

# Final Remedial Investigation Status Report and Path Forward, UXO 15, Atlantic Fleet Weapons Training Area-Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico

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## Introduction

This Technical Memorandum (TM) presents the results to date and planned path forward for the Remedial Investigation (RI) activities at UXO 15, located within the former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico (**Figures 1 and 2**). RI activities were initiated in August 2012 in accordance with the *Final Expanded Site Inspection Sampling and Analysis Plan Addendum for the Remedial Investigation at UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico*, hereafter referred to as the RI SAP (CH2M HILL, 2012). The activities included surface clearance of metallic debris, digital geophysical mapping (DGM), and subsequent excavation and identification of subsurface anomalies along transects to determine if munitions had been buried within the subsurface. During these initial RI activities, more Range-Related Debris (RRD) was encountered than expected and multiple berms likely containing buried debris were identified, which altered the conceptual site model (CSM) and, ultimately, the necessary approach to sufficiently characterize the site. As a result, the RI field activities were suspended in September 2012 and the findings were presented to the Vieques Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Environmental Restoration Program (ERP) Technical Subcommittee in a meeting held on January 30, 2013. After discussing the findings and potential options, the Subcommittee concurred that the remainder of the RI activities as presented in the RI SAP would be conducted, and that the associated findings, including the information regarding the RRD and berms, would be used to prepare an RI SAP addendum to address any additional data needs identified. Based on this consensus, the activities defined in the RI SAP resumed and were completed in April 2013.

Based on the above information, the objective of this TM is to provide the rationale for the planned path forward to address additional data needs identified via evaluation of the data and other information collected during implementation of the RI SAP. It should be noted that the TM it is not intended to be a comprehensive evaluation of the results obtained to date, as this information will be documented in the RI Report once the site has been sufficiently characterized.

This TM was prepared under the United States Navy (Navy) Comprehensive Long-Term Environmental Action (CLEAN) Contract N62470-08-D-1000, Contract Task Order 0037, for submittal to the Naval Facilities Engineering Command (NAVFAC) Atlantic Division, United States Environmental Protection Agency (USEPA) Region 2, the Commonwealth of Puerto Rico Environmental Quality Board (PREQB) and the United States Fish and Wildlife Service (USFWS). The Navy, USEPA, PREQB, and USFWS work jointly as the Vieques ERP Technical Subcommittee.

UXO 15 is located in the western portion of the Eastern Maneuver Area (EMA) and comprises Photo Identified (PI) Sites PI 9 and PI 13 (**Figure 2**). PI 9 was likely used for ammunition storage and possibly ammunition disposal based on historical information and aerial photographs. PI 13 may have been the firing point from which long-range artillery was launched to the Live Impact Area (LIA)/Surface Impact Area (SIA). Previous munitions investigations identified Munitions Debris (MD) and Material Potentially Presenting an Explosive Hazard (MPPEH), five debris piles, and two elevated anomaly density areas (EADAs), which are indicative of a

high density of ferrous metallic objects or ferrous iron that may be associated with bedrock, within UXO 15 (**Figure 3**) (CH2M HILL, 2012). Previous environmental investigations included a biological assessment and a bedrock survey to identify potential locations of buried munitions conducted as part of an Expanded Site Inspection (CH2M HILL, 2012).

Since the initiation of the RI activities, the Commonwealth of Puerto Rico and USFWS have indicated that public access to the historic Spanish lighthouse (Faro Veridales) is desirable by the community, which is located within UXO 15 (**Figure 2**). USFWS has indicated that public access would be via vehicle or bicycle along the main road. Therefore, this TM also summarizes the findings of MEC investigations previously conducted along and in the vicinity of the main road.

## Munitions Terminology

To aid with the various munitions terminology used throughout the document, a brief description of the general classification of munitions-related items is provided below. Munitions-related items identified within the former VNTR are generally classified as Munitions and Explosives of Concern (MEC), Material Potentially Presenting an Explosive Hazard (MPPEH), Munitions Debris (MD) or Range-Related Debris (RRD). MEC is further subcategorized into Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), and Munitions Constituents (MC).

- MEC – distinguishes specific categories of military munitions that may pose unique explosive safety risks
- UXO – munitions that have been primed, fused, and armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a safety hazard; and remain unexploded
- DMM – munitions that have been abandoned or removed from storage without proper disposal
- MC – any materials originating from UXO, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such munitions. Munitions constituents (MC) may also be a subset of MEC if explosive constituents are present in high enough concentrations to pose an explosive hazard
- MPPEH – material that, prior to determination of its explosives safety status, potentially contains explosives or munitions, or potentially contains a high enough concentration of explosives that the material presents an explosive hazard
- MD – Remnants of munitions remaining after munitions use, demilitarization, or disposal
- RRD – Debris, other than munitions debris, collected from ranges (such as targets and fragments of metal)

## Background Documents

Planning documents that set the framework for the implementation of the RI and provide details related to the site background, physical characteristics, investigation history and previous findings, and transect and sampling rationale is listed below (beginning with the most recent document):

- *Final Expanded Site Inspection Sampling and Analysis Plan Addendum for the Remedial Investigation at UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico. (CH2M HILL, 2012)*
- *Final Expanded Site Inspection Sampling and Analysis Plan UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico. (CH2M HILL, 2011)*
- *Non-Time Critical Removal Action Work Plan, Surface Munitions and Explosives of Concern at Munitions Response Area-Surface Impact Area Munitions Response Sites 1-7, Former Vieques Naval Training Range (VNTR), Vieques, Puerto Rico. (CH2M HILL, 2009)*

- *Explosives Safety Submission/Site Approval Request, Former Vieques Naval Training Range, Rev. 3, Vieques, Puerto Rico. (CH2M HILL, 2006a)*

## Remedial Investigation Objectives and Approach

The specific objectives of the RI, as defined in the RI SAP, are to:

