROLS

There are currently signs indicating that the Fort Sample MRS and River South MRS are DoD property that is not to be accessed by the public. The general public does not access the site; however, there are no access controls in place (other than warning signs) to restrict boat traffic. Recreational users, fisherman, and hunters also use the surrounding River. The State Department of Natural Resources has six duck blind locations surrounding the installation. Hunters are required to stay at least 365 meters off-shore as measured during mean low water, although there are no security controls that inhibit hunters from gaining access to the shoreline. During the RI/FS field activities, there was evidence that boaters were trespassing on the shoreline. Additionally, the sites are accessible to installation personnel.

CONCLUSIONS

Stakeholders in the MMRP process will continue to be involved, with the addition of the State Department of Natural Resources. Stakeholders will provide input into the implementation of remedial options. Funding has been provided by the USACE through the DSMOA. The agencies will require additional DSMOA funding in order to continue engagement in the ongoing investigation or implementation of remedial alternatives at Fort Sample.

EXAMPLE MILITARY MUNITIONS RESPONSE PROGRAM REMEDIAL INVESTIGATION / FEASIBILITY STUDY REPORT OUTLINE

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Example MMRP RI/FS Report Outline

1. EXECUTIVE SUMMARY
2. INTRODUCTION
   - 2.1. Purpose
   - 2.2. Property Description and Problem Identification
   - 2.3. Historical Information
   - 2.4. Previous Investigations

3. PROJECT REMEDIAL RESPONSE OBJECTIVES
   - 3.1. Conceptual Site Model and Project Approach
   - 3.2. Preliminary Remediation Goals and Remedial Action Objectives
   - 3.3. Preliminary Identification of Applicable or Relevant and Appropriate Requirements and "To Be Considered" Information
   - 3.4. Summary of Institutional Analysis
   - 3.5. Data Needs and Data Quality Objectives

4. CHARACTERIZATION OF MUNITIONS AND EXPLOSIVES OF CONCERN AND MUNITIONS CONSTITUENTS, INCLUDING RECOVERED CHEMICAL WARFARE MATERIEL
   - 4.1. Munitions and Explosives of Concern Characterization These may include some, but not necessarily all, of the following:
     - 4.1.1. Surface Features
     - 4.1.2. Meteorology
     - 4.1.3. Surface-Water
     - 4.1.4. Hydrology
     - 4.1.5. Geology
     - 4.1.6. Soils
     - 4.1.7. Hydrogeology
     - 4.1.8. Demography and Land Use
     - 4.1.9. Ecology

4.2. Munitions Constituents Characterization (These may include some, but not necessarily all, of the following:)

4.2.1. Surface Features

4.2.2. Meteorology

4.2.3. Surface-Water Hydrology

4.2.4. Geology

4.2.5. Soils

4.2.6. Hydrogeology

4.2.7. Demography and Land Use

4.2.8. Ecology

5. REVISED CONCEPTUAL SITE MODEL AND REMEDIAL INVESTIGATION RESULTS

5.1. Munitions and Explosives of Concern

5.2. Munitions Constituents

6. CONTAMINANT FATE AND TRANSPORT FOR MUNITIONS CONSTITUENTS

6.1. Potential Routes of Migration (i.e., air, groundwater, etc.)

6.2. Contaminant Persistence

6.2.1. If they are applicable (i.e., for organic contaminants), describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.

6.3. Contaminant Migration

6.3.1. Discuss factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of groundwater, etc.).

6.3.2. Discuss modeling methods and results, if applicable.

PUBLIC INVOLVEMENT GUIDANCE

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Army Military Munitions Response Program Remedial Investigation / Feasibility Study Public Involvement Guidance

Purpose

This Public Involvement Guidance is for use by the Restoration Project Manager (RPM) throughout the Army Military Munitions Response Program (MMRP) Remedial Investigation / Feasibility Study (RI/FS) project execution. It provides background information, project message examples, templates, frequently asked questions and answers, and various other tools/techniques specifically designed to support the RPM to effectively engage the public about their Army MMRP RI/FS project.

Background

After decades of munitions-related activities required to maintain our military's readiness, unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) may be present to some degree at many active and former military installations. The MMRP addresses the potential explosives safety, health, and environmental issues caused by past Department of Defense (DoD) munitions-related activities.

