**US Army Corps
of Engineers ®**

Final

Transfer of InnovativeRemediation Technologies

FY 22 Annual Report: Military Munitions Response Program

Formerly Used Defense Sites Program

Prepared by
Environmental and Munitions Center of Expertise
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FY21 Annual Report
Transfer of Innovative Remediation Technologies

Formerly Used Defense Sites Program

1. Introduction

The U.S. Army Corps of Engineers (USACE) Innovative Technology Advocate (ITA) Program was established in 1989, with dedicated positions at Headquarters USACE, Missouri River Division (now the Northwestern Division), Kansas City District, and Omaha District. Since that time the ITA Program has grown to include partially funded positions in USACE offices around the country. ITAs now operate within the Hazardous, Toxic, and Radioactive Waste (HTRW) Program as well as the Military Munitions Response Program (MMRP). This report discusses the MMRP ITA Program. Current MMRP ITA positions are shown in Table 1.

The impetus behind the ITA Program is the emphasis to use innovative technologies as noted in the National Contingency Plan (40 CFR 300.430(a)(1)(iii)(E)). Engineer Regulation (ER) 200-1-1 provides policy and guidance for the development and implementation of the ITA Program within the Corps of Engineers. The ER states "It is the policy of the Corps of Engineers to use innovative technologies to reduce costs, expedite project schedules, minimize risk and maximize effectiveness during all phases of a project." The ER defines innovative technology as:

1) A technology which is significantly better, cheaper, or faster than existing technologies, that is not broadly applied due to limited knowledge or established standards within the engineering community;
2) A technology that is not commercially available from one or more vendors which has the potential to be better, cheaper, or faster than existing technologies. This may include technologies that are currently under development that have not been tested or evaluated on a full-scale project;
3) A technology that lacks full scale cost and performance data.

1.1. Report Organization

The MMRP ITA Program Annual Report is comprised of four main sections: Section 1 provides a brief introduction to the ITA program and presents general program information and funding; Section 2 describes various programmatic-level activities supported by the ITA program; Section 3 includes in-house technology assessment projects; Section 4 provides a description of communication and technology transfer activities that benefit the program as a whole; and Section 5 includes descriptions of innovative technology that is in use on active FUDS projects.

The report is intended to present a broad programmatic view of innovative technology applications benefiting the FUDS program. Additional information may be obtained on any activity by contacting the MMRP ITA Program Coordinators. Table 1, lists the ITAs for the FUDS

MMRP ITA Program.

Military Munitions Response Program (MMRP) TAs		
Amanda Sticker	EM CX	Military Munitions ITA Lead
Andrew Schwartz	EM CX	MMRP Technology Subject Matter Expert (SME)
John Jackson	EM CX	MMRP Technology Subject Matter Expert (SME)
Mike Madcharo	EM CX	Geophysics
James Salisbury	EM CX	Munitions Response
Elise Goggin	EMCX	Geophysics
Steve Stacy	EMCX	Geophysics
Tori Doven	EM CX	Geophysics
Amy Walker	Huntsville	Geophysics
Richard Perry	Huntsville	Geophysics
Rick Grabowski	Huntsville	Geophysics
Chad Wood	Huntsville	Geophysics
Kelly Enriquez	Huntsville	Geophysics
Ellen Haapoja	Huntsville	Geophysics
Bob Selfridge	Huntsville	Geophysics
Daryl Donatelli	Huntsville	Geophysics
Benton Williams	Huntsville	Geophysics
Eric Kirwan	Ft. Worth	Geophysics
Kyle Lindsey	Sacramento	Geophysics
Cesar Tapia	Sacramento	Geophysics
Lew Hunter	Sacramento	Geophysics
Hannah Rickertsen	Sacramento	Geophysics
Cheryl Webster	Albuquerque	Geophysics
David King	Baltimore	Geophysics
Tom Colozza	Baltimore	Geophysics
Greg Abrams	Baltimore	Geophysics
Aaron Ochsner	Omaha	Geophysics
Benjamin Konshak	Honolulu	Geophysics

Table 1 – USACE Innovative Technology Advocate Positions –
FY22-FY23

1.2. ITA Responsibilities

Innovative Technology Advocates (ITAs) interact with project managers and technical specialists within USACE, Department of Defense (DOD), Department of Energy (DOE), the Environmental Protection Agency (EPA), and other public and private entities within the research and development (R&D) community to gather information on new or innovative technologies for use on HTRW or MMRP applications. Additional ITA responsibilities are defined as follows:

- Advocate the consideration and evaluation of new or innovative technologies during Remedial Investigations (RI), Feasibility Studies (FS), and Remedial Designs (RD);
- Participate in development of project documents, including Performance Work Statements (PWS) and Quality Assurance Project Plans (QAPP) for investigations, FSs,

and RDs to incorporate innovative technologies;

- For identified ITA projects, report on progress of implementation in order to obtain lessons learned for sharing with USACE personnel on future applications;

- Act as a focal point to establish and maintain resources and disseminate useful investigation and design information regarding innovative technologies;
- Coordinate with the R&D community to obtain information, communicate research needs, and identify laboratory points of contact who can provide specialized assistance on new technology;
- Identify and recommend demonstration sites for new technologies; and
- Initiate and/or participate in local and national workshops, seminars, site demonstrations, and conferences addressing innovative technology issues.

1.3.   Funding

In fiscal year 2021, the Formerly Used Defense Site (FUDS) program provided $183,990.00 to the ITA program. The ITA program used $135,660.44 to execute ITA MMRP activities in FY21. The remaining funds were returned to HQ by the FUDS Liaison.

Funds were distributed as follows:

Activity	Funding Level
Total Funds received for ITA-MMRP	$596,550.00
Breakdown of ITA-MRP Funds	
Support for travel, conference attendance, etc.	$38,446.93
EM CX ITA labor	$270,221.79
Cross-labor charge codes, District in-house labor (MMRP)	$268,415.96
Repurposed within EM CX FUDS Activities	$19,221.45
Returned to HQ	$243.87
Execution rate	96.7%

Table 2 – FUDS ITA
Funding Summary

2.   Programmatic Level MMRP Innovative Technology Initiatives

During FY22, several tasks were either continued or initiated to advocate for and increase the use of new and innovative technologies for munitions response. These tasks generally are programmatic in nature; meaning that they are not specific to a particular project,rather, they will benefit the program in its entirety. These tasks focus on objectives that promote or facilitate the use of innovative technology on munitions response projects. The annual budget for the MMRP ITA program is used for travel and labor associated with these tasks.

2.1.   Military Munitions Geophysics Group (M2G2)

This information sharing and discussion forum met monthly via teleconference calls and is open to all MMRP geophysicists involved in the FUDS ITA program. Topics ranged across all types of work performed on MMRP projects where USACE geophysicists are involved and stimulated geophysical discussions and sharing of lessons learned. This forum is also used to update the group on the status of Advanced Geophysical Classification (AGC) projects for purposes of tracking and sharing knowledge and experience.

Professional representation and attendance at industry conferences and symposiums, as listed in subsequent sections of this report are included in the long list of accomplishments for this initiative.

2.2. Mentoring

The mentoring task ensures that USACE is developing and maintaining the in-house expertise required to successfully implement the program. It is one of the most important aspects of the FUDS MMRP ITA program. In short, this is our mechanism for workforce development and retention. This activity is intended to mentor USACE geophysicists and other technical team members who want to become proficient in AGC or who need to maintain or improve their proficiency and expertise. The task involves two main components: formal training and on-the-job experience. FY22 focused on additional software training and further outlining the AGC mentoring plan.

2.3. New and Emerging Technologies

USACE geophysicists have worked with Environmental Security Technology Certification Program (ESTCP) on various projects over the years. ESTCP is the primary source of new and emerging technologies for munitions response. The most exciting new technologies on the horizon are those that can detect and classify geophysical anomalies inthe underwater environment. This is an area with a definite need for the FUDS program as there are numerous water ranges in the inventory that have yet to be investigated or remediated. Other new technologies still in the research phase but that have great promise to benefit the FUDS program are UXO penetration calculators and underwater munitions mobility modeling.

A complete list and description of active research projects for munitions response technologies can be found here: https://www.serdp-estcp.org/Program-Areas/Munitions-Response/(list)/1/

3. In-House Technology Assessment Projects

This section describes small scale projects that are intended to field test existing technology to assess utility to the FUDS MMRP. These projects are completed by USACE personnel and are funded by the ITA program. Typically, the assessments are performed on FUDS properties; however, there are occasions where non-FUDS properties provide greater opportunity or efficiency for the technology assessment.

3.1 Simultaneous Localization and Mapping (SLAM), APEX, and EMClass Training and Introduction to ULEMA

Twenty USACE Geophysicists from various districts and design centers convened in Huntsville, AL for a two-week hands-on training session (August 22 – September 02). Instructors from Kaarta, Exploration Instruments (EXI), and White River Technology (WRT) provided detailed instruction for operating the SLAM and APEX Advanced Geophysical Classification (AGC) sensor and processing APEX data in the EMClass software suite.

The SLAM system uses high- resolution light detection and ranging (LiDAR) scanning to measure distances to objects within its field of view. This information is continuously compiled to create a map of the local environment and to track the LiDAR sensor's path within it. Participants were given the opportunity to utilize SLAM to: establish a basemap point cloud; georeference the basemap using known control points; and localize the sensor within an established basemap to complete reacquisition and mapping with the APEX sensor.