- Characterize the potential for subsurface MEC within PI 9 West and in the vicinity of PI 13
- Characterize the potential for a release of hazardous constituents to the subsurface soil from subsurface MEC, if encountered, the surrounding soil and sediment from the debris piles, and from potential areas identified by community members
- Characterize the extent of munitions-related items encrusted in the limestone of PI 9 East
- Determine the appropriate path forward for UXO 15

The RI approach, as defined in the RI SAP, comprises the following activities:

- Conduct uniformly spaced geophysical transects at PI 9 West and EADA 45 in areas where the depth to bedrock was found to be greater than 6 inches in depth to bedrock; excavate and inspect MEC and MPPEH from all geophysical anomalies; collect one soil sample beneath the MEC item, if identified
- Conduct a depth to bedrock survey within EADA 44 and outside of the PI 13 boundary
- Visually inspect community suggested areas of potential munitions-related items and caves
- Remove five debris piles and collect one discrete soil/sediment sample beneath the debris; remove other debris piles of comparable size if found and collect one soil sample beneath the debris
- Visually inspect, aided with a metal detector, the munitions and/or munitions-related debris encrusted in the rock within PI 9 East
- Remove the 31 MD and scrap and 1 MPPEH (50 caliber ball ammunition) items previously identified during the Expanded Range Assessment/Site Inspection (ERA/SI) (CH2M HILL, 2010a)

## Remedial Investigation Activities and Findings to Date

RI activities included: 1) vegetation removal and surface clearance of munitions; 2) surveying to support the DGM; 3) archaeological survey to support subsurface excavations; 4) DGM and analysis; 5) intrusive investigation of geophysical anomalies; 6) removal of the five previously identified debris piles; 7) chemical analysis of surface soil/sediment beneath the debris piles; 8) investigation and removal of previously identified munitions items; 9) investigation of all community identified areas of potential munitions-related items; 10) depth to bedrock survey; and 11) magnetometer-aided munitions-related debris delineation. Each activity and its results are summarized below.

### Vegetation Removal and Surface Clearance

Vegetation removal and the surface clearance of munitions-related items within PI 9 West were conducted by USA Environmental, Inc. (USA E) in August 2012 and March 2013. Transects were generally spaced approximately 60 to 70 feet (ft) apart (**Figure 4**) and 3 ft wide to facilitate DGM. Not all of the planned transects were accessible for vegetation removal and subsequent activities, as standing water and deep, soft mud near the edges of the lagoon and low lying areas were inaccessible and/or unsafe to work. These areas are shown on **Figure 4**. Vegetation was cut and removed using hand tools. Trees greater than 3-inches in diameter were not cut, and transects were routed around these trees.

Concurrent with the vegetation removal, transects were surface cleared of potential MEC, MPPEH, and metallic debris that would impact DGM results (**Figure 4**). In some instances, metallic surface debris was identified by the UXO qualified personnel but could not be physically removed from the ground due to the size of the item and or the item being partially buried; all of these items were deemed to be general metallic

debris that was safe/free of explosives. In these instances, flags were placed in the ground to denote that the debris was inspected and determined to not be MEC/MPPEH. One tear gas grenade (MK25) classified as DMM and four small piles containing small arms casings (MD items) were encountered on the surface during the RI activities. **Photo 1** in **Attachment 1** shows the tear gas grenade. Most of what was encountered on the surface was RRD and cultural debris, which included metal pallets, fencing material, general trash, steel matting, and partially buried drums (**Table 1**, **Figure 4**, and **Photo 2** in **Attachment 1**).

During the surface clearance activities, several manmade berms and one earthen mound were identified (**Figure 4**). The general lengths and locations of the berms are shown in **Figure 4**, which indicates they are oriented generally in a northwest to southeast direction. The berms are up to about 6 ft high, 10 ft wide, and up to hundreds of feet in length. Although the berms and mound appear to be primarily soil, debris was encountered both on the surface and within the subsurface and included:

- Berm A – barbed wire, cut-off fence posts, and nails
- Berms B, C, and D – aircraft/supply pallets, 55 gallon drum debris, and RRD
- Berm E – metal pallets, wire, fence material, and railroad spikes
- Berm F – no debris identified
- Mound G – isolated manmade earthen pile with fence material identified
- Berm H – no debris identified; smaller in size and isolated
- Berm I – cultural debris

### Land Surveying

Since the vegetation canopy at the investigation area impacted the Global Positioning System (GPS) signal strength and positional accuracy, survey stakes were placed along transects to assist with location control for the DGM. The surveying was performed from August 20 through September 8, 2012 by ECLS, a surveying firm licensed and registered in Puerto Rico.

UXO personnel provided subsurface anomaly avoidance support during the placement of the stakes. Stakes were labeled with a unique identifier consisting of the transect ID and a sequential number that re-started at “1” with each new transect. Stakes were placed at a maximum spacing of 25 meters (82 feet) or at shorter distances, as necessary, to maintain both line of sight from one stake to the next as well as a straight-line walking segment between successive stakes for the DGM system. The start and end locations of each transect were identified with flagging tape. The tape was labeled with the transect ID as well as whether it represented the transect start or end location. The results and details of the surveying activities are presented in the surveyor report (**Attachment 2**).

During the land surveying activities, UXO personnel placed four quality control (QC) seed items for the DGM. The QC seeds consisted of small industry standard objects (ISOs) buried at a vertical orientation and approximately 15 centimeters (6 inches) below ground surface. Additional details on the procedures for the placement of QC seeds can be found in the *Non-Time Critical Removal Action Work Plan, Surface Munitions and Explosives of Concern at Munitions Response Area-Surface Impact Area Munitions Response Sites 1-7, Former Vieques Naval Training Range (VNTR), Vieques, Puerto Rico*, hereafter referred to as the NTCRA Work Plan (CH2M HILL, 2009). ECLS recorded the locations of the QC seeds and provided the information to the QC Geophysicist.

### Archaeological Survey

To ensure that intrusive activities at the site would not negatively impact cultural resources, an archaeological survey was conducted from September 11 through 14, 2012 by R. Christopher Goodwin and Associates, Inc. The survey was conducted throughout each transect and no sites, features, or deposits were encountered during testing that required any alteration of the RI SAP approach (**Attachment 3**).