Previously, the Secretary of Defense's Defense Environmental Restoration Program (DERP) had focused only on the restoration of sites with potentially hazardous contaminants. MMRP, as a new program under the DERP, addresses the potential explosives safety hazards presented by munitions and explosives of concern (MEC), which include UXO, DMM, and MC concentrations high enough to pose an explosive hazard and potential environmental contamination at active installations, installations undergoing Base Realignment and Closure (BRAC), and Formerly Used Defense Sites (FUDS). The MMRP provides a focused program to address these challenges presented at munitions response areas (MRAs) and associated munitions response sites (MRSs) on these properties.

Public Involvement Posture

Be Proactive: Research and develop an understanding of local community concerns regarding MRAs/MRSs identified in the MMRP. Take appropriate action by amending communications plans, installation restoration community relations plans, and environmental messages based on input from local stakeholders. As appropriate, communicate with the community through the Restoration Advisory Board (RAB) or Technical Review Committee (TRC). Engage local news media with a safety message, as appropriate.

Key Message Points

It is important for the RPM to remember the following key message points when communicating with the public during the RI/FS process. These message points are the start of effectively communicating the Army's reassurances and concerns regarding the RI/FS at MRAs/MRSs on active Army, BRAC, and FUDS sites.

Safety: Safety is the Army's primary concern. The Army is committed to performing an appropriate munitions response on those sites known or suspected to contain MEC and/or MC in a manner minimizing risk to the public, workers, and the environment.

Stewardship: The Army is a good steward of the environment.

Readiness: The Army must train as it fights and will fight as it is trained.

Sustainability: The Army's long-term viability depends on balancing mission requirements worldwide with explosives safety and human health protections, as well as safeguards for the environment.

Expertise: The Army will make use of the nation's best available and appropriate technology to accurately assess these MRAs/MRSs and successfully complete required munitions response actions.

Partnership: The Army will work with regulators, local community leaders, and members of the public to address concerns and ensure the safe performance of munitions response actions.

Local Perspective: Provide a compelling message that the Army acknowledges and will address significant local community concerns (i.e., health, safety, environmental justice, economic issues, equity issues, and other policy issues).

Communication Tools and Techniques:

Throughout the RI/FS process, the RPM uses various communications tools and techniques to effectively disseminate information to stakeholders.

May be combined

Tools and Techniques	Inventory Announcement	Archives Search Report	Field Investigation	MEC Detection and Disposal	Engineering Evaluation	Decision Document	Removal Action	Site Closeout
Public Meetings	(may be needed)			(may be needed)	x			
Public Availability Sessions	(may be needed)			(may be needed)	x			
Community Interviews		(may be needed)			(may be needed)			
Focus Groups	(may be needed)				(may be needed)			
Information Products	x	x	x		x	x	x	x
News Releases	x	x	x	x	x	x	x	x
Web Site	x	x	x	x	x	x	x	x

Tools and Techniques	Inventory Announcement	Archives Search Report	Field Investigation	MEC Detection and Disposal	Engineering Evaluation	Decision Document	Removal Action	Site Closeout
Group Presentations	x				x	x		x
On-site Tours			x				x	
Information Repository								
Media Opportunities	(may be needed)		x		x		x	x

Following are more specific details and examples of tools, techniques, and strategies the RPM can employ during the RI/FS.

Public Meetings:

- At the discretion of the RPM and the Garrison Commander, FUDS Program Manager, or BRAC Program Manager, information on the MMRP and MRS RI/FS can be presented at any scheduled public meeting (e.g., RAB, TRC) to foster communication with stakeholders.
- Although public meetings can be held at any time during the RI/FS process, they are necessary when the Army officially accepts public comments on response actions, alternatives, and courses of action. Refer to your applicable environmental regulations for specific requirements.
- Hold the meetings in the local community, at times convenient to stakeholders, and in a facility large enough to hold the number of expected attendees.
- Inform the public at least 2 weeks in advance of the proposed meeting using multiple mediums of communication. For example, utilize display newspaper advertisements, e-mail notifications, public service announcements, Web site postings, and/or community newspapers.
- Provide for on-site documentation of any comments through the use of resources such as a court recorder.
- Designate a primary spokesperson, as well as a few secondary spokespeople. Provide them with talking points and key messages. Consider the value of using active military personnel as your spokesperson.