Kaarta's instructors were also able to provide information necessary for developing project Measurement Quality Objectives (MQO) for this relatively new technology. Throughout the two-week training session, there were many lessons learned. One such example was related to the accuracy and distribution of established control points in the region of interest. It was observed that any issues with the control point coordinates would result in an unusable basemap. Additionally, if control was not available throughout the area of interest the SLAM would have difficulty locking onto an established basemap and would report lower confidences when in an area lacking control points.

EXI and WRT provided instruction on operating the APEX in combination with the SLAM. APEX is a DOD Advanced Geophysical Classification Accreditation Program (DAGCAP) Accredited dynamic AGC sensor that eliminates the need to return to detected sources to collect cued measurements. This type of sensor typically provides the best value to the government due to its proven ability to classify targets of interest and reject high percentages of clutter in a single phase of mapping. Participants collected APEX data over approximately 2 acres of variable terrain. The areas designated for mapping contained various densities of trees and slopes greater than 30 degrees. The data collected in the field was processed in EMClass with support from WRT.

The consensus after completing the training was that the SLAM and APEX sensors provide an efficient and effective solution for collecting AGC data in GPS denied environments. Utilizing SLAM positioning should allow for production rates close to those obtained with RTK GPS, however, there will be additional time needed to establish georeferenced point clouds prior to data collection. Despite this added step, utilizing SLAM will be more efficient than Robotic Total Station (RTS) and more accurate than using fiducial methods.

During the second week of training, two employees from the Cold Regions Research and Engineering Laboratory (CRREL) introduced participants to the ULEMA AGC sensor. This sensor was built in coordination with Dartmouth College and is still in development. It is not DAGCAP accredited, however the concept is to provide a lightweight, handheld alternative for acquiring AGC data in challenging terrain. CRREL personnel and class participants were able to successfully integrate the ULEMA with the SLAM positioning system and collect approximately 0.25 acres of dynamic data. A joint on the ULEMA boom failed while collecting data and rendered the system inoperable, however, this was still considered a successful demonstration of concept.

3.2. Contracted ITA Initiatives

Two contracts, Boise and Fort Huachuca QA Seeding, were awarded during FY21 with ITA initiatives attached to the task orders. The Boise QA Seeding contract includes tasks to further demonstrate the SLAM technology in GNSS denied areas on steep terrain. An added benefit of the SLAM point cloud is the ability to calculate terrain parameters. A demonstration of SLAM integrated with AGC sensors was conducted at Boise Barracks. The data collected not only provide additional technical data to support the Remedial Investigation, but also provide cost data to support the Feasibility Study. Because no cost data currently exists for implementation of this approach during a Remedial Investigation, the data collected at Boise Barracks will provide an initial data point for future cost estimates in the FUDS program. Field work was conducted in the second and third quarters of FY22 and the analysis is ongoing.

A second contract initiative was awarded with the Fort Huachuca QA Seeding contract. The EM CX identified several QA activities commonly conducted on AGC projects that are being performed manually by the USACE geophysicist. The intent of the task order award is to provide a means of automating these processes to streamline QA efforts. Work on this task began in the first quarter of FY22 and is still ongoing.

4. ITA Coordination, Communication, and Technology Transfer Activities

This section describes activities and initiatives that may not be explicitly or uniquely associated with the FUDS ITA Program, but USACE is involved with on behalf of the FUDS ITA program in support of overall technology transfer and communication. This includes expert representation at technical conferences and seminars and participation on working groups related to munitions response. The investment in these activities ensures that FUDS program personnel continue to be leaders in innovation, understand the logistics to provide better QA, and maintain influence within the community of practice.

4.1. Geosoft Licenses, Training, and Maintenance

A new 5-year Seequent (formerly Geosoft) contract was awarded in March 2021. Due to revised licensing structures under the new ownership, a new approach to the licenses was awarded. There are 10 individual licenses assigned to USACE "power users" and 10 shareable licenses usable across the design centers. This contract allows USACE geophysicists to process and analyze geophysical data, including AGC data, which is necessary to perform Quality Assurance oversight. Award of this contract represents the successful transfer of the new and innovative technologies that comprise the UX-Process and UX-Analyze suite of tools. The government further benefits from this award by receiving a volume discount for the licenses. These licenses were used on all FY22 FUDS MMRP projects, in addition to other programs. In September of 2022, an Oasis Montaj Basic Training course was provided to all available Geosoft users. The course aimed to refresh current users as well as teach new users the ins and outs of MMRP data

processing in the program. The funding for this contract is under the DAGCAP cost-sharing activities.

4.2. SERDP/ESTCP Symposium

ITAs attended the FY22 Virtual Strategic Environmental Research and Development Program (SERDP)/ESTCP Symposium hosted November 29th through December 3rd, 2021. The Symposium is a nationally recognized conference focusing on the Department of Defense's priority environmental and installation energy issues. The Symposium hosted virtually due to the COVID-19 pandemic, highlighted recentefforts to enhance mission capabilities, reduce costs in times of increasing fiscal constraints, and improve environmental and energy performance. The Symposium brings together environmental and energy researchers and technology developers with the defense user and regulatory communities to showcase cutting edge environmental technologies and ideas. The team attended multiple technical sessions to include Development and Use of Underwater UXO Demonstration Sites. The virtual symposium also included 20 break out technical sessions, technical poster presentations, and exhibitors from funding and partnering organizations. There were a variety of networking opportunities for themore than 1,000 attendees from the military services; academic and research institutions; private sector technology and environmental firms; and Federal, state, and local regulatory andpolicy making organizations.

4.3. Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP)

Members of the MMRP ITA community attended the SAGEEP 2022 hosted March 20-24. The conference was held in Denver, Colorado. The conference hosted the First Munitions Response meeting as a special topic. Over 100 attendees from industry (NAOC) and government participated, to include HQ USACE. The EM CX and design centers submitted several abstracts that were accepted for presentation. Topic areas included MR Cost Estimating, marine classification technology, Automated Quality Assurance, SLAM Positioning Systems, and MR Case Studies. The MR program was well received with both industry and government interested in continuing the collaboration in future symposiums.

4.4. Quarterly Calls with the National Association of Ordnance Contractors (NAOC)

FUDS MMRP ITA Program continued quarterly technology calls with the National Association of Ordnance Contractors (NAOC). This coordination was started in FY20 and continued throughout FY22. These calls are part of a broader effort to increase collaboration between government and industry partners with the goal of improving program execution. Topics included "More Effective Ways to Write up Technical Proposals", "PWS Characteristics that Facilitate High Quality Technical Proposals", "Root Cause Analysis", "Dynamic AGC Payment Milestones", and "Validation Seed Failure Process". Comments and discussion from these sessions resulted in significant beneficial changes to the guidance documents and facilitating better products for the acquisition process. Lessons learned from these topics will also be included in the PWS template revisions.

4.5. Performance Work Statement (PWS) Template

Beginning in 2019, Nick Stolte assembled a Project Delivery Team (PDT) of government and industry representatives to develop a standard RI/FS PWS template for the munitions response acquisitions. In addition, suggested evaluation criteria were also developed. A policy memo from HQUSACE was received January 2021 regarding use of the PWS template and evaluation criteria. Goals for FY22 include updating the RI/FS PWS Template and issuing a RA Template after the MR-QAPP Toolkit #2 is released. Training materials for the PWS Templates will be developed in tandem with the EM 200-1-15 training efforts.

This template will improve munitions response contracts for USACE and industry. The goals of this effort are to: 1.) increase uniformity and standardization of Performance Work Statements usedfor munitions response; 2.) develop acquisition strategies with the flexibility needed for the level of uncertainty inherent in munitions response; and 3.) fully implement the process of RI/FS and RA in accordance with the Munitions Response Quality Assurance Project Plan (MR-QAPP) toolkit. Amanda Sticker has taken on the revising the RI/FS PWS template. Extensive updates have been done to the tasks from lessons learned from USACE and NAOC.

4.6. Development of GIS Requirements for PWS

Geographic Information Systems (GIS) are an integral component of Munitions Response (MR) investigation and remediation projects, required on every Task Order. To date, there has been little emphasis on consistently defining and enforcing standards for GIS deliverables across the USACE. This has resulted in the following impacts to the quality of MR projects: Incomplete and insufficient data deliverables; Inability to centrally manage and archive data due to non-standard formatting; Residual data issues are passed on through multiple phases of work; And data is lost due to lack of internal procedures and systems for archiving data deliverables.
The EMCX has worked to identify GIS professionals, project managers and other relevant technical subject matter experts with knowledge applicable to solving this problem. Working groups were established in August 2022 and a path forward has been developed. Pending funding, the recommend path forward will be to tackle each of the primary concerns with an integrated approach. The recommended actions are: Integrate procedures for USACE MR GIS management into PWS; Further develop a multi-tiered GIS working group; Create an MR-specific standard model within the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE); and develop procedures for USACE MR GIS data management.

4.7. Structural Acoustic Repeatability & Variability Experiments

The EMCX identified a means to provide the first repeatability and variability in structural acoustics of real munitions items that had been submerged in sea water since the 1940s. To date all structural acoustic signatures (also referred to as 'acoustic color') have been made using pristine inert munitions items or fabricated simulants. After learning of this data gap in the structural acoustic research community the EMCX contacted the project manager for the Great Tisbury Pond RA to see about acquiring certified inert MK23 practice bombs. Through coordination between the SERDP Munitions Response Program Area director and the USACE RA

contractor we were provided nineteen examples of MK23 bombs. In FY22 we supported the research proposal and identified additional inert munitions items they might include in their test other than the MK23 practice bombs. Currently the structural acoustics activity is on hold until a SERDP research award is made in FY23.