## Digital Geophysical Mapping

### ***Data Collection***

DGM data collection was conducted from September 12 through 19, 2012 (**Attachment 4**). Data were collected with a 1-meter wide (i.e., width of coil) pass of the EM61-MK2 along each transect, during which the DGM field crew moved from one survey stake to the next. **Photo 3** in **Attachment 1** shows DGM surveying along a transect. This procedure resulted in a total footprint coverage of approximately 1.4 acres within the 47 acres of PI 9 West. Fiducial markers were added in the data when the center of the EM61-MK2 coil passed over the survey stakes. The surveyed coordinates of the stakes and the fiducial markers allowed the DGM data to be geo-referenced during data processing to Universal Transverse Mercator (UTM) coordinates.

### ***Data Interpretation/Anomaly Identification***

The target anomaly threshold of 2.5 millivolts (mV) on Channel 3 was utilized for selecting anomalies because of the uncertainty of the specific types and sizes of munitions that could be present at the site. In addition, this threshold is the program threshold utilized at the former VNTR for the interim removal action (in non-elevated anomaly density areas) due to the historic use of 20mm projectiles at the former VNTR.

Initial target selections were made using the automatic peak picking module (Blakely Test) in the Oasis Montaj UX-Detect module to identify peak amplitude responses in the gridded Channel 3 data that appeared to be indicative of potential MEC or MPPEH. Data profiles for all four channels were reviewed by the data processor to evaluate the validity and position of the auto-selected targets. Targets found to be invalid or incorrectly located were adjusted and/or removed from the final selection list. This review was performed by evaluating the decay in mV responses laterally from a peak response as well as the general shapes of the response curves for each channel at the selected anomaly locations. The intent of this evaluation was to identify automatically-selected targets that appear to be associated with surface debris or noise spikes. These anomalies typically exhibit different characteristics compared to subsurface anomalies potentially indicative of MEC/MPPEH. This review process also facilitates adding anomalies to the target selection list that may not have been automatically selected by the UX-Detect module but appear to represent potential MEC or MPPEH.

### ***DGM Quality Control***

Daily QC tests were conducted in accordance with the NTCRA Work Plan (CH2M HILL, 2009) and included an instrument warm-up period, static test measurements of background values and response values with a small Industry Standard Objective (ISO), collection of the seeded Instrument Verification Strip (IVS) transect, and collection of repeat data profiles. Descriptions of the QC tests and Measurement Quality Objectives (MQOs) for each are included in the NTCRA Work Plan. Additional field information (e.g., QC test file names, weather conditions, general survey notes) was recorded using the Munitions Response Program (MRP) Enterprise Personal Digital Assistant (PDA).

The Geophysical System Verification (GSV) process was followed for the DGM. This process compares signal strength and sensor performance to known response curves of ISOs to validate DGM systems before and during site surveys. The GSV process, the MQOs and Measurement Performance Criteria (MPC) are discussed in detail in the NTCRA Work Plan.

An IVS was also conducted for the DGM near Camp Garcia after first conducting an initial background survey to verify that the location was suitable (i.e., minimal existing geophysical anomalies) for construction of an IVS. Initial testing was conducted along the IVS transects to verify that the along-transect distances were accurately tracked by the EM61-MK2 wheel encoder. The initial IVS data were collected on September 4, 2012 and were submitted to the data processor. The QC Geophysicist reviewed the results and confirmed that the MQOs were being met prior to the start of the production survey.

The IVS was also used to verify positioning of the EM61-MK2 system by evaluating through the twice daily measurements along the seeded transect that seed items buried within the IVS were detected within the

positioning MQO ( $\pm 9.8$  inches [25 centimeters]) of the surveyed locations at the time of seed emplacement). The positioning MQO was met during the DGM at UXO 15.

Additional QC measures performed on a daily basis included monitoring the system for noise spikes ( $>2$  mV from the mean Channel 3 response) during personnel and cable shake tests. These tests were conducted to determine whether the DGM operator or vibration of cables and connectors during movement of the system along the transects introduced noise in the data stream. The data collected during the DGM at UXO 15 met the QC criteria for the personnel and cable shake tests.

Static test measurements were made periodically throughout each production day to evaluate whether the DGM system was responding appropriately to a known reference item (a small ISO). These tests were conducted with the system kept stationary in an area relatively free of metallic response. A small ISO was placed at a fixed height above the EM61-MK2 bottom coil and centered over the coil, and the EM61-MK2 response was recorded. The response from the system used at UXO 15 was within  $\pm 20\%$  of the predicted response value for a small ISO (Naval Research Laboratory, 2009) after background response removal, thereby meeting the MQO for system response during the static tests. Similarly, the response from the ISOs in the IVS was reviewed during QC in order to demonstrate that responses from the buried ISOs were within acceptable tolerances. Unlike the static tests, evaluation of the IVS seed response was performed on a qualitative basis because of the inherent variables that cannot be strictly controlled with the EM61-MK2 in motion.

During each production day, a portion of the survey area was re-collected and the data compared against the initial production survey data. This test was performed in order to evaluate repeatability of the DGM survey along the transects. Similar to the IVS seed response, evaluation of these data was performed on a qualitative basis due to the inherent variables that cannot be controlled with the EM61-MK2 in motion. The repeat test data were determined to meet the repeatability MQO during the DGM at UXO 15.

Additional details on the DGM data collection procedures, equipment and methodology, data analysis, target selection, findings, and QC measures are provided in Attachment 4: Digital Geophysical Mapping Report, UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico (CH2M HILL, 2012).

### ***Intrusive Investigation of Geophysical Anomalies and Subsurface Findings***

The subsurface investigation of geophysical anomalies (except two) was conducted from September 20 through October 15, 2012 by USAE. Two anomalies were investigated in April 2013 because the areas were incorrectly identified initially as being below 2.5mV during data processing and were therefore not submitted for intrusive investigation. **Photo 4** in **Attachment 1** shows the subsurface geophysical anomalies being re-acquired for the subsurface investigation.

