

State Munitions Response Forum (MRF) Issue Paper

**Management of U.S. Legacy Underwater
Military Munitions Sites:
States' Perspective**

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Management of U.S. Legacy Underwater Military Munitions Sites: States' Perspective

Problem Statement

Underwater sites impacted by unexploded ordnance (UXO) or discarded military munitions (DMM) may pose an unacceptable risk to human health and the environment. Due to the explosive properties of munitions, the risk to humans of exposure to underwater munitions may be immediate and debilitating, if not fatal. At some of these sites naturally occurring phenomena such as wave actions and currents may cause underwater military munitions¹ (UWMM) to migrate to near or onshore areas. At other sites, UWMM present may be accessible to recreational divers or may be inadvertently recovered or disturbed by other recreational uses or commercial maritime activities. As these UWMM move or are disturbed there is a potential explosive or chemical hazard. In addition, UWMM present underwater are expected to deteriorate over time, releasing munitions constituents (MC) to the aquatic environment. Such releases may adversely impact human health and the environment.

The United States Department of Defense (DoD) has historically focused its munitions response efforts on investigating the potential risks posed by UXO, DMM, and MC on land, rather than in the water. However, since mid-2000, DoD has begun efforts to understand the potential impact of the freshwater, estuarine, and marine environments on UWMM, and UWMM on the freshwater, estuarine, and marine environments and human health.

Notwithstanding DoD's recent efforts, DoD and the States² have differing opinions about the potential risk posed, the requirements for addressing, and the timing of actions to characterize, evaluate, and address the potential risks posed by UWMM, including MC, to human health and the environment. The States believe that to more fully protect human health and the environment it is imperative that DoD commit more resources to develop a robust framework for evaluating the potential risks posed by UWMM, and to address those sites determined to pose an unacceptable risk to human health and the environment in a timely manner.

Introduction

Throughout its history, the DoD has conducted munitions-related activities such as live-fire training and testing required to maintain a trained and ready military.

¹ The U.S. Navy uses the term "underwater munitions" to refer to a unique class of munitions designed to be deployed underwater such as torpedoes, sea mines, and depth charges. This paper uses the term Underwater Military Munitions to distinguish it from "underwater munitions."

² In this paper, "the States" is used to collectively refer to the states, the District of Columbia, and the U.S. Territories.

These activities have created hundreds of sites in inland and coastal U.S. waters that are known or suspected to contain UXO, DMM, or MC, collectively referred to as Munitions and Explosives of Concern (MEC). Such sites exist on operational and former ranges, at munitions disposal and accident sites, and at former combat areas, including vessels containing munitions that were sunk during combat. This paper addresses the States' concerns about the potential risks posed by UXO, DMM, and MC that are underwater.

According to the Strategic Environmental Research and Development Program (SERDP), many operational and former military installations have ranges and training areas that include adjacent water environments (e.g., ponds, lakes, rivers, estuaries, and coastal ocean areas).³ SERDP reported that the U.S. Army Corps of Engineers (USACE) and the U.S. Navy have identified more than 400 underwater sites in the United States that potentially contain military munitions that may pose a threat to human safety and the environment.

Although DoD has performed a significant amount of work towards addressing the potential risks at munitions response sites (MRS) under its Military Munitions Response Program (MMRP), the MMRP does not include munitions sea-disposal sites, operational ranges, munitions resulting from an act of war, or locations outside the United States.⁴

Historically, DoD has focused its environmental response efforts on the land portion of an MRS because the potential risks posed by munitions on land are normally higher than those that may be posed by munitions in watered portions of an MRS. Additionally, in the past DoD policy for its Defense Environmental Restoration Program (DERP) limited the extent to which funding could be used to address UWMM.⁵ Although the States recognize that the characterization and conduct of response actions to address underwater environments present unique challenges, the States believe it is critical for DoD to place greater effort toward assessing potential risks associated with UWMM, including MC.

DoD has conducted research into the potential impact of UWMM on the freshwater, estuarine, and ocean environments and the freshwater, estuarine, and ocean environment on UWMM. This work has included research on technologies and procedures that can be used to increase the efficiency and reduce the risks associated with characterizing these sites and, to a lesser

³ Strategic Environmental Research and Development Program/Environmental Security Technology Certification Program (SERDP/ESTCP). 2010. *Munitions in the Underwater Environment: State of the Science and Knowledge Gaps*.

⁴ DoD maintains responsibility for munitions sea-disposal sites even though they do not fall under the MMRP.

⁵ Prior to the publication of DERP Manual 4715.12, Defense Environmental Restoration Program Management, DoD's policy for DERP considered property where UWMM were more than 100 yards seaward of the mean high-tide points to be ineligible for funding under DERP.

degree, with conducting any response action required. However, DoD has yet to apply this research extensively to specific underwater sites.

This paper discusses several categories of water areas that may contain UXO, DMM, or MC; examines the current technology and policy limitations that make it difficult to assess and address the risks these sites may pose; and discusses States' concerns and recommendations regarding UWMM site management.

Types of Water Areas Known to Contain Munitions

There are several categories of sites where UWMM may be found. These include MRS (e.g., former ranges), operational ranges, munitions sea-disposal sites, former combat areas, and areas where UWMM have come to be located due to emergencies or accidents. The following section provides some background on these categories.

MRS Addressed under DoD's Defense Environmental Restoration Program's MMRP

The MMRP, which is a category under DERP, funds environmental munitions responses at specified sites where UXO, DMM, or MC are known or suspected to be present. Such sites are referred to as MRS and can encompass areas covered by water. Other sites such as operational ranges, permitted treatment facilities, and munitions production facilities are not considered MRS, and are not funded under the MMRP.

Since the MMRP's inception in 2000, DoD has developed an inventory of MRS and uses a standard protocol to assign a relative risk priority to each MRS for use in sequencing munitions response actions.⁶

Operational Ranges

DoD uses operational ranges for live-fire training and testing to help maintain the readiness of U.S. military forces. For operational ranges that impact water, the locations, authorized times of operations, and other details are specified in Title 33-Navigation and Navigable Waters - Code of Federal Regulation - Part 334, Danger Zone and Restricted Area Regulations. This part requires agencies to certify that they have not used a range for a purpose that requires clean up or that they have removed all hazardous materials and munitions before an area is opened for use by the public.