Public Availability Sessions (poster stations):

- Public availability sessions are types of public meetings facilitating face-to-face communications between the community and the Army.
- Public availability sessions provide additional avenues for public participation and allow Army officials to interact with the public in a less formal and, often,

a less adversarial setting. They can be used in lieu of public meetings as long as formal public comments can be recorded. They do not include agendas or briefings and generally involve an informal poster session and provide community members opportunities to have one-on-one interaction and conversations with Army officials and regulators.

- Site activities and public interest will determine the scheduling of these events, as these are not required under environmental law.
- Format of the public availability session is dependant upon the needs of the community and the information to be shared. Figure 1-1 provides an example of a possible format for disseminating controversial or potentially volatile information.
- Provide spokespeople with talking points and key messages.

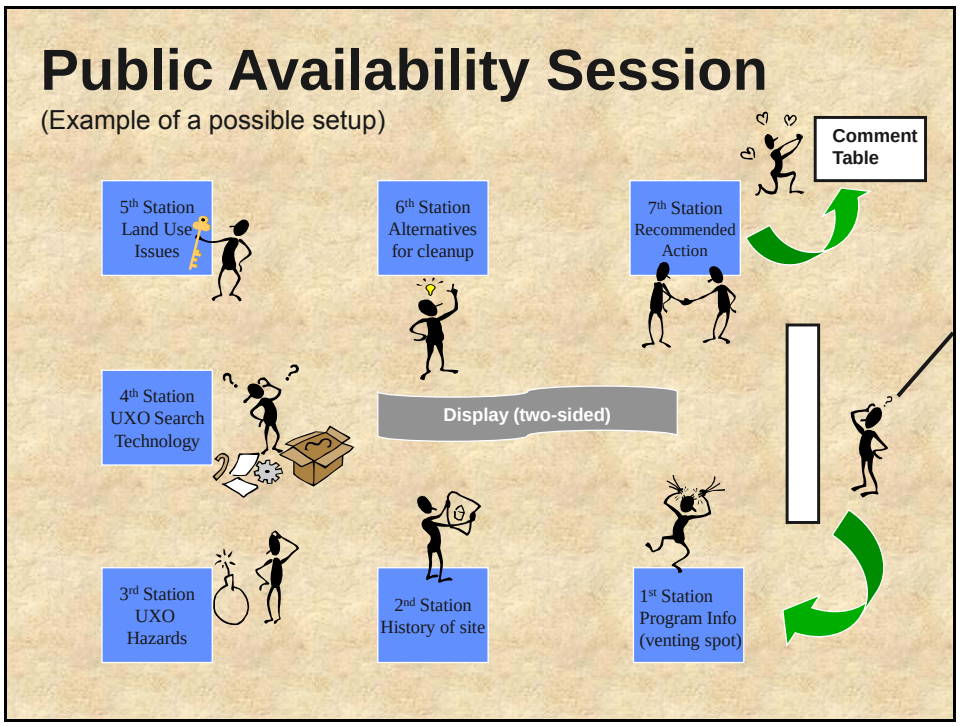

Figure 1-1: Public availability session model

Community Interviews:

- Community interviews are required to develop and maintain an effective community relations plan for any type of environmental program such as the MMRP. Talking and listening to neighbors and community leaders help to develop an understanding of community concerns about an MRS, current community perceptions, and sources of information useful to communicate interested stakeholders.

- Community interviews usually last 15 to 20 minutes each. Generally, the goals of interviews are to identify public concerns, interests, and information needs, as well as determine how they would like to receive information or participate in community involvement activities. Refer to community interview guidance included in the EPA Community Involvement Toolkit (www.epa.gov/superfund/tools/pdfs/5cominterv.pdf).
- Include the following categories of people in interviews:
  - Randomly selected neighbors near the installation
  - Community leaders (principals, chamber of commerce officials)
  - Influential persons or opinion leaders (church leaders, civic association presidents, etc.)
  - Environmental activists
  - Municipal officials (fire, police, emergency, and disaster planning)
  - Elected officials (mayor, county executive, health officer)
  - Homeowner associations, as applicable
  - Local historians

Focus Groups:

- Focus groups supplement other types of community research by providing insights into target audience perceptions, beliefs, and language.
- Interviews are usually conducted with a group of 8 to 12 people for 1 to 2 hours.
- Using a discussion outline, a moderator keeps the session on track while allowing respondents to talk freely and spontaneously. As new topics related to the outline emerge, the moderator probes further to gain useful insights.
- Focus group sessions are often recorded or videotaped for later review.
- Focus groups also can be useful for pretesting such materials as brochures, newsletters, and videotapes before these products are completed.
- Those selected for focus groups should be typical of the intended target audience.