A total of 432 of the 455 discrete anomalies were investigated. The remaining 21 discrete anomalies identified through DGM were not intrusively investigated since the sources of the anomalies were located outside of the cleared/approved transects. Therefore, the dig team was not able to access the area in order to dig these anomalies. In one instance, for example, the mV reading was attributed to a metal pallet on the ground surface that was within the vegetated area.

No MEC was identified in the subsurface; 10 MD items were identified within the subsurface. **Photo 5** in **Attachment 1** shows an example MD item excavated. Similar to the surface findings, most of what was encountered in the subsurface was RRD and cultural debris, which included metal pallets, fencing material, steel matting, general trash, and partially buried drums (**Table 2** and **Figure 5**).

In total, 1,381 items were identified in the subsurface; 990 within the top 1 ft and 391 items from 1 to 2 ft, which indicates that most of the items found were closer to the surface. In areas of the berms and mound, the anomalies were investigated to the extent possible for this investigation. In most cases anomalies within the berms were investigated and found to be a sizeable completely buried object (e.g., metal pallets, lengths of wire rope, etc.) that was not possible to remove without the use of large equipment.

## Debris Piles Removal

Four of the five historic debris piles (Piles A through D) were located and removed; however, while the location of Pile E (previously noted as a small arms pile less than 16 square feet) was found, there was no small arms pile present (**Figure 6**). The area around the previously recorded GPS positions of Pile E was visually inspected and inspected using a hand-held magnetometer. Although Pile E does not appear to be present, another small arms debris pile (denoted as Pile F in **Figure 6**) was identified and removed. Descriptions of the debris piles are summarized below.

- Pile A- Located within a periodically flooded area adjacent to a lagoon on the western end of Puerto Ferro. The pile was approximately 20 feet long and 10 feet wide (200 square feet). The pile contained wood pilings and assorted cultural debris. **Photos 6A** and **6B** in **Attachment 1** show the debris pile A area pre- and post-debris removal.
- Pile B- Located near the center of UXO 15 in an upland area. Debris covered less than several square feet and consisted of various tools, a small tool bag, and a few small vehicle-related pieces such as a spark plug. **Photos 7A** and **7B** in **Attachment 1** show the debris pile B area pre- and post-debris removal.
- Pile C- Located near the center of UXO 15 in an upland area. Debris consisted of rusted metal debris including pallet banding, pieces of 55 gallon drums, and recoilless rifle casings. The pile covered an area of approximately 400 square feet. **Photos 8A** and **8B** in **Attachment 1** show the debris pile C area pre- and post-debris removal.
- Pile D- Located near the center of UXO 15 in an upland area. Debris consisted of rusted metal debris including pallet banding, pieces of 55 gallon drums, and recoilless rifle casings along with some small arms shell casings and rubber spacers. The pile covered an area of approximately 600 square feet. **Photos 9A** and **9B** in **Attachment 1** show the debris pile D area pre- and post-debris removal.
- Pile F- Located within a periodically flooded area adjacent to a lagoon on the western end of Puerto Ferro. Debris contained expended small arms shell casing and was approximately 16 square feet in size. **Photos 10A** through **10C** in **Attachment 1** show the debris found at debris pile F and the debris removal process.

Piles A through D and F were removed in March 2013 by USAE using both hand tools and a back hoe and transported to the Central Processing Center (CPC) within the Live Impact Area (LIA) for recycling and disposal. Piles B, C, and D also included the removal of surface soil that appeared to contain flakes of rust from the overlying debris that was removed. Two drums of soil/metal fragments were excavated at Piles C and D and placed into two drums. A composite sample was collected on July 30, 2013 from the two drums and analyzed for full TCLP and reactivity, corrosivity, and ignitability by Katahdin Analytical Services, Inc. of Scarborough, Maine. Analytical results for the sample showed the drum contents to be non-hazardous. The drums will be processed and shipped offsite accordingly.

### Soil Sampling

Surface soil samples were collected from beneath the approximate center of Piles A, B, C, D and F on March 15, 2013, following the removal of the debris from these areas; however, since Piles A and F are within an ecological setting that is intermittently inundated with water from the adjacent lagoon, these soil samples were denoted as sediment samples. As stated in the SAP (CH2M HILL, 2012), a single soil/sediment sample was planned beneath each debris pile due to their relatively small size. Although Piles C and D covered an area greater than approximately 100 ft<sup>2</sup>, the debris was relatively scattered (vs piled) and relatively uniform in its composition. Therefore, a single soil sample was sufficient to characterize whether a release had occurred. However, additional samples associated with the debris piles are planned for the supplemental RI, as discussed under "*Planned Path Forward*". All surface soil/sediment samples were collected from a depth of 0 to 6 inches below ground surface using a stainless steel spoon and pan. All samples were submitted for explosives, inorganics, and general chemical parameters analysis by Katahdin Analytical Services, Inc. (sediment samples included acid volatile sulfide/simultaneously extracted metals [AVS/SEM]) (**Tables 3 and**

**4 and Attachment 5**). The analytical parameter list was jointly selected by the Navy, USEPA, and PREQB and did not include Explosive D (ammonium picrate) because there are no widely-accepted human health or ecological screening values, as stated in Worksheet #17 of the SAP Addendum (CH2M HILL, 2012). Analytical results were validated by an independent, third-party validator, DataQual Environmental Services, LLC located in Saint Louis Missouri. Sampling techniques followed the Master SOPs for Soil Sampling and Sediment Sampling (CH2M HILL, 2010b).

