MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT GUIDANCE

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Reserved for Disclaimer Information

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ACRONYMS

AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Requirements
ASR	archive search report
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	conceptual site model
CTT	Closed, Transferred, and Transferring
DD	decision document
DDESB	Department of Defense Explosives Safety Board
DMM	discarded military munitions
DoD	Department of Defense
DOI	Department of the Interior
DQO	data quality objective
DTSC	Department of Toxic Substances Control
EE/CA	engineering evaluation/cost analysis
EOD	explosive ordnance disposal
EPA	Environmental Protection Agency
ESP	explosives siting plan
ESQD	Explosive safety quantity-distance
ESS	explosives safety submission
FS	feasibility study
FUDS	Formerly Used Defense Sites
HA	hazard assessment
HE	high explosive
HEAT	high explosive anti-tank
HMX	high melting explosive; Octahydro-1,3,5,7-tetranitro-triazine
HTRW	Hazardous, Toxic and Radioactive Waste
LUCs	land use controls
MC	munitions constituents
MEC	munitions and explosives of concern
MEC HA	munitions and explosives of concern hazard assessment
MMRP	Military Munitions Response Program
MRA	munitions response area
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
NAVFAC	Naval Facilities Engineering Command
NCDENR	North Carolina Department of Environment and Natural Resources
NCP	National Contingency Plan
NTCRA	non-time critical removal action
OB/OD	open burning/open detonation
PA/SI	preliminary assessment/site inspection
QA/QC	quality assurance/quality control
RAB	Restoration Advisory Board

RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-triazine
RFI/CMS	RCRA facility investigation/corrective measure study
RI	remedial investigation
ROD	record of decision
SPP	systematic planning process
TASWER	Tribal Association for Solid Waste and Emergency Response
TCRA	time critical removal action
TNT	2,4,6-trinitrotoulene
TPP	Technical Project Planning
TWG HA	Technical Working Group for Hazard Assessment
USACE	United States Army Corps of Engineers
UXO	unexploded ordnance
WP	White Phosphorus

EXECUTIVE SUMMARY

This guidance document describes the munitions and explosives of concern hazard assessment (MEC HA) methodology for assessing explosive hazards to human receptors at munitions response sites (MRSs). The MEC HA allows a project team to evaluate the potential explosive hazard associated with a site, given current site conditions and under various cleanup, land use activities, and land use control alternatives.

This document was developed by the Technical Working Group for Hazard Assessment, which consists of representatives from the Department of Defense, Department of the Interior, State program managers from Association of State and Territorial Solid Waste Management Officials, Tribal Association for Solid Waste and Emergency Response, and the U.S. Environmental Protection Agency. These organizations provided personnel to develop the technical framework for this hazard assessment and guidance document.

The MEC HA is designed to provide benefits at the project team level (e.g., individual installation or site). It is intended to reduce costs and streamline the evaluation of explosive hazards by providing project teams with a consistent, accepted methodology. The MEC HA will support consistency and reproducibility of efforts at multiple sites. Its repeated use by project teams will further reduce costs through familiarity and ease of oversight. The MEC HA will promote mutual understanding of technical issues on the site through a collaborative, team-based hazard assessment process. The MEC HA is designed to enhance communication of hazards within a project team, and between project teams and external stakeholders. Use of the MEC HA will facilitate evaluation of removal and remedial alternatives and evaluation of determined or reasonably anticipated future land use activities. At the program level, the MEC HA will provide benefits by instilling confidence in decision-making through the use of a standardized evaluation approach, and support understanding at the national level of the process that project teams are using to support decisions.

The MEC HA is intended to fit into military munitions response program (MMRP) activities and the regulatory structure of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). It addresses the National Contingency Plan (NCP) direction to conduct site-specific risk assessments for threats to human health and the environment.

The 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 MEC 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 will result in death or injury also exists. Consequently, if MEC is known or suspected to be present, a munitions response will be required. That may include further investigation, cleanup of MEC through a removal or remedial action, including land use controls (LUCs), or land use controls alone. Where a cleanup action for MEC has occurred, some level of LUCs will often be required to address the uncertainty that all MEC items have been found and removed from the site. These may range from educational programs to restrictions on land use activities.

The 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 explosive or other hazards associated with stockpile or non-stockpile chemical warfare material. It does not directly address environmental or ecological concerns that might be associated with MEC.

The MEC HA is conducted through the systematic planning process that guides environmental investigations. As such, it is designed to be a collaborative process that draws upon the collective understanding and expertise of a project team consisting of lead agency personnel, regulators, and stakeholders. The team should include personnel with the range of disciplines required to understand the data that have been gathered and to be able to evaluate appropriate removal and remedial alternatives, land use activities, and land use controls.

The MEC HA is structured around three components of potential explosive hazard incidents:

- Severity, which is the potential consequences (e.g., death, severe injury, property damage, etc.) of an MEC item functioning.
- Accessibility, which is the likelihood that a receptor will be able to come in contact with an MEC item.
- Sensitivity, which is the likelihood that a receptor will be able to interact with an MEC item such that it will detonate.

Each of these components is assessed in the MEC HA by input factors. Each input factor has two or more categories. Each input factor category is associated with a numeric score that reflects the *relative* contributions of the different input factors to the MEC hazard assessment. *The MEC HA scores should not be interpreted as quantitative measures of explosive hazard.* The sum of the input factor scores falls within one of four defined ranges, called hazard levels. Each of the four levels reflects site attributes that describe groups of sites and site conditions ranging from the highest to lowest hazards.

The MEC HA allows a project team to assess sites on the most appropriate scale by dividing an MRS into subunits, if necessary. The MEC HA can be used to score a site several times to assess current site conditions, as well as conditions after completion of different levels of proposed cleanup, to assess different types of determined or reasonably anticipated future land use activities, or to assess the application of land use controls. The scoring tool is contained in Appendix A as an automated workbook.

The MEC HA can be used at several points in the CERCLA process. It is primarily designed to be used at two points in the CERCLA process: the end of a removal or remedial investigation to assess explosive hazards of current conditions; and in the Engineering Evaluation/Cost Analysis (EE/CA) report evaluation of removal alternatives or in the Remedial Investigation/Feasibility Study (RI/FS) report evaluation of remedial alternatives. In the EE/CA removal analysis it supports the CERCLA analysis for implementability and effectiveness. In the FS remedial analysis of alternatives, the MEC HA supports the CERCLA nine-criteria evaluation. The MEC HA provides input to the threshold criteria of protection of human health and the environment, and compliance with applicable, or relevant and appropriate requirements (ARARs). Information from the MEC HA assists in the analysis of four of the balancing criteria — long-term effectiveness, short-term effectiveness, implementability, and reduction of toxicity, mobility, or volume through treatment. The MEC HA does not address the criteria of cost.

The MEC HA does not answer the question of "how clean is clean?" Several alternatives or combinations of alternatives (e.g., surface or subsurface cleanup combined with land use controls) may be able to meet the protection of human health and the environment criteria. All alternatives are analyzed to determine which combination of alternatives best meets the

CERCLA statutory requirements. Site-specific project teams will determine “how clean is clean?” by selecting the alternative to be implemented to meet CERCLA requirements.

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CHAPTER 1: INTRODUCTION TO THE MEC HA GUIDANCE

This chapter introduces the Munitions and Explosives of Concern Hazard Assessment (MEC HA). It presents an overview of the background, purpose, use, benefits, and integration of the MEC HA into the evaluation of removal and remedial alternatives under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

> **Important Terms in This Chapter**
>
> **Munitions and Explosives of Concern (MEC)**
> MEC includes unexploded ordnance, discarded military munitions (including buried munitions), and bulk explosives, as well as soils contaminated with explosives at concentrations that can detonate.
>
> **Hazard Assessment (HA)**
> An HA is the evaluation of existing and potential conditions at a munitions response site that can lead to an explosive event when a member of the general public (i.e., a receptor) interacts with the item. The evaluation considers the likelihood and the severity of the event that may occur.
>
> **Munitions Response Area (MRA) and Munitions Response Site (MRS)**
> An MRA is any area that is known or suspected to contain MEC. An MRS is the specific discrete location within an MRA that is known to require a munitions response (either investigation or removal of munitions items). For example, a former range area may be an MRA, but only that portion of the range (e.g., a target area) for which a response action has been identified would be the MRS.

1.1 Background of the MEC HA

Since the early 1990s, military and civilian land managers and the public have been increasingly concerned about munitions response decisions at sites that are being released back to the public through the Base Realignment and Closure (BRAC) program or other land transfer programs. In addition, ongoing site investigations at munitions response areas (MRAs) and munitions response sites (MRSs) demonstrate that a number of formerly used defense sites (FUDS) contain munitions and explosives of concern (MEC). On March 7, 2000, the Department of Defense (DoD) and the U.S. Environmental Protection Agency (EPA) signed the *Interim Final Management Principles for Implementing Response Actions at Closed, Transferred, and Transferring (CTT) Ranges.*[1] The principles included a commitment to implement "a process consistent with CERCLA … [as the] preferred [regulatory] mechanism." In 2001, DoD published management guidance for the CERCLA-based Installation Restoration Program that established the Military Munitions Response Program (MMRP).[2] The management guidance required DoD to establish and maintain an inventory of other than operational ranges that contain or are suspected to contain MEC and required installations to program and budget for MMRP response actions. In 2002, the National Defense Authorization Act affirmed the MMRP and the need for an inventory, and required DoD to develop an approach for prioritizing munitions response sites. This effort resulted in the October 5, 2005 finalization of the Munitions Response Site Prioritization Protocol (MRSPP).

The CERCLA process for responding to releases or potential releases of hazardous substances, which is described in the National Contingency Plan (NCP),[3] includes the development of site-

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[1] DoD and EPA. *Management Principles for Implementing Response Actions at Closed, Transferred, and Transferring (CTT) Ranges (Interim Final)*, 7 March 2000.
[2] Department of Defense, *Management Guidance for the Defense Environmental Restoration Program*, ODUSD(I&E), September 2001.
[3] National Oil and Hazardous Substances Contingency Plan (more commonly called the National Contingency Plan, or NCP), 40 CFR 300 et seq.

specific risk assessments appropriate to the requirements of the site.[4] The results of the risk assessment are used to help site managers decide whether a response action is required, and to support the risk management decisions that are made through the remedy evaluation, selection, and implementation process. However, the CERCLA methodology for human health chemical risk assessment was not designed to address explosive safety hazards at MEC sites. The differences between the chemical risk assessment methodology and the MEC HA approach are discussed in more detail in Section 1.6.

In March 2004, EPA invited Federal agencies and State and Tribal organizations to participate in an effort to develop a consensus methodology and guidance document for the site-specific assessment of explosive hazards associated with MEC sites. The collaborative group that formed from this effort, the Technical Working Group for Hazard Assessment (TWG HA), included representatives from the DoD, Department of the Interior, State program managers from Association of State and Territorial Solid Waste Management Officials (ASTSWMO), and Tribal Association for Solid Waste and Emergency Response (TASWER),[5] along with EPA. These organizations provided personnel to develop this hazard assessment framework and guidance document. An executive committee composed of senior-level officials from each of the participating organizations was also established to guide policy decisions.

1.2 Purpose of the MEC HA

The purpose of the MEC HA is twofold:

- Support the hazard management decision-making process by analyzing site-specific information to:
    - Assess existing explosives hazards
    - Evaluate removal and remedial alternatives
    - Evaluate land use activity decisions
- Support hazard communication:
    - Between members of the project team and among other stakeholders
    - By organizing site information in a consistent manner

The MEC HA addresses the NCP direction for site-specific assessment of risks to human health and the environment. The MEC HA will help a project team understand the hazards associated with a site if no action is taken, and to evaluate the effects of removal or remedial alternatives. As with any CERCLA-based cleanup process, several different alternatives may be protective of human health and the environment. The results of the MEC HA will provide input into the CERCLA remedy evaluation and selection process.

[4] A preamble discussion in the proposed rule and the final rule itself highlight the focus of a risk assessment that is appropriate to the requirements of the site. 40 CFR 300 (Preamble to NCP, December 21, 1988, page 51425); 40 CFR 430 (b), March 8, 1990, page 8846.

[5] The participation of the TASWER in the TWG HA ended with the development of the technical framework for the MEC HA. In the summer of 2005, TASWER ceased operations and was therefore unable to participate further in development of this guidance document.

1.3 Scope and Applicability of the MEC HA

The MEC HA is designed to be used as the CERCLA hazard assessment methodology for MRSs where there is an explosive hazard from the known or suspected presence of MEC. The MEC HA addresses the hazards from conventional weapons. It does not address hazards associated with underwater sites or from stockpile and non-stockpile chemical warfare material. It also does not address risks associated with exposure to munitions constituents (MC) as environmental contaminants. MC in concentrations low enough not to present an explosive hazard, will continue to be addressed by the existing CERCLA human health and ecological risk assessment processes and protocols.

1.4 Benefits of the MEC HA

The MEC HA will provide substantial benefits at the project team level (e.g., individual installation or site). The application of a consistent methodology will save resources during the investigation and decision-making processes at MRSs. It will foster communication by contributing to a common understanding within a project team of the nature of the hazard present and the options for addressing that hazard.

For project teams, the MEC HA is designed to do the following:

- Maximize use of data gathered during development of the Conceptual Site Model (CSM).
- Reduce costs and streamline the hazard evaluation process at MRSs because individual project teams will not have to develop their own process.
- Provide a consistent format and process for multiple sites. Repeated use of the process by project teams, including regulators, will further reduce costs by supporting familiarity and ease of oversight.
- Promote mutual understanding of technical issues on the site through a collaborative, team-based hazard evaluation process.
- Focus investigations on key issues that must be addressed to support site-specific decisions.
- Support the systematic planning process and collaborative decision-making at MRSs.
- Facilitate site-specific decisions, including evaluation of removal and remedial alternatives.

The MEC HA is intended to provide program-level benefits, including the following:

- Increased confidence in decision-making through use of a standardized hazard assessment.
- Improved understanding at the national level of the processes that project teams are using to support decisions.
- Improved predictability of outcomes — similar sites, with similar facts, will give similar results.
- More efficient data compilation at the national level through standardized data gathering and analysis.
- Ability to provide program support through a standardized approach to training and guidance.

1.5 Role of the MRSPP and the MEC HA in the CERCLA Process

The relative priority assigned to response activities at defense sites is to be based on the overall conditions at each MRA/MRS and take into consideration various factors related to safety and environmental hazards. The MRSPP is designed to be applied after the CERCLA preliminary assessment (PA) phase but before completion of the CERCLA remedial investigations (RI).[6]

The MEC HA has several input factors that are similar to those in the MRSPP Explosive Hazard Evaluation module. The MEC HA includes additional capability to assess the potential effects of removal and remedial alternatives (e.g., surface cleanup, subsurface cleanup, or land use controls) on the potential explosive hazards at a site. The MEC HA supports project teams that are making hazard management decisions through the CERCLA response process at individual munition sites. Table 1-1 compares purposes and applications of the MRSPP and the MEC HA.

Table 1-1. Comparison Between MRSPP and MEC HA

MRSPP	MEC HA
• Description and Purpose: – Is a prioritization tool used to determine the order in which responses at MRSs are funded.	• Description and Purpose: – Is a tool used to compare the effects of clean-ups and/or changes to land use on the explosive hazard of an MRS (or a subunit of an MRS)
• Is applied: – To each MRS – Initially at the preliminary assessment phase (unless insufficient data are available).	• Is applied: – To each MRS (or a subunit of an MRS) – As part of the evaluation of baseline hazards and removal alternatives in an engineering evaluation/cost analysis (EE/CA) – At the conclusion of the remedial investigation process and during the feasibility study for each alternative to be evaluated
• Is reapplied: – When new information becomes available – After completion of response actions – Upon further delineation of MRSs within an MRA – To categorize an MRS previously classified as “evaluation pending” – On an annual basis	• Is reapplied: – When new information becomes available – At removal/remedial action completion – At the five-year review

The MEC HA supports the CERCLA process for both removal and remedial actions. In the March 7, 2000 *Management Principles for Implementing Response Actions at Closed, Transferred, and Transferring Ranges*, DoD and EPA expressed the preference for response actions at munitions sites follow the CERCLA process. When the State has the lead in overseeing a response action, it may be conducted under State Resource Conservation and Recovery Act (RCRA) requirements, under other federally delegated authorities, or under other State authorities. Because the RCRA corrective action program is conducted similarly to the

[6] 32 CFR Part 179, Page 50905, first paragraph, “Application of the Protocol,” as published in Proposed Rules, *Federal Register* 68, no. 163 (August 2003).

CERCLA program, the integration of a hazard assessment under that process will be similar to the process under CERCLA.

The MEC HA is primarily designed to be used at two points in the CERCLA process: the end of a removal or remedial investigation to assess explosive hazards of current conditions; and in the EE/CA report evaluation of removal alternatives or in the Remedial Investigation/Feasibility Study (RI/FS) report evaluation of remedial alternatives. Project teams can apply it at different points in the CERCLA process. The MEC HA should be viewed as an iterative and dynamic process. As more information about a site is gathered, information can be added and the site can be reassessed with the MEC HA to reflect that current understanding.