5.   USACE-Lead FUDS Projects with Innovative Technology

MMRP projects with an innovative technology component were initiated or underway in FY22. This section identifies each project and describes how and why the technology was used, as well as the results, lessons learned, and current status.

5.1.   Camp Blanding, I04FL001504, Project 04 (Anti-Tank Rocket & Rifle Grenade Range)

The RA was awarded to HydroGeoLogic, Inc. (HGL) in FY 21 to satisfy the remediation goal stated in the DD (paragraph 10.3.8) by performing a subsurface MEC removal to 2 feet. HGL self-performed the AGC data collection component of the project under HGL's DAGCAP accreditation. AGC validation seeding was performed by contractor PIKA International, Inc. (PIKA) and its subcontractor APTIM Federal Services (APTIM). The Kaarta Stencil simultaneous location and mapping (SLAM) system global positioning system (GPS) technology has been implemented for the project due to dense tree canopy which prohibits the use of traditional GPS systems in the production area. Dynamic mapping was performed using the UltraTEM Screener system, which was followed by cued data collection using both Metal Mapper 2X2 (MM2x2) and Man Portable Vector (MPV). Anomaly densities at the site were greatly underestimated which caused costs to exceed their signature authority to the point where this project has recently been de-scoped. As of 1SEP there have been 29,848 targets cued out of the 41,969 total cued targets identified. The USACE PDT is currently re-evaluating the path forward for this project. The AGC technologies employed at the site worked well with the SLAM integration, with 2 important lessons learned throughout the project. (1) Accuracy of the Stencil base map at the IVS was affected by its physical location with a tree line to the north and an open field to the south; this caused a bias in the Stencil's localization result of 0.4m to the south resulting in some initial MQO failures at the IVS. It is recommended on future projects to place the IVS in an area with more surrounding structures to inhibit better localization and avoid a directional bias. (2) Early in the project an MQO failure led to the identification of a shift between the time bases of the UltraTEM Screener and Kaarta Stencil resulting in an apparent lag in the merged Screener data which can affect accurate recovery of polarizabilities even after a lag correction is applied. The use of UXOLab processing software, which is only available to Black Tusk Geophysics (BTG), was required to apply independent model location inversion (IMLI) algorithm to estimate independent source locations on adjacent passes to improve polarizability accuracy. Future projects using the UltraTEM screener paired with SLAM may want to consider using "non-blind" seeds for data processors to evaluate lag on a grid-by-grid basis (i.e., SLAM seeds).

5.2.   Camp Blanding, I04FL001502 and I04FL001509, Project 02 (Grenade Ranges) and Project 09 (Combat Firing and Range Complex No. 4)

The RI/FS was awarded to HGL in FY 21. HGL self-performed the AGC component of the project

under HGL's DAGCAP accreditation. AGC validation seeding was performed in the grids by contractor PIKA International, Inc. (PIKA) and its subcontractor APTIM Federal Services (APTIM). Dynamic DGM transect surveys were performed over 118 miles of the site using the EM-61, with limited AGC in-fill transects using the MM2x2 in dynamic mode to refine anomaly density estimates. A total of 37 grids were placed throughout the various MRSs in areas with elevated anomaly densities meeting our critical density criteria, dynamic surveys were performed in the grids with follow-on cuing using the MM2x2. At this time only one HD grid remains for characterization, all others have been completed.

5.3. Fort Pickens, I04FL0063, Project 01 (Multi-Use Range Complex)

A task order was awarded to Pika-Pirnie JV in FY16 to conduct a RI to characterize nature and extent of MEC contamination. A Treatability Study was completed in FY18 to evaluate peak response picking and informed source selection methodologies for anomaly selection. An underwater autonomous vehicle (UAV) was used to assist with marine mammal and sea turtle monitoring and avoidance during detonation of MEC. The RI report is currently being finalized after a new contract was awarded in FY22 to Pika-Pirnie JV for document completion of the Proposed Plan (PP) and a Record of Decision (ROD).

5.4. Osprey - Venice Ranges RI/FS, W912DY20D0073, Project 01

An RI/FS was awarded to EA-Wood in FY 20, with Acorn SI/NAEVA JV Geophysics as subcontractor providing AGC support. Following dynamic transect surveys AGC data will be collected in grids in dynamic and cued modes to aid in characterization of nature and extent of MEC contamination. AGC in-fill transects will be performed to refine anomaly densities at the site. There is a marine component in a large lake at the Venice MRS, the contractor has selected the Geometrics G822 magnetometer for transect data collection. The QAPP is currently under review and field work is tentatively scheduled to begin early FY23.

5.5. Waikoloa Maneuver Area, H09HI0359, Project 02 (Areas B, O, Q and J-Cleared) and H09HI035904 Project 04 (Areas B, O, Q, and J-Remnants)

A task order to conduct a Remedial Design (RD) at BOQJ Project 02 and Project 04 was awarded in FY20 to HGL with Na Ali'I and Parsons as a subcontractor for the AGC work. The RD is necessary to resolve data gaps in support of future RAs for these Munition Response Sites (MRSs). To collect the maximum amount of AGC and DGM data, the technical approach is using multiple AGC instruments (APEX, MPV, UltraTEM Screeber) and DGM instruments (PDM8). The QAPP was approved in June of 2021.

RD field activities have been on-going since the Fall of 2021 in multiple phases of work as rights of entry are obtained from landowners and coordination is completed for residential areas. The target selection memos included informed source selection and classification filters to reduce background geology targets from the iron-rich substrate. The filters were tested with synthetic seeding and a selection of targets verified in the field. Field activities have consisted of transect, grid sampling, and 100% coverage using AGC instrumentation. Data collection has consisted of a one pass AGC dynamic survey using the APEX. In areas where the APEX has not been used, dynamic AGC collection with the UltraTEM Screener followed by a cued survey using

the MPV instrument was conducted. The regulator has received briefings on the geophysical filtering approach and project status. Fieldwork is expected to continue through 2023.

5.6.   *Waikoloa Maneuver Area, H09HI0359, Project 02 (Areas B, O, Q and J-Cleared)*

A task order to conduct an RA at the unobstructed areas of Areas B, O, Q and J was awarded in FY18 to Na Aliʻi–ERRG JV with Parsons as a subcontractor for the AGC work. This project is using AGC, where terrain permits. The PDM8 sensor will collect data in dynamic mode for difficult terrain, UltraTEM will be used in less rugged terrain, and the MPV will be used to cue targets. Field work commenced in March of 2021.

The Quality Assurance (QA) seeding contract was awarded to TPMCWRT at the end of FY19. TPMCWRT conducted field work from February through March 2021 that consisted of QA seeding prior to Na Aliʻi–ERRG JV conducting their geophysical survey.

A contract modification was awarded in FY20. The intent of the MOD was to shift the project acreage to the non-developed acreage inside the Lalamilo housing development within the Project 2 boundaries. The technical approach consists of collecting AGC data with the UltraTEM to the maximum extent practical. The UltraTEM dynamic survey work began in March 2021 and concluded in May 2021. The MPV cued survey work began in July 2021 and continued through 2021. The PDM8 handheld digital geophysical instrument was collected in areas where data collection with the UltraTEM was not feasible due to inclement terrain. Intrusive investigation of TOI and other anomalies were completed by August of 2022. Analog work (where collection with the PDM8 is not practical) was completed by September of 2022. The final quality control/assurance activities, residual intrusive work and site restoration are in progress. The report writing is underway and will extend through early 2023.

5.7.   *Guam Area 101, H09GM0295, Project 01 (Disposal Range)*

A task order was awarded to EA with Acorn SI/NAEVA Joint Venture as the AGC subcontractor to conduct an RI to characterize the site conditions; determine the nature and vertical and horizontal extent of MEC contamination in FY19. The contractor will conduct a dynamic DGM survey followed by a cued AGC survey. In July of 2020, a historical photo analysis was conducted by St. Louis District to clarify the discrepancy between the FUDS project boundary and the MRS boundary. An Inventory Project Report (INPR) amendment was developed for the clarification of the MRS boundary. The INPR amendment was finalized in August of 2022. A revised QAPP is currently under development and rights of entry are in the process of being obtained. Field work is planned to commence in Fall of 2023.

5.8.   *Oahu Target Island, H09HI026401*
A task order was awarded to HGL in FY17 for a Remedial Action. USACE team demonstrated the Alford Technology Vulcan system for low-order (deflagration) disposal of UXO. This is a first for POH, and new throughout the enterprise. It was demonstrated at Oahu Target Island FUDS.

The Vulcan uses a small amount of C4 explosive to create a magnesium plasma that penetrates the munition shell and burns out, as opposed to igniting the explosives within the shell. USACE coordinated with landowners and resource agencies, which include, DLNR Land Division, State

Parks, DLNR Division of Aquatic Resources DAR, NOAA National Marine Fisheries Service, and Hawaii Marine Animal Rescue for protection of protected, threatened, and endangered species. The Vulcan successfully disposed a fragmentation bomb with minimal impact to the surrounding environment, i.e., less than a quarter of the impact of a high-order explosion. UAV drone imaging support by the POH Technical Integration Branch (TIB) provided an additional observation point for biological resources. Additional fieldwork was completed by Fall of 2022 and the project has transitioned in the reporting phase with completion expected by end of 2023.