**Tables 3 and 4** present the explosives and inorganics results for the soil and sediment samples collected from beneath the five debris piles. No explosives were detected beneath any of the debris piles. The inorganics results are summarized below:

- Pile A – Only arsenic was detected (33 mg/kg and 19 mg/kg [duplicate]) above both soil background (9.2 mg/kg) and screening criteria (**Table 4**). The detected concentration may be associated with the unique lagoon edge setting or from potential treatment of the wood pilings.
- Pile B – Aluminum, chromium, iron, lead, selenium, silver, thallium, and vanadium were detected above background and screening criteria (**Table 3**). A broad-perspective consideration of the inorganic concentrations relative to the background concentrations and the fact that the site appeared to be discarded auto-related tooling and supplies indicates the inorganics concentrations are naturally occurring.
- Pile C – Aluminum, arsenic, chromium, cobalt, iron, lead, manganese, selenium, silver, thallium, vanadium, and zinc were detected above background and screening criteria (**Table 3**). Although iron, lead, and zinc may be associated with metallic debris, that the inorganics concentrations were relatively consistent among debris piles that contained different debris types suggests the inorganics at Pile C are mainly attributable to natural conditions. However, this supposition will be further evaluated, as discussed under *Planned Path Forward*.
- Pile D – Aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, manganese, selenium, thallium, vanadium, and zinc were observed above background and screening criteria (**Table 3**). Like Pile C, although several of the inorganics are commonly found in metal, the similarity of concentrations across debris piles suggests the inorganics at Pile D are mainly attributable to natural conditions. However, this supposition will be further evaluated, as discussed under *Planned Path Forward*.
- Pile F – Antimony, copper, lead, and zinc were detected above background (for soil; antimony does not have a background value) and screening criteria (**Table 4**). The antimony (4J mg/kg), copper (560J mg/kg), lead (528 mg/kg), and zinc (3,710J mg/kg) concentrations were anomalously high compared to the other debris piles and, therefore, may be associated with the former small arms debris.

Hexavalent chromium was not detected in any of the soil samples. However, the non-detect reporting limits for hexavalent chromium (0.38 to 4.2 mg/kg) exceed the RSL (0.29 mg/kg) due to required dilutions and moisture percentage. As noted in Appendix R of the Site Inspection/Expanded Site Inspection Report (CH2M HILL, 2010), naturally occurring chromium across Vieques is predominantly in the trivalent form, based on historical data and evaluation of geochemical characteristics of environmental media. Further, there is no anticipated source of hexavalent chromium at UXO 15. In addition, the RSL is based on a target cancer risk of  $1 \times 10^{-6}$ , and the maximum reporting limit is 4.2 mg/kg, which is associated with a residential scenario cancer risk of approximately  $1 \times 10^{-5}$ . Therefore, although the non-detect reporting limits exceed the RSL, they are within USEPA's target risk range. Based on all of the above information, hexavalent chromium is not a concern at UXO 15 and will not be included in future RI sampling activities at UXO 15 unless additional information is found or observed that suggests different conditions than those presented above.

#### ***Removal of Previously Identified Surface Munitions Items***

Of the 34 munitions-related items identified previously during the ERA/SI, one MPPEH and 32 MD were reacquired and removed in April 2013 (**Figure 7**). One MD could not be found. Each item was transported to the CPC for processing.

### ***Community-member Identified Features***

Each of the community-member suggested areas of potential munitions-related items were visually inspected in March 2013 (**Figure 6**). A visual inspection of each of the areas was conducted using GPS maps, topography, and natural features to ensure the areas were sufficiently inspected. A summary of each area is provided below:

- Possible location of 20 military tanks – No military tanks were found, but pads where vehicles may have been parked were identified
- Possible location of bullet boxes – Ammunition cans were identified and removed. No MEC or MD was identified. **Photo 11** in **Attachment 1** shows the location where the bullet boxes were found
- Possible location of detonation areas – Two potential detonation pits were located and the positions were recorded and photographed (**Figure 6** and **Attachment 4**). In addition, remnants of 3.5-inch rockets were identified within these pits and classified as MD. **Photo 12** and **Photo 13** in **Attachment 1** show the location of the potential detonation pits
- Possible location of grenades and fuzes – No items were found in the area
- Possible location of caves – no caves or cave complexes were located; however, a few overhanging rock ledges and trenches that appear to have once been covered with camouflage netting were found on the southern end of PI-9 West. No munitions items were identified in these areas. **Photo 14** in **Attachment 1** shows the location of the feature probably mistaken to be a cave

### ***Depth to Bedrock Survey***

To determine the need for subsurface investigations within EADA 44 and PI-9, a depth to bedrock survey was conducted to determine if areas had sufficient soil to allow for the potential burial of munitions related items. A bedrock survey was previously conducted in October 2011 during the Expanded Site Inspection (ESI), which covered PI-9, EADA 45, and PI-13, as documented in the RI SAP (CH2M HILL, 2012). The bedrock survey conducted as part of the RI activities presented in this memorandum expanded beyond the PI-13 boundary within EADA 44. **Figure 8** shows the combined survey areas in PI-13 from ESI and RI.

The bedrock survey was conducted during both the ESI and RI with a UXO Technician and geologist using a steel rod driven into the ground at each survey point shown in **Figure 8** until refusal was encountered. The depth to refusal was recorded. Measurements were collected along transects to provide sufficient coverage, with interpolation and extrapolation performed in areas where sensitive vegetation is located, which was not cut.

The depth to bedrock was found to be greater than 6 inches within only the central portion of EADA 44 (**Figure 8**). However, a magnetometer was used to sweep this area during the bedrock survey and no subsurface responses were detected. As a result, the potential for subsurface debris is unlikely in this area.

### ***Terrestrial Extent of Munitions Debris at PI-9 East***

The site boundary of PI-9 was established by historical aerial photographs during the Environmental Baseline Survey. Because the shoreline changes over time, the historical boundary may appear to extend into the near shore depending on the particular aerial photograph upon which the site boundary is displayed. However, PI-9 includes only the terrestrial area. UXO 16 is defined as the underwater areas, which includes the near shore area.

PI-9 East contains empty shell casings that can be seen extending out into the water. The area extending into the open water is part of UXO-16 and will be addressed accordingly. The extent of the munitions debris in the terrestrial area (PI-9 East) was delineated by a UXO Technician on March 20, 2013 using a handheld magnetometer and GPS. The terrestrial extent of the munitions debris based on this survey is shown in **Figure 9**.