⁶ This standard protocol is The Munitions Response Site Prioritization Protocol (MRSPP), 32 Code of Federal Regulation, Part 179

Munitions Sea-Disposal Sites

DoD disposed of excess, obsolete, unserviceable military munitions, and captured enemy munitions in U.S. coastal waters until 1970.⁷ Sea disposal, which was an internationally accepted practice, was considered one of the safest disposal alternatives for excess, obsolete, or unserviceable munitions.

DoD has developed and maintains an inventory of munitions sea-disposal sites.⁸ Additional munitions sea-disposal sites may be identified through further historical research. However, many military records have a retention period of only a few years before they are destroyed, resulting in the availability of only a limited number of records of sea disposal.⁹ In addition, some suspect that undocumented munitions were dumped before reaching their designated disposal sites so historical research may not reflect correct locations.

As DoD completes its archival research, it will work with the National Oceanic and Atmospheric Administration (NOAA) to identify any necessary updates to nautical charts.

To date, DoD has not identified any freshwater munitions disposal sites.¹⁰

Acts of War Sites

Acts of war sites (i.e., former combat areas) are a potential source of UWMM in U.S. coastal waters. The term acts of war sites includes sites where U.S. or foreign munitions were used during battles or other hostile actions, mines were deployed, and ships containing munitions were lost as the result of hostilities. Although a comprehensive list of such sites has not been compiled, several federal agencies have knowledge of such areas.

Emergencies and Accidents

In addition to the types of sites described above, munitions may be present in water areas as the result of an emergency or accident involving vessels or

⁷ Congress essentially prohibited the practice with the passage of the Marine Protection, Research, and Sanctuaries Act of 1972.

⁸ This inventory is found in: DoD. 2010. *Defense Environmental Program, Annual Report to Congress for Fiscal Year 2009*. Chapter 10: Sea Disposed Munitions.

⁹ Carton, G., Cioffi, K., and Overfield, M. 2011. Echoes of World War I – Chemical Warfare Materials on the Atlantic Coast. *Sea History*, 133(Winter 2010/2011): 14-18.

¹⁰ However, between 1959 and 1962 a DoD contractor disposed of approximately 1400 drums of classified munitions components in Lake Superior offshore of Duluth, MN. The vast majority of this material was essentially scrap metal though as reported by ATSDR the US Army Corps of Engineers (USACE) found that two barrels contained possible M1A1 mine fuses and that, "...the part contains a firing pin and a block of explosive material." See Agency for Toxic Substances and Disease Registry. 2008. *Health Consultation: Barrels Disposed in Lake Superior by U.S. Army, Duluth, St. Louis County, Minnesota*.

aircraft carrying military munitions, the jettisoning or disposal of munitions for safety reasons, or a detonation that scattered munitions.

Potential Risks to Human Health and the Environment from UWMM Sites

Acute risks to humans from encounters with UXO or DMM include the potential for immediate injury or death due to blast, shock, heat, or chemical exposure. Given the large area impacted by UWMM, acute injuries have been limited in the United States, generally resulting from the inadvertent recovery of UWMM in commercial fishing gear.

Acute risks to marine biota may occur as a result of shock pressure or noise from underwater detonations such as blow-in-place operations¹¹.

Chronic impacts from the release of MC underwater are much more difficult to assess as attribution of observed effects to a specific source is hard to establish. MC, particularly MC that is a toxic chemical agent, may pose direct adverse risk to human health due to contact or exposure. Indirectly, the consumption of seafood or freshwater fish contaminated by MC may pose adverse risk. Research into this issue is ongoing.¹² Likewise, chronic impacts to aquatic biota may occur via MC uptake and accumulation within the organism.

Although DoD has been conducting studies to determine the potential for MC to impact the aqueous environment and/or human health, States with UWMM sites are concerned that DoD is not doing enough to address the potential risks posed by UWMM, including MC.

Limitations to Effective Investigation of Underwater Munitions

DoD's focus has been to address the land portion of MRS that present the greatest potential risk to the public. The limited focus on UWMM sites has been due to technology limitations as well as weaknesses in or a lack of applicable federal policy or guidance. These two issues are discussed below.

¹¹ Blow-in-place (BIP): destruction of MEC by in-place detonation.

¹² Craig, H., and Taylor, S. 2011. Framework for Evaluating the Fate, Transport, and Risks From Conventional Munitions Compounds in Underwater Environments. *Marine Technology Society Journal*, 45(6): 35-46. And SERDP/ESTCP. 2010. *Munitions in the Underwater Environment: State of the Science and Knowledge Gaps*. And others.

Technical Limitations

Locating Sites and Boundaries

To date, identifying, classifying, and otherwise determining the exact footprint (vertically and horizontally) of a UWMM site has presented serious challenges. Defining firing fans¹³ and impact areas may be easier for sites with fixed firing positions provided some basic historical information is available. However, sites where targets were mobile or otherwise ill-defined, disposal sites, sites where acts of war occurred, and accident sites are much more difficult to define. The majority of these sites have either poorly defined or essentially undefined boundaries. Also, the specificity of the geographic locations of these sites in the historical record varies widely.

The dynamic nature of the water environment, especially the near shore zone, the limited experience in addressing such sites, and difficulty in positioning equipment further complicate definition of the footprint of UWMM sites. Although DoD has made significant advances in its ability to locate and remotely identify UWMM, the investigations of such sites are costly, particularly for greater depths that require the long-term mobilization of highly specialized personnel and equipment.

Additionally, per DoD guidance, UWMM recovered by fishermen are typically put back into the water. Because the recovered munitions may be transported some distance before they are jettisoned, already ill-defined borders become even blurrier.

Detection and Discrimination

Current technology is limited in its ability to detect and distinguish UWMM from natural and other man-made objects, particularly those that are either buried in sediments or at significant depths.¹⁴ A site area may be highly cluttered with cultural and other debris making identification of individual UWMM difficult. Also, instruments are often unable to determine the size or number of targets.¹⁵ However, DoD is researching a variety of survey techniques and technologies for detecting items of concern on the seafloor.

