TECHNICAL BRIEFING – MILITARY MUNITIONS RESPONSE PROGRAM (MMRP)
REMEDIAL INVESTIGATION (RI) – DECEMBER 2013

The document reviewed was a remedial investigation (RI) for the Military Munitions Response Program (MMRP). The munitions response sites (MRSs) at the base were the subject of the RI. The main goal of the RI was to determine the nature and extent of munitions and explosives of concern (MEC) and munitions constituents (MC) and then to determine the potential hazards and risks posed to human health and the environment by MEC and MC.

MRS Sites

The following sites were identified at the base:

- 1926 Explosion Radius
- 1926 Explosion Radius Off-Post
- Shell Burial Grounds
- Green Pond and Former DRMO Yard
- Former Operational Areas
- Lakes MRS
- Lake Denmark – Off-Post
- Inactive Munitions Waste Pit
- Inactive Munitions Waste Pit – Off-Post

The Former Munitions and Propellant Test Area had to be dropped because it is an operational range and therefore not eligible for the MMRP. The sites that made the list were either associated with former ranges, were historical testing areas, were an area derived from the explosion of munitions storage magazines in 1926, or specific locations where munitions have reportedly been recovered. Three of the sites are off-post. Many IRP sites are located within the MRS boundaries. Within the Former Operational Areas MRS there are several Areas of Interest (AOIs). These AOIs required different investigation methods than the overall Former Operational Areas MRS. The AOIs are as follows:

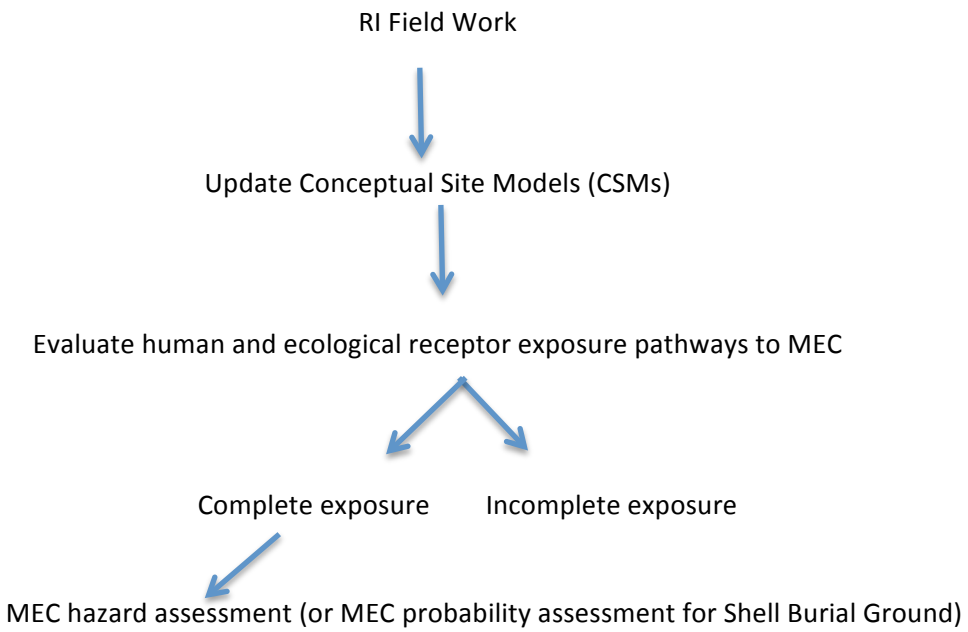
- Code 300 Area
- Former Sanitary Landfill and Dredge Pile
- Waste Burial Area
- Site 20/24

RI Project Objectives

- Characterize the type, density, and/or distribution of MEC on the surface and in the subsurface at each MRS
- Characterize the nature and extent of MC in soil
- Perform hazard assessment for MEC
- Perform baseline risk assessment for MC
- Evaluate MRS boundaries based on RI result