## Conceptual Site Model Update

The generalized CSM of UXO 15 is presented in the RI SAP (CH2M HILL, 2012). Updated elements of the CSM from the RI findings to date are summarized below.

### Future Land Use

The intended land use has been revised since the submittal of the SAP. Public access via vehicle or bicycle is intended along the main road of UXO 15 for access to the historic Spanish lighthouse (**Figure 2**). The road was constructed by USFWS in 2007 to allow workers access to the lighthouse and surrounding areas. The road was built with 6-inch thick aggregate from offsite with geotextile at its base (**Attachment 6**). An embankment for drainage was constructed along the road buffer up to 11 feet from the edge of the road. It is important to note that during the road construction, munitions were not identified. During the August 2013 Vieques ERP Technical Subcommittee meeting, it was concurred that an NTCRA will be performed for the lighthouse and immediate surroundings, road leading to the lighthouse, and beach adjacent to the lighthouse to facilitate public access through and to these areas while the full CERCLA process for the site as a whole continues.

### Potential Source of a CERCLA Release and Release Mechanism

Based on the findings of the RI activities, subsurface debris (i.e., drums, metallic debris, etc.), including those present in the berms, may have the potential to release contaminants to the environment. The former contents of the drums and the nature of material within the berms are not sufficiently known.

### Nature and Extent of Contamination

#### ***MEC/MPPEH***

Based on the findings of the ERA/SI and RI activities (**Figure 10**), and the lack of munitions identified during road construction, the nature and extent of MEC/MPPEH (and related debris) have been characterized sufficiently within most of UXO 15, including the main access road and in the immediate vicinity of the lighthouse. However, it is not known whether MEC/MPPEH is present within the berms identified during the initial RI activities or the beach area adjacent to the historic lighthouse. Only two MPPEH items were identified on the surface within UXO 15, both in the area with the highest potential for munitions (PI 9 West); MEC/MPPEH was not identified in the subsurface. However, there may be the potential for MEC amongst the munitions debris encountered within PI 9 East, as only the lateral extent of the encrusted debris was delineated. Based on these findings, PI 9 East may have been used for ammunition disposal and PI 9 West may have been used for miscellaneous debris disposal.

During the ERA/SI, no evidence of long-range artillery use was found at PI 13, which would be required to reach the LIA/SIA from UXO 15. Therefore, it is highly unlikely that PI 13 was used as a gun position.

#### ***Environmental Media***

No explosives were detected beneath any of the debris piles. Inorganics were detected above screening criteria beneath Piles A, B, C, D, and F, but most are likely attributable to natural conditions. However, this supposition will be further evaluated, as discussed under *Planned Path Forward*. Further, since these debris piles were relatively small, the extent of inorganics contamination is likely localized in these areas.

No environmental samples have been collected to date in the bermed areas of PI 9 West and within the extent of the munitions debris in PI 9 East.

None of the data collected to date suggest groundwater sampling is warranted (i.e., no significant contamination identified).

## Planned Path Forward

The following path forward is planned for UXO 15:

- Initiate a NTCRA for the road to the lighthouse and lighthouse area.

- Conduct a NTCRA at Playa [Verdiales](#) and associated path for public access from the area around the lighthouse to the beach, in accordance with the NTCRA for the Roads and Beaches (CH2M HILL, 2008).
- Prepare a SAP Addendum to:
  - Further characterize the nature of the material (including potential MEC/MPPEH) and potential contamination associated with the berms, especially where subsurface drums were encountered. Since the former contents of the drums are unknown, each soil sample adjacent to drum locations will be analyzed for full suite of Target Analyte List (TAL)/Target Compound List (TCL) – Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), inorganic constituents, and explosives.
  - Characterize the nature and extent of contamination at the potential former detonation area. These samples will be analyzed for explosives, SVOCs, and inorganic constituents.
  - Characterize the nature and extent of contamination within PI 9 East. These samples will be analyzed for explosives and inorganic constituents.
  - Confirm inorganics associated with debris piles are attributable to background (by collecting location-specific background samples) or define the spatial extent of contamination.
  - Collect groundwater data only if additional samples collected suggest significant source of potential groundwater contamination. This will be determined via concurrence among the Subcommittee members upon review of the additional data together with the existing data.
- Once the nature and extent have been sufficiently delineated, prepare an RI Report to document the nature and extent of contamination and assess potential risks to human health and the environment.

## References

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Naval Research Laboratory, 2008. *Final Report for the Evaluation of UXO Detection Technology at the Standardized UXO Test Sites Aberdeen and Yuma Proving Grounds, Standardized UXO Technology Demonstration Site Program, SERDP. NRL/MR/6110-08-9155 (EM61-MK2 Response of Standard Munitions Items)*. October.