An RA contract was awarded in FY20 to Weston Solutions, Inc. The 3rd party validation seeding contract was awarded to Joint Venture Seres Arcadis. The objective of this task order is to remove MEC using a detection threshold required to detect a 37mm projectile at 12 inches below the ground surface, and larger items up to 2 feet (all anomalies classified as likely TOI will be resolved even if deeper than 2 feet), through use of classification methods to reduce the number of excavations per the DD. Three funding areas have been awarded to date as follows: Funding Area 1 (436 acres), Funding Area 2 (183 acres in the recreational area), and Funding Area 3 (an additional 98 acres in the recreational area).

Field work began in Winter 2021 and is ongoing. To date, the one-pass APEX (White River Technologies) survey is roughly 93% complete in Funding Area 1 and 63% complete in Funding Area 2. Geophysical surveys have not been initiated in Funding Area 3 The intrusive investigation has begun and is approximately 8% complete in Funding Area 1 and 2% in Funding Area 2.

Dynamic data is being collected with 6 APEX systems configured with the Kaarta SLAM positioning system and is being followed by the intrusive investigation of classified digs. There are some gaps due to difficult terrain and creeks where APEX and analog clearance will be performed, as well as saturated response areas that will be remapped with the APEX after analog is complete.

This project has presented several challenges and lessons learned. One challenge has been operating in the dense woods and hilly terrain, requiring the use of RTS positioning, and leading to slow productivity and difficulty achieving full coverage. However, the implementation of the Kaarta SLAM positioning system has doubled production rates over the RTS taking advantage of the dense woods for positioning. The hilly and rough terrain continues to be challenging but engineering controls and safe and proper techniques help minimize lacks in production. For the 3rd Party QA seeding team, conductive geology and soils have made it difficult to locate valid backgrounds for cuing the validation seeds. We have agreed that the 0.9 fit threshold does not always have to be met with consideration that the seed is still detectable and classifiable. This has sped up the seeding production.

Even with the challenges noted above for this large-scale wooded and hilly site, AGC has performed well in terms of data quality but has suffered in production. A project of this size has a lot of moving parts and settling into a rhythm is quite a process. As new technology and techniques continue to be implemented production rates have increased; however, overall efficiency has yet to be determined until more data is collected.

5.9.   *Waikoloa Maneuver Area, H09HI0359-10, Project 10 (Sector 17D)*

A task order to conduct an RD to gather additional information to support future remedial action(s) for the Sector 17D MRS that was awarded in FY22 to EA-Wood-2 MP JV with Acorn SI/NAEVA JV as a subcontractor for the AGC work. USACE completed the review of the Draft QAPP in August of 2022 and the contractor is currently addressing these comments.

The project sampling approach will consist of collecting transect data using the APEX one pass AGC sensor. Following the transect survey, HD and LD areas will be delineated. Grids will be placed by the PDT within elevated HD areas and survey using the APEX system and the intrusive phase of the investigation will then commence.   Fieldwork activities are scheduled to begin in the Spring of 2023.

5.10.   *Waikoloa Maneuver Area, H09HI0359-21, Project 21 (Sector 17A-F)*

A task order was awarded to HGL with Parsons as a subcontractor to perform AGC in FY22, to conduct an RI to review existing data from previous investigations to understand existing conditions and determine what munitions related contamination data gaps remain.

The PDT examined the historical lines of evidence from previous remedial investigations in order to design a sampling approach to address remaining datagaps. The project sampling approach will consist of collecting transect data followed by grid surveys using the APEX one pass AGC sensor. Fieldwork activities are scheduled to begin in the March of 2023 and continue into August of 2023. HGL is currently planning to submit the Draft QAPP in August of 2022 for USACE review.

5.11.   *Waikoloa Maneuver Area, H09HI0359-20, Project 20 (Sector 16)*

A task order to conduct a supplemental RI to address several areas that were not investigated during the previous RI conducted between September 2015 through July 2016. This supplemental RI will perform additional investigations in areas that were not investigated during the previous RI due to lack of ROE and a data gap that exists in the southern portion of Sector 16 due to interference from overhead powerlines. This RI effort to was awarded in FY22 to HGL with Parsons as a subcontractor for the AGC work. USACE completed the review of the Draft QAPP in August of 2022 and the contractor is currently addressing these comments.

The project sampling approach will consist of collecting transect and grids using the APEX one pass AGC sensor to address the datagaps due to a previous lack of ROE and overhead powerlines. The APEX has been successfully deployed during dynamic AGC surveys near powerlines in the neighboring BOQJ MRSs.

5.12.   *Waikoloa Maneuver Area, H09HI0359-23, Project 23 (Area F)*

A task order to conduct a supplemental RI to datagaps from a previous NTCRA that used analog methods in the northwestern portion of the site and outside of the NTRCA to verify the anomaly density results where HD areas were delineated during the previous RI conducted between September 2015 – July 2016. This RI effort to was awarded in FY22 to HGL with Parsons as a subcontractor for the AGC work. USACE completed the review of the Draft QAPP in August of 2022 and the contractor is currently addressing these comments.

The project sampling approach will consist of collecting transect using the UltraTEM Screener for dynamic surveys along transects and grids using the Man-Portable Vector (MPV) dynamic survey in grids following the transect survey.

5.13. Yellow Jacket Target Area, J08UT1098-01, DoD Chemical Weapons and Conventional Munitions Test Area

A RI/FS/PP/DD was awarded in FY21 to Parsons. The overall objectives of this task order are to perform a RI, PP and DD and FS, if required. Field work was originally scheduled to start in Spring 2022; however, delays in finalizing workplans has resulted in a new start date of Spring 2023. Parsons has proposed to use the UltraTEM Screener, followed by cued AGC data collection using the MetalMapper 2x2 or MPV (dependent upon terrain and access). Intrusive investigations on selected cued anomaly targets will be completed consistent with the findings in the Area of Interest (AOI) probability assessments and by first conducting conventional MMRP operations, then shifting to Chemical Warfare Material (CWM) training and ultimately CWM intrusive operations.

5.14. Tanaga Island, F10AK022803, Range Complex No. 1 Munitions Response Area, 1984 Explosive Ordnance Disposal (EOD) Demolition Sites MRS, which includes Demo Sites 42 and 43

A RI/FS/PP/DD was awarded in FY21 to HGL with NAEVA Geophysics as a subcontractor supporting AGC work. The overall objectives of this task order are to perform a third phase and complete the RI, PP and DD. Additionally, an FS will be performed if required. Field work was originally scheduled to begin in Spring 2022; however, delays in finalizing workplans has resulted in a new start date of Spring 2023. The Contractor has proposed the use of the MetalMapper 2x2 to acquire dynamic data in up to 25 mini-grids (50-foot square) within the HUA to better characterize the anomaly densities as well as to obtain more complete vertical depth distributions for the munitions.

5.15. Bostwick Bomb Target, I04FL0914, Project 01 (Bostwick Bomb Target)

A task order for a RI/FS was awarded to HGL and their subcontractor AcornSI/NAEVA JV in FY17 to determine the nature and extent of MEC and MC contamination. In accordance with USACE FUDS policy, the request for proposals emphasized the preference for AGC technology to be used in the RI phase to collect better data and to minimize the number of intrusive investigations required. DGM was conducted in May 2019 and followed by a cued AGC survey in June 2019. Based on the results from this field effort, a data gap exists within the MRS with the finding of 20mm projectiles, a smaller munition than what was anticipated based on the conceptual site model. Additional fieldwork began in the fall of 2019 to address this data gap by conducting additional geophysical survey work using DGM and AGC methods. MC sampling fieldwork was completed in the spring of 2020.

USACE is currently responding to Florida Department of Environmental Protection (FDEP) comments on the Draft Final RI/FS.

5.16. Camp Breckinridge, G04KY0028, Project 06 (Range Investigation)

A task order for RI/FS was awarded to HGL and their subcontractor Parsons in FY16 and is ongoing to determine the nature and extent of MEC and MC contamination. The request for proposals emphasized the preference for AGC technology to be used in the RI phase to collect better data and to minimize the number of intrusive investigations required. All contractor proposals came back with AGC as a component and the selected contractor, HGL with Parsons, proposed the use of MetalMapper 2x2 to cue anomalies following dynamic DGM data collection. Dynamic DGM transects were collected from November to December 2017 to assess the site's anomaly densities. Following the identification of the high anomaly density areas, full DGM coverage grids were placed in both the high density and low-density areas of the site.

In the fall of 2018, dynamic DGM was collected in the high density and low-density grids. Following the DGM grid survey, there were eight grids in the high anomaly density areas where the anomaly density was at such a high level that performing the planned follow-up cued AGC survey was impractical. The contractor proposed digging test pits in these grids to ascertain the nature of the metallic contamination. This approach was accepted by the PDT and the test pits were dug over the winter of 2018-2019.

Two of the grids in the high anomaly density area contained elevated anomaly densities. These elevated anomaly densities resulted in not being able to attain accurate anomaly density estimates using the DGM survey data. Additionally, the presence of MEC items in this area posed an imminent risk to personnel conducting farming activities on this property. Given the high anomaly density in this area and the presence of MEC items, the PDT decided to conduct a Time-Critical Removal Action (TCRA) to reduce the risk to farming personnel on this property. The TCRA proceeded over the spring and summer of 2019. The TCRA consisted of doing an anomaly reduction effort using analog methods followed by a dynamic AGC survey to determine accurate anomaly densities following the analog anomaly reduction effort.

Additional fieldwork occurred from October 2020 through November 2020. The intent of this fieldwork was to improve the accuracy of the FS cost estimates by defining the High Use Area (HUA) boundaries using a single pass AGC survey. This survey was accomplished using the UltraTEM towed-array system which is a DAGCAP accredited AGC one pass classifier instrument.