Overview

Tasks included geophysical surveys, intrusive investigations, and environmental sampling. A total of 6,900 anomalies were detected and investigated. MEC was found in three MRSs (1926 Explosion Radius, Former Operational Area, and Lakes MRS). The most anomalies investigated (3,194) were in the Former Operational Area. The most MEC found (75) was also in the Former Operational Area. MC sampling was only done in two areas (Former Operational Areas and Inactive Munitions Waste Pit MRS). Other areas were not sampled because intrusive investigation results did not warrant it or MC had already been addressed under the Installation Restoration Program (IRP). The following diagram shows the main steps in the RI which concludes with a hazard assessment.



Sites were classified as follows:

Level 1: Highest potential explosive hazard condition

- 1926 Explosion Radius
- Former Operational Areas

Level 2: High potential explosive hazard condition

- Lakes

Level 3: Moderate potential explosive hazard condition

- 1926 Explosion Radius – Off-Post
- Fuze Area (not originally in MRS inventory)

Level 4: Low potential explosive hazard condition

- Inactive Munitions Waste Pit

MEC Hazard Assessment Not Warranted

- Lake Denmark Off-Post
- Inactive Munitions Waste Pit – Off-Post

Moderate to High Risk of Encountering MEC

- Shell Burial Grounds
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Previous Work Related to MEC/MC

Several of the MRS sites have undergone investigations and removal actions related to MEC and MC. These activities are briefly discussed below.

1926 Explosion Radius: Previous work excluding IRP investigations at numerous individual sites included the 2008 Engineering Evaluation/Cost Analysis (EECA) investigation and subsequent intrusive portion of the investigation for MEC, MPPEH, and MD conducted at six areas. Work was done because of the potential presence of MEC in construction area footprints. Three of the parcels were within the construction footprint for the RCI Military Housing Project Properties and are as follows:

- Navy Hill
- Fisher's Pond
- Farley Avenue

The other three construction footprints were as follows:

- Childcare Development Center (CDC)
- Electromagnetic Research Facility
- Packaging, Handling, Storage and Transportation Center.

Forty-five MEC items were found in four of the six areas and the majority of the items were associated with the 1926 explosion.

1926 Explosion Radius – Off-Post: Three time critical removal actions (TCRAs) were completed at this site, the majority property holder for land within the site is the Tilcon Quarry. The TCRAs were performed on the Tilcon property due to active quarrying. MEC objects had been picked up on the belt leading into the processing plant. As such it was a safety concern for workers and nearby residents. TCRA I was completed between December 2006 and March 2007 on 22.6 acres of the Mt. Hope quarry where future quarrying was planned. TCRA II was completed between May 2008 and June 2008 on another 22 acres at the quarry. A third removal, TCRA III, was completed between December 2009 and March 2011. A soil pile was cleared and a removal action was done at the former pile location.

Green Pond MRS and Former DRMO Yard: The Former DRMO Yard was the site of a TCRA in a 0.5-acre area where improved conventional munitions (ICMs) were removed. After the surface was cleared of ICMs a 2-foot thick layer of soil cover was installed. A total of 192 ICMs were found to be inert and were disposed by detonation. A total of 282 items classified as MD were also removed.

Former Operational Areas MRS: There are several AOIs within this MRS and each AOI has been the subject of IRP investigation. The Former Sanitary Landfill and Dredge Pile has a soil cover placed over polyaromatic hydrocarbon (PAH)-contaminated soil in accordance with the record of decision (ROD) dated July 2007. The dredge pile originated from Green Pond Brook and is alleged to contain MEC as is the landfill. The AOI Waste Burial Area was also covered by a ROD signed July 2007. LUCs consisting of institutional controls (ICs) and engineering controls address potential MEC and UXO at the site. Site 20/24 which has a remedy in place is also an AOI. It is a former pyrotechnic testing area and includes a portion of a former mortar training area. There are two soils caps in place - one located over PCBs and lead, and a smaller one located over PCBs. Some soil containing PCBs was excavated prior to capping. LUCs are in place. Groundwater is being treated and monitored.