Information Products:

- RPMs and installations can produce several types of information products to communicate RI/FS technical information to the public in language that is easy to understand.
- They should include information addressing concerns and information needs expressed by the local community. They should also explain Army actions, plans for the future, and points of contact for more information.

- Types of information products include fact sheets, newsletters, brochures, briefing charts, annual reports, and videos.
- They can highlight various topics of interest, such as historical and background information, status updates, technical milestones, and success stories.
- Widely distribute these products to stakeholders (e.g., area residents, members of citizens groups, regulatory officials, elected and civic officials).
- Branding techniques—the consistent use of similar visual elements, including colors, graphics, fonts, and layout—can be used and carried throughout the graphic design for each type of information product disseminated to the public throughout the RI/FS process, as well as the MMRP at an active installation, FUDS, or BRAC property. This helps to create an identity for the program, and over a period of time, make information products recognizable to stakeholders. These branding elements can and should also be incorporated into press release templates, the Web site, any display ads, etc.
- Installations are encouraged to use the text and graphics from existing United States Environmental Command (USAEC) fact sheets to meet the needs of their stakeholders. USAEC fact sheets are available at http://aec.army.mil/usaec/publicaffairs/factsheets00.html.
- Information products about decision documents and the munitions response site prioritization protocol (MRSPP) evaluation should be distributed prior to the initiation of a public comment period. Such products must describe the alternatives considered and offer the Army's preferred alternative for public comment. Upon final decision, an updated product should be produced that explains the selected alternative.

News Releases:

- A news release will be disseminated by the Garrison Commander at active installations or FUDS/BRAC designated point of contact to announce the RI/FS and the MRAs/MRSs within the commander's or program designee's purview. News releases are distributed to address major program milestones, such as contract award, initiation of investigative studies, and the initiation of removal work (see Attachment A).
- News releases about decision documents and the MRSPP are distributed prior to the initiation of a public comment period. Such news releases must describe the alternatives considered and offer the Army's preferred alternative for public comment. An updated news release must address the selected alternative.
- This medium keeps the news media informed, supplements information directly disseminated to the stakeholders, and keeps the general public informed indirectly. News releases must be filed in the Administrative Record or information repository.

- Media advisories are used to invite media outlets and reporters to events such as public meetings, site tours, and group presentations/events specifically catering to the media. Media advisories are used to invite attendance, rather than summarize the outcome of an event. Media advisories are similar to press releases, only the body is a bulleted list on the press release template detailing who, what, where, when, and why.

Web Site:

- Installation and/or project Web sites are used as another means to provide the public with up-to-date installation messages and to distribute information products regarding the MMRP RI/FS.
- All Web sites must be compliant with security and accessibility requirements.
- The Web sites must be easily navigable to ensure access to public-friendly products.
- Public documents, such as studies, news releases, fact sheets, site updates, and presentations, should be kept current on the project's Web site.
- In addition, community concerns are addressed by topic as they develop or are expressed.
- A .pdf map identifying MRAs/MRSs associated with the project is posted on the Web site. The electronic .pdf of the map is provided in the RI/FS report.

Group Presentations:

- Slide briefings, speeches, and informational programs can be presented upon request to RAB, TRC, homeowner associations, civic groups, and others at their regularly scheduled meetings.
- Site history, program background, work milestones, safety issues, ongoing/future actions, and community concerns should be addressed in these kinds of presentations.
- Use the informal feedback from these presentations to evaluate the communications strategy.
- Special safety presentations may be appropriate for school children, homeowners associations, and other community organizations as part of an overall USAEC safety awareness program (see http://aec.army.mil/usaec/cleanup/mmrp02.html).