Figure 1-1 illustrates the points in the CERCLA process at which the hazard assessment can inform project team evaluations and decisions:

- **EE/CA.** At the conclusion of a removal investigation, the MEC HA supports the assessment of the explosive hazards that would remain if no action were taken. This evaluation of the "no action" alternative will help to identify the site conditions and use activities that should be addressed by alternatives considered in the EE/CA.
- **FS.** The MEC HA supports the evaluation of remedial action alternatives, including land use controls (LUCs). These evaluations are made in the feasibility study of the remedial program through the CERCLA nine-criteria analysis.[7] For the CERCLA remedial action program, the MEC HA provides input to several of the nine-criteria, including: the protection of human health and the environment, compliance with applicable or relevant and appropriate requirements (ARARs), long-term effectiveness, short-term effectiveness, implementability, and treatment to reduce mobility, toxicity, or volume of the principal threat at the site.
- **Five-Year Review.** The MEC HA allows project teams to evaluate the impact of changes in land use activities, the effectiveness of LUCs, and the protectiveness of the remedy with LUCs in place. If conditions have not changed from completion of the remedial action at the time of the Five Year Review, it will not be necessary to rerun the MEC HA as part of the review. If conditions have changed, project teams may rerun the MEC HA to evaluate potential changes to explosive hazards at the site.

[7] The nine-criteria analysis can be found in the National Contingency Plan (40 CFR 300.430(e)(9)).

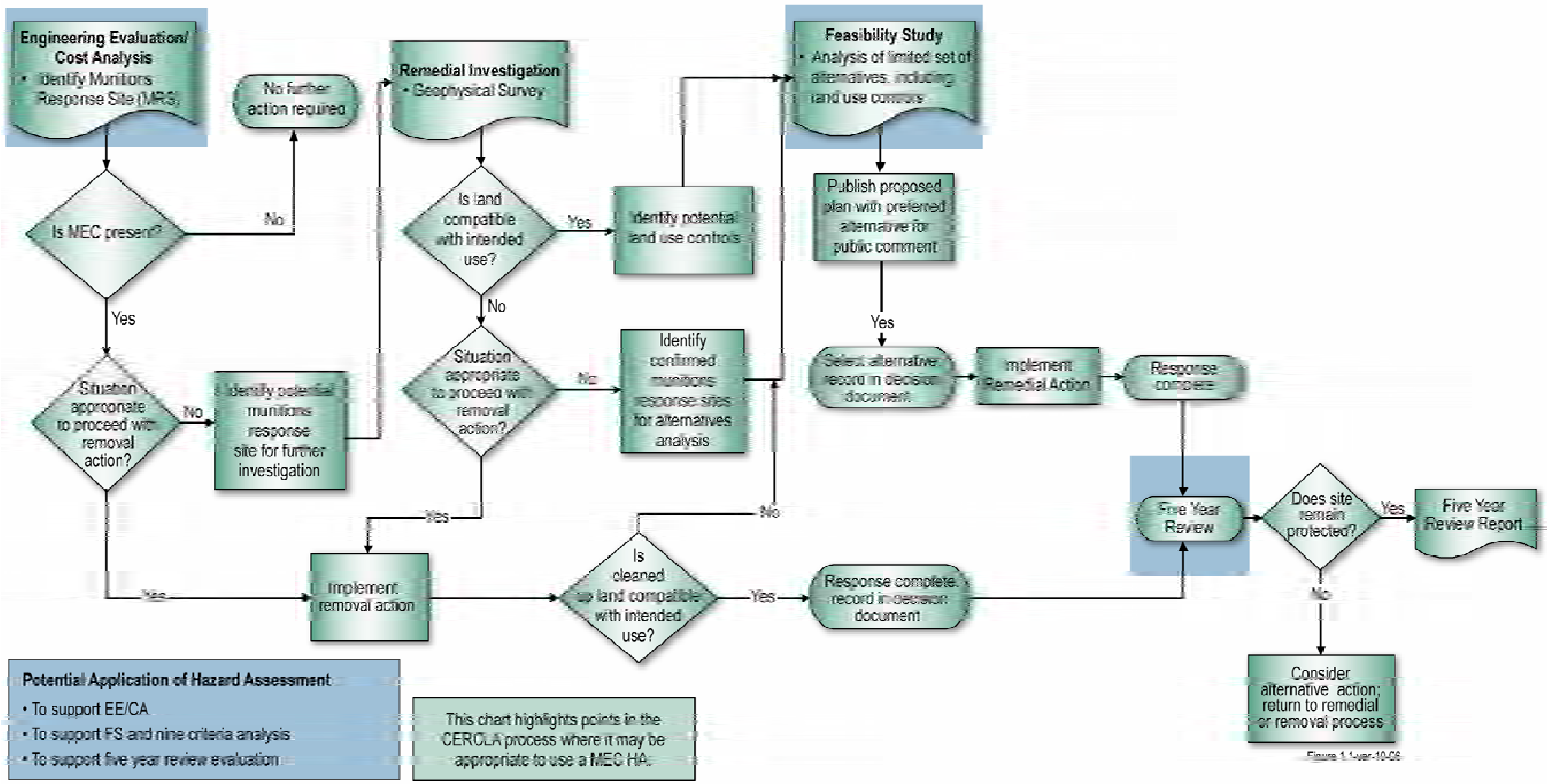


Figure 1-1. Application of the MEC Hazard Assessment During the CERCLA Process

1.6 Differences Between MEC Hazard Assessment and Chemical Risk Assessment

The MEC HA has been developed to address the NCP direction to assess site-specific risks to human health and the environment. The MEC HA focuses on the explosives safety hazards posed by MEC to human receptors. Chemical risk assessments, including those to assess MC as environmental contaminants, and the MEC HA require many of the same kinds of site information. However, project teams should recognize the fundamental difference between assessing chronic chemical exposure risk and assessing acute MEC explosive hazards. These differences drive the approaches to the structure of the explosives hazard assessment process.

The very nature of an explosives hazard is the potential to result in immediate injury or death as a result of an encounter. No accepted method exists for establishing the probability of an incremental potential for death or injury resulting from an encounter with MEC. Instead, MEC explosive hazards are evaluated as either being present or not present. If the potential for an encounter with MEC exists, the potential that the encounter will result in death or injury also exists. Consequently, if MEC is known or suspected to be present, some action will be required to address the MEC.

CERCLA chemical risk assessments evaluate long-term or chronic exposure to chemicals released to the environment. Estimates are made of potential increases in carcinogenic and noncarcinogenic risks. The levels that are considered to be protective of human health for carcinogens are established using the target risk range of 1×10E-4 to 1×10E-6. A carcinogenic risk of 1×10E-4 equates to one cancer diagnosis beyond what is expected in a population of 10,000 people exposed to a certain chemical under certain exposure scenarios.

A MEC hazard assessment and a chemical risk assessment performed at the same MRS may have very different results. Unlike chemical contaminants that can migrate through different media, MEC items are generally stationary and typically require action by a receptor to complete the explosive hazard pathway. The land use activities that present the highest hazard are those that take place outdoors and involve situations where people can come in contact with MEC items and cause them to detonate. A major source of potential exposure at MEC sites is intrusive activities. MEC at an MRS with recreational or agricultural uses involving intrusive activities, such as camping or tilling soil, provide a potentially complete MEC exposure pathway and a may result in a relatively “high” hazard assessment.

These same activities may be of durations that limit exposure to environmental contaminants and result in a “low” chemical risk assessment evaluation. Assumptions about durations of exposure for chemical risk assessments are tied to specific land uses and play a major role the conclusion as to which land uses present the greatest risk. Residential land use is generally considered to be the land use with the highest potential risk because it is typically associated with the highest estimates for personal exposure. The land uses with the next highest risks are typically industrial and commercial, then recreational, followed by agricultural and open space. The level of activities that take place where explosives hazards exist may or may not follow this order.

1.7 Limitations of the Hazard Assessment

The MEC HA supports hazard management decisions. It does not make the decisions nor does it answer the question, “How clean is clean?” The MEC HA relies on data produced as a result of the systematic planning process (SPP), but does not assess the quality of that data independent of the data quality objectives (DQOs) established by project teams.

1.8 Presence of Critical Infrastructure, Cultural Resources, or Ecological Resources

The MEC HA assesses the explosive hazard to *human* receptors. Munitions response site activities can pose hazards to infrastructure, cultural resources, or ecological resources. Project teams need to evaluate the potential for damage to the resources by specific site activities. This evaluation includes consideration of location-specific and action-specific ARARs during the planning and evaluation of investigations and removal or remedial actions. For removal actions, this analysis should be included in the implementability evaluations. For remedial actions, this should be done as part of the implementability and short-term effectiveness criteria analysis.

The MEC HA addresses the effects of an unintentional detonation and the hazardous fragments it can produce within a given radii. This distance is represented by an explosive safety quantity-distance (ESQD) arc. Project teams must understand that critical infrastructure, and cultural and ecological resources within the ESQD arc are vulnerable unless mitigation measures are employed.

1.9 Organization of the MEC HA Guidance

The remainder of this guidance provides the background and instructions necessary for successfully applying the MEC HA. Chapter 2, Understanding the Hazard Assessment Framework, describes the input factors, categories, scores and weighting, and the hazard levels. Chapter 3 discusses the project team roles and responsibilities for undertaking the MEC HA, considerations for identifying areas for assessment, and information sources. Chapter 4 describes the processes for scoring the MEC HA under the specific input factors. Chapter 5 describes the outputs of the MEC HA analysis and provides guidance on the integration of the MEC HA analysis with the CERCLA process.

Several technical appendices are included to provide additional information. Appendix A provides an electronic form of the worksheets, as a tool for project teams to use in completing a MEC HA evaluation. Appendix B provides an example of a completed MEC HA worksheet and report. Appendix C (reserved) presents frequently asked questions and answers. Appendix D provides a technical report on the development of MEC HA scores.

CHAPTER 2: UNDERSTANDING THE HAZARD ASSESSMENT FRAMEWORK

This chapter presents an overview of the technical framework of the MEC HA.

2.1 Components of Explosive Hazard

The MEC HA framework is organized into three components of explosive hazard, each of which is defined in Table 2-1.

Important Terms in This Chapter

Cleanup
Removal or remedial actions or previous clearance activities in which MEC items were or will be removed from the surface or subsurface to a specified depth and lateral extent.

Conceptual Site Model (CSM)
The CSM is a description of a site and its environment that is based on existing knowledge. It describes sources, pathways, and receptors, and the interactions that link these. It assists the team in planning, data interpretation, and communication.

Table 2-1. Components of Explosive Hazard in MEC HA

Component of Explosive Hazard	Definition
Severity	The potential severity of the effect on a receptor or receptors should an MEC item detonate.
Accessibility	The likelihood that a receptor will be able to interact with an MEC item.
Sensitivity	The likelihood that an MEC item will detonate if a receptor interacts with it.

Organization of the MEC HA into three components reflects the nature of explosive hazard and information contained in the CSM.

2.2 Elements of the MEC HA

The MEC HA technical framework consists of three elements: input factors, structure, and output. Each of these terms is defined in Table 2-2 and discussed in detail in this chapter.

Table 2-2. Framework Elements of the MEC HA

Framework Element	Definition
Input factors	A series of factors that describe the characteristics of a site in terms of the components of the explosive hazard.
Structure	The methods used to assign weights to, score, and combine the input factors to assess the site's explosive hazard.
Output	The description of the explosive hazard level of the site.

2.2.2 MEC HA Input Factors

This section introduces the input factors that are used in the MEC HA. Input factors describe the conditions at an MRS that determine the severity, accessibility, and sensitivity components of explosive hazard.

2.2.2.1 Severity

The severity component is determined by two characteristics related to the potential consequences should an MEC item function:

- Energetic material type in the MEC items in the MRS (e.g., high explosive, incendiary)
- Location of additional human receptors

The first factor describes the hazard inherent in the MEC items known or suspected to be at the MRS. The second factor addresses the possibility that should an MEC item detonate it could affect one or more secondary human receptors in addition to the initiating receptor.

2.2.1.2 Accessibility

The accessibility component is described by the following input factors:

- Site accessibility
- Potential contact hours (i.e., number of hours that people use a site each year)
- Amount of MEC
- Minimum depth of MEC relative to the maximum intrusive depth of receptor activity (i.e., the relationship of receptor activity to the location and depth of MEC)
- Potential for migration of MEC items

2.2.1.3 Sensitivity

The following input factors describe the sensitivity component of explosive hazard:

- MEC classification (e.g., unexploded ordnance [UXO], fuzed or unfuzed discarded military munitions [DMM], bulk explosives)
- MEC size

2.2.2 MEC HA Structure

The MEC HA framework uses a numeric structure to assign weights, score, and then combine scores to describe the hazards associated with MEC. The sum of the numeric scores determines the hazard level. The three characteristics of the MEC HA numeric structure of weights, scores, and combination are described in Table 2-3.

Table 2-3. Numeric Structure Characteristics of the MEC HA

Characteristic	Description
Weights	The weight assigned to an input factor represents the percentage of the maximum score for that input factor when compared with the sum of the maximum scores of all input factors. The different weights for the explosive hazard components are calculated in a similar manner.
Scores	Numeric scores are assigned to each of the input factor categories. The difference in scores reflects greater or lesser relative contributions to the explosive hazards at a site.
Combination	Scores are summed to produce a final numeric score that determines which of four hazard levels applies to the conditions described by the input factor categories.

These characteristics and their relationship to the other characteristics are described in more detail in the following sections.

2.2.2.1 Weights

Weighting of input factors ensures that the MEC HA is sensitive enough to distinguish between different removal and remedial action alternatives and land use decisions. Weighting balances the input factors that *do not* change and those that *do* change in response to a cleanup, as well as the input factors that change to describe differences in land use activities. In addition, the scoring reflects the CERCLA statutory preference for treatment of the principal threat at a site, as well as the NCP instructions on giving institutional controls the lowest consideration for remedial actions. This preference is reflected in the scoring by assigning a higher relative weight to cleanup actions than is given to changes in land use activities. Table 2-4 presents the maximum scores and corresponding weights assigned to each input factor.

CERCLA Statutory Preference for Active Cleanup

The implementation regulation for CERCLA, the National Contingency Plan, states: "The use of institutional controls shall not substitute for active response measures (e.g., treatment and/or containment…) as the sole remedy unless such active measures are determined not to be practicable." 40 CFR 300.430(a)(iii)(D)

Table 2-4. Input Factor Maximum Scores and Resulting Weights

Explosive Hazard Component	Input Factor	Maximum Scores	Weights
Severity	Energetic Material Type	100	10%
	Location of Additional Human Receptors	30	3%
	Component total	***130***	***13%***
Accessibility	Site Accessibility	80	8%
	Total Contact Hours	120	12%
	Amount of MEC	180	18%
	Minimum MEC Depth/Maximum Intrusive Depth	240	24%
	Migration Potential	30	3%
	Component total	***650***	***65%***
Sensitivity	MEC Classification	180	18%
	MEC Size	40	4%
	Component total	***220***	***22%***
	Total Score	**1,000**	**100%**

Appendix D contains an in depth discussion and analysis of the development of the scores and weights for the MEC HA.

2.2.2.2 Scores

Table 2-5 contains the MEC HA scores. The scores are organized into rows for each input factor category, and columns that reflect site conditions or cleanup status.

The input factor categories are intended to describe site-specific conditions. Users select the category for each input factor that best represents the site conditions being evaluated. These categories may change as different land use activities are assessed. The input factor category determines the row from which the score is selected.

There are three different columns to assess different removal or remedial alternatives. The "Baseline Condition" column is selected for any set of site conditions that do not include a cleanup alternative. This will typically be the current conditions at the MRS, but can also be applied to evaluate changes to land use activities, including those associated with the application of LUCs as a remedial action. The "Surface Cleanup" column is selected when evaluating a removal or remedial alternative involving surface clean-up. If the alternative under evaluation involves subsurface clean-up, then scores are selected from the "Subsurface Clean-up" column. Scoring is discussed in more detail in Chapter 4.

Table 2-5. Scores for Input Factor Categories

Input Factor	Input Factor Category	Score		
		Baseline Condition	Surface Cleanup	Subsurface Cleanup
Energetic Material Type	High Explosives and Low Explosive Fillers in Fragmenting Rounds	100	100	100
	White Phosphorus	70	70	70
	Pyrotechnic	60	60	60
	Propellant	50	50	50
	Spotting Charge	40	40	40
	Incendiary	30	30	30
Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	30	30	30
	Outside of the ESQD arc	0	0	0
Site Accessibility	Full Accessibility	80	80	80
	Moderate Accessibility	55	55	55
	Limited Accessibility	15	15	15
	Very Limited Accessibility	5	5	5
Potential Contact Hours	Many Hours	120	90	30
	Some Hours	70	50	20
	Few Hours	40	20	10
	Very Few Hours	15	10	5
Amount of MEC	Target Area	180	120	30
	Open Burning/Open Detonation (OB/OD) Area	180	110	30
	Function Test Range	165	90	25
	Burial Pit	140	140	10
	Maneuver Areas	115	15	5
	Firing Points	75	10	5
	Safety Buffer Areas	30	10	5
	Storage	25	10	5
	Explosive-Related Industrial Facility	20	10	5

Table 2-5. Scores for Input Factor Categories

Input Factor	Input Factor Category	Score		
		Baseline Condition	**Surface Cleanup**	**Subsurface Cleanup**
Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth	**Baseline Condition:** MEC located surface and subsurface; **After Cleanup:** Intrusive depth overlaps with subsurface MEC	240	150	95
	Baseline Condition: MEC located surface and subsurface; **After Cleanup:** Intrusive depth does not overlap with subsurface MEC	240	50	25
	Baseline Condition: MEC located only subsurface; **Baseline Condition or After Cleanup:** Intrusive depth overlaps with minimum MEC depth	150	N/A*	95
	Baseline Condition: MEC located only subsurface; **Baseline Condition or After Cleanup:** Intrusive depth does not overlap with minimum MEC depth	50	N/A*	25
Migration Potential	Possible	30	30	10
	Unlikely	10	10	10
MEC Classification	UXO Special Case	180	180	180
	UXO	110	110	110
	Fuzed DMM Special Case	105	105	105
	Fuzed DMM	55	55	55
	Unfuzed DMM	45	45	45
	Bulk Explosives	45	45	45
MEC Size	Small	40	40	40
	Large	0	0	0

*N/A – Not Applicable: Surface cleanups for MEC would not be appropriate for site conditions where MEC is all in the subsurface.