Lakes MRS: Picatinny Lake and Lake Denmark comprise the Lakes MRS. Picatinny Lake was the site of a 3-inch projectile Barbette gun firing range that was built between 1919 and 1922 and used until 1931. The range had two firing points. Flare Island was used for flare testing. The lake was also used for storage of smokeless powder and explosives under water. Explosions in the building near the lake shore may have resulted in MEC releases. Lake Denmark was the site of a mortar range for experimental testing of inert projectile mortars and a range for testing a 20 mm cannon. In 2010 both lakes were drawn down for dam repairs. Visual and/or analog surveys were completed. Several MD items were recovered from Flare Island and a 60-mm white phosphorous mortar along the shore of Lake Denmark was identified.

Lake Denmark – Off-Post MRS: The RTI Superfund site is located on property off post near Lake Denmark. In a 2010 RI Report perchlorate was reported to be found in groundwater with a wide distribution and low concentration so as to suggest that there was no significant source area remaining.

Inactive Munitions Waste Pit: This testing area was reportedly in use from 1955 to the mid-1980s. Limited information is available on the site. Filling occurred in the 1980s and 1990s and obscured signs of use for disposal or burial. Investigations nearby have been performed as part of other IRP sites. One such investigation was test pits for 600 Area groundwater. Intact gravel mines which resulting in halting the 2011 test pits. Additional test pits were completed in 2012 in which the source of TCE in 600 Area groundwater was identified.

Physical Setting

The physical setting for each of the nine MRS sites was described in the RI Report. Location, topography, soils, hydrology, sensitive environmental resources, cultural and archaeological resources, and current and projected land use were addressed for each area. Specifics are not described herein.

Remedial Response Objectives

Preliminary conceptual site models (CSMs), project approach, data needs, and data quality objectives (DQOs) for each MRS were used to develop response objectives for each MRS. A brief description of the components is provided below along with an example for the 1926 Explosion Radius. The CSM has

several parts including potential sources, interactions related to activity and access, and receptors for MEC and/or MC with complete, potentially complete, and incomplete exposure pathways.

For data quality objectives and data needs there is seven step process that is part of the characterization approach for each MRS. The steps are as follows:

1. State the problem. The available information (from detections of MEC during regular operations and TCRAs) does not adequately characterize the site because the material was distributed by an explosion, the anomaly and MEC density and distribution are unknown.
2. Identify the decisions. Available data indicates that there may be varying densities – with higher density closest to the explosion center and reduced outward. Therefore an inner 0.5-mile radius and outer 0.5 to 1.0-mile radius have been established with the goal to determine the MEC density and depth within each area. Also to be determined is whether MEC is present in the 300 Area AOI and if so, to determine the nature and extent of the MEC release.
3. Identify the inputs to the decision. VSP input parameters are based on available information. For the Code 300 Area information on the type and quantity of projectiles wasn't known so a 57 mm was assumed. From that the shape, size, and nature of the potential target area were used. Density transects were selected to determine the anomaly density and distribution. Collection of digital and analog geophysical data was selected for the inner and outer radii and for within the 300 Area.
4. Define study boundaries. The area within the 0.5-mile radius was included with the exception of operational areas, the Green Pond MRS, and those areas previously investigated during EE/CA or TCRAs. The same was done with the outer radii area. The 300 Area was based on the area identified in a 1973 report excluding areas outside the 1926 Explosion Radius and operational ranges. Other constraints further limited the study area. For example, in heavily vegetated areas sampling had to be completed in colder months when vegetation had died back.
5. Develop a decision rule. "The purpose of this step is to integrate the outputs from the previous steps into a statement that defines the conditions that would cause the decision-maker to choose among alternative actions. For the case of the 1926 Explosion Radius the following decision rules are cited in the report:

- If anomalies are found within the Code 300 Area, then their density and distribution will be defined.
- If surface MEC is found during the investigation, then the type and density of the surface MEC will be defined for both the inner and outer radii.
- If subsurface MEC is found during these investigations, then the type, depth, and density of the subsurface MEC will be defined within the the inner and outer radii.