Another significant challenge in the use of any detection technology is maintaining optimal positioning of the sensors above the seafloor and tying the sensor output with accurate location data. The height of the sensors above the bottom affects the resolution and the depth beneath the sediment surface that

¹³ Firing fans: areas of potential munitions impact between weapons and targets.

¹⁴ This issue with current technology has been covered in depth in: SERDP/ESTCP. 2010. *Munitions in the Underwater Environment: State of the Science and Knowledge Gaps*.

¹⁵ U.S. Environmental Protection Agency (U.S. EPA). 2005. EPA 505-B-01-001. *Handbook on the Management of Munitions Response Actions, Interim Final*, pp. 4-1 and 9-13.

acoustic and magnetic sensors penetrate. Smaller distances result in better resolution of the items located, improving the ability to discriminate between items of interest and other materials.

The following is a description of potentially applicable UWMM detection technologies.

- Magnetometers. Most geophysical sensors used in marine surveys are magnetometers that can detect only metallic targets containing iron. Their detection range varies from hundreds of feet for an intact sunken ship to just a few feet for individual UWMM.
- Electromagnetic Induction (EMI) Systems. EMI instruments are hand-held or towed devices that investigators use to detect small metal items. These EMI systems are limited in use to the typical depth a diver can achieve, approximately 130 feet. DoD is researching the development of larger EMI systems. However, the maximum range of detection by these systems is still less than that for magnetometers.
- Optical Detection. Optical sensors offer the highest resolution, but the material must be exposed above the seafloor. Additionally, biofouling or concretion¹⁶ can obscure the UWMM preventing identification. Detection is dependent on water clarity and lighting, and is thus limited to about 90 feet from the sensor under ideal conditions. In many areas water clarity may be limited to just a few feet.
- Acoustic Detection. Acoustic sensors, commonly referred to as SONAR, are available in many configurations. Acoustic systems are used to either obtain rapid coverage while searching for large items such as sunken ships, or in slower modes to provide high-quality images of small items in dark, murky water. Since absorption and dispersion phenomena reduce the detection effectiveness for objects buried below the seafloor, most systems are limited to searching for targets at or above the seafloor. Some systems have a limited sub-bottom detection capability and DoD is actively involved in developing new SONAR systems, with improved capabilities to detect sub-bottom items.

Migration of Munitions

The migration of UWMM and any MC released is an issue that must be considered during site characterization. Munitions may migrate or become buried and resurface in rivers, intertidal areas, and other areas prone to strong currents.

¹⁶ Biofouling: the accumulation of microorganisms, plants, algae, or animals on wetted surfaces.
Concretion: hardened biofouling.

Tidal and wave action, and other naturally occurring phenomena have the potential to move UWMM, sometimes over relatively large distances. Even after UWMM have been located, such forces may rapidly bury or move them, negating investigative results in short periods of time. In the dynamic environment of the near-shore and surf zone, these forces can transport UWMM from the seafloor to the beach. Determining how, when, and where near-shore UWMM may move is extremely difficult.

Human activities such as dredging, beach replenishment, and fishing with bottom contact gear also have the potential to relocate UWMM from their original location. These activities also have a potential to inadvertently recover UWMM; exposing the public to increased risk.

Release, Fate, and Transport of MC

As the metal parts of UWMM corrode, MC may be released to the environment. Developing an understanding of release rates is necessary to evaluate the potential risk from a release of MC from UWMM to the underwater environment. Such releases, which may occur instantaneously upon descent or over time, have the potential to impact human health and the environment.

The release of MC from an individual munition is affected by several factors including the properties of the MC such as solubility, whether the UWMM is buried or lays on top of the sea-bed or lake-bed, the degree of corrosion, and environmental conditions including currents. Observations of UWMM in the underwater environment have found that even UWMM in close proximity may have significantly different degrees of corrosion.

Little is known about the rates of corrosion of UWMM although existing research indicates that relatively thin skinned munitions fail more rapidly than thicker skinned munitions. DoD is currently conducting several studies to understand corrosion of munitions, particularly UWMM.¹⁷ A better understanding of corrosion rates in different environments will help characterize the potential for release and the rate of release of MC to the aquatic environment.

Once released, the fate and transport of the MC needs to be understood in order to identify the risk to human health and the environment. The fate of MC upon release to the underwater environment varies. Following release, MC "...can be adsorbed in sediment, dissolve into the overlying waters, or bind to particles and be resuspended into the overlying waters. Over time, various chemical, biological, and physical processes change the MC to other chemical forms that

¹⁷ For example, the Army is planning to measure the levels of corrosion of munitions recovered from Ordnance Reef in Hawai'i. In addition, DoD participated in an international meeting on marine corrosion (www.marinecorrosionworkshop.org) and has been involved in the development of a UXO corrosion prediction model (SERDP, 2010).

have different transport and toxicity properties in various ecosystems. Although much work has been conducted on MC transformation in terrestrial and groundwater systems, little information is available on rates of attenuation or transport of energetics in coastal aquatic systems. This information is needed to support future risk assessments and site management decisions.”¹⁸

Transport is controlled by the solubility of the constituent, its other physical and chemical properties, and local conditions. Currents can transport MC great distances however in such instances the MC is likely diluted to such an extent that there is little to no effect on aquatic biota.

Although understanding the corrosion, fate, and transport of an individual munition is helpful to determine the risk to human health and the environment of a site, the effects on all of the munitions present must be understood in order to model munitions constituent concentrations across a site.

Policies Addressing UWMM¹⁹

The lack of specific policy and funding related to risk evaluation and remedial actions at UWMM sites is a major limitation preventing effective investigation of these sites. The following is a discussion of the various policies and guidance that can be applied to UWMM sites.