Currently CEHNC and CELRL are addressing EMCX comments on the HUA/LUA DD. Resolution of the EMCX comments on the HUA/LUA DD is expected to be completed in September 2022.

5.17.   Camp Ellis Military Reservation, E05IL0007, Projects 08 (Aircraft Bombing Area – Area D), 09 (Obstacle Area – Area M), 14 (Rockets and Rifle Grenades – Area C NE) and 16 (Mines South Area – Area F South)

This is an RA, awarded in FY18 to Parsons, with an objective of MEC removal at the Aircraft Bombing Area - Area D and the Obstacle Area - Area M to depth of contamination. The PWS stated that AGC methods should be utilized to the maximum extent practical for purposes of site characterization. The site-specific capabilities of AGC will be established during the field investigation of the MRS. All contractor proposals came back with AGC as a component. The selected contractor, Parsons, proposed dynamic DGM survey followed by a cued survey with the MetalMapper 2x2.

Dynamic DGM followed up by cued AGC data collection was conducted from January - May 2018. The intrusive investigation fieldwork for Area D and M was completed over the fall / winter 2018 - 2019. Additionally, the optional RI for Area C Northeast and Area F South was awarded in fall 2018. This fieldwork was conducted over the winter and spring of 2019. The PDT decided to conduct dynamic DGM and then intrusively investigated these targets. Given the short Right of Entry (ROE) periods, low number of intrusive investigations, and already demonstrating the use of AGC methods in Areas D and M, a cued AGC survey was not conducted in Area C Northeast and Area F South.

The SSFR for Areas D and M has been updated to incorporate institutional controls where remediation goals could not be met due to site conditions. An INPR revision was conducted that carved out areas where ROE could not be obtained in areas C NE and F. As of September 2022, CEHNC and CELRL are reviewing the final GIS data submittal and working to closeout the TO.

5.18.   Naval Air Station Banana River, I04FL0027, Project (Off-Base Disposal Area)

A task order to conduct an RI was awarded to IE Weston JV in March 2021. This project will be using Ground Penetrating Radar in combination with sampling to identify potential subsurface off base disposal areas associated with Naval Air Station Banana River. The first Systematic Planning Process (SPP) meeting was conducted in August of 2021 with project stakeholders including USACE and the regulator. The contractor submitted and USACE approved the GPR transect sampling approach based on the available ROEs obtained in August 2022. RI field activities are scheduled to begin in September 2022.

5.19.   Benicia Arsenal, J09CA0756, Project 02 (Artill, Camel Barn, Revet Demo Areas)

A task order was awarded to Tetra Tech in FY19 to conduct an RI. The proposal includes the use of AGC technology along transects and grids and will utilize the MR-QAPP toolkit. Field work was scheduled to begin FY21; however, due to ROE access issues, the contract will be terminated.

5.20.   Borrego Springs, J09CA7011, Project 04 (Borrego Springs Hotel)

A contract was awarded to Dawson in FY19 to conduct a RA with Tetra Tech as the subcontractor providing AGC support. The contract is for surface clearance on 222 acres and subsurface clearance on 31 acres. Dynamic and cued AGC data were collected using the UltraTEM Screener and the MetalMapper 2x2. Surface clearance field work was completed in FY21, and subsurface AGC was completed in early FY22. Anticipating the RACR in late FY22 and closeout of the project by end of calendar year 2022.

5.21.   Borrego Springs, J09CA7011, Project 03 and 05, Area E-1 Naval Impact Area and Borrego Target #64

A RI/FS/PP/DD was awarded in FY22 to HGL. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of AGC technology for both dynamic mapping and cued

classification in grids utilizing the APEX sensor. Field work is scheduled to begin in FY23.

5.22.   Camp San Luis Obispo, J09CA203, Project 09 (Rifle Grenade Range (1952))

A contract was awarded to Bristol in FY19 to conduct an RI/FS. The investigation will include the use of AGC technology along transects and grids and will be utilizing MR-QAPP toolkit. Fieldwork began in late FY21 and was completed by early FY22.

5.23.   Temecula Bomb Target #107, J09CA7469, Project 01
A task order was awarded to AECOM in FY19 to conduct an RI/FS. The proposal includes the use of AGC technology along transects and grids and will be utilizing MR-QAPP toolkit. Field work is scheduled to begin FY23.

5.24.   Irvine Park – Army Camp, J09CA7129, Project 01 (Multi-Range Training Complex)

A task order for an RI/FS was awarded to SRS in FY20 to determine nature and extent of MEC and MC contamination. The project includes the uses of AGC technology along transects and grids and will be utilizing the MR-QAPP toolkit. Field work for preliminary MRS characterization began in the summer of FY22. Detailed MRS characterization is scheduled to be complete by end of FY22.

5.25.   El Centro Rocket Target NO. 2 (#93), J09CA0147, Project 01

A task order for an RI/FS was awarded to Parsons in FY20 to determine nature and extent of MEC an MC contamination. The project includes the uses of AGC technology along transects and grids and will be utilizing the MR-QAPP toolkit. Field work began in late FY21 and was completed FY22.

5.26.   Holtville Rocket Range 1R (#94), J09CA0172, Project 01

A task order for an RI/FS was awarded to Parsons in FY20 to determine nature and extent of MEC an MC contamination. The project includes the uses of AGC technology along transects and grids and will be utilizing the MR-QAPP toolkit. Field work began in late FY21 and was completed FY22.

5.27.   Carrizo Impact Area, J09CA7018, Project 02 (Range Complexes and Impact Areas)

A task order for an RI/FS was awarded to AECOM in FY20 to determine nature and extent of MEC an MC contamination. The project includes the uses of AGC technology along transects and grids and will be utilizing the MR-QAPP toolkit. Field work is scheduled to begin in FY23.

5.28.   Mojave Gunnery Range 'C', J09CA7281, Projects 01 (Bombing Target), and Project 05 (Bombing Range #73)

A contract was awarded to Arcadis-Versar JV in FY21 to conduct a RA. The contract is for

surface clearance on MRS-05; and surface clearance, and subsurface data collection and classification on MRS-01. Both dynamic and cued AGC technology will be utilized using the UltraTEM Classifier, UltraTEM Screener, and the MetalMapper 2x2 for MRS-01. Surface clearance field work is began in FY22, and subsurface data AGC also began in FY22 and should be completed in FY23.

5.29.   Fort Douglas, J08UT110801, Impact Area Munitions Response Site, Project 01

A RI/FS/PP/DD was awarded to HGL in FY22 to determine the nature and extent of MEC and MC contamination. The project is using the MR-QAPP toolkit and includes the use of AGC technology for both dynamic mapping and cued classification in grids utilizing the APEX sensor. Field work is scheduled to begin in FY23.

5.30.   Camp Elliot, East Elliot MRS-01CDF, J09CA0067, Project 6

A task order was awarded to Tetra Tech in FY22 for a Remedial Action. The contract is for surface clearance and subsurface data collection and classification on the Delineated Response Areas identified during the remedial investigation. The AGC technology to be utilized for subsurface clearance is the APEX sensor. Field work is not anticipated to begin until the beginning of FY24.

5.31.   Camp Beale, J09CA0136, Project 01 (Northwest Combined Use Area) and 04 (West Central Combined Use Area)

A RI/FS was conducted by Bristol with Black Tusk and InDepth as subcontractors for the DGM and AGC work. The field work utilized DGM and both dynamic and cued AGC technology along transects and grids per the MR-QAPP toolkit. Field work was completed in the fall of 2021 and the RI and FS reports are expected to be finalized in 2023.

5.32.   Camp Beale, J09CA0136, Project 05 (Southwest Combined Use Area)

A RI/FS was conducted by Bristol with Black Tusk and InDepth as subcontractors for the AGC work. The field work utilized AGC technology to cue anomalies selected from EM61 transect data to reduce or eliminate the need to evacuate nearby residences during intrusive operations. Field work was completed in March of 2019. A total of 90 targets were identified within evacuation zones of nearby residences. Of these, only 11 targets were identified for digs that required residential evacuation. No MEC items were discovered. In addition to the AGC work, the contract was also modified to add a drone survey with a hanging magnetometer and LiDAR. Several wetland areas are spread throughout the property and the drone technology allowed for characterization with limited impact to the sensitive environments. The field work was completed in January of 2019 and the pilot study report was completed in FY20. The FS is expected to be finalized in 2023.

5.33.   Mount Owen Rifle Range, J09CA0877, Project 04 (Infiltration Course/Burn Area)

A work plan was developed in FY16 to utilize AGC data in the RI/FS phase to limit the number of intrusive excavations required to fully characterize the site to minimize impact to sensitive

species and habitat. This was one of the first projects to implement use of AGC technology at the characterization phase. Field work began in September FY17 and continued into FY18. However, in FY18 a stop work order was issued due to a change of site conditions and lack of DAGCAP accreditation and QC procedures. The continuation of the RI/FS was awarded to Weston in FY19. The proposal includes cued AGC data collection in grids as part of the RI. Field work is expected to be completed by the end of 2022.

5.34.   Fort Huachuca, J09AZ1067, Projects 03 (Artillery/Mortar Range, Target Area A), and Project 04 (Artillery/Mortar Range, Target Area B)

A contract was awarded to Bristol in FY21 to conduct a RA at MRS04 and RD at MRS03. The contract is for surface clearance on MRS04; and surface clearance and dynamic classification using the APEX at MRS 03. Field work for MRS04 was completed in FY22 and the RACR is expected to be finalized by the end of 2022. Field work for MRS03 is currently ongoing and expected to be complete by the end of 2022.