On-Site Tours:

- On-site tours offer stakeholders the opportunity for first-hand views of sites, actions, and technologies.
- Tours should be held on an as-needed basis for elected officials, community leaders, and the news media to show work progress or address safety concerns.
- Additional stakeholder groups benefiting from a site tour may include local government, school groups, social organizations, homeowner associations, and businesses.
- On-site tours can also be catered to the media (see Media Opportunities).
- Visitor safety is paramount. As the RI/FS MRSs are still under investigation and characterization, windshield tours of the area may be more appropriate. Prior to all site tours, visitors will receive a safety briefing from the active installation Garrison Commander's or FUDS or BRAC program manager's technical representative. This individual should be aware of site safety concerns and may be an individual from Explosive Ordnance Disposal (EOD). No visitors should physically enter an MRS unless escorted by UXO Safety Supervisor.

Information Repository:

- All MMRP documents, to include the RI/FS report, will be placed in the project information repository.

Media Opportunities:

- Media opportunities allow journalists to learn more about the site and get an in-depth understanding of the MMRP and RI/FS process without the pressure of a deadline. These events also allow the journalists to take stock photos and video footage to use in future stories.
- Most importantly, media opportunities provide the Army with a chance to build relationships with the media in an effort to ensure more balanced coverage.
- Media opportunities could include site tours, editorial boards, and others.

Common Questions and Answers

Throughout the public involvement process, the RPM and other Army staff may receive questions from the community and its leaders regarding the RI/FS. The following common questions and answers are provided for use in response to query.

Q.1. What is the Military Munitions Response Program (MMRP)?

A.1. The Military Munitions Response Program (MMRP) is a program element of the Defense Environmental Restoration Program (DERP), under which the Secretary of Defense carries out environmental restoration resulting from past Department of Defense activities. The DERP has focused on the cleanup of sites contaminated with hazardous constituents in soil or water. The MMRP addresses the safety, health, and environmental issues presented by unexploded ordnance, discarded military munitions, and munitions constituents.

Q.2. What is an RI/FS?

A.2. An RI/FS is the common term used to refer to a Remedial Investigation / Feasibility Study. An RI/FS is a phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process employed to provide a detailed analysis of remedial alternatives based on site characterization. The RI/FS process is essentially an investigation and analysis effort. It provides a means to proceed from a position of limited information about a site to one of sufficient information such that an assessment of risk and selection of a method(s) to reduce risk can be achieved. Specifically, an RI/FS conducted under the Military Munitions Response Program addresses sites with unexploded ordnance, discarded military munitions, and munitions constituents related issues.

Q.3. What is UXO?

A.3. UXO stands for "unexploded ordnance." Basically, UXO is munitions used (e.g., in training or testing) or munitions that failed to function as designed or intended. UXO is defined, in law, as "military munitions that have been primed, fused, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause." (10 U.S.C. 101(e)(5)(A) through (C))

Q.4. Where is unexploded ordnance found?

A.4. Unexploded ordnance (UXO) is typically found in areas where the military conducts (e.g., operational ranges) or formerly conducted (e.g., former ranges) training or testing involving munitions. UXO can also be encountered in other areas. The vast majority of UXO, however, will be found in impact areas of operational and former ranges. Historically, Army training ranges generally were located in rural, isolated areas. Because of growing development near Army installations, as well as base closures and realignments, there are many sites where former ranges are now outside the installation borders.

Q.5. If unexploded ordnance is found near where I work or live is my family in danger?

A.5. When encountered, unexploded ordnance may pose an immediate explosive hazard and should never be touched, moved or picked up. Remember

the 3Rs, if you have something that could be unexploded ordnance: Recognize, Retreat, and Report. Recognize it! Leave it alone. Do not touch it. Do not disturb it. Retreat! Mark the general location and leave the area in the same direction in which you entered it. Report! Report what you saw and where you saw it to local law enforcement—call 911. Local law enforcement authorities will secure the area and notify trained explosive ordnance disposal personnel who will dispose of the item.

Q.6. What should I do if I find unexploded ordnance?

A.6. When encountered, unexploded ordnance can pose an immediate explosive hazard and should never be disturbed in any way (touched or moved) or picked up. Remember the 3Rs. Recognize, Retreat, and Report. Recognize the danger (do not touch); Retreat (mark the general area and carefully walk away in the same direction in which you entered the area); and then Report it (call 911). Local law enforcement authorities will secure the area and notify trained explosive ordnance disposal personnel who will dispose of the item.