Policies and guidance addressing UWMM are many and varied though, with the exception of the John Warner National Defense Authorization Act, none specifically addresses UWMM alone. Two documents that establish DoD responsibility for UWMM are DoD 6055.9-M, *DoD Ammunition and Explosives Safety Standards*, Volume 7 and Section 314 of Public Law 109 – 364, October 17, 2006, “The John Warner National Defense Authorization Act for Fiscal Year 2007.”

The John Warner Act requires the Secretary of Defense to conduct a historical review of available records to determine the number, size, and probable locations of sites where the U.S. Armed Forces disposed of military munitions in coastal waters. The Act requires that DoD share this information with the Secretary of Commerce to assist NOAA in preparing nautical charts and other navigational materials for coastal waters that identify known or potential hazards posed by disposed military munitions.

Other federal agencies or the States also may issue relevant policy that can be specific to munitions, e.g., EPA’s 2010 Munitions Response Guidelines, or may

¹⁸ SERDP/ESTCP. 2010. *Munitions in the Underwater Environment: State of the Science and Knowledge Gaps*.

¹⁹ Some policies are specific to ranges under DoD control. Those policies are not discussed here.

address munitions under a broad umbrella of related issues.²⁰ In addition, policy may address response actions or it may be educational in nature.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the DoD-preferred response mechanism for addressing UXO on other than operational ranges.^{21, 22}

Very few policies apply to investigation and remediation of munitions sea-disposal sites or sites where munitions are present as an Act of War, although emergency response procedures may be taken when necessary at either.

Applicable policies for planned munitions responses, including those that may involve UWMM, typically differ from those that address explosives or munitions emergency responses. This is expected given the intent of the regulatory framework, which is to address imminent and substantial threats in a timely manner, while allowing planned responses without such threats to follow an established process.

Planned Response

The MMRP is the primary program under which DoD conducts planned munitions responses at MRS. Such responses typically follow CERCLA's Removal Action process.

Policies of the United States Coast Guard (USCG) may also play an important role in planned response as part of their mission is maritime safety.

Emergency Response

Emergency response procedures are generally used when munitions may pose an imminent and substantial threat to public health or the environment. When DoD is requested to support an explosives or munitions emergency, DoD Explosive Ordnance Disposal (EOD) personnel are dispatched to address the munitions involved. Typically, EOD, environmental regulators, and safety officials work closely to manage any potential adverse impacts. However, management of emergency response actions may also be addressed under the Incident

²⁰ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or State hazardous substance regulations and RCRA policies may address munitions under the broader umbrella of waste.

²¹ DoD, March 9, 2012. *Defense Environmental Restoration Program (DERP) Management*. Department of Defense Manual No. 4715.20.

²² This is in accordance with a 2000 joint DoD-EPA memorandum indicating that the legal authorities that support site-specific response actions at closed, transferring, and transferred ranges include, but are not limited to, CERCLA, DERP, and the DoD Explosives Safety Board. DoD and U.S. EPA. March 7, 2000. Department of Defense and Environmental Protection Agency Memorandum, "Interim Final Management Principles for Implementing Response Actions at Closed, Transferring, and Transferred Ranges."

Command System, a systematic tool used for the command, control, and coordination of an emergency response. As with planned response the USCG may have a role in emergency response.

Explosives Safety

The Interim Munitions and Explosives of Concern Hazard Assessment (MEC HA) was developed as a tool to assist site managers and regulators during feasibility studies in evaluating explosive safety hazards to people at land-based munitions response sites. The MEC HA intentionally does not address UWMM. With modifications, it could be a tool to provide guidance for assessing risk from UWMM but there is no funding for these changes.

DoD's *Maritime Industry Safety Guide* focuses on the safety of mariners related to explosive hazards and chemical agents.

Other various DoD policies related to explosives safety may be applicable when addressing UWMM sites. These include, but are not limited to:

- DoD Directive 6055.9E, "Explosives Safety Management and the DoD Explosives Safety Board", August 19, 2005, and related issuances (e.g., DoD Manual 6055.09-M, "DoD Ammunition and Explosives Safety Standards"), and
- DoD Directive 4715.11, "Environmental and Explosives Safety Management on Operational Ranges within the United States", May 10, 2004.

Other Applicable Policies

As stated in U.S. Environmental Protection Agency's (EPA) Munitions Response Guidelines some of the other programs under which both land and water munitions sites may be addressed include:

- Resource Conservation and Recovery Act (RCRA, 1976, 42 U.S.C. §6901 et seq.; 40 CFR Parts 240-282);
- Safe Drinking Water Act (SDWA, 1974, 42 U.S.C. §300f et seq.; 40 CFR Parts 141-149);
- Clean Water Act (CWA, 1972, 33 U.S.C. §1251; 40 CFR, Parts 100-136, 140, 230-233, 401-471, 501-503);
- Clean Air Act (CAA, 1970, 42 U.S.C. §§ 7401, 7412(r) and 7603;
- State Superfund Laws;
- State RCRA Programs;
- Other State hazardous waste management programs;

- Tribal hazardous waste management programs.²³

However, other applicable authorities may be more appropriate depending on site specifics.²⁴

Sites with No Substantial Policies

Munitions Sea-Disposal Sites – Munitions sea-disposal sites are categorically excluded from funding under the MMRP. In addition, there is no definitive national policy or program to deal with munitions at these sites.

Acts of War - There is no policy that specifically addresses UWMM at former combat sites and these sites are ineligible for funding under the DERP. In discussing former combat sites in general, the 2012 DERP Management Manual states that, “DERP environmental restoration actions do not include...Responses to address releases that are solely the result of an act of war.”²⁵

Education and Notification

DoD has developed the 3Rs (Recognize, Retreat, Report) Explosive Safety Education Program to alert people to the proper course of action if they encounter munitions. This program includes explosives safety education material targeted at the commercial maritime industry such as the *Maritime Industry Safety Guide*. Working with NOAA, DoD has distributed this material to all federally-permitted vessels, with subsequent distributions made to other elements of the maritime industry.

In addition, NOAA and other federal agencies use a variety of means to notify mariners of potential risks such as Notices to Mariners, Coast Pilots, and identifying sea disposal areas on nautical charts.