6. Specify tolerable limits on decision errors. The decision maker chooses between the null hypothesis (H_o) which is the baseline condition presumed to be true in the absence of strong contrary evidence and the alternative hypothesis (H_a). Decision errors involve rejecting the null hypothesis when it is true (Type I decision error) or failing to reject the null hypothesis when it is false (Type II decision error). Type I errors could result in increased project costs due to additional investigation. Type II errors could result in increased risks to receptors. The null hypothesis for the 1926 Explosion Radius "will confirm the results of the previous investigations and that MEC resulting from the 1926 explosion [both on- and off-post] is restricted to the 0.5-mile inner radius. The decision errors associated with this H_o are that ther is MEC due to the 1926 explosion in the outer radius when there is not (Type I), and there there is no MEC due to the 1926 explosion in the outer radius, when there is (Type II). If H_o is rejected because MEC is identified in the outer radius, then the actual MEC density within the outer radius may be higher than the assumed MEC density used as an input in UXO Estimator. This could result in several outcomes, depending on numerous factors, including, but not limited to, the type of MEC found [e.g., manufactured before or after 1926] and the location of the MEC found [e.g., on- or off-post]. The outcomes could include revising the CSMs, re-evaluating the input and output statistical parameters in UXO Estimator, and/or additional investigations. The ultimate outcome will be determined based on an assessment of the historical and new data."
7. Optimize the design. UXO Estimator, a software program, was utilized to determine the area needing to be covered by grid surveys in both the inner and outer radii. Inputs were based on the EE/CA performed for the RCI Housing and the Tilcon Quarry TCRA (despite that area being off-post).

For each MRS the same process was utilized and was described in Section 4 of the RI Report.

Schedule

Field activities were completed between November 2011 and November 2012. Field work started with location surveying and mapping in November 2011. The last task to be completed in September 2013 was the Lake Denmark Off-Post MRS transect survey. This task lagged behind the other field tasks which were finished in May 2012 due to issues with obtaining access to the property.

MEC and MC Characterization

Methods for investigation along with results are described in Section 5 of the RI Report. An attempt to summarize these results is provided in Table 1 in which only very limited data is provided. Methods and instrumentation used in the areas include the following: analog transects, density transects, EM31-MK2 transects, visual survey transects, EM-61-MK2 grids, underwater EM61-MK2 transects, White's MXT, G-58, and ER.

Intrusive Investigation and Model Revision

Anomalies within each of the areas were selected for further investigation. Table 2 summarizes the results of intrusive investigation of the target anomalies. While some anomalies were identified as MEC many were identified as MD or as cultural debris. Also found were geologic "hot" rocks whose composition was magnetic or metal rich and registered as an anomaly on the instrumentation.

CSMs were revised as necessary based on the results of the intrusive investigation. For example no MEC source was identified at the Lake Denmark – Off-Post MRS and an explosive safety hazard is not anticipated. Also no activity, access, or receptor interactions are ongoing or anticipated under current or future land use. Therefore the revised CSM for MEC shows "incomplete pathways for surface and subsurface soils for all receptors having access to the MRS."

MEC Hazard Assessment and MEC Probability Assessment

The MEC Hazard Assessment is a tool used to assess the risk from MEC. Sites can be scored as a whole or as parts of the whole. Three components of a potential explosive hazard that are considered are as follows:

- Severity – death, severe injury, property damage resulting from MEC exploding

- Accessibility – the likelihood of a receptor coming into contact with MEC
- Sensitivity – the likelihood of a receptor interacting with the MEC so as to result in detonation.