Q.7. What are munitions constituents?

A.7. The term "munitions constituents" is defined in law. Munitions constituents are " any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions." (10 U.S.C. 2710(e)(4))

Q.8. What are discarded military munitions?

A.8. The term "discarded military munitions" is defined in law. Discarded military munitions are " military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations." (10 U.S.C. 2710(e)(2))

Q.9. What are munitions and explosives of concern?

A.9. This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means (A) unexploded ordnance, as defined in 10 U.S.C. 101(e)(5)(A) through (C) (see Q.3); (B) discarded military munitions, as defined in 10 U.S.C. 2710(e)(2) (see Q.8); or (C) munitions constituents (e.g., TNT), as defined in 10 U.S.C. 2710(e)(4) (see Q.7), present in high enough concentrations to pose an explosive hazard.

Q.10. What does the Army mean by "cleanup"?

A.10. Cleanup is a general term used to describe the environmental actions required by the Comprehensive Environmental Restoration, Compensation, and

Liability Act (CERCLA), the "Superfund Law." In the case of the Military Munitions Response Program, there are two primary concerns. The first concern is the potential explosive hazard. To address these hazards, cleanup could include, but would not be limited to, implementation of an unexploded ordnance (UXO) safety education program, implementation of land use controls, removal of UXO and other munitions debris from the surface of the ground, removal of UXO from beneath the ground surface, or a combination of these actions. The second concern is the potential environmental contamination caused by munitions constituents. Actions to address these may range from environmental monitoring to the use of available technology to remove the potential contaminants from the soil or the water.

Q.11. What is the Army's role in cleaning up unexploded ordnance, discarded military munitions, and munitions constituents?

A.11. The Army is responsible for addressing unexploded ordnance, discarded military munitions, and munitions constituents on properties it currently owns, and those properties designated to fall within the Department of Defense's Formerly Used Defense Site and the Base Realignment and Closure Program. The Army will fund, prioritize, and perform appropriate munitions responses to address the explosives risks posed by munitions and explosives of concern and/or environmental concerns posed by munitions constituents.

Q.12. Why is the U.S. Environmental Protection Agency or my state environmental agency involved in this?

A.12. The Environmental Protection Agency and state environmental agencies are important contributors to the Department of Defense (DoD) Restoration Program. These organizations have independent authorities and/or responsibilities to evaluate the public safety and environmental aspects of all planned munitions response actions and to help ensure that DoD is meeting the environmental laws and requirements established in federal statute or state regulations.

Q.13. If the Army identifies a high priority site in my neighborhood, does that mean there is a danger to my family?

A.13. It means there is a potential danger of which you should be aware. The Army conducted an inventory to identify sites known or suspected to require a munitions response. This was done to address the potential explosive hazards presented by unexploded ordnance, other munitions and explosives of concern. In addition environmental contamination from munitions constituents and other incidental contaminants will be addressed. The Army's inventory, which included any site for which there was an indication that munitions-related activities might have occurred, simply means that there is a potential for an explosives safety or environmental risk at these sites. Those sites deemed to have the greatest potential risk to the public will be given priority for munitions response actions.

The assessment used to determine the potential risk is very conservative, defaulting to the side of safety.

Q.14. What will the Army do to address the situation?

A.14. These sites are now part of the Army's munitions response program. Although other factors (e.g., public interests, planned development, land value) may impact the sequencing of munitions responses, the Army, will work with the states and local communities to determine the sequence of munitions responses. The Army believes that those sites that present the highest risk should be scheduled first. In the interim, appropriate actions (e.g., safety awareness training or notifications, implementation of land use restrictions) will be implemented to enhance public safety as the situation warrants.

Q.15. What are explosives or munitions emergency responses?

A.15. Explosives or munitions emergency responses are all immediate response activities by an explosives and munitions emergency response specialist to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. An explosives or munitions emergency response may include in-place render-safe procedures, treatment or destruction of the explosives or munitions, and/or transporting those items to another location to be rendered safe, treated, or destroyed. Any reasonable delay in the completion of an explosives or munitions emergency response caused by a necessary, unforeseen, or uncontrollable circumstance will not terminate the explosives or munitions emergency. Explosives and munitions emergency responses can occur on either public or private lands and are not limited to responses at RCRA facilities. (Military Munitions Rule, 40 CFR 260.10). Within the Department of Defense, only Explosive Ordnance Disposal personnel are authorized to respond to request for support of an explosives or munitions emergency response from civil authorities.