2.2.3 Outputs from the MEC HA Scoring

Each scenario assessed by the MEC HA produces a score that is associated with one of four hazard levels. These hazard levels reflect the interaction between the current or future human activities in an MRS, and the types, amounts, and conditions of MEC items within the MRS.

Table 2-6 contains the hazard level ranges. The ranges for each of the hazard levels are based on the results of a large number of sensitivity runs designed to ensure that the appropriate site conditions are associated with each hazard level. The complete sensitivity runs are contained in Appendix D. Section 5.2 describes the typical attributes associated with each of the hazard levels.

Table 2-6. Hazard Level Scoring Ranges

Hazard Level	Maximum MEC HA Score	Minimum MEC HA Score
1	1,000	840
2	835	725
3	720	530
4	525	125

CHAPTER 3: SCOPING THE HAZARD ASSESSMENT

This chapter describes how to conduct a MEC HA. The MEC HA consists of four steps: planning, compiling, implementing, and documenting. This chapter provides general information to consider when identifying the area or areas for assessment. This chapter begins by outlining the role of the project team in conducting the MEC HA

3.1 Project Team

A project team includes the group of organizations and disciplines within those organizations responsible for planning and executing a specific CERCLA activity. The make-up of a project team varies, but it often includes the lead agency Project Manager, regulatory authorities (e.g., U.S. EPA and/or the State or Tribal agency), land owner/manager, technical experts and support staff associated with the lead agency and the regulatory authorities, and supporting contractors and consultants. Table 3-1 shows the likely project team members for different types of sites.

Table 3-1. Potential Project Team Members for Common Types of Sites

Type of Site[a]	Potential Project Team Members
National Priorities List	• DoD personnel or other agency personnel — Installation environmental manager — Service organization personnel, such as Air Force Center for Environmental Excellence (AFCEE), U.S. Army Corps of Engineers (USACE), or Naval Facilities Engineering Command (NAVFAC) — DoD Explosives Safety Activities • State or Tribal regulatory agency • U.S. EPA
Formerly Used Defense Site	• DoD FUDS manager (USACE), DoD Safety Components • Federal landowning agency (if involved) • State or Tribal regulatory agency • U.S. EPA (if involved) • Private landowners or owners representatives • Local government representatives
Base Realignment and Closure	• DoD — Closing base environmental manager — Service BRAC program offices — DoD Explosives Safety Activities • State or Tribal regulatory agency • Federal landowning agency (if involved) • U.S. EPA • Local land reuse authority
Non-NPL	• DoD personnel or other agency personnel — Installation environmental manager — Service organization personnel (e.g., AFCEE, USACE, NAVFAC) — DoD Explosives Safety Activities • State or Tribal regulatory agency • U.S. EPA (if involved)

a. Much of this discussion is focused on DoD sites. MEC may exist on facilities or sites owned or managed by other Federal agencies (e.g., Department of Agriculture, Department of the Interior) or private entities. This guidance is equally applicable to those sites, and the nature of the project team membership will reflect that ownership or management.

- **Lead Agency.** Personnel from the lead agency typically will compile the data necessary to conduct the assessment, assemble the data into the data collection forms, and conduct the scoring. It is most likely that these individuals will analyze the munitions-related data and provide the information necessary to conduct various calculations.
- **Regulatory Agency.** Personnel from the regulatory agencies help to determine whether the quantity and quality of data is sufficient to make required hazard management decisions.
- **Others.** Current and prospective land users will ensure that the MEC HA accurately reflects the current and determined or reasonably anticipated future land use activities.

3.2 Outreach

Public participation is required throughout the CERCLA process.[8] Specific CERCLA requirements ensure that the public has the opportunity to review key documents leading to the identification of removal or remedial alternatives. Community acceptance is one of the CERCLA nine criteria used in the evaluation and selection of a remedial alternative. Finally, all documents that support the site evaluation and decision process must be part of the administrative record for CERCLA response actions and must be available to the public.[9]

The project team should keep all stakeholders informed of the MEC HA deliberations and results. Restoration Advisory Boards, local government officials, and other parties should be provided opportunities to learn about the overall hazard assessment process. In addition, they should be offered information about the assumptions used in data evaluation and given an opportunity to discuss their concerns and issues concerning the hazard assessment process. Stakeholders should be provided the opportunity to learn about the cleanup alternatives that are evaluated by the MEC HA and addressed in the CERCLA removal and remedial evaluations.

3.3 Overview of the MEC HA

Figure 3-1 provides an overview of the MEC HA implementation. Each step is described in more detail in the following sections.

3.3.1 Planning the HA

The MEC HA is an element in the SPP. The SPP is based on collaborative decision-making. The project team should represent all the appropriate organizations (e.g., the lead and support agencies, stakeholders, etc.) and needs the right mix of disciplines. These disciplines should include project managers, explosive safety experts, MEC cleanup specialists, geophysicists, environmental engineers, planning specialists, quality assurance managers, and community involvement coordinators.

Systematic Planning Process (SPP)
An SPP is a systematic, objective approach to planning and executing an environmental investigation. An SPP uses a collaborative team-based approach to planning an environmental investigation. The U.S. EPA Data Quality Objectives process and the U.S. Army Corps of Engineer Technical Project Planning (TPP) process are examples of SPPs.

[8] Superfund Amendments and Reauthorization Act of 1986, PL 99-499, Section 117.
[9] 40 CFR 300.800 et seq.

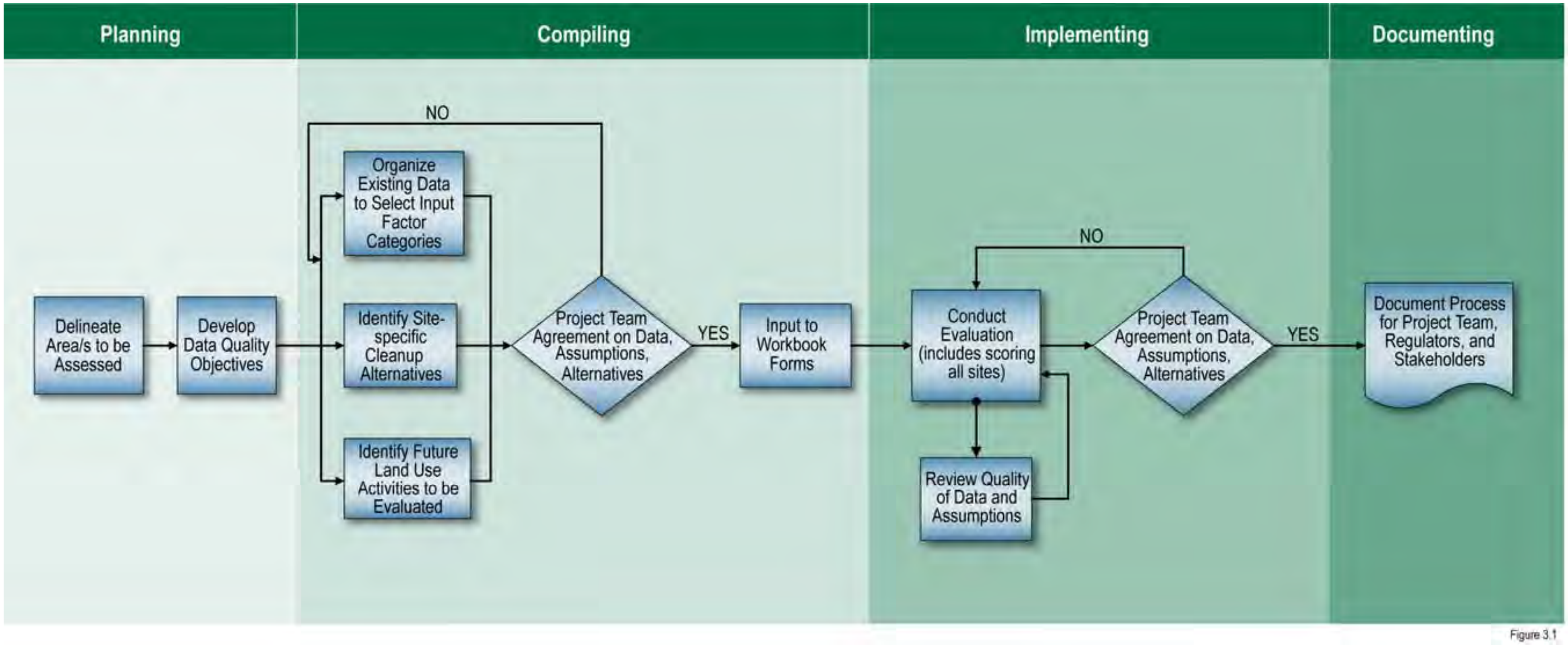


Figure 3-1. Overview of Hazard Assessment Process

The two critical tasks for the project team are to clearly identify the areas that are to be assessed, and develop the DQOs for the information that will be used to conduct the MEC HA.

3.3.2 Identifying the Area to be Assessed

This section describes the process of identifying the MRS or a subset of the MRS on which the MEC HA will be conducted.

The area being assessed by the MEC HA is referred to as a munitions response site. An MRS is defined as a discrete location that is known to require a munitions response. The boundaries of the MRS may have been defined for a variety of reasons, including investigation efficiencies, funding, or programmatic (e.g., contracting) reasons. Within an MRS, subunits may differ widely with respect to the explosive hazards they pose because of the different past munitions uses, as well as different land use activities within the MRS. Attachment 3A to this chapter provides an example of delineating areas for assessment.

The following are specific considerations for delineating the area to be assessed by the MEC HA:

- Boundaries must be clear.
- Boundaries should outline an area of a single past munitions-related activity, such as a target area or an area where opening burning/open detonation (OB/OD) occurred.
- Boundaries should separate areas in which different types of munitions were used, if possible.
- Boundaries should delineate areas of similar land use activities (for both current and determined or reasonably anticipated future).

At sites with variations in any of the following: current land use activities; determined or reasonably anticipated future land use activities; or site access, it may be beneficial to subdivide an MRS into subunits for the purpose of conducting the MEC HA. For example, if a range safety fan of a large MRS has multiple current or future land use activities within its borders, it may be most efficient to subdivide that MRS into smaller areas, analyzing each unit on the basis of its specific use.

Accurate maps provide the best portrayal of the area to be assessed. Maps should contain information such as the past munitions use, boundaries of that use, and any features or buildings where people may congregate (e.g., athletic fields, picnic areas, cultural resources, or inhabited buildings). Physical features that can affect the accessibility of the site such as streams or hills should be clearly marked, as should manmade features such as fences or other barriers. Ground cover, such as heavy undergrowth or marshy areas that could affect accessibility or movement through the area, should also be indicated. The map should be georeferenced using appropriate global positioning equipment that have the level of precision and accuracy (e.g., plus or minus *x* meters) agreed to by the project team.

3.3.3 Compiling Information

The team must gather the information required for the input factors. The information will be derived from a variety of sources. Much of the information may already have been gathered during the preparation of the CSM and in previous site investigations.

A MEC HA requires information concerning the following:

- Prior military munitions use
- Past military activities
- Past munitions response activities (e.g., explosive ordnance disposal [EOD] clearances)
- Current site conditions (e.g., land use activities, access)
- Determined or reasonably anticipated future land use (e.g., future land use activities, response alternatives)

After gathering all the necessary information, the project team will select the appropriate category from each input factor. Depending on the available information, the team may need to make assumptions about certain characteristics of the site. The decisions associated with the information should reflect a team consensus and be clearly documented in the MEC HA worksheets.

Most of the information needed to conduct MEC HA will be available from site-specific documents developed during CERCLA response activities, and will not need to be collected specifically for the MEC HA. Table 3-2 describes the types of information that are required for the MEC HA, and identifies likely sources of that information.

Table 3-2. Required Types of Data and Likely Sources

Type of Information	Input Factors/Purpose of Data	Sources of Data
Site description and boundaries	• Define area to be assessed	• Historical research reports such as Archive Search Report • Aerial photography and interpretation reports • Past action reports from removal actions or clearances • Preliminary Assessment/Site Investigation (PA/SI) reports • EE/CA reports • RI/FS reports • RCRA Facility Investigation/ Corrective Measure Study (RFI/CMS) reports • CSM from investigations • Base master plans (active bases) • Reuse plans (BRAC facilities) • Community land use plans

Table 3-2. Required Types of Data and Likely Sources

Type of Information	Input Factors/Purpose of Data	Sources of Data
Site physical conditions	• Site accessibility • Migration potential	• PA/SI reports • EE/CA reports • RI/FS reports • RFI/CMS reports • CSM from investigations (e.g., PA/SI, EE/CA, RI/FS) • Environmental baseline surveys (BRAC) • Current and historical aerial photography • Base master plans (active bases) • Reuse plans (BRAC facilities) • Community land use plans (including zoning) • U.S. Geological Survey topographic maps
Past munitions-related activities	• Filler Type • Location of Additional Human Receptors • Amount of MEC • Minimum MEC Depth Relative to the Maximum Intrusive Depth • Migration Potential • MEC Classification • MEC Size	• Historical research reports such as Archive Search Reports • Unit histories, EOD response reports • Aerial photography and interpretation reports • Explosive Safety Submission (ESS) or Explosive Siting Plan (ESP) • PA/SI reports • EE/CA reports • RI/FS reports • RFI/CMS reports • CSM from investigations • Past removal after-action reports • Site interviews
Current, Determined and Reasonably Anticipated Future Land Use Activities	• Location of Additional Human Receptors • Site Accessibility • Potential Contact Hours • Minimum MEC Depth Relative to the Maximum Intrusive Depth	• Base master plans (active bases) • Reuse plans (BRAC facilities) • Community land use plans (e.g., county zoning data, census data, and physical observations) • Land ownership maps from local tax records • ESS or ESP • PA/SI reports • EE/CA reports • RI/FS reports • RFI/CMS reports • CSM from investigations (e.g., PA/SI, EE/CA, RI/FS) • Information obtained from Federal, local, or regional land-holding agencies on outdoor recreation use (quantity and type) • Information obtained from Tribal governments

Table 3-2. Required Types of Data and Likely Sources

Type of Information	Input Factors/Purpose of Data	Sources of Data
Removal or remedial alternatives	• Location of Additional Human Receptors • Site Accessibility • Potential Contact Hours • Amount of MEC • Minimum MEC Depth Relative to the Maximum Intrusive Depth	• CSM from investigations • Past removal action reports and associated documentation • ESS or ESP • PA/SI reports • EE/CA reports • RI/FS reports • RFI/CMS reports

Two widely available documents that provide sources of information useful in supporting data gathering are *Munitions Response Historical Records Review* published by the Interstate Technology and Regulatory Council's UXO Team (November 2003) and *EPA Handbook on the Management of Munitions Response Actions* (May 2005, Interim Final). These documents can be downloaded from http://www.itrcweb.org/gd_UXO.asp and http://www.epa.gov/fedfac, respectively.

3.3.4 Implementing

Once the site data have been gathered, the team can then score the sites. The team enters data into an automated workbook which then arranges the data into scoring sheets for each set of site conditions. The worksheets calculate separate scores for each scenario identified by the project team. The team can compare the relative hazard of different scenarios and compare various cleanup actions or land use activity changes on the hazard level. The electronic worksheets are located on a CD-ROM in Appendix A.

3.3.5 Documenting

The project team must document the MEC HA for the administrative record. The documentation may be part of a larger document (e.g., RI/FS report) or it may be a stand-alone document. The automated workbook will produce a series of report tables documenting the inputs and outputs. The project team must add further information to these tables, including the sources of information and the rationales for any assumptions.

The MEC HA worksheets contain fields to document the basis for the information used in the MEC HA. These fields must be filled in for all information and should describe the following:

- The specific data that are the basis of the category selection (e.g., the mark or model of the munition that is used to determine Energetic Material Type)
- Sources of information (e.g., PA/SI, EE/CA, RI/FS, reuse plans, etc.)
- Qualitative descriptions of the uncertainty associated with the information
- Descriptions of assumptions made in the absence of hard information or in the presence of uncertainty

3.4 Data Quality Issues

Data quality impacts all aspects of the MEC HA. Concerns about data quality will vary depending on the phase of the investigation and the sources of information. Table 3-3 briefly describes data quality issues associated with different sources of information.

Table 3-3. Comparison of Data Quality of Different Information Sources

Source of Data	Data Quality Issues
Archive Search Report or other historical research	• Completeness of historical research information; gaps in time and types of information available
Past removal after action reports (e.g., Certificates of Clearance)	• Completeness of cleanup activities • Accuracy of information about the removal
Investigation results (EE/CA, RI)	• Completeness of investigation • Depth to which sensors could detect the items of concern • Quality assurance/quality control (QA/QC) associated with the investigation • Match between area investigated and MRS (or portion of MRS) to be evaluated through MEC HA process • Sufficiency of information to bound the area to be evaluated by the MEC HA
Removal or remedial action results	• Geophysical detectors used and their validation for the treatment objective (MEC sizes and depths) • Depth of the cleanup action • Extent of the cleanup action • QA/QC associated with the cleanup actions • For surface cleanups, site conditions that may have led to the exposure of subsurface MEC items • For subsurface clean-ups, process and criteria used in identifying anomalies that were dug and those that were not

It is important to keep in mind that some level of uncertainty exists with any environmental investigation. Realistic but conservative assumptions can reduce uncertainty. For example, it may be appropriate to assume MEC is still present on the surface at an MRS where there was a historic surface clearance with little documentation. A thorough discussion about the nature of any uncertainty and its effect on the selection of MEC HA input factor categories will be an important part of the collaborative decision making process.

