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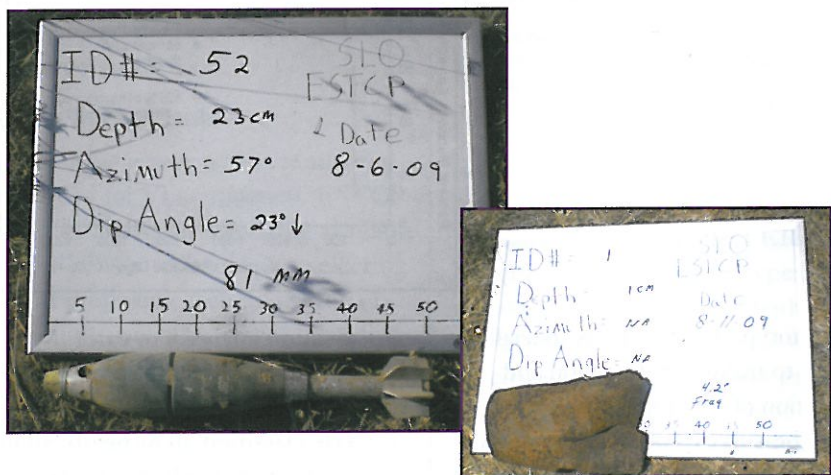
SERDP research and development and ESTCP demonstration and validation efforts are leading to technical and environmental advances that are relevant to the Department of Defense (DoD), Department of Energy (DOE), Environmental Protection Agency (EPA), and many other user communities.

Pilot Program Demonstrates Successful UXO Classification at Increasingly Complex Sites

In the second in a series of live site demonstrations being conducted through the ESTCP Classification Pilot Program, emerging electromagnetic induction (EMI) sensors optimized for unexploded ordnance (UXO) classification produced nearly perfect classification results at the former Camp San Luis Obispo in California. Commercially available sensors were paired with advanced processing methods to successfully classify munitions from other nonhazardous items on a site with a mix of munitions types. Successful classification paves the way for reduced costs and an accelerated timeline to remediate munitions-contaminated sites throughout the nation.

Pilot Program Overview

The Military Munitions Response Program (MMRP) is charged with characterizing and, where necessary, remediating munitions-contaminated sites. When a site is cleaned up, it is typically mapped with a geophysical system, based on either a magnetometer or EMI sensor, and the locations of all detectable signals are excavated. Many of these detections are not munitions, but rather harmless metallic objects or geology: field experience indicates that often in excess of 90 percent of objects excavated during the course of a munitions response are found to be nonhazardous items. Existing technology, as it is traditionally implemented, does not provide a



Distinguishing intact munitions from nonhazardous metal and geology, or classification, was the aim of demonstrations conducted as part of ESTCP's Pilot Program at the former Camp San Luis Obispo, California. Above are two examples of classified items, a seeded munition item (left) and a nonhazardous munition fragment (right).

physics-based, quantitative, validated means to discriminate between hazardous munitions and nonhazardous items.

Remediation of the entire site inventory using current practices is cost prohibitive and estimated completion dates for munitions response on many sites are decades out. If the potential savings from distinguishing munitions from nonhazardous objects were fully realized, the limited resources of the MMRP could be used to accelerate the cleanup of munitions response sites.

In response to this need, ESTCP initiated a pilot program that is validating the application of recently developed classification technologies in a comprehensive approach to munitions response. A series of demonstrations at live sites of increasing difficulty is under way, with demonstrations at the former Camp Sibert in Alabama and the former Camp San Luis Obispo in California

now complete. Demonstrations at the former Camp Butner in North Carolina are ongoing. Results from the former Camp Sibert were reported previously. Highlighted here are results from the former Camp San Luis Obispo.

Former Camp San Luis Obispo Results Now Available

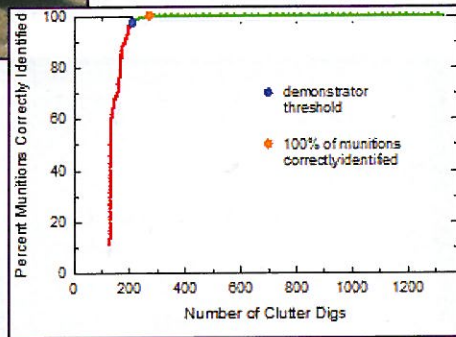
A hillside range at the former Camp San Luis Obispo was selected for its wide mix of munitions types. At this site, there were four known munitions types prior to the study, including 60-mm, 81-mm, and 4.2-in mortars and 2.36-in rockets. Three additional munitions types were discovered during the course of the demonstration.

The demonstration consisted of several combinations of data collection platforms and analysis approaches, ranging from careful application of commercial EM61 survey instruments to

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Receiver operating characteristic curve based on analysis of MetalMapper data from the former Camp San Luis Obispo. Items correctly classified as non-munitions are highlighted in green.



three prototype EMI systems specially designed to maximize detection and classification of munitions.

After the survey systems completed data acquisition, anomalies were selected from the data by recording all locations for which the sensor signal exceeded a system-specific threshold. Multiple groups demonstrated classification approaches on data collected using commercially available and emerging sensors. Mature, physics-based analysis methods were used to estimate properties of buried objects, such as size, depth, aspect ratio, remnant magnetization, and electromagnetic decay rates—properties that may be useful in distinguishing munitions from other sources. Advanced classification algorithms use this information to determine whether a signal is likely to arise from a munition or another source.

The site was seeded with inert munitions and all anomalies were dug to confirm technology performance. Demonstrators were scored based on their ability to eliminate nonhazardous items while retaining all detected munitions.

Substantial classification ability was demonstrated. In the application of

classification analyses to carefully collected survey data from commercial EMI sensors, the best performers correctly classified all or nearly all of the targets of interest, while achieving reductions of up to 50 percent in the number of non-munitions. Recently developed EMI sensors optimized for UXO classification that were demonstrated at the former Camp San Luis Obispo showed even better results. For example, an analyst using data from the MetalMapper system in cued mode was able to correctly classify nearly 1,000 of the approximately 1,300 non-munitions. A simple cost model based on these results shows the potential for large savings as the

classification approach is adopted on munitions response sites.

Former Camp Butner Demonstrations Ongoing

The former Camp Butner is known to be contaminated with items as small as 37-mm projectiles, adding yet another layer of complexity into the process. Data collection occurred over the summer of 2010, data analysis is being performed throughout the fall, and initial results will be presented at the upcoming Partners in Environmental Technology Technical Symposium & Workshop (www.serdp-estcp.org/symposium).

In an effort to engage members of the local community, an open house was held at the demonstration site in July. The former Camp Butner Restoration Advisory Board and neighbors were invited to observe data collection sensors in the field and meet with technology developers. ESTCP plans to host open houses at future demonstration sites based on the positive response from this event.

For further information on the ESTCP Classification Pilot Program, including the Final Report documenting the former Camp San Luis Obispo demonstrations, visit [Featured Initiatives > Munitions Response Initiatives > Classification Applied to Munitions Response at www.serdp-estcp.org](#). ♦



ESTCP hosted an open house at the former Camp Butner for community members to meet technology developers and observe data collection sensors in the field.