## Tables

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Table 1

**Items Identified on the Ground Surface**

UXO 15 Remedial Investigative Status Report

Former Vieques Naval Training Range

Vieques, Puerto Rico

**Items Observed on the Ground Surface Outside of the Transects**

Item/ Feature #	Northing	Easting	Group	Comments
1	2003385.639	242577.6238	CD	Empty plastic motor oil can
2	2003404.762	242445.0311	CD	Metal (galvanized) debris
3	2003411.234	242439.2019	CD	Metal (galvanized) debris
4	2003429.652	242413.3508	MD	Packing material and expended cartridge casing munitions debris/flash tube
5	2003423.322	242411.0395	MD	Expended cartridge casing munitions debris
6	2003438.856	242388.8012	CD	Railroad tie
7	2003429.957	242387.529	CD	Metal (galvanized) debris
8	2003445.044	242366.1949	RRD	Empty ammunition cans
9	2003446.529	242365.3855	MD	Expended cartridge case
10	2003433.14	242337.4923	Other	Sea Turtle Shell reported to USFWS
11	2003441.568	242307.1771	RRD	Empty powder charge shipping container
12	2003418.483	242233.0936	CD	Cut-off wooden telephone pole
13	2003408.363	242175.9435	CD	Crushed, empty 55 gallon steel drum
14	2003408.055	242173.9825	CD	Metal (galvanized) debris
15	2003402.013	242181.2351	CD	Metal (galvanized) debris
16	2003387.924	242173.7607	CD	Metal (galvanized) debris
17	2003392.388	242162.5269	RRD	Steel marsh matting (~15' long)
18	2003394.878	242155.4926	CD	Crushed, empty 55 gallon steel drum
19	2003509.05	242332.3943	RRD	Cartridge shipping container
20	2003527.309	242260.5635	CD	36" rubber tire
21	2003541.899	242189.5298	CD	Cultural metal debris (burn barrel w/ smaller circular metal debris)
22	2003392.915	241922.3909	CD	Cultural metal debris
23	2003276.293	241942.1278	RRD	Munition container lid
24	2003308.996	241954.1928	CD	Metal auto body panel
25	2003275.102	241951.0972	CD	~7" Metal cylindrical can (Cultural Debris)
26	2003415.369	241944.6594	CD	Partial palette (metal)
27	2003365.439	241981.2027	CD	Palettes (metal), and protruding, flat metal debris
28	2003448.626	241984.7426	CD	Empty, deteriorated 55 gallon steel drum
29	2003492.936	241985.441	CD	Palette debris (metal)
30	2003496.901	241982.615	CD	Metal wire (~15' in length)
31	2003356.065	242001.8973	CD	Television set
32	2003460.126	242046.9824	CD	Empty, deteriorated 55 gallon steel drum
33	2003455.602	242039.6005	RRD	Top/bottom of empty/deteriorated munitions container and munition container lid
34	2003442.723	242046.6556	RRD	Two munitions container lids
35	2003315.384	242089.9191	RRD	Munition container lid and 175mm container sleeve
36	2003351.807	242065.9892	RRD	Steel marsh matting
37	2003371.01	242069.8874	CD	Metal cylindrical casing (unknown classification)
38	2003438.844	242058.4005	CD	Metal cylindrical casing (unknown classification)
39	2003462.233	242075.4145	RRD	Partial steel drum and munition container lid
40	2003457.378	242070.3591	CD	Palette
41	2003351.432	242074.5888	RRD	Munitions container
42	2003346.88	242087.4293	CD	Palette
43	2003346.88	242087.4293	RRD	Two empty prop charge cans, 1 empty smoke generator, and palette debris
44	2003323.143	242085.6204	CD	Mostly buried fenceposts, palettes, one 55 gallon steel drum (not empty), planar sheet metal
45	2003324.887	242101.2632	RRD	Empty, intact smoke generator
46	2003350.055	242104.8919	RRD	Steel matting
47	2003419.906	242109.9719	CD	Empty, crushed 55 gallon steel drum
48	2003575.029	242027.8027	CD	Palette

Table 1

**Items Identified on the Ground Surface**

UXO 15 Remedial Investigative Status Report

Former Vieques Naval Training Range

Vieques, Puerto Rico

**Items Observed on the Ground Surface Within the Transects**

Item/ Feature #	Northing	Easting	Group	Comments
49	2003544.087	242010.899	CD	Surface Metal
50	2003485.897	242004.714	CD	Surface Metal
51	2003294.36	242019.561	CD	Surface Metal
52	2003485.151	242022.947	CD	Surface Metal
53	2003504.077	242023.416	CD	Surface Metal
54	2003536.876	242023.335	CD	Surface Metal
55	2003539.282	242022.799	CD	Surface Metal
56	2003493.886	242042.475	CD	Surface Metal
57	2003493.457	242042.803	CD	Surface Metal
58	2003492.902	242043.2	CD	Surface Metal
59	2003488.001	242042.401	CD	Surface Metal
60	2003445.592	242044.439	CD	Surface Metal
61	2003338.147	242064.672	CD	Surface Metal
62	2003491.645	242064.739	CD	Surface Metal
63	2003468.185	242062.939	CD	Surface Metal
64	2003425.469	242061.436	CD	Surface Metal
65	2003425.512	242061.384	CD	Surface Metal
66	2003339.898	242084.553	CD	Surface Metal
67	2003329.984	242081.39	CD	Surface Metal
68	2003481.053	242121.306	CD	Surface Metal
69	2003438.631	242158.407	CD	Surface Metal
70	2003407.255	242176.426	CD	Surface Metal
71	2003432.69	241975.43	DMM	ABC Mk 25 CS Grenade
72	2003510.49	242092.49	MD	
73	2003499.12	242064.08	RRD	
74	2003470.01	242061.49	RRD	
75	2003426.85	242059.95	RRD	
76	2003339.15	242063.03	RRD	
77	2003446.89	242043.17	RRD	
78	2003489.4	242041.1	RRD	
79	2003540.4	242022.71	RRD	
80	2003506.24	242022.26	RRD	
81	2003487.75	242022.48	RRD	
82	2003485.99	242003.92	RRD	
83	2003545.81	242009.36	RRD	
84	2003409.27	242176.71	CD	barrel & steel wire
85	2003481.97	242120.87	CD	fense wire
86	2003341.58	242082.84	CD	metal pallets & scrap metal
87	2003332.55	242079.24	CD	N/A
88	2003495.04	242041.51	CD	N/A
89	2003584.62	242043.5	CD	N/A
90	2003600.01	242103.33	CD	N/A
91	2003550.19	242144.63	CD	N/A
92	2003530.13	242216.6	CD	N/A

Table 2  
**Subsurface Anomaly Investigation Results**  
*UXO 15 Remedial Investigation Status Report*  
*Former Vieques Naval Training Range*  
*Vieques, Puerto Rico*