Attachment 3A. Examples of Dividing an MRS for an MEC HA Evaluation

The following example shows how sites may be divided into subunits, depending on their past munitions use and current, determined or reasonably anticipated future land use activities.

Figure 3A-1 shows the MRA as containing three MRSs, before they are subdivided:

- MRS-1 – An indirect fire range, including the firing point, range safety fan, target area, and an OB/OD area
- MRS-2 – A buffer area around the range safety fan
- MRS-3 – A former maneuver area

Figure 3A-2 shows the same MRA once it has been subdivided. MRS-1 has been divided into four subunits, labeled MRS 1(a) through MRS 1(d), based on past military munitions activities. The firing point, range safety fan, target area, and OB/OD area are each treated as separate assessment areas. This is because each area is expected to have different concentrations, and conditions of munitions, and therefore have different MEC HA hazard levels. MRS-2 is assessed in its entirety, because the past military uses, the current use, and the future use uniform throughout the MRS. MRS-3 is a former maneuver area that had one past military use and one current use. It is separated into two hazard assessment areas labeled MRS 3(a) and MRS 3(b) because it has different reasonably anticipated future land use activities.

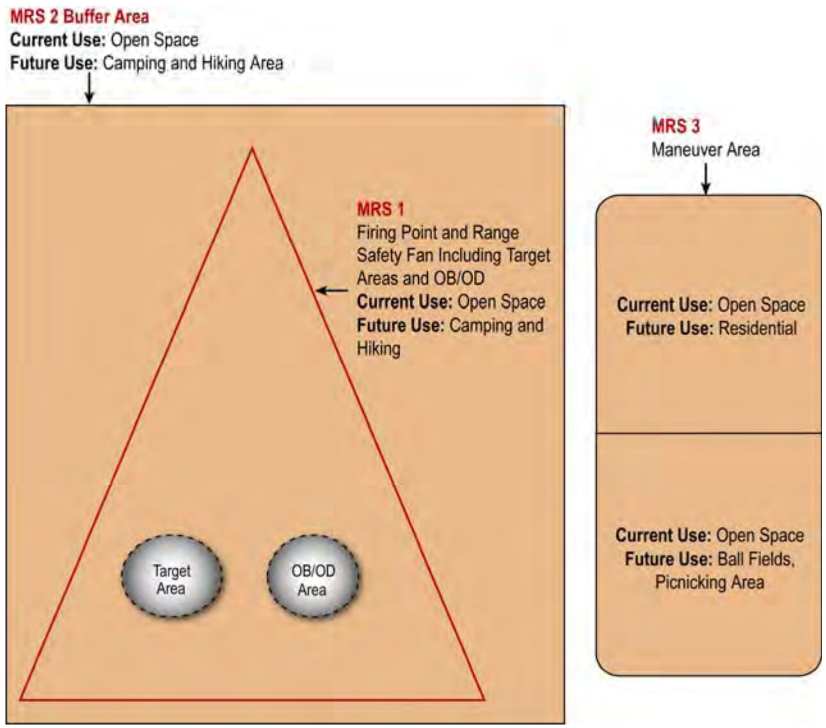


Figure 3A-1. Munitions Response Area Containing Three MRSs

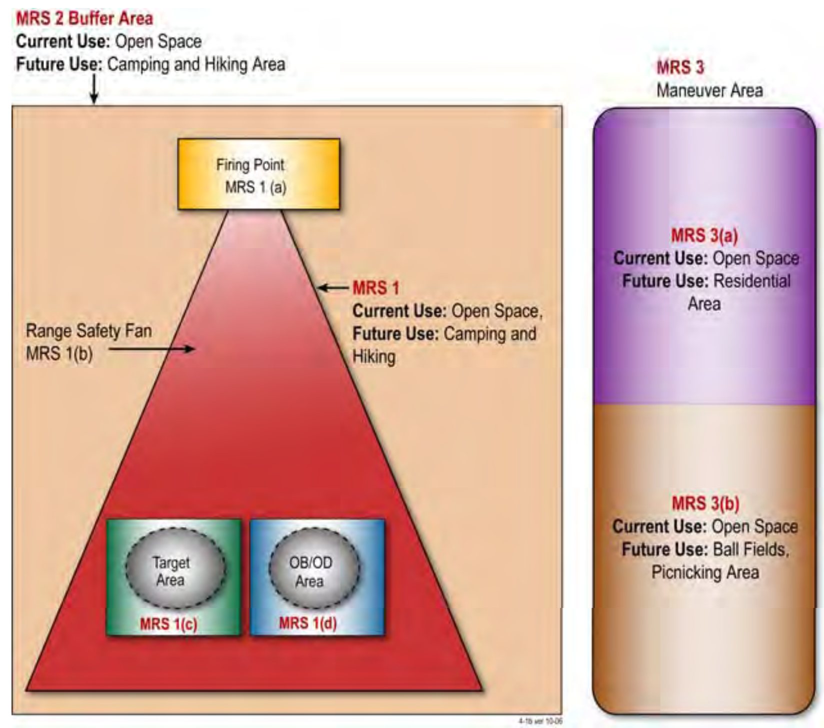


Figure 3A-2. MRSs Subdivided for Assessment Purposes

CHAPTER 4: INPUT FACTORS AND SCORING

This chapter describes the selection and scoring of input factor categories. The input factor categories are used to describe site-specific conditions. Project teams select the category for each of the nine input factors that best represents the site conditions being evaluated. These categories may change as different land use activities are assessed. Sections 4.1 through 4.9 describe how to select the appropriate input factor category for scoring current conditions, different response alternatives, and determined or reasonably anticipated future land uses.

Tables in the nine sections also provide scores for the input factors. The input factor categories determine the rows which contain the applicable scores. The tables have three columns of scores to assess different removal or remedial alternatives. The "Baseline Condition" column is selected for any set of site conditions that do not include a clean-up alternative. This will typically be the current conditions at the MRS, but can also be used to evaluate changes to land use activities, including those associated with the application of LUCs as a remedial action. The "Surface Cleanup" column is selected when evaluating a removal or remedial alternative involving surface clean-up. If the alternative under evaluation involves subsurface clean-up, then scores are selected from the "Subsurface Cleanup" column.

The MEC HA addresses the residual uncertainty of surface and subsurface cleanup. The current methods for detection, discrimination and removing MEC cannot ensure that all MEC are removed during a cleanup. [10] Detection of MEC is a function of size, depth, and orientation of the object. In general, small MEC is more difficult to detect at depth than larger MEC. The MEC HA scores address this residual uncertainty by not reducing scores in several of the input factor categories in the "Surface Cleanup" and "Subsurface Cleanup" columns.

Project teams must determine the type and amount of QA/QC measures to ensure that the cleanup actions are being carried out in accordance with the site-specific requirements.

The final sections of this chapter discuss general issues to consider when scoring the MEC HA, and present a table that summarizes all the input factor scores.

4.1 Energetic Material Type

The type of energetic material is the primary determinant of the severity of the explosive hazard. The six categories for the Energetic Material Type input factor are in Table 4-1. The project team must use the type with the highest hazard level that is known or suspected to be present. Energetic material types are grouped by both their characteristics and inherent explosive hazard. Categories associated with greater relative explosive hazards are listed first.

[10] The exception is to this would be where all soil is removed beyond the maximum depth for the MEC, or down to bedrock. Under these conditions, there should be little or no uncertainty that all MEC have been removed.

Table 4-1. Input Factor Categories: Energetic Material Type

Category	Category Description	Required Information
High explosives and low explosive filler in fragmenting rounds	High explosive (HE) fillers, including bulk explosives and cased munitions filled with compounds such as TNT, tetryl, RDX, and HMX. Fragmenting rounds filled with low explosive fillers (generally black powder) are also included in this category.	• Mark or model of munition (cased munitions) • Type of filler (cased munition) • Type of explosive (bulk explosives)
White phosphorus	A bursting smoke filler that burns rapidly when exposed to oxygen. Skin contact can cause burns.	
Pyrotechnic	Used to send signals, illuminate areas of interest, simulate other weapons during training, and as ignition elements for certain weapons. Pyrotechnics produce heat but less gas than explosives or propellants.	
Propellant	Compositions used to propel projectiles and rockets and to generate gases for powering auxiliary devices.	
Spotting charge	Low explosive or pyrotechnic fillers designed to produce a flash and smoke when detonated, providing observers or spotters a visual reference of munition impact.	
Incendiary	Any flammable material that is used as filler in munitions intended to destroy a target by fire.	

Energetic Material Type Categories: Rationale for Hazard Order

Categories are listed in decreasing order of the severity of anticipated hazards, as follows:

- High explosives are characterized by a very rapid rate of decomposition and detonation. They produce fragments that move out from the detonation at a rapid rate. Low explosive fragmenting rounds combust at a slower rate. They are combined with high explosives for the purpose of the MEC HA categories when contained in cased munitions that fragment when they detonate. Although high explosive rounds detonate more rapidly, both are likely to throw fragments that may present a hazard to people.
- White phosphorus (WP) is ranked next in hazard. It is very dangerous to come into contact with and ignites when exposed to air. Munitions containing WP also contain a high-explosive burster that is designed to split the case and throw WP over the surrounding area.
- Pyrotechnics are designed to produce smoke and an audible signal in training. In general, they are not fragment-producing munitions. Certain pyrotechnic devices, such as grenade simulators, contain photoflash powder.
- Propellants contain low explosives to propel projectiles, rockets, etc. Propellants are more likely to burn than to explode, and they are ranked as less hazardous than WP because they do not typically produce fragments. They are normally consumed as they propel the projectile or rocket to the target.
- Spotting charges are generally low explosives or smoke-producing compounds and are designed to produce smoke, not fragmentation. They are often a fraction of the net explosive weight of the live round. Although spotting charges are generally ranked as low hazards, spotting charges that contain high explosives are scored in the high explosive category.
- Incendiaries are designed to burn structures, materials, or areas. They are typically filled with burning agents such as thickened fuels and metallic filings.

4.1.1 Scores for Energetic Material Type Categories

Table 4-2 shows the scores assigned for each category within the Energetic Material Type input factor. The score for this input factor does not change with cleanup to address residual uncertainty.

Table 4-2. Scores for Energetic Material Type Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100	100	100
	White phosphorus	70	70	70
	Pyrotechnic	60	60	60
	Propellant	50	50	50
	Spotting charge	40	40	40
	Incendiary	30	30	30

4.1.2 Category Changes for Energetic Material Type

The only time the category chosen for Energetic Material Type will change is when new information indicates that the selected category is incorrect.

4.2 Location of Additional Human Receptors

It is possible that additional human receptors, beyond the individual who causes an item to detonate, may be exposed to overpressure and/or fragmentation hazards from the detonation of MEC. This factor requires the project team to identify if places where people might congregate are located either within the MRS or within the ESQD arc. To address uncertainties about the MEC locations, a conservative approach is to extend the ESQD arc from the edge of the MRS. Two sources for the ESDQ arc are the Explosive Siting Plan or the Explosives Safety Submission prepared by the Lead Agency, with input from Project Team members, and approved by Department of Defense Explosives Safety Board (DDESB). Table 4-3 contains the two categories for the Location of Additional Human Receptors input factor.

Places People Might Congregate

The following are examples of places where people might congregate:

- Athletic fields
- Picnic areas
- Campgrounds
- Cultural resource or sacred areas
- Fishing or hunting camps
- Inhabited buildings

Table 4-3. Input Factor Categories: Location of Additional Human Receptors

Category	Category Description	Required Information
Inside the MRS or inside the ESQD arc	Places where people might congregate are located within the MRS or within the ESQD arc established for the MRS.	• Boundary of the MRS (area to be assessed) or hazard assessment area • Specific location of features or facilities that attract people to locations potentially on or near MRS boundaries • The ESQD arc from either the ESS or the ESP
Outside of the ESQD arc	There are no places where people might congregate within the MRS or within the ESQD arc.	

A project team selects the appropriate category for this input factor as follows:

- If people congregate at places within the MRS, then the category for this input factor is "Inside of the MRS or inside the ESQD arc."
- If people congregate at places outside of the MRS boundaries, but within the ESQD arc then the category for this input factor will be "Inside the MRS or inside the ESQD arc".
- If people are not within the MRS and not within the ESQD arc, then the category for this input factor is "Outside of the ESQD arc."

Figure 4-1 illustrates how the distance of potential receptors from the boundary of the MRS could be determined.

4.2.1 Scores for Location of Additional Human Receptors Categories

Scores for these categories are provided in Table 4-4. The scores for these categories do not change with cleanup because clean-up does not impact the presence or absence of places where people might congregate.

Table 4-4. Scores for Location of Additional Human Receptors Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc	30	30	30
	Outside of the ESQD arc	0	0	0

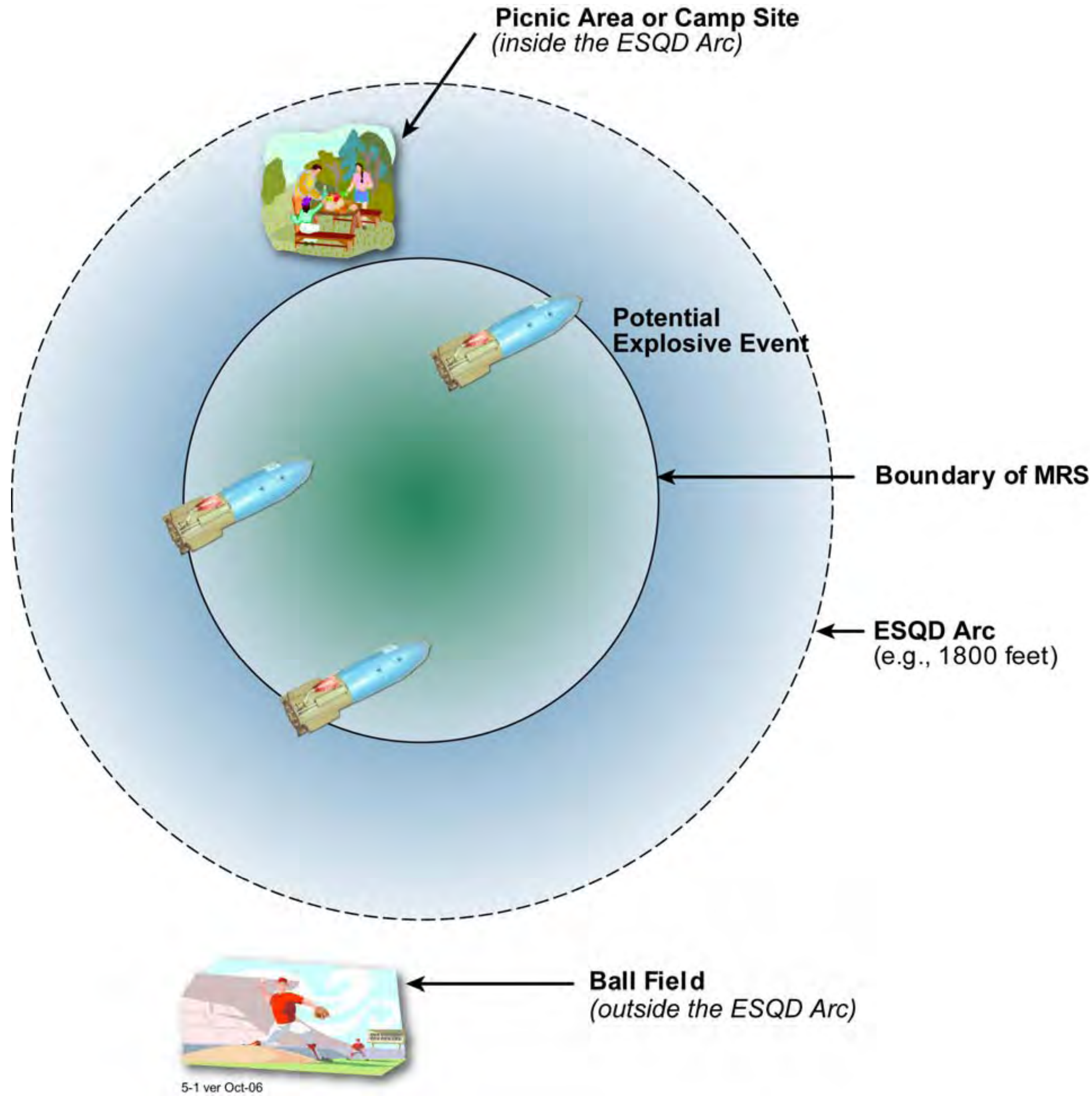


Figure 4-1. Location of Additional Human Receptors

4.2.2 Category Changes for Location of Additional Human Receptors

The category for this input factor should change if planned changes to land use add or remove a feature or facility where people will congregate. If such a feature or facility currently exists within the MRS or within the ESQD arc, and plans exist to remove the facility or feature, or if no feature or facility to attract people exists within the MRS boundary or within the ESQD arc, but future plans include the addition of such a feature, then the input factor category should be changed.

4.3 Site Accessibility

The Site Accessibility input factor describes the ease with which casual users (e.g., trespassers or people taking shortcuts) can access an MRS. This differs from the Potential Contact Hours input factor, which describes the total number of hours associated with site users' participation in planned activities on the MRS. Table 4-5 contains the four categories for the Site Accessibility input factor.