Q.16. What is the Military Munitions Response Program and what does it require of the Army?

A.16. The Military Munitions Response Program requires the Department of Defense to establish and maintain an inventory of defense sites that are known or suspected to contain unexploded ordnance, discarded military munitions, and/or munitions constituents. It establishes the requirement to identify, characterize, track, and report data on these sites and our responses. Further, the program assigns each defense site a relative priority for site cleanup. In general, sites that present a greater relative risk to explosives safety, human health, or the environment will be addressed before sites that present lesser risk. The program will also produce site-specific cost estimates, and it requires installations to program and budget for response actions.

Q.17. Does the Army maintain control of munitions response area / munitions response site once cleaned up?

A.17. In most cases, the Army does not maintain control. Transferred sites, like those in the Formerly Used Defense Site program, are not under the control of or owned by the Army. These sites may be owned by private individuals or may be under the control of other federal, state or local government land managers. Other sites, like those on installations affected by base realignment and closure decisions, remain under Army control until final transfer. In addition, some sites are located on active Army installations, which remain under Army control. For property already transferred from Army control or that to be transferred in the future, the Army will work with appropriate environmental regulators and property owners to help ensure that the response actions remain protective of the public.

Q.18. What is the Munitions Response Site Prioritization Protocol?

A.18. In 10 U.S.C. 2710, Congress directed the Secretary of Defense to develop, in consultation with representatives of the States and Indian Tribes, a proposed protocol for assigning to each defense site (munitions response site) a relative priority for munitions responses. The priority assigned to each site is to reflect the overall condition at the site taking into consideration various factors relating to safety and environmental hazard potential. A joint-Service and Office of the Secretary of Defense work group developed the Protocol. During its development, the Protocol was coordinated extensively with the states, tribes, U.S. Environmental Protection Agency, and other federal land managers. It was also extensively tested.

The Protocol evaluates the explosive hazards posed by munitions and explosives of concern; the unique hazards associated with the effects of chemical warfare material (CWM); and the chronic health and environmental hazards posed by munitions constituents and any incidental non-munitions-related contaminants. The Department of Defense recognizes the different hazards inherent to each class of materials. To address these differences, the Protocol has three hazard evaluation modules, each of which is specific to one type of hazard. Explosive hazards are evaluated using the Explosives Hazard Evaluation (EHE) module; CWM-related hazards are evaluated using the Chemical Warfare Materiel Hazard Evaluation (CHE) module; and health and environmental hazards posed by munitions constituents are evaluated using the Health Hazard Evaluation (HHE) module.

A munitions response site (MRS) priority is determined based on the ratings from the EHE, CHE, and HHE modules. Until all three hazard evaluation modules have been evaluated, the MRS priority shall be based on the results of the modules completed. Each MRS is assigned to one of eight MRS priorities based on the ratings of the three hazard evaluation modules, where Priority 1 indicates the highest potential hazard and Priority 8 the lowest potential hazard. Under the Protocol, only MRSs with CWM can be assigned to Priority 1, and no MRSs with CWM can be assigned to Priority 8. Where there is insufficient information to

assess any of the three hazard evaluation modules, the site receives an "evaluation pending" rating for that module.

Dealing with Emotionally Charged Situations:

Dissemination of information about the MMRP may create situations inciting emotions. This is understandable considering stakeholders are asked to participate in highly technical and/or unfamiliar decisions about potential explosive and/or environmental hazards. Emotions can be further provoked when these decisions have the power to directly impact their safety or the safety of their families. While these emotions are understandable, they can be difficult to deal with from a public involvement standpoint.

When attempting to manage emotionally charged situations, one should initially allow the person/group to vent. Do not attempt to interrupt, be defensive, or argue. Use active listening skills to slow the conversation down and ask questions to clarify the source of the concerns. Attempt to summarize what you have heard and seek agreement on your summary. Ask what they would like to see done and offer to look further into their request. Commit to a time to report back your findings.