Summary of Issues

Technical issues, funding, and lack of specific policy related to risk evaluation and remedial actions limit timely investigation of UWMM sites and remediation of those exhibiting unacceptable risk. Without the tools necessary for effective evaluation of UWMM sites, accurately assessing and responding to potential risks to human health and the environment posed by these sites is difficult.

²³ U.S. EPA Office of Solid Waste and Emergency Response, Federal Facilities Restoration and Reuse Office. July 2010. EPA Munitions Response Guidelines, OSWER Directive 9200.1-101, Interim Final.

²⁴ See EPA’s 2010 Munitions Response Guidelines for an in-depth discussion of policies applicable to munitions responses.

²⁵ DoD. March 9, 2012. *Defense Environmental Restoration Program (DERP) Management*. Department of Defense Manual No. 4715.20.

States' Concerns

Both States and DoD share the common goal of characterizing and eliminating potentially unacceptable risks to human health and the environment posed by UWMM sites. However, because of the limits discussed above, States are concerned that such risks will not be addressed within an acceptable timeframe.

States recognize the current technological limitations to investigating UWMM sites are many and support DoD's continuing efforts to overcome these limits. Therefore, the States' concerns regarding response to UWMM sites are primarily related to state capacity, funding, and policy.

State Capacity

Currently, the States rely on the federal government to perform investigations of UWMM sites and undertake response actions. While the lack of national policy impacts what DoD is able to do, other factors impact the States' ability to address these sites. A major limitation for the States is a lack of personnel who have the expertise to evaluate the potential hazards or provide adequate oversight of investigations conducted. Another limitation is a lack of funds to independently investigate UWMM. As a result and given the lack of a national policy, when there are disagreements over how to address either UWMM sites or UWMM in general, the States have little leverage to require an investigation. Additionally, in many cases, there is minimal communication between DoD and their State counterparts. Collectively, these limitations significantly impact the ability of States to assert adequate oversight over environmental responses that involve UWMM.

Funding

States believe that to more fully protect human health and the environment it is imperative that DoD commit more resources toward addressing these sites and developing a robust framework for evaluating and, when appropriate, addressing the potential risks posed by UWMM including MC. A lack of adequate funding is a significant factor limiting DoD's ability to address UWMM sites. The States believe DoD should work with Congress to develop a policy allowing for additional funding and more effective use of currently available funding. Such a policy should allow MMRP and non-MMRP UWMM sites to be investigated and addressed and should provide for the additional research and development required to better understand the potential risk posed by UWMM.

Policy

Although DoD is addressing MRS that may contain UWMM, the States are concerned that the lack of national policy with regard to other sites where UWMM are known or suspected to be present will cause many such sites not to be

addressed in a timely manner or to the extent States believe necessary. The various policies and guidelines that can be used to address UWMM can be cumbersome, confusing, and often open for interpretation. A significant consequence of a lack of a national policy for UWMM is that DoD is limited in its ability to address such sites; therefore, the potential risks remain largely unaddressed.

Policy Related to FUDS MMRP Sites

The MMRP is DoD's primary program to address known MRS that contain UWMM. However, States believe the program has limitations impacting UWMM sites that need to be resolved. These include the lack of a timeline for addressing MMRP sites at Formerly Used Defense Sites (FUDS), depth/distance spatial limits of investigation, the prior lack of separation of land ranges from water ranges, and the ineligibility of munitions sea-disposal sites and former combat areas under the program.

Schedules and Interim Risk Management - One of the States' major concerns regarding FUDS UWMM sites is DoD's lack of a schedule for addressing them. For the MMRP, DoD is working to achieve a goal of response complete at 95% of all munitions response sites (MRS) at active and BRAC installations by the end of Fiscal Year 2021. However, because of the large number of FUDS MRS and limited resources, DoD has not yet set a goal of Remedial Investigation or Response Complete for any FUDS MRS, either underwater or terrestrial.

As a result, States may not see progress at any FUDS UWMM MRS for many years. This is especially true since DoD will most likely address MRS that only encompass land - normally determined to pose the greatest risk - before addressing MRS that are entirely in the water. Where an MRS includes both land and water, DoD may also address the portion on land before addressing portions that encompass water. States are concerned with this situation so want both UWMM and land-based MRS addressed as soon as possible.

Given these schedule constraints, the States believe it is imperative that DoD implement interim risk management at all FUDS MRS. Specifically, DoD needs to develop interim risk management measures to be applied to UWMM sites, other than the education and notification efforts discussed above, where they are not otherwise addressed as part of larger FUDS that include terrestrial MRS.²⁶

Separation of Land and Water Ranges - States have been concerned that water ranges that have not been investigated will not get addressed if DoD determines that no further DoD action is required for the associated land portion. However, the current DERP Manual addresses this as it divides land MRSs from water

²⁶ See the December 2012 State Munitions Response Forum Issue Paper *Interim Risk Management: States' Perspective* available at www.ecos.org for further discussion of this issue as it applies to MMRP sites.

MRSs, stating, “Normally, when an MRA [Munitions Response Area²⁷] encompasses land and water (e.g., ocean shore and adjacent offshore, lakes, rivers), the DoD Component should divide the MRA into at least two MRSs.”²⁸ USACE currently is realigning MRSs within the FUDS inventory. As a result, in most cases, by the end of fiscal year 2014, the land and water portions of an MRA will be listed as separate MRS. Then the watered MRS can be integrated into DoD’s schedule for future investigation. The States welcome DoD’s initiative to separate land and water ranges and believe that in most cases it will allow DoD to better address the watered portion of MRSs.

Depth Considerations - DoD policy indicates that munitions at depths deeper than 120 feet should be considered as having a physical constraint, similar to a barrier. DoD selected this depth because of the limited time (less than 15 minutes) normally allowed for recreational scuba divers to remain at this depth, the considerable effort needed to dive to and below this depth, and the dangers associated with deep dives.²⁹ As a result of this policy, some States are concerned DoD will not address the potential risk related to UWMM in deep water. These risks include the possibility for recreational or commercial fishermen to recover munitions from these depths, and the possibility that munitions may migrate to shallower depths.