Table 4-5. Input Factor Categories: Site Accessibility

<table>
<tr><th>Category</th><th>Category Description</th><th>Required Information</th></tr>
<tr><td>Full accessibility</td><td>A site with no barriers to entry, including sites with signage but no fencing.</td><td rowspan="4">• Boundary of MRS
• Location and type of fencing
• Terrain and topography within and surrounding MRS
• Location of transportation routes or access points to MRS
• Location of any guarded areas</td></tr>
<tr><td>Moderate accessibility</td><td>A site with some barriers to entry, such as barbed wire fencing or rough terrain.</td></tr>
<tr><td>Limited accessibility</td><td>A site with significant barriers to entry, such as unguarded chain-link fences or requirements for special transportation (e.g., boats or all-terrain vehicles) to reach the site.</td></tr>
<tr><td>Very limited accessibility</td><td>A site with guarded chain-link fences, or terrain that requires special skills and equipment (e.g., mountain climbing) to access.</td></tr>
</table>

These categories give the project team guidelines for determining the appropriate level of accessibility to the site. The category descriptions do not include LUCs. A project team can choose to run multiple iterations of the MEC HA with different Site Accessibility categories to reflect the effects of LUCs. This will help determine the impact of accessibility changes on the overall hazard assessment.

4.3.1 Scores for Site Accessibility Categories

Table 4-6 shows the scores for each of these categories. The scores do not change with cleanup, since cleanup does not affect site accessibility.

Table 4-6. Scores for Site Accessibility Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Site Accessibility	Full accessibility	80	80	80
	Moderate accessibility	55	55	55
	Limited accessibility	15	15	15
	Very limited accessibility	5	5	5

4.3.2 Category Changes for Site Accessibility

If planned future land use controls for the MRS will change accessibility characteristics, then the Site Accessibility input factor category may change as well. Possible changes to accessibility characteristics include the following:

- Change in engineering controls, such as installation or removal of fencing
- The removal of heavy vegetation that impedes access to the MRS
- The construction of a road to the area containing the MRS where one does not currently exist

4.4 Potential Contact Hours

This factor captures the effect of human receptors intentionally performing activities at a site when they might come into contact with MEC. This contact may either deliberately or accidentally initiate an explosive incident.

Both the number of receptors and the amount of time each receptor spends in the MRS contribute to the likelihood of a receptor encountering MEC.

Potential contact hours are calculated on a site-specific annual total basis. These include outdoor activities. Where MEC is on the surface, any outdoor activity could lead to an interaction. Where MEC is located only in the subsurface, an interaction can only result from intrusive activities (e.g., digging a fire pit or latrine, maintaining a trail or fence, or planting a tree).

The project team must estimate both the number of users per year and the number of hours that each user engages in activities that may result in encounters with MEC. Once all of the activities have been identified, the receptor-hours per year for each activity is calculated. The sum of these receptor-hours determines the total receptor-hours per year.

The Potential Contact Hours factor is calculated as follows:

(number of users/year) × (number of hours/use) = receptor hours/year

The categories for this input factor are ranges of receptor-hours per year. These ranges are based on order of magnitude differences between the categories, as shown in Table 4-7.

Table 4-7. Input Factor Categories: Potential Contact Hours

Category	Category Description	Required Information
Many hours	≥ 1,000,000 receptor-hours/year	• Types of land use activities that will occur on the MRS • Average amount of time a person spends on each activity • Number of people who participate annually in each activity
Some hours	100,000 to 999,999 receptor-hours/year	
Few hours	10,000 to 99,999 receptor-hours/year	
Very few hours	< 10,000 receptor-hours/year	

The number of users per year can be estimated various ways, for example:

number of users/year = (number of hikers/week) × (number of weeks park is open/year)

number of users/year = (number of residents who garden) × (number times gardening/week) × (number of weeks in gardening season/year)

4.4.1 Scores for Potential Contact Hours Categories

Table 4-8 shows the scores for each of the Potential Contact Hours categories. Cleanup lowers the scores. This decrease reflects the reduced likelihood that human receptors will come into contact with MEC after cleanup is performed.

Table 4-8. Scores for Potential Contact Hours Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Potential Contact Hours	Many hours	120	90	30
	Some hours	70	50	20
	Few hours	40	20	10
	Very few hours	15	10	5

4.4.2 Category Changes for Potential Contact Hours

Changes in assumptions about the use of LUCs and changes in land use activities can bring about changes in the category for this input factor. The application of engineering controls, such as fencing or barriers, or the use of institutional controls, such as restricting the permissible land use, may reduce the potential contact hours at an MRS. Changes in future land use activities could increase or decrease potential contact hours. For example, a decision to change an area from an open space with no hiking trails to an area with hiking trails, picnic areas, and athletic fields can dramatically increase usage.

4.5 Amount of MEC

This input factor captures the relative quantity of MEC that may remain from past munitions-related activities. The greater the quantity of MEC items, the greater the likelihood that MEC may be encountered. For example, more MEC is likely to be present at a former target area than at a former function test range. Therefore, the target area is given a higher relative score. Table 4-9 contains the categories for the Amount of MEC input factor.

Table 4-9. Input Factor Categories: Amount of MEC

Category	Category Description	Required Information
Target area	Areas at which munitions fire was directed.	• Nature of the original munitions activities or sources of MEC (e.g., target area, OB/OD area) • Boundary of MRS
OB/OD areas	Sites where munitions were disposed of by OB/OD methods. This category refers to the core activity area of an OB/OD area (see "Safety buffer areas" category for information on safety fans and kick-out areas).	
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items. Also includes ranges used for research and development and surveillance.	

Table 4-9. Input Factor Categories: Amount of MEC

Category	Category Description	Required Information
Burial pit	The location of a burial of large quantities of MEC items.	
Maneuver areas	Areas used for conducting military exercises in a simulated conflict area or war zone.	
Firing points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	
Safety buffer areas (range safety fans and OB/OD kick-out areas)	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	
Explosives-related industrial facility	Former munitions manufacturing or demilitarization sites and TNT production plants.	

4.5.1 Scores for Amount of MEC Categories

Table 4-10 shows the scores for the categories of the Amount of MEC input factor. The scores for each category become lower with the increased level of cleanup at an MRS. The reduction in scores reflects both the reduction in the amount of MEC and the lower likelihood that human receptors will come into contact with MEC after cleanup.

Table 4-10. Scores for Amount of MEC Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Amount of MEC	Target area	180	120	30
	OB/OD area	180	110	30
	Function Test Range	165	90	25
	Burial pit	140	140	10
	Maneuver areas	115	15	5
	Firing points	75	10	5
	Safety buffer areas	30	10	5
	Storage	25	10	5
	Explosives-related industrial facility	20	10	5

4.5.2 Category Changes for Amount of MEC

The categories chosen for Amount of MEC will not change unless additional information indicates that the selected category is incorrect.

4.6 Minimum MEC Depth Relative to the Maximum Intrusive Depth

This factor is used to indicate whether MEC items are at depths that can be reached by expected human receptor activity. Table 4-11 contains the categories for this input factor.

Table 4-11. Input Factor Categories: Minimum MEC Depth Relative to the Maximum Intrusive Depth

Category	Category Description	Required Information
Baseline Condition: MEC located surface and subsurface **After Cleanup:** Intrusive depth *overlaps* with subsurface MEC	The area contains munitions that are entirely or partially exposed above the ground surface as well as entirely beneath the ground surface, and the known or suspected minimum depth of the subsurface MEC is less than the expected depth of intrusive activity. See Figure 4-2.	• Specific land use activities within the MRS now or in the future • Maximum intrusive depths associated with each of the activities • Past munitions-related activities that occurred in the MRS • Minimum depth at which MEC is expected to be found (e.g., surface, *x* feet below ground surface), as a result of that activity • Minimum depth at which MEC is expected to be found for each remediation alternative
Baseline Condition: MEC located surface and subsurface **After Cleanup:** Intrusive depth *does not overlap* with subsurface MEC	The area contains munitions that are entirely or partially exposed above the ground surface as well as entirely beneath the ground surface, and the known or suspected minimum depth of the subsurface MEC is greater than the expected depth of intrusive activity. See Figure 4-2.	
Baseline Condition: MEC located only subsurface **Baseline Condition or After Cleanup:** Intrusive depth *overlaps* with minimum MEC depth	The area contains munitions that are entirely beneath the ground surface. The known or suspected minimum depth of the subsurface MEC is less than the expected depth of intrusive activity. See Figure 4-2.	
Baseline Condition: MEC located only subsurface **Baseline Condition or After Cleanup:** Intrusive depth *does not overlap* with minimum MEC depth	The area contains munitions that are entirely beneath the ground surface. The known or suspected minimum depth of the subsurface MEC is greater than the expected depth of intrusive activity. See Figure 4-2.	

Assuming a minimum MEC depth is necessary to determine whether or not it overlaps with the maximum intrusive depth, the results of site-specific geophysical investigations and digging of target anomalies will be the best source of information on the depths of MEC. It will be reasonable to assume that MEC is located both surface and subsurface for the Baseline Conditions in many types of MRSs. If the project team agrees that a past surface clearance has been effective, then it may select one of the two categories with MEC located only in the subsurface for the Baseline Conditions.

Past Surface Clearances

Many sites, especially World War II era FUDS, were surface cleared before they were released from DoD control. Information adequate to determine the extent and effectiveness of these clearances might not be available.

Project teams may have information to support assumptions about whether Baseline Conditions should have MEC located both surface and subsurface, or MEC located only in the subsurface.

The input factor categories are illustrated in Figure 4-2.

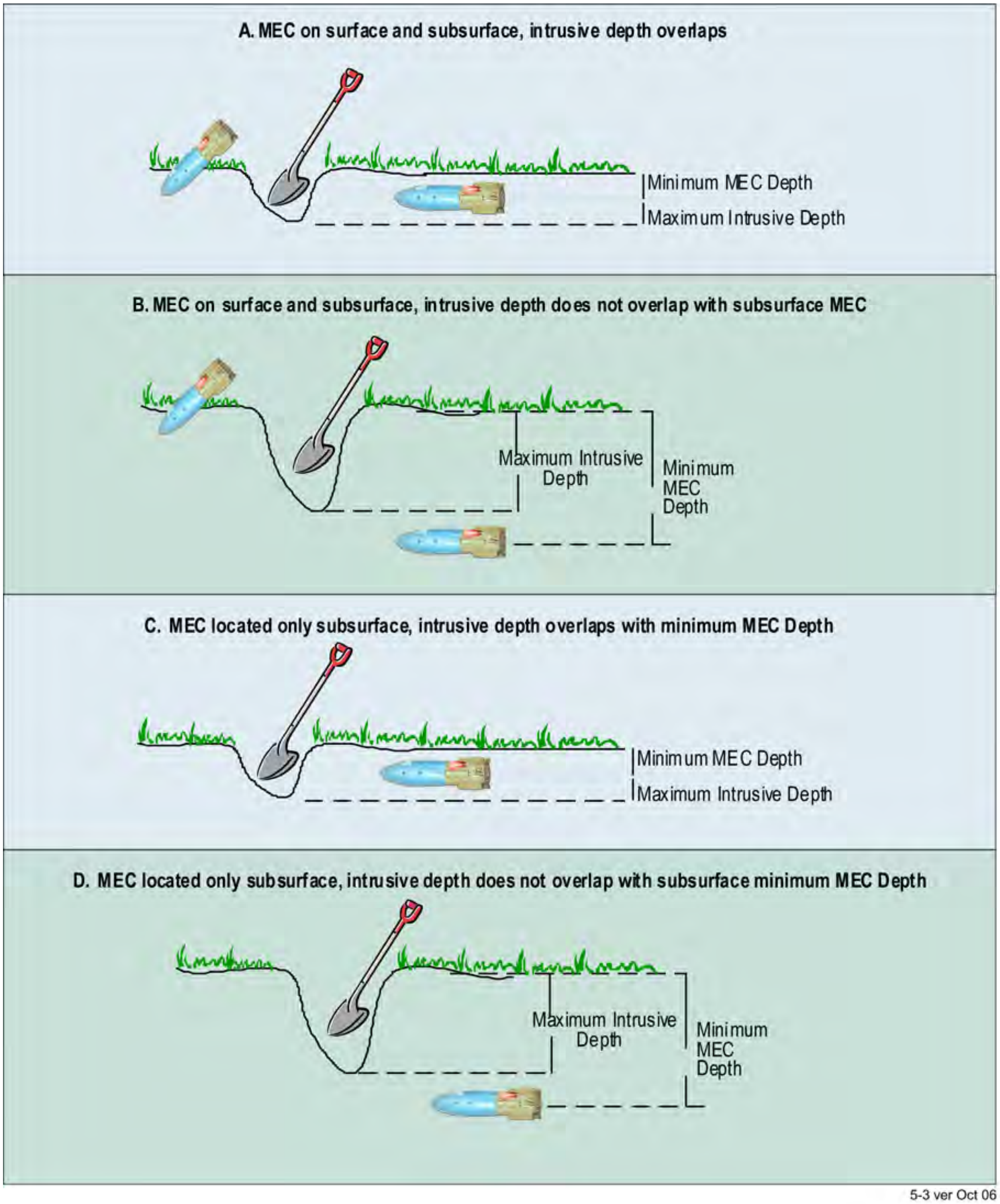


Figure 4-2. Minimum MEC Depth Relative to the Maximum Depth of Receptor Activities

4.6.1 Scores for Minimum MEC Depth Relative to the Maximum Intrusive Depth Categories

Table 4-12 shows the scores for each of these categories.

Table 4-12. Scores for Minimum MEC Depth Relative to the Maximum Intrusive Depth Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Minimum MEC Depth Relative to the Maximum Intrusive Depth	**Baseline Condition:** MEC located surface and subsurface **After Cleanup:** Intrusive depth *overlaps* with subsurface MEC	240	150	95
	Baseline Condition: MEC located surface and subsurface **After Cleanup:** Intrusive depth *does not overlap* with subsurface MEC	240	50	25
	Baseline Condition: MEC located only subsurface **Baseline Condition or After Cleanup:** Intrusive depth *overlaps* with minimum MEC depth	150	N/A*	95
	Baseline Condition: MEC located only subsurface **Baseline Condition or After Cleanup:** Intrusive depth *does not overlap* with minimum MEC depth	50	N/A*	25

*N/A – Not Applicable: Surface cleanups for MEC would not be appropriate for site conditions where MEC is all in the subsurface.

4.6.2 Category Changes for Minimum MEC Depth Relative to the Maximum Intrusive Depth

This category will change when the relationship between the minimum MEC depth and the maximum intrusive depth changes. The minimum MEC depth will only change when a subsurface cleanup is evaluated. Generally, subsurface cleanups to depths that exceed the maximum intrusive depth will be among evaluated alternatives. The MEC HA can also score alternatives where the minimum MEC depth after cleanup remains above the maximum intrusive depth to help evaluate subsurface cleanup alternatives with determined or reasonably anticipated future land uses that are more intrusive than the current land use.

The maximum intrusive depth may change with land use activity changes. Examples of scenarios that may change the maximum intrusive depth include the following:

- Allowing camping in an area where it was previously prohibited.
- Converting open space to cattle grazing, requiring the installation of fencing and water stations.
- Developing an undeveloped area, which may involve extensive grading and excavations for the construction of building foundations.

4.7 Migration Potential

This factor addresses the likelihood that MEC items can be moved by natural processes (e.g., erosion or frost heave). The movement or exposure of MEC items by natural processes can increase the likelihood that receptors will encounter the items.

The categories for this factor are shown in Table 4-13. This input factor category will rarely change over time.

Table 4-13. Input Factor Categories: Migration Potential

Category	Category Description	Required Information
Possible	Historical or physical evidence indicates that it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items or to move surface or subsurface MEC items.	• Climatic and geologic conditions • Types of land cover associated with site (vegetative conditions) • Boundary of MRS area • Location of frost line and potential for frost heave • Rainfall patterns and amounts • Direction of overland flow • Location of areas of erosion activity within MRS • Location or areas of tidal influence within MRS
Unlikely	Historical or physical evidence indicates that natural physical forces in the area (e.g., frost heave, erosion) are unlikely to expose subsurface MEC items or to move surface or subsurface MEC items.	

4.7.1 Scores for Migration Potential

Table 4-14 shows the scoring values for these categories. If subsurface cleanup of MEC occurs, MEC is less likely to be exposed.

Table 4-14. Scores for Migration Potential Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
Migration Potential	Possible	30	30	10
	Unlikely	10	10	10

4.7.2 Category Changes for Migration Potential

The project team can decide to change this input factor category if specific measures are taken to control migration, or if new information about site dynamics indicates greater chance for migration than the project team assumed originally.

4.8 MEC Classification

This input factor describes how easily an initiating receptor might detonate MEC. By definition, UXO are 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 whether by malfunction, design, or any other cause. The failure of a military munition to function as designed is what creates the greatest hazard with MEC. Although all UXO are dangerous and subject to detonation, some of the UXO have fuzes are more susceptible to functioning and thus are more hazardous and likely to function by casual or intentional contact. These MEC have been designated “UXO Special Case.”

There are a number of fuzed DMM that may more easily arm and function. These limited DMM are given the category “Fuzed DMM Special Case.” Other fuzed DMM less likely to arm are in the “Fuzed DMM” category to reflect the hazard difference between the two categories of fuzed DMM.