5.35.   Hurricane Mesa Test Site, J08UT002601, Project 01

A task order for an RI/FS was awarded to Parsons in FY21 to determine the nature and extent of MEC and MC contamination. The project is using the MR-QAPP toolkit and includes the use of AGC technology for both dynamic mapping and cued classification in grids utilizing the MetalMapper 2x2 and MPV. Field work was completed in FY22 and the RI and FS reports are expected to be finalized in FY23.

5.36.   Cadiz Lake Sonic Target #9, J09CA0263, Project 01

A RI/FS/PP/DD was awarded in FY22 to Parsons. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of DGM for mapping transects and AGC technology for dynamic classification in grids utilizing the APEX sensor. Field work is scheduled to begin in FY23.

5.37.   Carrington Island Precision Bombing Range, J08UT0777, Project 01

A RI/FS/PP/DD was awarded in FY22 to Parsons. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of DGM for mapping transects and AGC technology for dynamic and cued classification in grids utilizing the UltraTEM Screener, MetalMapper 2x2, and MPV sensors. Field work is scheduled to begin in FY23.

5.38.   Gavilan Plateau Maneuver Area, J09CA0375, Project 01

A RI/FS/PP/DD was awarded in FY22 to Parsons. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of AGC technology for mapping transects and

characterization grids utilizing the MetalMapper 2x2, and cued classification in grids utilizing the MPV sensor. Field work is scheduled to begin in FY23.

5.39.   Burma Road, F10AK0291, Projects 02 (Burn Areas), 05 (Small Arms Pit), 06 (Scrap Area), 07 (Blow Holes), and 08 (Magazine Areas)

A RI/FS/PP/DD was awarded in FY22 to Ayuda-Plexus JV with TetraTech subcontracted to perform the geophysical investigation. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of DGM (EM61 and EM31) for mapping transects and AGC technology for dynamic mapping and cued classification in grids utilizing the UltraTEM Screener and MetalMapper 2x2 sensors. The AGC sensors utilized for surveys in characterization grids will equipped with SLAM in GPS-denied areas. Field work is scheduled to begin in FY23.

5.40.   Fort Learnard, F10AK0017, Project 03 (Magazines E2 and J Detonation)

A RI/FS/PP/DD was awarded in FY22 to EA Engineering with ANJV subcontracted to perform the geophysical investigation. The overall objectives of task order are to determine the nature and extent of MEC and MC contamination at the two MRSs. The project is using the MR-QAPP toolkit and includes the use of AGC technology for mapping transects and characterization grids utilizing the APEX and MPV, and cued classification in grids inaccessible to the APEX utilizing the MPV. Field work is scheduled to begin in FY23.

5.41.   Spring Valley, C03DC0918, Project 01 (Burial Pits/Field Test Areas)

A RA order was awarded to Weston with Black Tusk as a subcontractor providing data analysis. The task order objective includes remediation of MEC through use of AGC (dynamic and cued MPV) on 92 private residential properties and 13 federal/city lots along Dalecarlia Parkway. Fieldwork was completed in FY22. There has been successful classification of TOIs and non-TOIs in residential environment while maximizing coverage around site obstacles.

5.42.   Suffolk County Army Airfield (AAF), Project 02 (Bombing and Gunnery Range Munition Response Site)

A RI task order was awarded to Tetra Tech in FY20 to conduct an RI. The contract is to determine the nature and extent of MEC contamination across 4,297 acres. The proposal includes the use of dynamic and cued AGC technology grids and will be utilizing MR-QAPP toolkit. The RI will make use of AGC to characterize the depth distribution and potentially reduce the number of digs and evacuations. Fieldwork is scheduled to begin in September of FY22 and will be completed February of FY23.

5.43.   Morgan Deport Formerly Used Defense Site

A RI task order will be awarded by the end of FY22. The contract will be used determine the nature and extend of MEC contamination across 3,156 acres. The MRS covering areas in the Borough of Sayreville, the City of South Amboy, and the Township of Old Bridge in Middlesex

County, New Jersey. AGC technologies will be used within residential and commercial areas within the MRS. Field work is estimated to begin in FY24.

5.44. IVS Memo Standardization

In cooperation with NAOC and M2G2, an effort has been made to create an IVS template that can be used on all MRS investigations. A small working team with USACE and NAOC representatives have produced a draft template which is in the processes of being reviewed and revised by USACE. After all comments and revisions have been resolved, the document will be shared with the CX and HQ for their input and review. The overall goal of this effort is to set standard requirements for IVS documentation to streamline the creation and concurrence of these routine time-sensitive technical documents.

5.45. Motlow Range, G04TN019507, Projects 07 (37mm Impact Area) and 08 (Mortar Impact Area)

An RA contract was awarded in FY17 to USA Environmental (Sub is Parsons for DAGCAP). The objective of this task order is to remove MEC using a detection threshold required to detect a 37mm projectile at 12 inches below the ground surface, and larger items up to 2 feet (all anomalies classified as likely TOI will be resolved even if deeper than 2 feet), through use of classification methods to reduce the number of excavations per the DD. Field work began in Summer 2018 and is ongoing. To date, the Dynamic EM61 survey and cued MetalMapper 2x2 survey are complete, as is most of the intrusive investigation, in the original MRS1 and MRS2 boundaries. The field team remobilized in FY22 after approval of a ROD Amendment and contract mod for step-out areas due to MEC finds near the MRS boundaries. The collection of EM61 dynamic data, cued MetalMapper 2x2, and dynamic MM2x2 data under high voltage power lines in the step-outs is ongoing.

This project has presented several challenges and lessons learned. One challenge was operating in the dense woods, requiring the use of Robotic Total Station (RTS) positioning, and leading to slow productivity and difficulty achieving full coverage. To address this problem in the step-out areas, the data is now being positioned with SLAM, which has significantly improved productivity while still meeting positioning accuracy requirements. Another challenge has been a higher than expected number of targets being classified as likely TOI. One reason for this was unexpected and variable background geologic response, resulting in matches above the dig threshold even though the polarizability curves did not appear 'TOI-like'. The contractor developed an approach to quantitatively identify these 'background' curves and reduce these non-TOI digs while safely classifying TOI. Another lesson learned is the importance of using a site-specific TOI Library. The M5 60mm mortar is made of a zinc alloy and has very different polarizability curves than other 60mms, similar to the curves for geologic background. It was determined that this item went into production beginning in the 1990s, after the closure of the Motlow Range, and could be safely removed from the library. Doing so resulted in a significant reduction in required digs.

Even with the challenges noted above for this large-scale wooded site, AGC has performed well. The MEC recovered so far have been well above the stop dig point, successfully removing the hazard while saving ~40,000 intrusive investigations.

5.46.   North Field, H09CN0100, Project 01 (Burial Pit)
This project is done in conjunction with Ordnance Plan, H09CN0060, Project 01 (see below).

5.47. Ordnance Plan, H09CN0060, Project 01 (Matoisa Ordnance Depot)
An RI/FS was awarded to Parsons at the end of FY17 and field work was completed in FY19 after schedule impacts due to Super Typhoon Yutu. Field work included cued MPV data collection in grids as part of the RI, in order to determine its site-specific effectiveness. Even though the Treatability Study at Marpi Point Field (another MRS entirely within the Ordnance Plan boundary), which was completed in 2016, indicated that AGC was not very effective in the local conditions, the PDT wanted to collect additional data to verify this and especially to test the technology in some more developed areas in order to potentially reduce evacuations, as well as to guide the limited intrusive investigations. The results of AGC in this RI were consistent with the Treatability Study, in that it does not appear to be the most effective technology for future removals at this site. This is due to a number of factors that cause very high dig rates, as well as difficulties meeting all MQOs: (1) The very wide range of UXO types (from 25mm to 8" rounds) means that the library is very large and additionally includes items with polarizability curves similar to the background response, (2) low dig/no dig decision thresholds required to identify small MEC with low signal to noise levels; and (3) Variable and high background responses due to local geology. In addition to these factors, the amount of metal in the ground is so high that many grids included large areas of saturated response where AGC cannot be used. The use of dynamic AGC might improve some of these results, but would still encounter many of the same difficulties. However, the use of AGC was successful at guiding the decisions of which anomalies to investigate during the RI. The RI Report was finalized in FY20 and the FS Report was finalized in FY22. Due to expiration of funds, the PP and DD will be deobligated form the current task order and re-awarded.

5.48 Papohaku Ranchland Sub, H09HI0032, Project 01 (H09HI003201 OEW)
An RI/FS was awarded to URS(AECOM) in FY 18, with Black Tusk Geophysics as subcontractor providing AGC support. After a delay due to COVID travel restrictions, fieldwork occurred in late FY20 and concluded in FY21. Dynamic and Cued AGC data was collected with an MPV to aid in characterization of nature and extent of MEC contamination and determine site-specific capabilities. AGC was performed in a total of five quarter acre grids, with 1855 cued targets. Additional transects and grids were performed with EM61 and intrusively investigated.
AGC performed very well in the lower density grids, where all non-seed anomalies were predicted to have a geologic source, confirmed through verification/validation digging. This offered a distinct advantage over the EM61 in the local volcanic geology, as many EM61 anomalies due to 'geology/hot rock' required intrusive investigation. Multiple challenges were encountered due to the site-specific conditions. An extremely high anomaly density in the target center (up to ~6000 raw amplitude picks per acre) reduced the effectiveness of AGC. Munitions were recovered from verification/validation digs beyond the depth of detection for the MPV. Overall, 100 TOI of five different munitions types were found at depths beyond their theoretical detection depths. It is unknown if other AGC sensors would result in better detection performance. The EM61 was able to detect the larger munitions deeper than the MPV; however, the MPV was able to detect the

20mms deeper than the EM61. Additional challenges were encountered due to some of the recovered munitions found to be in various states of completeness (e.g. with and without attached flash tube, which was bent at random angles; with and without fins) making it difficult to include library measurements for all possible configurations of the munitions.