Policy Related to Sites Ineligible under MMRP

Sites ineligible under MMRP include former combat areas known as Acts of War sites and munitions sea-disposal sites.

Acts of War Sites - The States and EPA disagree with the policy that Acts of War sites are ineligible for funding under the DERP.

Munitions Sea-Disposal Sites - States have concerns that munitions sea-disposal sites have presented and will continue to present unacceptable risks to human health and the environment. In recent years, there have been several well-documented cases in which chemical warfare materiel (CWM) inadvertently recovered by commercial fishermen resulted in severe injuries as well as exposure of many persons both on ship and ashore to the CWM hazard.³⁰ While reported incidents such as these may be relatively low in number, an incident in 2010 led to an investigation of instances of such recoveries within the Mid-Atlantic States. The investigation results indicated that such recoveries were

²⁷ A Munitions Response Area is any area on a defense site that is known or suspected to contain UXO, DMM, or MC. An MRA may contain several MRSs.

²⁸ DoD. March 9, 2012. *Defense Environmental Restoration Program (DERP) Management*. Department of Defense Manual No. 4715.20.

²⁹ DoD. April 2007. *Munitions Response Site Prioritization Protocol Primer*.

³⁰ Centers for Disease Control and Prevention. 2013. Notes from the Field: Exposures to Discarded Sulfur Mustard Munitions – Mid-Atlantic and New England States 2004-2012. *Morbidity and Mortality Weekly Report* 62(16): 315-316.

extensive in the Mid-Atlantic States and primarily by the clamming industry. In addition, anecdotal accounts suggest that fishermen on the east coast “often” find conventional and chemical UWMM resulting in substantial opportunities to become exposed to these hazards.³¹

States are concerned that without a national policy for these sites the potentially catastrophic risk associated with munitions inadvertently recovered during commercial fishing and other maritime activities will remain.

Education

DoD’s *Maritime Industry Safety Guide* is an effort to educate commercial fishermen about hazards from UWMM sites. While it conveys important information its recommendation to jettison recovered UWMM can also have the unfortunate consequence of these munition items becoming distributed over a wider area. Given that mariners place themselves and potentially others at greater risk by keeping munitions aboard jettisoning recovered UWMM may be the best current option. However, it is critical that accurate location information regarding the jettisoned munition be communicated to the maritime community in a timely manner. The guidance could also be improved by expanding first aid information.

Recommendations

Technical Recommendations

As previously stated, States support SERDP’s recommendations as put forth in *Munitions in the Underwater Environment: State of the Science and Knowledge Gaps*. These recommendations are to:

- Conduct field data collections on several worst-case MRS, using the data to support ecological risk assessment studies at each site using available components. Collect data on water, sediments, and tissue to support all aspects of the assessment. Conduct modeling studies in parallel and compile the results to support the overarching risk assessment findings.
- Develop a standardized approach to field data collection at underwater sites, collecting data in single efforts to support all components of comprehensive risk assessments.

³¹ Schworm, P., and Daley, B. June 9, 2010. Weapons are common catch, fishermen say. *The Boston Globe*. Available at: http://www.boston.com/news/science/articles/2010/06/09/weapons_are_common_catch_fishermen_say/.

- Increase communication between DoD and other agencies investing in research, development, and demonstrations related to UWMM in the underwater environment. Information exchange through periodic forums such as meetings, workshops, or conference calls is encouraged.³²

Additionally, improvement of technology to detect, characterize, and respond to UWMM sites is critical. DoD through its SERDP and Environmental Security Technology Certification Program (ESTCP) invested \$5.2 million in fiscal year 2010 in the area of detection and classification of UWMM. Nevertheless, this technology is approximately five years behind similar land-based technology. The States urge DoD to ensure that funding remains stable to allow this research to continue. Opportunities to reduce time to routine deployment should be sought.

Policy Recommendations

Timeline

DoD must significantly shorten the time to bring the watered portion of MRS that are FUDS to the Remedial Investigation and Response Complete stages. Accelerating this process will allow for more accurate risk assessment and greater protection to human health and the environment. States recognize that with current funding levels and resource availability it will take decades to reach this stage. However, this argues for DoD to aggressively seek additional funding and resources.

Interim Risk

It is important that DoD develop and fund an interim risk management policy specifically for UWMM sites. Since water sites are lower on the funding/action priority list than the land munitions sites, and it may take quite a long time before these sites are addressed, having some type of interim risk management policy in place is necessary.³³

MEC HA

DoD needs to develop a hazard assessment methodology for UWMM sites given that the MEC HA does not address such sites.

³² SERDP/ESTCP. 2010.

³³ See the December 2012 State Munitions Response Forum Issue Paper *Interim Risk Management: States' Perspective* for further information on interim risk management issues at munitions sites. Available at www.ecos.org.

Separation of Land and Water Ranges

States encourage DoD to ensure that efforts by the USACE to review MRSs and to separate most land and water ranges into separate MRSs proceed as planned and that funding remains available to complete this task.

Depth Limits

States recommend that DoD identify those MRS with munitions that are deeper than 120 feet but have the potential to migrate to shallower depths and consider this in its sequencing decisions.

Acts of War Sites

States believe that, at a minimum, as with sea disposal sites, DoD should develop a comprehensive inventory of Acts of War sites including approximate boundaries. Also, states encourage all parties involved to work to determine under what policy and with what funding these sites can be addressed to minimize risk to human health and the environment.

Munitions Sea-Disposal Sites

The States believe that DoD should seek authority and funding to address munitions sea-disposal sites. DoD should also begin discussions with the States and EPA to resolve States' concerns about the human health and environmental risk that may be present at these sites. As part of this effort, DoD should continue to research and document sea-disposal sites and to add their locations to nautical charts.

Education

DoD should update the *Maritime Industry Safety Guide* with more first aid instructions for mariners who come into contact with a chemical agent including how to handle injuries resulting from chemical agent contact as well as information on any unique first aid equipment that may be stowed aboard the vessel in case of such emergencies.³⁴

In addition, DoD should continue, and when necessary expand, its current efforts such as the 3Rs, press releases, brochures, and public meetings to alert the public to the possibility of the presence of munitions on local beaches and what to do if any are found.