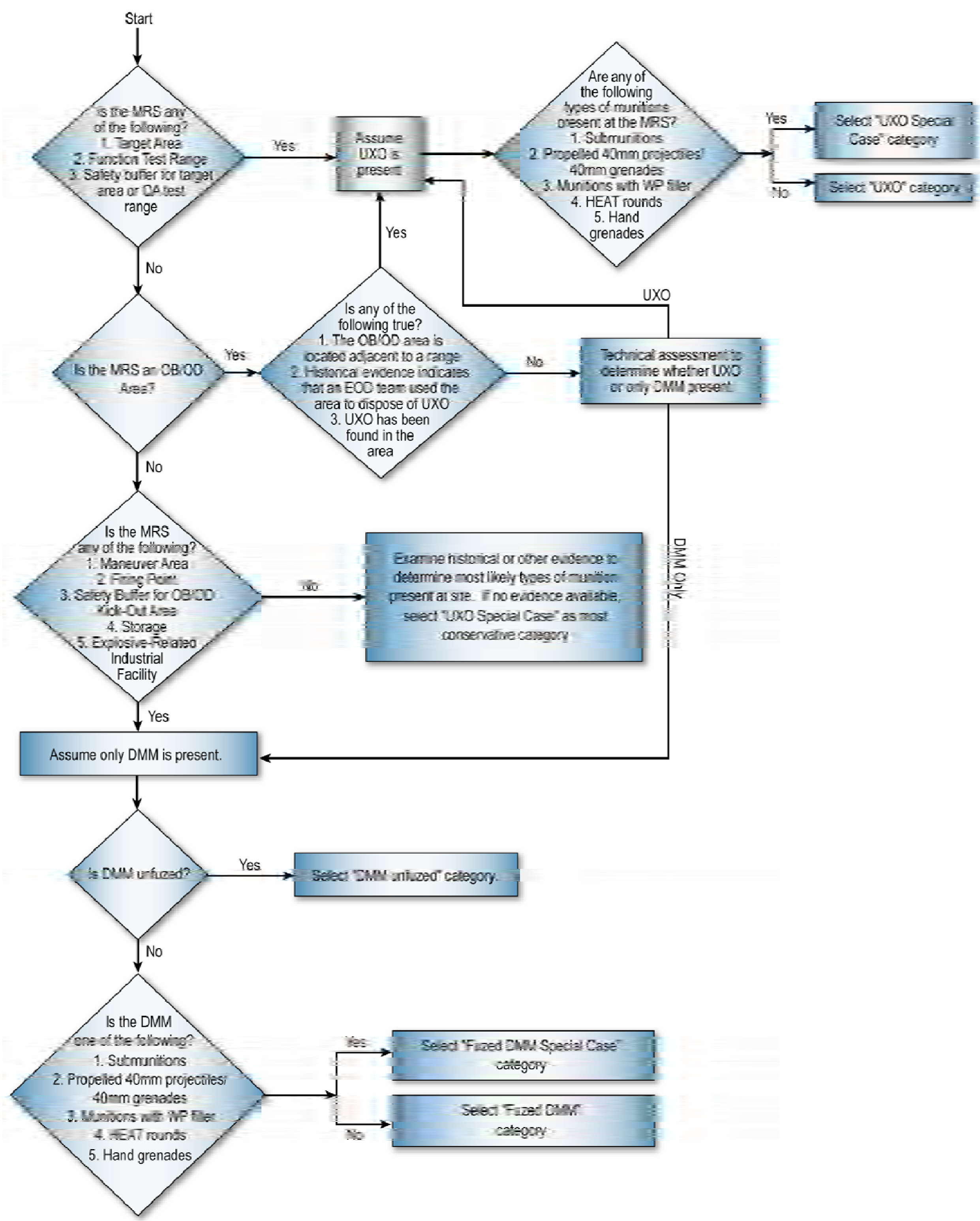
Table 4-15 contains the categories for this input factor. The categories are listed in order from those posing the highest explosive hazard to those posing the lowest.

Table 4-15. Input Factor Categories: MEC Classification

Category	Category Description	Required Information
UXO Special Case	UXO items with fuzes that are more likely to function with any movement (e.g., all-way-acting fuzes) or potential environmental conditions (e.g., piezoelectric fuzes).	• Nature of munitions-related activities that took place on the MRS • Types of munitions (mark or model) • Presence and type of fuzing • State of fuzing (armed or unarmed)
UXO	All other UXO items.	
Fuzed DMM Special Case	DMM with a fuzing mechanism present, but not armed (put into a state of readiness) for use. DMM with special case fuzes can be armed and functioned through human activity (e.g., hand grenades).	
Fuzed DMM	DMM with a fuzing mechanism present, but not armed (not put into a state of readiness) for use. Fuzes on DMM in this category require high inertial energy (e.g., g-forces or rapid rotation) to be armed.	
Unfuzed DMM	DMM without fuzing mechanisms.	
Bulk explosives	Explosive material that is not contained in a cased munition or is present in soils or sediment.	

UXO items are always more hazardous than DMM. Where uncertainty exists about the condition of MEC, conservative assumptions should be made and documented. For example, if there is uncertainty about type of fuzes in DMM, then the conservative assumption would be the input factor category Fuzed DMM Special Case.

The flowchart in Figure 4-3 provides a decision process that can be used to determine the category for MEC Classification for cased munitions. A text summary of the decision process is also provided.



901
902 **Figure 4-3. Selecting the MEC Classification Category for Cased Munitions**

UXO: Project teams can assume UXO is present in target areas, QA function test ranges, and safety buffers for target areas or QA function test ranges. UXO may also be present in OB/OD areas when:

- The OB/OD area is located adjacent to a range, indicating that it was sited to serve as a UXO disposal area.
- Historical evidence indicates that an explosive ordnance disposal team used the OB/OD area to dispose of UXO.
- UXO has been found in the OB/OD area.

If these circumstances do not apply, then it is probably more reasonable to assume that the OB/OD area only contains DMM. DMM in OB/OD areas have "experienced abnormal environments"[11] (i.e., have been subjected to attempted demilitarization by OB/OD) and should be *scored as UXO* until assessed and determined to be DMM by technically qualified personnel.

If the MEC is UXO, the project team must determine whether the UXO is special case. When the following types of MEC are present, the project team should select the "UXO Special Case" category for this input factor:

- All submunitions
- Rifle propelled 40mm projectiles (often called 40mm grenades)
- All munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- All mortar rounds

DMM: Sites where a project team can assume that the MEC items are DMM include the following:

- OB/OD Areas where a DMM has been found
- Maneuver areas
- Firing points
- Burial pit
- Storage

The DMM can be either fuzed or unfuzed. If fuzed, then the fuze category for the DMM should be determined. The "Fuzed DMM Special Case" category includes the following:

- All submunitions
- Rifle propelled 40mm projectiles (often called 40mm grenades)
- All munitions with white phosphorus filler
- HEAT rounds
- Hand grenades
- All mortar rounds

4.8.1 Scores for MEC Classification Categories

Table 4-16 shows the scores for each of these categories.

[11] Minutes of the 327th Meeting of the Department of Defense Explosives Safety Board, 14 December 2004.

Table 4-16. Scores for MEC Classification Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
MEC Classification	UXO Special Case	180	180	180
	UXO	110	110	110
	Fuzed DMM Special Case	105	105	105
	Fuzed DMM	55	55	55
	Unfuzed DMM	45	45	45
	Bulk explosives	45	45	45

4.8.2 Category Changes for MEC Classification

The categories chosen for MEC Classification will not change unless additional information indicates that the selected category is incorrect.

4.9 MEC Size

This factor indicates the ease with which MEC can be moved by a receptor. A receptor is more likely to pick up or interact with a small item. For example, an individual is more likely to pick up or accidentally kick a grenade than a large bomb.

"Small" and "Large" are the categories used to describe this input factor. Large MEC is equal to or greater than 90 pounds (e.g., a 155mm projectile). It is unlikely that receptors could move MEC weighing over 90 pounds without special equipment. Table 4-17 contains the categories for this input factor.

Table 4-17. Input Factor Categories: MEC Size

Input Factor Category	Category Description	Required Information
Small	MEC items that weigh less than 90 pounds; small enough for a receptor to be able to move and initiate a detonation.	• Mark or model of munitions used at site • Outer diameter of munition
Large	MEC items that weigh 90 pounds or more; too large to move without equipment.	

4.9.1 Scores for MEC Size Categories

Table 4-18 shows the scores for MEC Size. The scores for these categories do not change with clean-up.

Table 4-18. Scores for MEC Size Categories

Input Factor	Category or Value	Score		
		Baseline Condition	Surface MEC Cleanup	Subsurface MEC Cleanup
MEC Size	Small	40	40	40
	Large	0	0	0

4.9.2 Category Changes for MEC Size

The categories chosen for MEC Size will not change unless additional information indicates that the selected category is incorrect.

4.10 Scoring Considerations

Project teams may find it useful to score the MRS several times to reflect different site conditions. This includes conditions after cleanup, different land use activities, or land use controls.

Information on current, determined or reasonably anticipated future land use activities is used for the selection of categories for four input factors:

- Location of Additional Human Receptors
- Site Accessibility
- Potential Contact Hours
- Minimum MEC Depth Relative to the Maximum Intrusive Depth

Outdoor activities create the greatest exposure to MEC. Each land use type (e.g., residential, industrial or commercial, recreational, and open space) may have associated outdoor activities. Residential users may garden or build an addition onto their home. Construction, agriculture, and mining are by their nature intrusive; examples include upgrading or replacement of buried infrastructure and seasonal plantings or landscape upgrades.

Project teams will need to agree on the determined or reasonably anticipated future land use activities. The CERCLA process requires the evaluation of “reasonably anticipated” future land use. The NCP preamble suggests that residential land use may be assumed in the absence of other information, to ensure that uncertainty errs on the side of conservatism.[12] EPA land use guidance emphasizes that project teams evaluate reasonable assumptions that are sufficiently conservative to be protective into the future.[13]

In order to fully evaluate current and future land use activities, the project team will need to obtain the following information for every MRS that is assessed:

- Location of places where people may congregate, either within the boundaries of the MRS or in proximity (within the ESQD arc) of the boundaries of the MRS.
- Specific separate land use activities (e.g., plowing, gardening, construction) that might bring receptors into contact with MEC. When MEC is located in the subsurface, this will include only intrusive activities.
- Intrusive depth of all activities.
- Number of people engaging in each activity per year.
- Duration of each activity.

Sources of information on future land use scenarios include, but are not limited to, zoning maps, local government master plans, local reuse authorities for BRAC sites, base master plans (for

[12] 40 CFR 300, NCP Final Rule, 55 *Federal Register* 8710, March 8, 1990.
[13] U.S. EPA, *Land Use in the CERCLA Remedy Selection Process*, OSWER Directive No. 9355.7-04, May 25, 1995.

active bases), historical land use trends, parcel ownership maps from local government, and public park authorities.

The MEC HA supports the evaluation of removal or remedial actions that are protective of human health and the environment. The project team using the CERCLA removal or remedial process will often identify two types of removal or remedial alternatives:

- Cleanup of MEC items from the surface and subsurface. The major variation will be the depth and area covered by the cleanup.
- Identification of LUCs that effectively control potential exposure to any remaining MEC.

Response actions can range from removal of MEC items combined with use of LUCs, to use of LUCs alone. The NCP remedy preference is that institutional controls not be the sole remedy unless treatment is impracticable.

Removal or remedial alternatives are input factors. Each alternative can affect various input factor categories. The project team must clearly describe these alternatives to ensure that changes in selections of input factor categories reflect reasonable assumptions.

Land Use Controls (LUCs)

LUCs include a wide range of restrictions or controls that arise from the need to protect human health and the environment and that limit the use of or exposure to any portion of a property. They include both *engineering* and *institutional* controls.

Engineering controls are physical barriers, such as fences, walls, or site security such as guards that restrict access to a site.

Institutional controls are legal or other non-engineered controls on access. Examples include zoning, permitting, deed notifications, deed restrictions, sign-posting requirements, and restrictive easements or covenants.

4.11 Summary of MEC HA Scores

Table 4-19 summarizes all of the scoring tables presented in this chapter. Scores for the categories are in multiples of five, with a maximum possible score of 1000 and a minimum possible score of 125. The numeric scores reflect the relative contributions of the different input factors to MEC hazard. The MEC HA scores should not be interpreted as quantitative measures of explosive hazard. The use of the hazard levels in the CERCLA process is described in Chapter 5.

Table 4-19. Complete MEC HA Scoring Table

Input Factor	Input Factor Category	Score: Baseline Condition	Score: Surface Cleanup	Score: Subsurface Cleanup
Energetic Material Type	High Explosives and Low Explosive Filler in Fragmenting Rounds	100	100	100
	White Phosphorus	70	70	70
	Pyrotechnic	60	60	60
	Propellant	50	50	50
	Spotting Charge	40	40	40
	Incendiary	30	30	30
Location of Additional Human Receptors	Inside MRS or inside the ESQD arc	30	30	30
	Outside of the ESQD arc	0	0	0

Table 4-19. Complete MEC HA Scoring Table

Input Factor	Input Factor Category	Score: Baseline Condition	Score: Surface Cleanup	Score: Subsurface Cleanup
Site Accessibility	Full Accessibility	80	80	80
	Moderate Accessibility	55	55	55
	Limited Accessibility	15	15	15
	Very Limited Accessibility	5	5	5
Potential Contact Hours	Many Hours	120	90	30
	Some Hours	70	50	20
	Few Hours	40	20	10
	Very Few Hours	15	10	5
Amount of MEC	Target Area	180	120	30
	OB/OD Area	180	110	30
	Function Test Range	165	90	25
	Burial Pit	140	140	10
	Maneuver Areas	115	15	5
	Firing Points	75	10	5
	Safety Buffer Areas	30	10	5
	Storage	25	10	5
	Explosive-Related Industrial Facility	20	10	5
Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth	**Baseline Condition:** MEC located surface and subsurface; **After Cleanup:** Intrusive depth overlaps with subsurface MEC	240	150	95
	Baseline Condition: MEC located surface and subsurface; **After Cleanup:** Intrusive depth does not overlap with subsurface MEC	240	50	25
	Baseline Condition: MEC located only subsurface; **Baseline Condition or After Cleanup:** Intrusive depth overlaps with minimum MEC depth	150	N/A*	95
	Baseline Condition: MEC located only subsurface; **Baseline Condition or After Cleanup:** Intrusive depth does not overlap with minimum MEC depth	50	N/A*	25
Migration Potential	Possible	30	30	10
	Unlikely	10	10	10
MEC Classification	UXO Special Case	180	180	180
	UXO	110	110	110
	Fuzed DMM Special Case	105	105	105
	Fuzed DMM	55	55	55
	Unfuzed DMM	45	45	45

Table 4-19. Complete MEC HA Scoring Table

Input Factor	Input Factor Category	Score		
		Baseline Condition	Surface Cleanup	Subsurface Cleanup
MEC Classification (continued)	Bulk Explosives	45	45	45
MEC Size	Small	40	40	40
	Large	0	0	0

*N/A – Not Applicable: Surface cleanup for MEC would not be appropriate for site conditions where MEC is all in the subsurface.

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CHAPTER 5: OUTPUT OF THE MEC HA: HAZARD LEVELS

This chapter discusses both the scores that are associated with each hazard level and the meaning of the different levels. The chapter also describes the use of the MEC HA in the CERCLA process.

Important Terms in This Chapter

CERCLA Nine Criteria
The factors evaluated during a CERCLA feasibility study to evaluate remedial action alternatives.

Hazard Levels
One of four groups or ranges of numbers that is the result of the scoring process of the MEC HA. Each hazard level category describes the relative hazard of a munitions response site.

Removal Action
A response action under CERCLA that addresses immediate threats to human health and the environment.

Remedial Action
A response action under CERCLA that is intended to be a permanent remedy. Remedial actions can be taken instead of or in addition to a removal action.

When the MEC HA scoring is complete, each MRS, and each alternative response or reuse evaluated for that MRS, will have a score that falls into one of four hazard levels.

Each MRS may have several MEC HA scores, depending on alternatives responses and reasonably anticipated future land uses. Different assumptions about land use activities, cleanup options, or LUCs can be considered in combination or can be considered separately. A typical MEC HA conducted after a thorough investigation (removal or remedial) should evaluate the following alternatives.

- No action
- LUCs alone
- Surface cleanup with or without LUCs, under current, determined or reasonably anticipated future land uses
- Surface and subsurface cleanup both with and without LUCs, under current, determined or reasonably determined future land uses

5.1 Scoring and Hazard Levels

Table 5-1 presents the four MEC HA Hazard Levels. The Hazard Levels should be considered the final MEC HA result, not the total score. An MRS that scored 870 should be treated the same as one that scored 920. They are both Hazard Level 1 sites. The score ranges for the Hazard Levels were based on sensitivity runs that are documented in Appendix D.

Table 5-1. Hazard Level Scores

Hazard Level	Maximum MEC HA Score	Minimum MEC HA Score
1	1000	840
2	835	725
3	720	530
4	525	125

5.1.1 Hazard Level 1

This category identifies sites with the highest potential explosive hazard conditions. There may be instances where there is an imminent threat to human health from MEC. This hazard may be so obvious that an emergency response is appropriate without calculating a MEC HA.

Where an emergency response was performed, it would be appropriate to calculate a MEC HA after the imminent threat was addressed. As an example, an emergency response surface removal may be conducted at an MRS where there are both surface and subsurface MEC. The MEC HA score after surface cleanup may indicate that additional responses (subsurface cleanup and/or the application of LUCs) would reduce the hazard level and leave the MRS safer for the current, determined or reasonably anticipated future land use.

Typical characteristics of a Hazard Level 1 site conditions include the following:

- High-explosive-filled UXO, usually “UXO Special Case” on the surface
- A former target area or OB/OD area
- An MRS with full or moderate accessibility

5.1.2 Hazard Level 2

Typical characteristics of a Hazard Level 2 site conditions include the following:

- UXO or Fuzed DMM Special Case on the surface, or intrusive activities that overlap with minimum depths of MEC located only subsurface
- Former target area, OB/OD area, function test range, or maneuver area
- An MRS with full or moderate accessibility

A heavily used MRS with surface MEC and intrusive activities that originally scored in Hazard Level 1 would score in Hazard Level 2 after a surface cleanup.

5.1.3 Hazard Level 3

An MRS scored in Hazard Level 3 would be considered safe for the current land use without further munitions responses, although not necessarily suitable for reasonably anticipated future use. Generally, Hazard Level 3 MRSs have restricted access or a low number of contact hours, or both, and will typically have MEC only in the subsurface, with no intrusive activity below the minimum depth of the MEC. Two different possible Hazard Level 3 scenarios are described below.