The RI Report is currently under review by the State Regulators. The FS report will further describe the capabilities/limitations of AGC at this site, and how they relate to the risk conditions and possible clean-up alternatives.

5.49 Culebra Puerto Rico, I02PR0068, Projects 10 (Defensive Firing Area #1) and 11 (Defensive Firing Area #2)

A task order was awarded in FY18 to conduct a RI and FS, if needed, at the marine portions of Culebra Defensive Areas #1 and #2. The field work was completed during the fall of 2021. DGM data were collected using a ROV (Remote Operated Vehicle) platform using ultra-short baseline (USBL) for positioning for part of the data collection. Divers used the Shark Marine Navigation System tablet to reacquire DGM anomalies more efficiently. The noise of the underwater EMI sensor was high particularly in areas with choppy seas. Noisy DGM transect data were supplemented with divers using analog sensors to confirm density numbers. The RI report is currently under review.

5.50. Fort Custer Rec/Industrial Areas, E05MI0013, Projects 10 (Hand Grenade Court), 11 (Range Complex No. 1 (Eastern Part)), 12 (Burial Area), and 13 (Bombing Targets)

The original task order was awarded in FY17 to conduct an RI/FS using AGC to help characterize nature and extent of munitions and explosives of concern (MEC) contamination. The task order was closed out at the end of FY22, and a new award will be made in FY23 to complete the FS, PP, and RODs. During the land field work AGC, with MetalMapper 2x2 and MPV, was used and is expected to be part of a future remedy. The RI Report was finalized in August 2020.

5.51. Fort Taylor, I04FL0227, Projects 01 (Interior Fort and Casements), 02 (Artillery Ranges – Land & Disposal Area), and 03 (Artillery Ranges – Water)

A task order was awarded in FY17 to conduct a RI/FS at the historic Fort Taylor in Key West, FL. Field work was conducted in FY20 and included AGC to help characterize the nature and extent of MEC contamination on land. A small moat surrounding the fort was DGM surveyed using a remotely operated robotic marine system. The water artillery ranges had magnetometer data collected using USBL positioning in deeper waters. Challenges on land included much higher than expected anomaly densities surrounding the fort. Possible data gaps within the fort interior and in the surrounding waters were identified. The task order was closed out before the RI/FS report was finalized and a new award will be made in FY23 to finalize documents and potentially fill data gaps.

5.52. FT Pierce Naval Amphibious Training Base, I04FL0698, Projects 02 (Engineer Board Area), 03 (Naval Demolition Research Area), 05 (Offshore Obstacle Area)

A new task order was awarded in FY22 to finalize report documentation for the former Fort

Pierce Naval Amphibious Training Base, Indian River and St. Lucie Counties, FL. During the previous task order, cued MetalMapper 2x2 data were collected to help characterize the nature and extent of MEC contamination. Underwater DGM surveys were conducted using the EM61-Flex3 Underwater UXO Towed Array (UUTA). The field work was extended to multiple seasons due to impacts from Hurricane Irma and to minimize evacuations. Revised RI and FS reports are expected during the next FY and AGC data collection is expected to be included in land removal alternatives.

The Ft Pierce FUDS underwater project area was chosen by the SERDP Project MR21-1081 Principal Investigator to test a European underwater munitions mobility model. The site was selected from among several FUDS project that were identified to the PI and his team. The project is lacking more site-specific oceanographic data and the PI is exploring using a wave model to help inform the mobility model. USACE will continue to support this research project through to its conclusion. The research project is anticipated to be complete in FY23.

5.53. Former Camp Fannin, K06TX0061, Projects 01 (2.36-Inch Rocket Area) and 04 (60/81mm Mortar Area)
This is a RA awarded in FY17 to Jacobs with NAEVA/Acorn SI for the AGC work.
The PWS laid the framework for AGC and all potential bidders proposed some level of AGC. There are almost 200 acres within the MRSs that AGC will be utilized, including a 60/81mm targets and 2.36-inch rocket target area. Although the DAGCAP requirement was not included as part of the PWS due to the number of available geophysical corporations at the time of solicitation, the winning bidder includes two DAGCAP-accredited geophysical firms.
Site Specific Final Report is going through review/revision cycles.
Following the DGM effort the contractor decided to perform a pilot study using the UltraTEM due to the magnetic soils which made traditional dynamic DGM difficult. The pilot study was a success and the UltraTEM was utilized across the site.
The Ultra-TEM was successful.

5.54. Former Camp Maxey, K06TX0305, Projects 05 (Western Range Area D), 07 (Eastern Range Area A), and 12 (Mine and Booby Trap Training Area)
This is a RA awarded in 4th quarter FY19 to Weston.
The PWS laid the framework for AGC and most bidders proposed some level of AGC. There are 334 acres within the MRSs that AGC could be utilized in target areas within the 3 MRSs to 1-foot, including a 76mm (and larger) target, mine & booby trap area, and 37mm.
The Contractor is currently in the field.
The AGC (utilizing the MetalMapper 2x2) has been successful so far.
The PWS was too vague in its requirement for AGC so the successful bidder (low price, technically acceptable) included a large amount of analog work.

5.55. Former Camp Claiborne, A06LA0006, Project 08 (Impact Area 5 (MRS-5))
This is a RD awarded in 2nd quarter FY21. Due to the age of the EE/CA & RI/FS it was decided to award a RD.
The PWS laid out the framework for Advanced Geophysical Classification. There are 1,249 acres within the MRS that AGC could be utilized upon, MEC including 37mm – 155mm and practice

bomb target areas to 2 feet.
The contractor mobilized to the field in August.

5.56. Former Camp Robinson, K06AR0029, Project 14 (Burns Park Area 5 Action Area)
This is a RD end of FY20 award.
Burns Park action area is 277 acers in size. The PWS required the use of AGC. During previous field activities 37mm HE, Hand Grenades, 75mm shrapnel, and 105mm HE projectiles were found. The Contractor is in the field.
The MM2x2 had technical issues and had to be sent back to manufacture and due to low available of other systems or parts for repair, the project correctly is in a 2-month shutdown.

5.57. Former Camp Robinson, K06AR0029, Project 10 (Central)
This is a RD awarded in 2nd quarter FY21.
Central MRS is 2130 acers in size. The PWS required the use of AGC. During previous field activities 37mm APT, 57mm APT, and 105mm Smoke & Illumination Projectiles along with 60mm HE and 81mm HE & Smoke mortars were found.
The QAPP is currently in draft-final.

5.58 Former Camp Robinson, K06AR0029, Projects 09 & 08 (Southwest & Westcentral)
This is a RD with a planned award in 4th quarter FY22.
Southwest MRS is 1340 acers in size. Westcentral MRS is 1465 acers in size. The PWS requires the use of AGC. During previous field activities 37mm APT, 105mm Projectiles along with mortars were found in Southwest and 37mm TP, 75mm shrapnel, and 105mmin Westcentral.
Proposals are under review.

5.59. Former Camp Howze, K06TX0015, Projects 16 (Artillery Range Southeast), 19 (Artillery Range Northeast), and 20 (Rocket and Rifle Grenade Ranges)
This is a RA with a planned award in 4th quarter FY22.
Artillery Range Southeast MRS is 107 acers in size. Artillery Range Northeast MRS is 224.5 acers in size. Rocket and Rifle Grenade Ranges MRS is 28.8 acers in size. The PWS requires the use of AGC. During previous field activities various AP, HE, shrapnel, smoke (including WP), and practice projectiles ranging from 20 to 155 mm; 60 and 81 mm HE, practice, and smoke mortars; 2.36-inch high explosive anti-tank (HEAT) and practice rockets; fragmentation, AT, and practice rifle grenades; fragmentation and practice hand grenades; demolition materials; antipersonnel and practice AT mines; flares, signals, simulators, and screening smoke were found in the Artillery MRSs and 60mm mortars HE and practice, 2.36-inch HEAT and practice rockets, rifle grenades HEAT and practice in the Rocket and Rifle Grenade MRS .
Proposals are under review.

5.60. Former Camp Howze, K06TX0015, Project 10 (Artillery Range Southwest)
This is a RA with a planned award in 4th quarter FY22.
Artillery Range Southwest MRS is 304 acers in size. The PWS requires the use of AGC. During previous field activities Various AP, HE, shrapnel, smoke (including WP), and practice projectiles ranging from 20 to 155 mm; 60 and 81 mm HE, practice, and smoke mortars; 2.36-inch high explosive anti-tank (HEAT) and practice rockets; fragmentation, AT, and practice rifle grenades;

fragmentation and practice hand grenades; demolition materials; antipersonnel and practice AT mines; flares, signals, simulators, and screening smoke were found in the Artillery MRSs. Proposal is under review.