The hazard assessment doesn't take into account underwater MEC or environmental and/or ecological hazards associated with MEC. The water portion of the lakes was not subjected to the hazard assessment. No MEC were found at the Inactive Munitions Waste Pit – Off-Post and the Lake Denmark – Off-Post and, as such, the sites were not subjected to a hazard assessment and neither was the Shell Burial Grounds MRS. No MEC were identified but the site does have high potential for MEC to be present and merited a probability assessment.

For the hazard assessment points are assigned for each of the different factors that make up the scare. The highest score is associated with Hazard Level 1 which is the highest potential explosive hazard condition. The lowest scare is 4 and represents a low potential explosive hazard condition. Results are as follows:

Hazard Level 1: 1926 Explosion Radius MRS, and Former Operational Areas MRS

Hazard Level 2: Lakes MRS (land portions only),

Hazard Level 3: Fuze Area MRS, and 1926 Explosion Radius – Off-Post MRS

Hazard Level 4: Inactive Munitions Waste Pit MRS

<u>MRS Prioritization Protocol</u>

The MRS Prioritization Protocol (MRSPP) is another scoring system to identify priorities for funding and responses at MRS sites. Three different categories comprise the system: EHE to evaluate explosive hazards, CHE to evaluate chemical warfare materiel hazards, and HHE to evaluate MC risks. EHE has the following considerations: munitions type, source of hazard, location of munitions, ease of access, status of property, population density, population near hazard, types of activities/structures, and ecological and cultural resources. CHE did not apply since there is no evidence of chemical warfare materiel at Picatinny. HHE was determined based on whether MC sampling was done and what the results were; also factored in was whether all or part of the site was covered by the IRP.

Scores were as follows:

MRSPP of 3: 1926 Explosion Radius MRS, 1926 Explosion Radius – Off-Post MRS, Former Operational Areas MRS

MRSPP of 4: Fuze Area, Lakes MRS, Inactive Munitions Waste Pit MRS

MRSPP of 5: Shell Burial Grounds MRS

No known or suspected MEC or MC Hazard: Lake Denmark – Off-Post, Inactive Munitions Waste Pit – Off-Post MRS

Contaminant Fate and Transport

Contaminant fate and transport for both MEC and MC were described for each of the MRS sites. Migration of MEC can come from a person picking up and moving a MEC item but may also result from natural processes such as erosion. Potential mechanisms are discussed for each area. MC constituents may have other means of transport depending on the site characteristics. For example transport can occur by erosion and runoff to a stream. Fate and transport dynamics are not addressed where MEC and/or MC were not detected.

Risk Assessment for Munitions Constituents

The only sites subject to the risk assessment for MC were the Former Operational Areas MRS and the Inactive Munitions Waste Pit MRS. They were the only sites to have soil sampling for MC performed as part of the MMRP RI. A screening level ecological risk assessment (SLERA) was also performed. For the Former Operational Areas MRS manganese was the only constituent to present a concern. However, "because the manganese EPC likely over-estimated average exposure conditions throughout the Former Operational Areas MRS, no further action based on the potential for human health is warranted." The explosives and metals detected in soil from the Operational Areas MRS do not pose risks to human health either because of their concentrations and/or their depth of occurrence (greater than 10 ft)

Potential Applicable or Relevant and Appropriate Requirements (ARARs)

As with all the multitude of IRP sites, ARARs were identified for the MRS sites. The ARARs are similar to those for IRP sites. There are no chemical-specific ARARs for MC in groundwater because groundwater is being addressed under the IRP.

Summary/Conclusions

Section 11 of the RI report includes a summary and conclusions for each MRS. The report contains a large amount of information which I have attempted to summarize as succinctly as possible and to

depict in a couple tables. Figures within the report are valuable graphic displays of the extent of field surveys and may be considered a useful reference.