³⁴ For example, the Danish Maritime Authority has very specific requirements for first aid equipment to be carried onboard vessels that may come into contact with UWMM chemical agents. See Appendix 5 of: Danish Maritime Authority. 2007. *Technical Regulation on Occupational Health in Ships*. Chapter XI Part B: Examinations, Medical Treatment and Ship Medicine.

Other Recommendations

Funding

States believe that the FUDS program is chronically underfunded and additional funds are needed. These funds could be used to support increased research and development of technologies applicable to UWMM sites, to enable investigation and risk assessments of more UWMM sites, and to provide training to the States.

State Capacity

As mentioned above, States typically are short of personnel with expertise in munitions. For several years the Interstate Technology and Regulatory Council (ITRC) has provided internet-based training courses on UXO-related topics. The States, which would benefit greatly from similar training focusing on UWMM issues, encourage DoD to work with EPA and ITRC to develop such training as more information on underwater munitions issues becomes available.

Database of Site-Specific Information

DoD should maintain a comprehensive inventory of locations where underwater military munitions are known or suspected to be present. The States believe this information is important to assist them in both assessing risk and prioritizing any required response actions. Ideally, this database of site-specific information would include:

- Locations of UWMM sites, and the probable extent of each site (e.g., range fans)
- Type of site (e.g., former or operational range, disposal area)
- History (link to Archive Search Reports, when available)
- Status –
 - Is the site being addressed in some fashion (e.g., Site Investigation or Remedial Investigation)?
 - Under what authority (FUDS, Active) does the site fall?
 - Are risk management procedures in place (e.g., 3Rs explosives safety education or annotation on nautical charts)?
- Munition Type (e.g., chemical, conventional), family (e.g., bombs, projectiles, grenades), and category (i.e., UXO, DMM)
- Condition of UWMM (known or suspected)
- Potential for MC release
- Potential for movement based on information such as depth, substrate, wave exposure, geomorphology, tides, and currents.
- Pertinent miscellaneous information such as acreage, sediment type, salinity, and slope.

Some of this information is already known for MRS that include watered areas; however, similar information is needed for other locations that contain UWMM.

On-line Information Repository/Exchange

Information regarding UWMM sites exists in many different locations, on-line and off. An on-line information repository that consolidates much of this information through links to other sites or actual hosting of information would be very beneficial to States. This website should be robust, comprehensive, and clear. It should be developed and maintained jointly by DoD, the States, and other agencies.

Some information that could be on or linked to this site includes:

- Relevant guidance from DoD, EPA, States, and other agencies
- Conference presentations, notes, and minutes
- Research related to UWMM issues
- Information regarding existing technology
- Policy documents
- Publicly available internal memos providing information or otherwise clarifying various policy decisions
- Site-specific documents (e.g., Archive Search Reports, Inventory Project Reports)
- Scientific literature
- Information regarding upcoming conferences, trainings, meetings, etc.
- Educational resources
- Case studies - What went right. What went wrong. What worked. What did not work.
- Reports of UWMM investigation and remediation in other countries

State-DoD Communication/Dialogue

DoD *must* include States from the earliest stages of the UWMM site evaluation process. States often have much more intimate knowledge of the physical and biological properties around a site. Therefore, States can provide valuable information to ensure more efficient and accurate characterization of these sites.

The States support the continuation of a dialogue between States, DoD, EPA, and other stakeholders on the management of UWMM. The State-led Munitions Response Forum (MRF) and its predecessor, the Munitions Response Committee (MRC), have been valuable forums for this dialogue as was the National FUDS Forum in 2011. However, more time should be focused on UWMM sites and related issues at the next National FUDS Forum.

States are pleased to see that the dialogue initiated with the MRC and MRF will continue in the new Munitions Response Dialogue group. States expect that the

continuing discussion of UWMM-related issues will be an important part of the Munitions Response Dialogue. Additionally, the ongoing dialogue of ITRC's munitions team, while focusing on more technical issues, is an excellent venue for collaboration between States, DoD, and others. However, other avenues of dialogue should be considered for the future, especially given funding and travel constraints.⁵⁶

Finally, constructive dialogue must continue at the project management and upper management levels.

Conclusions

There are hundreds of UWMM sites in U.S. coastal and inland waters.³⁵ UWMM at these sites may have the potential to pose a significant risk to human health and the environment. States believe DoD should commit more resources to address the technical limitations and policy issues hampering comprehensive investigation of these sites. Without proper investigation the potential risks associated with these sites generally remain unknown.

In addition, States believe DoD should commit more resources to addressing these sites and to developing comprehensive guidance for evaluating and remediating the potential risks posed by UXO, DMM, and MC at UWMM sites, including former combat areas and munitions sea-disposal sites. Although, DOD has and continues to put significant effort into minimizing the technological barriers, more research is necessary. Existing policies should be made clearer and, in some instances, revised. Advances in detection and discrimination technology combined with new and revised policies will allow DoD and the States to more efficiently characterize UWMM sites to better understand and, when necessary, respond to risks they pose to human health and the environment.

³⁵ SERDP/ESTCP. October 2007. Final Report: SERDP & ESTCP Workshop on Technology Needs for the Characterization, Management, and Remediation of Military Munitions in Underwater Environments.

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- DoD. 2004. Formerly Used Defense Sites (FUDS) Program Manual. Dept. of the Army, Engineering Regulation 200-3-1, May 2004.
- ESTCP, 2008. Final Report: UXO Detection and Characterization in the Marine Environment. ESTCP Project MM-0324.
- FY10 DEP-ARC, 2011. FY10 Defense Environmental Programs Annual Report to Congress, Chapter 6, Restoration, July 2011.
- USACE. 2011. Handbook on Realignment, Delineation, and MRSP Implementation, v. 1.0.2, October 2011.