Scenario 1

- The MRS is a former range fan. The target area is addressed under a separate hazard assessment.
- The MRS is fully accessible by a large number of people who will conduct non-intrusive activities such as hiking.

Scenario 2

- The MRS is golf course built over a bombing range. The bombing range was capped with several feet of soil before grading for a golf course. There is no intrusive use that exceeds the depth of the cap.
- The MRS was cleared prior to a change in reuse but the quality of the clearance cannot be determined. Information exists that the bombing range covered a larger area than the golf course.
- The area adjacent to the golf course is planned for residential and commercial development.

5.1.4 Hazard Level 4

An MRS scored in Hazard Level 4 is compatible with current and determined or reasonably anticipated future use.

Typical characteristics of an MRS in Hazard Level 4 may include the following:

- Either a MEC cleanup was performed or the type of munitions activity and subsequent investigations indicate that MEC is not likely to be present.
- The evaluated alternative supports the current, determined and reasonably anticipated future land uses.

LUCs may be required to reduce the MEC hazard level to support the reasonably anticipated land use. As an example, an MRS that was a range fan may be a Hazard Level 3 without LUCs, but be an Hazard Level 4 with LUCs.

The known presence of MEC at an MRS means that an explosive hazard may exist. This means that an MEC may still pose a hazard in MRSs in Hazard Level 4

5.2 MEC HA in the CERCLA Remedy Evaluation and Selection Process

The evaluation of removal and remedial action alternatives is required under the CERCLA. The primary differences between CERCLA removal and remedial programs are the urgency of a response and the objectives considered for the site. Removals must contribute to the effectiveness of the long-term actions of the remedial program. This section explains how the MEC HA input factors and hazard levels provide site-specific information that supports evaluations and decisions for removal or remedial actions.

> **Distinctions Between Removal and Remedial Actions**
>
> **"**Removals are distinct from remedial actions in that they may mitigate or stabilize the threat rather than comprehensively address all threats at a site."
>
> Preamble, National Contingency Plan, *Federal Register* vol. 55, p. 8695 (March 1990)

5.2.1 CERCLA Removal Process

CERCLA provides for three types of removal actions: emergency removals, time-critical removal actions (TCRA), and non-time-critical removal actions (NTCRA). Emergency removal actions and TCRA are generally taken to abate immediate threats to human health and the environment. All removal actions are required to contribute to the performance and protectiveness of future remedial actions.

Site investigations are performed and the evaluation of cleanup actions is documented in an EE/CA report in a NTCRA. An action memorandum documents the removal action. The removal alternatives must be protective of human health and the environment but will often be the first or an interim step in the cleanup process. Additional response actions may be necessary through the remedial program.

The MEC HA supports the analysis of EE/CA removal alternatives. The EE/CA examines three broad criteria: Effectiveness, Implementability, and Cost. The MEC HA input factors provide information to support evaluation of the protectiveness aspect of the Effectiveness criterion. In addition, the MEC HA provides data for the evaluation of Effectiveness (e.g., community and worker impacts and compliance with ARARs). The MEC HA input factors of Energetic Material

Type, Location of Additional Human Receptors, Site Accessibility, Amount of MEC, MEC Classification, and MEC Size support evaluation of the Implementability of each alternative. Cost data is neither collected nor evaluated in the MEC HA.

Table 5-2 describes the CERCLA selection criteria for evaluating removal alternatives.[14]

Table 5-2. CERCLA Removal Action Alternative Selection Criteria

Removal Criteria	Purpose
Effectiveness	• Establish protectiveness of remedy to human health and the environment. • Evaluate short-term effectiveness issues such as effect on the community and worker protection. • Ensure compliance with ARARs to the extent practicable and consistent with the urgency of the situation.
Implementability	• Consider technical feasibility and availability of resources to support the alternative. • Consider administrative feasibility (including required LUCs).
Cost	• Compare costs of alternatives, including capital costs, operation and maintenance costs, and present worth cost.

5.2.2 CERCLA Remedial Process

Under the CERCLA remedial process, site investigations are undertaken and the evaluation of remedial action alternatives is documented in an RI/FS.[15] The selection of remedial actions is documented in a Record of Decision (ROD)/Decision Document (DD). Each alternative is evaluated using the CERCLA nine-criteria to select the alternative that best meets the statutory requirements. The statute requires that the selected remedy be protective of human health and the environment; comply with ARARs; utilize treatment to reduce the toxicity, mobility, or volume of contamination to the maximum extent practicable; and be cost-effective.

Treatment Under CERCLA

Section 121 of CERCLA establishes a strong preference for cleanup from remedies to reduce the toxicity, mobility, or volume at the site and achieve “cleanup to the maximum extent practicable.” One objective of the nine criteria evaluation process is to identify remedies that meet those goals.

For MEC sites where the treatment options are generally limited to a narrow range of destruction alternatives (blow-in-place, consolidated shot, or containerized versions of these), the destruction of the MEC should be considered as constituting cleanup that reduces the amount or volume of MEC. At sites where an MEC item may be easily moved by physical processes such as erosion, frost heave, flooding, or tidal currents, removing or destroying such MEC should be considered as reduction of the mobility of MEC.

The CERCLA nine-criteria for analysis of remedial action alternatives are divided into **threshold criteria** that must be met, **balancing criteria** to form the primary basis to compare and contrast remedial action alternatives, and **modifying criteria** to reflect State and community acceptance and input on the analysis of alternatives. Table 5-3 provides a summary of the CERCLA nine criteria

[14] U.S. EPA, *Conducting Non-Time-Critical Removal Actions Under CERCLA*, EPA/540/F-94/009, December 1993.
[15] U.S. EPA, ***Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA***, Interim Final, OSWER Directive 9355.3-01, October 1988.

and how the MEC HA Input Factors and Hazard Levels support the nine criteria. The MEC HA supports these analyses and supports remedy selection. The MEC HA is not the decision tool for remedy selection.

Table 5-3. CERCLA Nine-criteria and MEC HA Inputs and Outputs: Considerations for Evaluation of Remedial Alternatives

CERCLA Nine-criteria	Description from EPA Guidance	Associated MEC HA Inputs and Outputs
Protection of Human Health and the Environment	Draws on assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	All of the input factors contain information related to protection of human health. Changes to site conditions brought about by activity changes, treatment, or LUCs are reflected in changes input factor categories and Hazard Levels.
	The RI/FS should describe in the context of this criterion how alternatives achieve adequate protection and should describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation also allows for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.	
Compliance With ARARs	This evaluation criterion is used to determine whether the alternative will meet all of its Federal and State ARARs (as defined in CERCLA 121) that have been identified in previous stages of the RI/FS process. The analysis should identify which are applicable, relevant and appropriate, or "to be considered," and describe how the alternative meets these requirements. If an ARAR cannot be met, the basis for justifying one of the six ARAR waiver requirements should be discussed. Three types of ARARs are defined: chemical-specific (related to cleanup levels); action-specific (related to conduct of cleanup actions); and location-specific (related to protection of specific locations).	The MEC HA guidance instructs project teams to assess the presence of critical infrastructure, cultural and ecological resources. These can include location-specific and action-specific ARAR considerations.

Table 5-3. CERCLA Nine-criteria and MEC HA Inputs and Outputs: Considerations for Evaluation of Remedial Alternatives

CERCLA Nine-criteria	Description from EPA Guidance	Associated MEC HA Inputs and Outputs
Long-Term Effectiveness	Magnitude of Residual Risk. This addresses the residual risk remaining from untreated wastes, or treatment residuals at the conclusion of remedial actions.	The MEC HA scores for the input factors of Energetic Material Type, MEC Category and MEC Size are not affected through cleanup actions. This reflects the uncertainty that all MEC can be found and removed. If any MEC remain, the attributes associated with these input factors are not changed. The Site Accessibility, Potential Contact Hours, Amount of MEC and Minimum MEC Depth Relative to the Maximum Intrusive Depth input factor scores will change with various response actions to reflect changes in hazards.
	Adequacy and Reliability of Controls. This addresses the adequacy and suitability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site.	For MEC sites evaluated under the MEC HA, the input factors associated with LUCs include engineering controls (fences, signage, etc.) and institutional controls (land use restrictions). The MEC HA input factors for Site Accessibility and Potential Contact Hours can be affected through changes in land use and activities. This in turn will result in changes in the Hazard Levels. The long-term effectiveness and permanence of LUCs will in turn take into account the administrative feasibility of maintaining the LUCs and the potential risks or hazards should the controls fail. Evaluation of the effectiveness of LUCs could in turn lead to reassessment of hazards without LUCs.

Table 5-3. CERCLA Nine-criteria and MEC HA Inputs and Outputs: Considerations for Evaluation of Remedial Alternatives

CERCLA Nine-criteria	Description from EPA Guidance	Associated MEC HA Inputs and Outputs
Reduction of Toxicity, Mobility, or Volume Through Treatment	This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of a hazardous substance, especially the principal threats.	The following MEC HA input factors provide information related to this criterion: Amount of MEC, Minimum MEC Depth Relative to the Maximum Intrusive Depth, and Migration Potential. All of these factors can be affected through treatment. This in turn will result in changes to scores and Hazard Levels. For MEC sites where the treatment options are generally limited to certain disposal options (blow-in-place, consolidated shot, containerized versions of these), the destruction of the MEC should be considered as constituting treatment that reduces the amount of MEC found. This is analogous to reduction in volume. Mobility in the context of waste treatment, where a hazardous substance is immobilized, does not have a direct analogy for MEC. Mobility may be considered a function of the ease of moving a MEC item, as well as physical processes (e.g., erosion, frost heave, flooding of surrounding soil or sediment, tidal currents) that may affect movement of MEC from its original depth or location. To the extent that MEC is detected, recovered, and disposed of, its ability to move is reduced.
Short-Term Effectiveness	This criterion addresses four areas. These include protection of the community during remedial actions; protection of workers during remedial actions; environmental impacts during remedial actions; and the time required to implement and complete the remedial action. In addition, this criterion should address how any potential adverse effects associated with these four areas can be mitigated or eliminated during remedial actions.	Information from several of the input factors should be considered in the analysis under this criterion. Location of Additional Human Receptors and Site Accessibility are key considerations in evaluating current conditions and potential mitigation actions that would be appropriate under evaluation of other alternatives. Consideration of mitigation measures can affect the input scores and in turn affect the scores and Hazard Levels.
Implementability	Technical Feasibility. This factor addresses construction and operation technical difficulties; availability and reliability of technologies to be implemented readily and without delays; the ease of undertaking additional actions at the project site where the remedy under consideration could make a future action more difficult; and long-term management issues associated with the action.	The MEC HA addresses this aspect of the criterion. It does this through information on Energetic Material Type, Location of Additional Human Receptors, Site Accessibility, Amount of MEC, MEC Classification, and MEC Size.
	Administrative Feasibility. Activities needed to coordinate with other offices and agencies (e.g., rights of entry for on-site activities and permits for off-site activities).	The MEC HA does not address this aspect of the criterion. However, administrative requirements associated with maintaining LUCs would need to be evaluated to determine if MEC HA evaluations of LUCs are based on realistic assumptions.

Table 5-3. CERCLA Nine-criteria and MEC HA Inputs and Outputs: Considerations for Evaluation of Remedial Alternatives

CERCLA Nine-criteria	Description from EPA Guidance	Associated MEC HA Inputs and Outputs
Implementability (continued)	Availability of Services and Materials. This includes availability of off-site treatment, storage, and disposal facilities; availability of equipment and specialists; availability of services and materials; and availability of prospective technologies.	The MEC HA does not directly address this aspect of the criterion.
Cost	The costs of activities typically include estimated capital costs (direct and indirect); annual operation and maintenance costs; a present worth analysis; and an evaluation of the accuracy of costs in the +50% to -30% range.	The MEC HA does not incorporate costs.
State Acceptance	This assessment evaluates the technical and administrative issues and concerns the State (or support agency in the case of State-led sites) may have regarding each of the alternatives. The project team will generally discuss this assessment during the course of the development and implementation of the RI/FS. It is also formally addressed in the decision documents.	The MEC HA is built on several principles, including systematic planning processes and collaborative decision-making. The input factors and Hazard Levels do not directly reflect these principles. However, when project teams follow these principles, then consensus decision-making and State acceptance is more likely to occur.
Community Acceptance	This assessment evaluates issues and concerns the public may have regarding each of the alternatives. As with State Acceptance, this criterion will be addressed in the decision document once comments on the RI/FS reports and proposed plan have been received.	The MEC HA is built on several principles, including systematic planning processes and collaborative decision-making. The input factors and Hazard Levels do not directly reflect these principles. However, when project teams follow these principles, then consensus decision-making and community acceptance is more likely to occur.

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GLOSSARY

The source for each term in this glossary is identified in one of two ways. First, when the term is used in a manner that is specific to this document, the definition is introduced with the phrase, "For the purposes of the MEC HA." Specific references are provided for the definitions of most other terms.

Accessibility. For the purposes of the MEC HA, a component of explosive hazard that reflects the ease with which a casual user can enter an area and thereby be potentially exposed to an MEC hazard.

Applicable or relevant and appropriate requirements (ARARs). *Applicable* requirements are those cleanup standards of control, and other substantive environmental protections, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. *Relevant and appropriate* requirements are those same standards mentioned above that, although not applicable to specific aspects of the CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site.[1]

Ammunition and explosives storage facility. Any facility used for the storage of military munitions. This definition includes, but is not limited to, earth-covered magazines, above-ground magazines, and open-air storage areas.[2]

Amount of MEC. For the purposes of the MEC HA, this input factor to the MEC HA captures the *relative* quantity of MEC that may remain from past munitions-related activities at the MRS. The greater the number of MEC items, the greater the likelihood that one may be encountered by a receptor. Source area types (such as target areas, open burning/open detonation areas) are used to indicate this relative amount of munitions.

Archive search report (ASR). A historical records review process for munitions responses, developed by the U.S. Army Corp of Engineers. An ASR is an initial historical records review conducted at FUDS that have the potential for munitions contamination. The purpose of this records search is to locate and retrieve sufficient information related to the presence and use of military munitions at the site to determine program eligibility. When evidence of military munitions is found, it is documented in the ASR. The ASR serves as initial documentation of the FUDS as a MRS. In the event the ASR shows that a site may contain MEC, additional, more exhaustive historical investigation may be required.[3]

Baseline risk assessment. An assessment conducted using the data collected during the RI to characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to groundwater or surface water, releasing to air by leaching through soil, remaining in the soil, and bioaccumulating in the food chain.[4]

Basic types of munitions. Small arms ammunition, grenades, artillery ammunitions, bombs, pyrotechnics, rockets, jet-assisted take-offs, mines (sea/land), demolition materials, guided missiles, cartridge-actuated devices for aircraft use, torpedoes.[5]

Bulk explosives. Explosives that are not contained in a cased munition. They can result from industrial processes, discarded donor charges used for demolition, or explosives released from low-ordered rounds. The first two sources could result in large amounts of bulk explosives; large amounts are much less likely with the third source. In the MEC HA, the amount of concern is the amount associated with the *"maximum credible event*" for the scenario in question.

Buried munitions. See definition for *discarded military munitions* (DMM).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Commonly known as Superfund, a Federal law that provides for the cleanup of releases from abandoned waste sites that contain hazardous substances, pollutants, and contaminants.[4]

Conceptual Site Model (CSM). A description of a site and its environment that is based on existing knowledge and is updated regularly. It describes sources of MEC at a site; actual, potentially complete, or incomplete exposure pathways; current or reasonably anticipated future land use; and potential receptors. The source-receptor interaction is one descriptive output of a CSM. The CSM serves as a planning instrument, a modeling and data interpretation aid, and a communication device among the response team members.[6]

Critical infrastructure. For the purposes of the MEC HA, unoccupied structures that provide vital resource to the surrounding community. Examples of infrastructure include, but are not limited to, electrical transmission or distribution lines, telephone lines, electrical substations, pipelines, bridges and highways.

Cultural resources. For the purposes of the MEC HA, cultural, traditional, spiritual, religious, or historical features of a *munitions response site* (e.g., structures, artifacts, symbolism). For example, American Indians or Alaska Natives deem the MRS to be of religious significance if it contains areas that are used by American Indians or Alaska Natives for subsistence activities (e.g., hunting, fishing). Requirements for determining if a particular feature is a cultural resource are found in the National Historic Preservation Act, Native American Graves Protection and Repatriation Act, Archaeological Resources Protection Act, Executive Order 13007, and the American Indian Religious Freedom Act.

Current land use. For the purposes of the MEC HA, the prevailing use or activity occurring in a given area. Activities may include a wide variety of intrusive actions, such as construction, camping, or gardening.

Department of Defense Explosives Safety Board (DDESB). The DoD organization charged with promulgating ammunition and explosives safety policy and standards, and with reporting on the effectiveness of the implementation of such policy and standards.[7]

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.[8] (10 U.S.C. 2710 (e)(2))

Ecological resources. For purposes of the MEC HA, ecological resources include the following: (1) a threatened or endangered species (designated under the Endangered Species Act) present on the MRS; (2) an MRS designated under the ESA as critical habitat for a threatened or endangered species; or (3) identified sensitive ecosystems such as wetlands or breeding grounds present on the MRS.

Energetic Material Type. For the purposes of the MEC HA, this input factor is to be used to determine the potential severity of impact should an MEC item function. This factor indicates the type of explosives in the munition.

Engineering Controls. Engineered measures designed to prevent or limit access and exposure to hazardous components left in place at a site or to ensure effectiveness of the chosen remedy. Engineering controls are usually, but not always, fences or other physical barriers to a site.