If you are at a public meeting, use a flip chart or whiteboard to record the group's comments. This makes their concerns visible, further enforcing that their concerns are being heard and acknowledged. If available, have a neutral person act as the recorder of the comments and position the main Army spokesperson physically away from the chart or whiteboard. This will act to separate the source of the group's emotion from the person representing the Army's interest. As much as possible, the Army spokesperson should avoid physical positioning that may appear to have the purpose of challenging or intimidating meeting participants.

If the conversation seems to spin out of control, attempt to pause the conversation. This can be done by excusing oneself for a short period of time or by suggesting continuing the conversation at another time and place. If you choose to meet again, be sure to commit to a time and a neutral location to discuss the issue.

Administration:

Administration of this Guidance should be conducted jointly with the designated project Public Affairs Officer, as well as the environmental coordinator in accordance with applicable regulations and policies.

Evaluation:

It is critical to take advantage of opportunities to collect feedback from stakeholders. Whether through casual conversations with stakeholders at

community events or more formal data collection methods, this information will help to continuously monitor the effectiveness of the communication with stakeholders and identify new opportunities for public interaction.

There are a variety of ways to gain feedback from the public and other stakeholders (as discussed previously in this plan). What is important is that the method used to solicit feedback should match the type of information you want. Data collected from in person interviews will be wide-ranging. Data collected from a survey or a comment card will be dependent upon the format of the available answers. Questions to incorporate into your selected evaluation mechanism include the following:

- Was the provided information clear and easy-to-understand?
- If you still have questions regarding this environmental issue, what are they?
- How often would you like updates regarding the installation's environmental program?
- Are you interested in being added to our mailing list?
- Are you part of a community group that would be interested in a presentation regarding the environmental program?

Use the evaluation data to amend the community relations approach, in terms of how specific tools and tactics are developed and executed, as well as the larger public involvement plan.

Follow up with stakeholders who participated in your initial assessment process to determine how effectively you were able to respond to their needs, as well as additional ways to improve Army communications.

Attachment A

Sample News Release

Army officials at (installation name) announced today that they have identified (number of) local sites that will be investigated for potential munitions response. This is part of an effort throughout the Department of Defense (DoD) to address the potential explosives safety, health, and environmental issues related to the military's use of land for munitions-related activities, both past and present. Installation officials have identified these locations as "munitions response sites" that fall within the new Military Munitions Response Program, an environmental cleanup program that identifies areas that are known or suspected to contain unexploded ordnance, discarded military munitions, or munitions constituents.

(*Insert localized information about the sites being identified including a quote from local Army leader stressing public safety as our first priority*).

The Army conducted a nationwide inventory to identify all sites known or suspected to require a munitions response and evaluated their potential hazards. Under the DoD Munitions Response Site Prioritization Protocol, each munitions response site will be further evaluated in coordination with environmental regulators and the public to determine a relative priority, based on potential risks at each site, and then to determine a sequence for munitions responses. The Army will respond to those sites that pose potential hazards through its Military Munitions Response Program.

(Insert information about any public availability session that may be planned to address questions face-to-face).

For more information about these sites identified for the Military Munitions Response Program, call (*installation POC*) or go on-line at (*Web site*).

REMEDIAL INVESTIGATION / FEASIBILITY STUDY
RELATED WEB SITES

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Organization Web sites with Military Munitions Response Program (MMRP) Remedial Investigation / Feasibility Study (RI/FS) Information

The following organizations and Web sites are an excellent source of information and RI/FS related documentation that the MMRP RI/FS Restoration Project Manager should access and consult as appropriate throughout the planning and execution of their assigned RI/FS project.

1. Environmental Protection Agency:
   http://www.epa.gov/superfund/policy/index.htm
   http://www.epa.gov/superfund/policy/index.htm
2. United States Army Corps of Engineers: (USACE)
   http://www.usace.army.mil/
3. USACE – Huntsville:
   http://www.hnd.usace.army.mil/
4. United States Army Environmental Command: http://aec.army.mil/usaec/
5. Environmental Sciences Division, Oak Ridge National Laboratory:
   http://www.esd.ornl.gov/
6. Environmental Security Technology Certification Program:
   http://www.estcp.org/
7. Strategic Environmental Research and Development Program:
   http://www.serdp.org/
8. The National Association of Ordnance and Explosive Waste Contractors:
   http://www.naoc.org/
9. Defense Environmental Network & Information Exchange:
   https://www.denix.osd.mil/