APPENDIX A

ACRONYMS

CAA – Clean Air Act
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act
CFR – Code of Federal Regulations
CWA – Clean Water Act
CWM – Chemical Warfare Materiel
DERP – Defense Environmental Restoration Program
DoD – U.S. Dept. of Defense
DMM – Discarded Military Munitions
EMI – Electromagnetic Induction
EOD – Explosive Ordnance Disposal
EPA – U.S. Environmental Protection Agency
ESTCP - Environmental Security Technology Certification Program
FUDS – Formerly Utilized Defense Site
ITRC – Interstate Technology and Regulatory Council
MC – Munitions Constituents
MEC – Munitions and Explosives of Concern
MEC HA - Munitions and Explosives of Concern Hazard Assessment Methodology
MMRP – Military Munitions Response Program
MRA – Munitions Response Area
MRC – Munitions Response Committee
MRF – Munitions Response Forum
MRS – Munitions Response Site
NOAA – National Oceanic and Atmospheric Administration
RCRA – Resource Conservation and Recovery Act
SDWA – Safe Drinking Water Act
SERDP – Strategic Environmental Research and Development Program
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
UWMM – Underwater Military Munitions
UXO – Unexploded Ordnance

Appendix B – Glossary

Blow-in-place (BIP). Destruction of a munition by detonation in place or in the immediate vicinity of its initial location.

Chemical Warfare Materiel (CWM). Munitions or containers holding blister agents, nerve agents, blood agents, and choking agents. CWM may include chemical agent identification sets, 4.2 inch mortars, projectiles, Stokes mortar shells and Livens drums.

Discarded Military Munitions (DMM). Military munitions that have been abandoned without proper disposal or removed from storage for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of, consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2)). DMM have not experienced the firing sequence normally required to arm their fuses and in general have a significantly lower probability of detonating than UXO.

Military Munitions. All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard.

Military Munitions Response Program (MMRP). The DoD program established to manage the environmental, health, and safety issues presented by UXO, DMM, and MC.

Munitions Constituents (MC). Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 U.S.C. 2710(e)(3)).

Munitions and Explosives of Concern (MEC). The term that distinguishes specific categories of military munitions that may pose unique explosives safety risks, i.e.,

- (A) Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5)(A) through (C);
- (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or
- (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions and Explosives of Concern Hazard Assessment (MEC HA). A multi-agency effort to develop a consensus methodology to evaluate baseline explosive hazards at munitions response sites.

Munitions Response. Response actions, including investigation, removal actions, 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).

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 response area is comprised of one or more munitions response sites.

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

Operational Range. A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101(e)(3)(A) and (B)). Also includes “military range,” “active range,” and “inactive range” as those terms are defined in 40 CFR §266.201.

Underwater Military Munitions (UWMM). Military Munitions that have come to be located underwater for whatever reason.

Unexploded Ordnance (UXO). Military munitions that (A) have been primed, fused, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded whether by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5)(A) through (C)). The term does not include DMM.

APPENDIX C – Links to Additional Underwater Munitions-Related Resources

GENERAL

3Rs Explosives Safety Guide for the Maritime Industry.

<http://www.history.navy.mil/library/online/munitionsatsea.htm>

Community Involvement Guidance for Munitions Response Sites, ASTSWMO, 2011.

http://www.astswmo.org/Files/Policies_and_Publications/Federal_Facilities/2011.01_FINAL_CI_MMRP_Paper.pdf

Community Perspectives on Underwater Munitions Response, Center for Public Environmental Oversight, 2008.

<http://www.cpeo.org/pubs/Underwater.pdf>

EPA Military Munitions/Unexploded Ordnance page.

<http://www.epa.gov/fedfac/documents/munitions.htm>

International Dialogue on Underwater Munitions web page

<http://www.underwatermunitions.org/>

Marine Technology Society Journal, 3-issue series on Legacy Underwater Munitions – available from <https://www.mtsociety.org/>

Military Munitions Response Program.

<http://www.denix.osd.mil/MMRP/>

Munitions Response Site Prioritization Protocol Primer, April 2007.

<http://www.denix.osd.mil/mmrp/Prioritization/MRSPP.cfm>

SERDP-ESTCP Underwater Munitions Response page.

<http://www.serdp.org/Program-Areas/Munitions-Response/Underwater-Environments>

U.S. Army Corps of Engineers, U.S. Army Engineering and Support Center, Environmental and Munitions Center of Expertise Huntsville, AL

<http://www.hnc.usace.army.mil/Missions/EnvironmentalandMunitions.aspx>

SELECTED UNDERWATER MUNITIONS RESPONSE SITES

Atlantic Fleet Weapons Training Facility/Vieques Island, Puerto Rico

Public information website – <http://public.lantops-ir.org/sites/public/vieques/Munitions/MunitionsSafety.aspx>

EPA Region 2 Vieques home page -
<http://www.epa.gov/region2/superfund/npl/0204694c.pdf>

Martha's Vineyard, MA FUD sites

USACE 2010 fact sheet -
<http://www.nae.usace.army.mil/projects/ma/MarthasVineyard/MVBrochure13Aug2010v2.pdf>

USACE 2010 presentation -
http://www.nae.usace.army.mil/projects/ma/MarthasVineyard/Presentations/MV_TPP_2_Master_10-12-13_v3.pdf

Nantucket Beach (Tom Nevers) FUD site, MA

USACE web page -
<http://www.nae.usace.army.mil/projects/nantucketBeach.htm>

Ordnance Reef Discarded Military Munitions site, Hawai'i

General information page from Project Team -
<http://ordnancereefhawaii.org/>

[Hawaii Undersea Military Munitions Assessment Program \(HUMMA\)](#)

Pier 91, Seattle, WA

Society of American Military Engineers conference presentation –
[http://posts.same.org/2012%20JETC%20Presentations/Track%205_%20Session%204%20\(3\).pdf](http://posts.same.org/2012%20JETC%20Presentations/Track%205_%20Session%204%20(3).pdf)

Torpedo and Bombing Range, Pyramid Lake, Nevada

USACE web page:
<http://www.corpsfuds.net/php/siteindex.php?site=J09NV1118&state=Nevada>

USACE fact sheet:

<http://www.corpsfuds.net/reports/Factsheet/J09NV1118factsheet.pdf>