Explosion. A chemical reaction of any chemical compound or mechanical mixture that, when initiated, undergoes a very rapid combustion or decomposition, releasing large volumes of highly heated gases that exert pressure on the surrounding medium. Also, a mechanical reaction in which failure of the container causes sudden release of pressure from within a pressure vessel. Depending on the rate of energy release, an explosion can be categorized as a deflagration, a detonation, or a pressure rupture.[5]

Explosive. A substance or mixture of substances that is capable, by chemical reaction, of producing gas at such temperatures, pressure, and speed as to cause damage to the surroundings. The term *explosive* includes all substances variously known as high explosives and propellants, together with igniter, primer, initiator, and pyrotechnic (e.g., illuminant, smoke, delay, flare, and incendiary compositions).[5]

Explosive Safety Quantity-Distance (ESQD). The prescribed minimum distance between sites handling, processing, storing or treating hazard Class 1 explosive material and specified exposures (i.e., inhabited buildings, public highways, public railways, other storage or handling facilities or ships, aircraft, etc.) to afford an acceptable degree of protection and safety to the specified exposure. The size of the ESQD arc is proportional to the Net Explosive Weight present.

Explosives Safety Site Approval. The authorization obtained prior to beginning new construction, modifying existing structures, or conducting munitions response actions that create new or impact existing ESQD arcs at Navy shore activities where ammunition and explosives are handled, processed, stored or treated, or on a defense site that is known or suspected to contain MEC. Explosives safety site approval is obtained by submitting a Site Approval Request.

Explosives Safety Submission (ESS). An ESS is a document that details how explosives safety standards in Service-specific explosives safety directives are applied to munitions response actions. The ESS also addresses how the project complies with applicable environmental requirements related to the management of MEC.

Feasibility Study (FS). The FS provides an analysis of remedial action alternatives to address a release at a site. It consists of screening of alternatives and comparison of alternatives to the CERCLA nine criteria. The FS is typically developed in conjunction with the remedial investigation. (40 CFR 300.430 (e)(1)).

Firing point or position. The point or location at which a weapon, other than those undergoing demolition, is placed for firing. (For demolitions, the firing position is the point or location at which the firing crew will be located during demolition operations.)[9]

Fixed ammunition. Ammunition, except small arms and rocket ammunition, that consists of a cartridge case loaded with propellant and a projectile, which are loaded in one operation into the weapon, the cartridge case being firmly attached to the projectile.[10]

Formerly used defense sites (FUDS). Real property that was formerly owned by, leased by, possessed by, or otherwise under the jurisdiction of the Secretary of Defense or the DoD components, including organizations that predate DoD.[11]

Fragment. Any complete ammunition item, subassembly, pieces thereof, or its packaging material, which is propelled from the site of an explosion.[12]

Fragmentation. The breaking up of the confining material of a chemical compound or mechanical mixture when an explosion occurs. Fragments may be complete items, subassemblies, or pieces thereof, or pieces of equipment or buildings containing the items.[10]

Function test range. For the purposes of the MEC HA, the QA function test range is the area where munitions or weapons systems are tested. Testing may include components, partial functioning, or complete functions of stockpile or developmental items.

Future land use. For the purposes of the MEC HA, defined as the type of land use intended to be implemented in a given area.

Fuze. (1) A device with explosive components designed to initiate a train of fire or detonation in ordnance. (2) A nonexplosive device designed to initiate an explosion in ordnance.[13]

Fuze sensitivity. For a choice associated with the MEC HA input factor called *MEC classification*, which reflects how sensitive a fuze may be to external forces, both mechanical and environmental. All fuzes that have been fired are assumed to be fully armed and as such have a risk associated with any movement or potential environmental actions on that item. Some fuzes have more risk with any movement (e.g., all–way-acting, cock-striker) or potential environmental conditions (e.g., piezoelectric).[10]

Hazard. Any real or potential condition that can cause injury, illness, or death of personnel; damage to or loss of a system, equipment, or property; or damage to the environment.[14]

Hazard assessment. For the purposes of the MEC HA, involves evaluation of the real and potential conditions at a munitions response site that can lead to an unplanned explosive incident (an explosive mishap) resulting from a member of the general public (i.e., a receptor) interacting with an MEC item. The evaluation considers the mishap risk (or likelihood) and the severity of the mishap if it occurs. The three components of explosive hazard that are used to conduct the MEC HA are severity, accessibility, and sensitivity.

Hazard assessment framework. For the purposes of the MEC HA, the hazard assessment framework incorporates the structure and input factors specified in the HA guidance to meet the objectives of the hazard assessment process.

Hazard assessment guidance. For the purposes of the MEC HA, the documentation developed to provide instruction on the objectives, hazard assessment framework, and hazard assessment process as developed by the MEC Hazard Assessment Technical Working Group.

Hazard assessment process. For the purposes of the MEC HA, the process by which MEC hazard is determined for munitions response sites. The hazard assessment process consists of the hazard assessment framework and the hazard assessment guidance used to meet the objectives.

Hazard Level. For the purposes of the MEC HA, *hazard level* refers to the information produced by the hazard assessment process using the input factors and MEC HA framework. The hazard level categories provide descriptions of the explosive hazard of an MRS.

High explosive. An explosive substance designed to function by detonation (e.g., main charge, booster, or primary explosive).[5]

Impact area. The identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapon systems.[15]

Incendiary. A chemical agent used primarily for igniting combustible substances with which it is in contact by generating sufficient heat to cause ignition.[16]

Inert items. Inert ordnance poses no explosive hazard to personnel or material. Includes those practice and service items manufactured or made empty or inert for use in training, for desk nameplates, on display boards, in demonstrations or public functions, and in offices or work areas of engineers or other personnel.[17] Inert items should not be confused with practice or training munitions (see *Spotting charge*).

Input factor. For the purposes of the MEC HA, one of several options for describing a hazardous component of the MRS. The input factor is assessed and subsequently assigned a score in the hazard assessment.

Input factor categories. For the purposes of the MEC HA, within each input factor, one of several options to describe the site characteristics associated with each input factor. The selection of the input factor category results in the score for that input factor. Each category has a separate score that is equal to or less than the total score available for that input factor.

Input factor component. For the purposes of the MEC HA, conditions that describe the explosive hazard components and frame the input factors. Input factor components are severity, accessibility, and sensitivity.

Institutional controls. Non-engineered measures designed to prevent or limit exposure to hazardous substances left in place at a site or to ensure effectiveness of the chosen remedy. Institutional controls are usually, but not always, legal controls, such as easements, restrictive covenants, and zoning ordinances.[18]

Interaction. The means by which receptors come in contact with MEC, involving two closely connected elements: access and activity. Access is the ability of a receptor to enter the source area. Activity is any action by a receptor that may result in direct contact with individual MEC items.[6]

Intrusive depth. For the purposes of the MEC HA, the depth below ground surface that activity on the land may intrude. Examples include construction activity, gardening, agricultural tilling, or erection of a tent (inserting stakes into the ground). This is a required information element for the input factor that is Minimum MEC Depth Relative to Maximum Intrusive Depth.

Land use controls (LUCs). Any type of physical (engineering controls), or legal, or administrative mechanisms (institutional controls) that restrict the use of, or limit access to, real property to prevent or reduce risks to human health, safety, and the environment. The objective of LUCs is to ensure that future land use remains compatible with the land use that was the basis for the evaluation, selection, and implementation of the response action. As such, LUCs are a common component of any response action that does not allow for unrestricted land use following the completion of the response action or of any response action that allows for unrestricted use, but that requires that the integrity of the remedy be protected. For example, in the case of a response to address military munitions (i.e., UXO or DMM), LUCs will likely be necessary to ensure protection of human health, public safety, and the environment, since technical limitations suggest that complete removal of the military munitions may not be possible.[19]

Lead agency. The agency that provides the on-scene coordinator or remedial project manager that will plan and implement response actions under the National Contingency Plan (NCP). EPA, the U.S. Coast Guard, another Federal agency, or a State may be the lead agency for a response action. In the case of a release of a hazardous substance, pollutant, or contaminant, where the release is on, or the sole source of the release is from, any facility or vessel under the jurisdiction, custody, or control of a Federal agency, that agency will be the lead agency. Lead agencies will operate under contract or by cooperative agreement under Section 104(d)(1) of CERCLA, or will be designated by a Superfund Memorandum of Agreement (SMOA) under subpart F of the NCP or other agreements.[4]

Location of additional human receptors. For the purposes of the MEC HA, an input factor to the MEC HA that applies to high explosives (i.e., bulk high explosives, or munitions filled with high explosives), fragmented munitions that contain high explosives (i.e., 37 mm), and munitions containing white phosphorus, and addresses the possibility that additional receptors, beyond the receptor that might cause an item to function, may be exposed to overpressure and fragmentation hazards from the detonation of the item.

Maneuver area. Area used for conducting military exercises in a simulated conflict area or war zone. It can also be used for other non-war simulations. Training aids and military munitions simulators, such as training ammunition, artillery simulators, smoke grenades, pyrotechnics, mine simulators, and riot control agents, are used in the maneuver area.

MEC (Munitions and explosives of concern). The term, which distinguishes specific categories of military munitions that may pose unique explosive safety risks, may include (1) unexploded ordnance (UXO) as defined in 10 U.S.C. 2710 (e)(9) and 40 CFR 266.201; (2) discarded military munitions (DMM), as defined in 10 U.S.C. 2710 (e)(2); (3) or munitions constituents (MC) present in high enough concentrations to pose an explosive hazard.[8]

MEC Classification. For the purposes of the MEC HA, this input factor is associated with the MEC HA sensitivity component. MEC items are described as bulk explosives, UXO or DMM, and fuzed or unfuzed, and in terms of the sensitivity of the fuze.

MEC Depth. For the purposes of the MEC HA, MEC depth is the information required for the input factor "Minimum MEC Depth Relative to the Maximum Intrusive Depth" in the accessibility component. It is the level on or below ground surface at which MEC is found.

MEC Size. For the purposes of the MEC HA, this input factor in the sensitivity component indicates the ease with which an MEC item can be moved by receptor activity.

Migration mechanism. For the purposes of the MEC HA, the natural physical forces in an MRS (e.g., frost heave, erosion, etc.) that can expose subsurface MEC items or move surface or subsurface MEC items.

Migration potential. For the purposes of the MEC HA, an input factor in the accessibility category that is defined as the likelihood of MEC items to be moved by natural processes (e.g., erosion, frost heave, etc.).

Military munitions. All ammunition products and components produced or used by or for the U.S. Department of Defense or the U.S. Armed Services for the national defense and security, including military munitions under the control of the Department of Defense, 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 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, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear 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 U.S.C. 2011 et seq.)[8]

Minimum MEC Depth Relative to Maximum Intrusive Depth. For the purposes of the MEC HA, this input factor describes the minimum depth of the MEC items (e.g., on the surface or below the surface) in relation to the maximum intrusive depth likely to occur from activities that take place in that area.

Munitions constituents (MC). Any materials originating from unexploded ordnance, discarded 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)).[8]

Munitions response. Response actions, including investigation, removal, and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC).[8]

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. A munitions area comprises one or more munitions response sites.[8]

Munitions response site (MRS). A discrete location within an MRA that is known to require a munitions response.[8]

Munitions Response Site Prioritization Protocol (MRSPP). A DoD protocol whose purpose is to assign a relative priority for munitions response to each location in the inventory of munitions response sites known or suspected of containing unexploded ordnance, discarded military munitions, or munitions constituents.[8]

National Oil and Hazardous Substances Pollution Contingency Plan, or National Contingency Plan (NCP). The regulations for responding to releases and threatened releases of hazardous substances, pollutants, or contaminants under CERCLA.[4]

Net explosive weight. The total weight of all high explosives and all propellants, expressed in pounds.[5]

Open burning (OB). The combustion of any material without control of combustion air to maintain adequate temperature for efficient combustion, without containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion, and without control of emissions of the gaseous combustion products.

Open burning/open detonation (OB/OD) area. Any area on an installation that was formally designated for disposal of munitions by either open burning or open detonation.

Open detonation (OD). A chemical process used for the treatment of unserviceable, obsolete, or waste munitions whereby an explosive donor charge initiates the munitions to be detonated. Although surface detonations can be performed under certain circumstances, most munitions are treated in 4- to 6-foot-deep pits for safety purposes. OD sites may be permitted as miscellaneous units as part of the EPA permitting process for treatment, storage, and disposal facilities.[3]

Potential Contact Hours. For the purposes of the MEC HA, this input factor describes the number of receptors and the amount of time each receptor spends in the MRS. This factor is calculated on a yearly basis for activities that may result in exposure, that is, current and future outdoor activities that could bring receptors into contact with MEC items. For cases where MEC is on the surface, any outdoor activity could lead to exposure; for cases where MEC is located subsurface only, the activities in question must have an intrusive component (e.g., digging a fire pit or latrine, or trail or fence maintenance).

Preliminary assessment (PA). Under CERCLA, PA involves review of existing information and an off-site reconnaissance, if appropriate, to determine if a release may require additional investigation or action. A PA may include an on-site reconnaissance if appropriate.[4]

Propellant, solid. Explosive compositions used to propel projectiles and rockets and to generate gases for powering auxiliary devices.[11]

Proximity. For the purposes of the MEC HA, proximity applies only to high explosives and addresses the possibility that specific resources may be exposed to overpressure and/or fragmentation hazards from the detonation of an item.

Pyrotechnics. Used to send signals, to illuminate areas of interest, to simulate other weapons during training, and as ignition elements for certain weapons. When ignited, pyrotechnics undergo an energetic chemical reaction at a controlled rate intended to produce, on demand in various combinations, specific time delays or quantities of heat, noise, smoke, light, or infrared radiation. [20]

Range. The term *range*, when used in a geographic sense, means a designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes the following: (a) firing lines and positions, maneuver areas, firing lines, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas; (b) airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101 (e)(3))[21]

Range fan. That part of the range that includes firing points, target areas, and buffer areas.

Receptor. Exposed human or ecological individual relative to the exposure pathway considered.[22]

Release. Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant).[23]

Remedial action (or Remedy). Those actions consistent with a permanent remedy taken instead of, or in addition to, a removal action in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present of future public health or welfare or the environment. (40 CFR 300.430(d)(1))[4]

Remedial alternatives. Potential remedies evaluated during the feasibility study that may include the following:

- One or more alternatives that involve little or no treatment, but provide protection of human health and the environment primarily by preventing or controlling exposure to hazardous substances, pollutants, or contaminants, through engineering controls, for example, containment, and, as necessary, institutional controls.
- For source control actions, an alternative in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element.
- For groundwater response action, a limited number of remedial actions that attain site-specific remediation levels within different restoration time periods. (40 CFR 300.430(d)(1))[4]

Remedial investigation (RI). An investigation conducted for the purpose of collecting data necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial alternatives. The RI includes field investigations, treatability studies, and a baseline risk assessment. (40 CFR 300.430 (d)(1)) [4]

Removal action. Short-term response actions under CERCLA that address immediate threats to public health and the environment. (40 CFR 300.415)[23]

Removal investigation (also called a *Removal site evaluation*). The investigation conducted to see if removal action is necessary or appropriate. (40 CFR 300.410)[23]

Resource Conservation and Recovery Act (RCRA). 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.[24]

Response action. As defined in Section 101 of CERCLA, remove, removal, remedy, or remedial action, including enforcement activities related thereto.[23]

Risk. The product of the probability or frequency that an accident will occur within a certain time and the accident's consequences to people, property, or the environment.[5]

Risk characterization (also referred to as risk assessment). A process used to identify potential risks posed by chemicals. During risk characterization, chemical-specific toxicity information, combined with quantitative and qualitative information from the exposure assessment, is compared with measured contaminant exposure levels and to levels predicted through environmental fate and transport modeling. These comparisons determine whether concentrations of contaminants at or near the site are affecting, or could potentially affect, human health or the environment. Results of this analysis are presented with all critical assumptions and uncertainties so that significant risks can be identified.[4]

Risk management. A process by which decision-makers reduce or offset risk.[190]

Rocket. A complete missile that derives thrust from ejection of hot gases generated from propellants carried in the missiles.[11]

Sensitivity. For the purposes of the MEC HA, a component of explosive hazard that reflects the likelihood that a receptor will be able to interact with an MEC item such that it will detonate.

Severity. For the purposes of the MEC HA, a component of explosive hazard that reflects the potential consequences (e.g., death, severe injury, property damage, etc.) of the MEC item functioning.

Site Accessibility. For the purposes of the MEC HA, this input factor describes the ease with which casual users (e.g., trespassers or people taking shortcuts) can access an MRS. The input factor captures the contribution that such receptor activities make to the likelihood that a receptor will encounter an MEC item.

Site inspection (SI). An on-site investigation to determine whether there is a release or potential release and the nature of the associated threats. The purpose is to augment the data collected in the preliminary assessment and to generate, if necessary, sampling and other field data to determine if further action or investigation is appropriate.[4]

Spotting charge. Most practice or training munitions contain a small amount of smoke-producing material to facilitate locating that round during training activities. A few practice or training munitions, such as bombs, may contain small amounts of high explosives.

Structure of hazard assessment. For the purposes of the MEC HA, the interrelation of the various parts that make up the hazard assessment framework.

Surface. For the purposes of the MEC HA, the position of a munition that is (1) entirely or partially exposed above the ground surface, or (2) entirely or partially exposed above the surface of a water body (e.g., as a result of tidal activity).

Target impact area. A point on the range at which the munitions are fired.

Unexploded ordnance (UXO). Military munitions that have been primed, fuzed, 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 that remain unexploded either by malfunction, design, or any other cause. (10 U.S.C. 101 (e)(5))[5]

White phosphorus (WP). A bursting smoke filler that is frequently used in munitions activity. It burns rapidly when exposed to oxygen. In soils with low oxygen, unreacted white phosphorus can lie dormant for years but may re-ignite if exposed to oxygen.

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