5.61. Former Blaine Naval Ammunition Depot (BNAD)

A Supplemental RI (SRI) contract was awarded in FY20 to SES Civil and Environmental (SCE) (Sub is Munitions Management Group (MMG)/Weston Solutions for DAGCAP). The SRI will utilize MetalMapper 2x2, dynamic and cued, to verify HUAs and LUAs, refine anomaly and MEC density estimates, and evaluate AGC technology for use in a remedial alternative. Survey data will be collected over 100'x100' and 200'x200' grids placed in select locations. Field work was ongoing from July—August 2022. Geophysical data is currently under technical review and is pending final QA acceptance. Geophysical data is pending final QA acceptance; target selection and cued data are currently undergoing review. Note that cued targets will not be intrusively investigated for this SRI but will be used for anomaly density data to support the FS.

5.62. Boardman Air Force Range (AFR) INPR Site No. 1 (Proj. 03) and Demo Site No. 2 (Proj. 06)

A Data Gap RI contract was awarded in FY19 to AOR International (Sub is Black Tusk Geophysics for DAGCAP). The objectives are to (1) determine the lateral extent of HUAs and LUAs using step-out transects as an addition to those conducted during a previous RI, (2) conduct DUA of the previous RI data, and (3) incorporate the findings of both investigations into Preliminary and Detailed Characterizations. The Data Gap RI employed UltraTEM for dynamic data collection along transects and MPV for cued data collection. The Data Gap RI report is currently undergoing technical PDT review. During production the polarizability accuracy MQO for cross-track small ISOs at the IVS failed repeatedly. The root cause of these failures was attributed to poor coupling with the primary polarizability and is documented in the project IVS memo. The IVS memo proposed additional passes over the IVS as a corrective action; this was reported to have mitigated, but not entirely eliminated, failures for cross-track seeds. However, the ongoing polarizability accuracy MQO passed for along-track seeds in all cases, indicating that the sensor was operating correctly throughout production. Failures for cross-track targets were attributed to a limitation of the AGC sensor, rather than an underlying issue with data collection or processing procedures. No further corrective action was taken.

An ongoing background validation measurement failure occurred using the MPV sensor in the production area. The end-of-day IVS data was nonetheless collected, resulting in a nonconformance with SOPs for MPV data acquisition. A root-cause analysis (RCA) was conducted, in which the MQO failure was attributed to observed elevated and flattened decays for the horizontal component data, and elevated responses for the vertical component data, in the IVS background measurement. These anomalous signals were then hypothetically attributed to either (1) operation of the MPV in cold temperatures (although the anomalous decays were not observed during other cold days), (2) potential mishandling of the equipment, (3) proximity of other electrical equipment to the sensor, or (4) other undiagnosed issue with the MPV. All production data were bounded by other successful background validations, IVS tests, and function tests. No recurrences of the flattened decays were observed. Corrective actions included removing

the sensor from production, recollecting production cues with a sensor known to be functioning properly, re-evaluating of and re-training on SOPs.

5.67. Boardman Air Force Range (AFR) Demo. Site No. 1 (Proj. 04), and Turret Gunnery Range (Proj. 05)

Selection board/contract award for Supplemental RI anticipated for early FY23. The contractor will utilize the data from the original RI for project 04 and 05 to develop the Supplemental RI approach to collecting sufficient AGC data to complete the RI Report and FS.

5.68. Former Boise Army Barracks Project 04 Range

A Phase II RI contract was awarded in FY20 to Robotics Fabrication, Inc. (RFI) (Sub is HydroGeoLogic (HGL) for DAGCAP). A third-party validation seeding contract was awarded to Terranear PMC-White River Technologies, LLC in FY21. The Phase II RI will utilize handheld EM61 along randomly-oriented transects and trails over steep and rugged terrain. Results of the EM61 survey will inform the placement approximately 14 grids (ranging from 0.25 to 0.5 acres each), where MetalMapper 2x2 will be utilized for both dynamic and cued data collection. A third-party contractor (Terranear PMC-White River Technologies) will conduct validation seeding activities, as well as AGC data collection, in eight 0.25-acre grids placed in GNSS-denied areas in which SLAM technology will be used for positioning. Field work is planned for Fall 2022-Spring2023.

5.69. Former Camp Adair Project 08 (Live Grenade Court MRS), Project 09 (Explosive Munitions Range MRS), and Project 12 (Field Combat Ranges MRS)

A Supplemental RI contract was awarded in FY21 to Auxilio-FPM JV (Sub is Black Tusk Geophysics for DAGCAP) The objective of the Supplemental RI is to characterize the nature and extent of MEC and MC within each MRS, and assess the MEC and MC risk to human health and the environment. The data from the RI will provide adequate information to develop Remedial Action Objectives (RAOs) in a future Feasibility Study (FS). The contractor will evaluate previous (2018) RI data to define any existing data gaps and collect AGC data within 7,395 acres of approved (ROE) access acreage, some of which was investigated during the original RI. The MR-QAPP is currently undergoing PDT technical review.

5.70. Former Nebraska Ordnance Plant (NOP) Project 12 Demolition Grounds and Project 13 Potential Landfill Area

A Supplemental RI (SRI) contract was awarded in FY20 to SES Civil and Environmental (SCE) (Sub is Weston Solutions for DAGCAP). The SRI will supplement previous field investigations to verify HUAs and LUAs, refine anomaly and MEC density estimates in support of a feasibility study (FS), and evaluate AGC technology for use in a remedial alternative. The SRI is utilizing MetalMapper 2x2 in both dynamic and cued modes. Fieldwork has been ongoing May through August 2022. Survey data was collected over thirteen grids placed in select locations to confirm HUA centers and boundaries. Geophysical data is pending final QA acceptance; target selection and cued data

are currently undergoing technical review. Geophysical data is pending final QA acceptance; target selection and cued data are currently undergoing technical review. Note that cued targets will not be intrusively investigated for this SRI but will be used for anomaly density data to support the FS.

5.71. Former Lowry Bombing and Gunnery Range (FLBGR) Multiple MRSs and AOIs (AGGR/SMUA)

An RI/FS contract was awarded in FY20 to GSI North America Inc (Subs are Terranear MPC and White River Technologies, LLC for DAGCAP). The objective of the RI is to verify the boundaries for high-use areas (HUA) and low-use areas (LUA), verify the characterization of the type, nature and distribution of MEC and MC within each HUA and LUA, evaluate residual risk, support determinations of nonimpacted areas (NIA), and collect any information needed in support of the FS to include accurate anomaly densities for all areas. The initial MR-QAPP (2021) proposed the following technical approach: An APEX advanced sensor system will be utilized to collect dynamic/cued over 10'-wide transects spaced 224' apart. This initial round of data collection will be used to identify high anomaly saturation areas, which will inform the placement of thirty-five 200'x10' areas to be scraped to a depth of 6" bgs. Following the excavation and MPPEH screening of the 6" soil lift, a secondary round of APEX data will be collected over the area to identify TOIs expected at greater depths. The MR-QAPP has not been approved (as of Sept. 2022) due to a lack of clarity regarding the overall approach to determining nature and extent of the AGGR/SMUA high density area. The technical approach is currently undergoing revision in order to fully incorporate previous investigations and define all data gaps. The revised approach for the geophysical (AGC) investigation will ensure all data gaps are addressed, and will be re-submitted for approval by the technical PDT, EMCX, and Colorado Department of Health and Environment (CDPHE). Field work is pending MR-QAPP approval.

5.72. Pine Ridge Gunnery Range: Badlands Bombing Range: Circle of Cars MRS

An RI contract was awarded in FY20 to AOR International, Inc. (Subcontractor is Black Tusk). The objective of the RI is to define the nature and extent of MEC and MC and incorporate previous findings to resolve any data gaps at the 500-acre Circle of Cars MRS. The contractor will utilize UltraTEM Classifier over transects to complete the RI. MR-QAPP currently undergoing PDT technical review.

6.   Acronyms

Acronym	Definition
AGC	Advanced Geophysical Classification
AOI	Area of Interest
APTIM	APTIM Federal Services
bgs	Below Ground Surface
CWM	Chemical Warfare Material
DAGCAP	Department of Defense Advanced Geophysical Classification Accreditation

	Program
DD	Decision Document
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
DUA	Data Usability Assessment
FS	Feasibility Study
FUDS	Formerly Used Defense Sites
GPS	Global Positioning System
HD	High Density
HGL	HydroGeoLogic, Inc.
HUA	High Use Area
INPR	Inventory Project Report
ISO	Industry Standard Object
IVS	Instrument Verification Strip
LUA	Low Use Area
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MPV	Man Portable Vector
MQO	Measurement Quality Objective
MR-QAPP	Munitions Response Quality Assurance Project Plan
MRS	Munitions Response Site
NIA	Non-Impacted Area
PDT	Project Delivery Team
PIKA	PIKA International, Inc.
PP	Proposed Plan
PWS	Project Work Statement
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RAO	Remedial Action Objective
RCA	Root Cause Analysis
RD	Remedial Design
RFI	Robotics Fabrication, Inc.
RI	Remedial Investigation
ROD	Record of Decision
ROE	Right of Entry
ROV	Remote Operating Vehicle
RTS	Robotic Total Station
SLAM	Simultaneous Location and Mapping
SOP	Standard Operating Procedure

SPP	Systematic Planning Process
SRI	Supplemental Remedial Investigation
SSFR	Site Specific Final Report
TCRA	Time Critical Removal Action
TOI	Target of Interest
UAV	Underwater Autonomous Vehicle
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
USBL	Ultra-Short Baseline
UUTA	Underwater UXO Towed Array
UXO	Unexploded Ordnance