Item/Feature #	Northing	Easting	Group	Comments
E1H9H2-UXO15_00043-00001	242102.8	2003325	Cultural Debris	
E1J0E2-UXO15_00022-00001	242014.23	2003600.12	Cultural Debris	
E1J0E2-UXO15_00024-00001	242011.9	2003634.74	Cultural Debris	
E1J0E3-UXO15_00025-00001	242010.86	2003657.13	Cultural Debris	
E1J0E4-UXO15_00024-00001	242009.66	2003634.2	Cultural Debris	
E1J0E4-UXO15_00026-00001	242002.46	2003676.94	Cultural Debris	FENCE POST LIP
E1J0E4-UXO15_00026-00002	242005.4	2003675.4	Cultural Debris	
E1J0E4-UXO15_00026-00003	242009.6	2003676	Cultural Debris	
E1J0E4-UXO15_00026-00004	242011.2	2003676.23	Cultural Debris	Old Fence
E1J0F0-UXO15_00034-00001	242024.45	2003565.42	Cultural Debris	
E1J0F0-UXO15_00034-00002	242024.7	2003571.66	Cultural Debris	
E1J0F0-UXO15_00034-00003	242024.7	2003573	Cultural Debris	
E1J0F0-UXO15_00034-00004	242024.7	2003574.41	Cultural Debris	
E1J0F1-UXO15_00034-00001	242024.61	2003584.9	Cultural Debris	pallet off transect
E1J0F1-UXO15_00034-00002	242024.61	2003587.56	Cultural Debris	
E1J0F1-UXO15_00034-00003	242024.53	2003591.14	Cultural Debris	
E1J0F1-UXO15_00036-00001	242042.8	2003599.4	Cultural Debris	RRD (1)
E1J0F2-UXO15_00034-00001	242023.4	2003630.8	Cultural Debris	
E1J0F2-UXO15_00034-00002	242023.2	2003633.8	Cultural Debris	
E1J0F2-UXO15_00034-00003	242023.4	2003637.8	Cultural Debris	
E1J0F3-UXO15_00034-00001	242023.37	2003640.32	Cultural Debris	
E1J0F3-UXO15_00034-00002	242023.8	2003656.4	Cultural Debris	
E1J0F3-UXO15_00034-00003	242023.8	2003659.2	Cultural Debris	
E1J0F3-UXO15_00034-00004	242024.2	2003663.4	Cultural Debris	
E1J0H1-UXO15_00038-00001	242080.2	2003582	Cultural Debris	
E1J0H1-UXO15_00040-00001	242103	2003582.4	Cultural Debris	
E1J0H1-UXO15_00040-00002	242103.2	2003599	Cultural Debris	
E1J0H1-UXO15_00040-00003	242102.5143	2003600.749	RRD	
E1J0H1-UXO15_00040-00004	242100.6	2003604.2	Cultural Debris	
E1J0H2-UXO15_00038-00001	242080.8	2003613.8	RRD	
E1J0I1-UXO15_00042-00001	242121.8	2003585.4	RRD	
E1J0I1-UXO15_00042-00002	242121.8	2003591.8	RRD	
E1J0I1-UXO15_00042-00003	242121.6	2003597.8	RRD	
E1J0J1-UXO15_00044-00001	242141.4	2003586	RRD	CD(1)
E1J0J1-UXO15_00044-00002	242144.2	2003594	Cultural Debris	
E1J0J1-UXO15_00044-00003	242142	2003601.2	RRD	
E1J0J1-UXO15_00044-00004	242140.4	2003607.2	Cultural Debris	
E1J0J1-UXO15_00084-00001	242160.4	2003581.8	Residual Reading	Source outside investigation area/dig radius
E1J0J1-UXO15_00084-00002	242160.4	2003585	Cultural Debris	FENCE POST
E1J0J1-UXO15_00084-00003	242159	2003595.4	Cultural Debris	RRD (1)
E1J8B0-UXO15_00029-00001	241927.6	2003256.8	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
E1J8B0-UXO15_00029-00002	241926.6	2003271.8	Cultural Debris	
E1J8B9-UXO15_00028-00001	241909.4	2003223	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
E1J8C0-UXO15_00030-00001	241946.6	2003268.6	Cultural Debris	
E1J8C0-UXO15_00030-00002	241946.9608	2003272.812	Cultural Debris	
E1J8C0-UXO15_00030-00003	241947	2003274.8	Cultural Debris	
E1J8C0-UXO15_00030-00004	241946.8	2003276.8	Cultural Debris	
E1J8C0-UXO15_00030-00005	241946.6	2003280	Cultural Debris	
E1J8C9-UXO15_00001-00001	241937.2	2003236.8	Cultural Debris	
E1J8C9-UXO15_00030-00001	241948	2003247.2	Cultural Debris	
E1J8D0-UXO15_00031-00001	241966.98	2003273.99	Cultural Debris	
E1J9B1-UXO15_00029-00001	241930.6	2003294.6	RRD	
E1J9B1-UXO15_00029-00002	241927.8368	2003303.202	Cultural Debris	
E1J9B1-UXO15_00029-00003	241929.6	2003308.6	RRD	MD(1) 105mm cart case
E1J9B2-UXO15_00002-00001	241920.0737	2003329.426	Cultural Debris	Pallet
E1J9B2-UXO15_00029-00001	241929	2003312.2	RRD	
E1J9B2-UXO15_00029-00002	241927.4	2003320	Cultural Debris	
E1J9B3-UXO15_00003-00001	241923.8	2003349.2	Cultural Debris	
E1J9B3-UXO15_00004-00001	241923.2	2003358.6	RRD	
E1J9B3-UXO15_00004-00002	241926.5114	2003358.964	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
E1J9B3-UXO15_00029-00001	241928.2155	2003350.633	Cultural Debris	
E1J9B3-UXO15_00029-00002	241928.2	2003360.2	Cultural Debris	
E1J9B3-UXO15_00029-00003	241928.4049	2003363.603	Cultural Debris	
E1J9B3-UXO15_00029-00004	241928.4	2003365.6	Cultural Debris	Rebar
E1J9B4-UXO15_00005-00001	241922	2003371.8	Cultural Debris	
E1J9B4-UXO15_00006-00001	241922	2003389.8	Cultural Debris	
E1J9B5-UXO15_00007-00001	241923.6	2003406.8	RRD	CD(1) Pallet
E1J9C1-UXO15_00030-00001	241947.4341	2003286.823	RRD	
E1J9C1-UXO15_00030-00002	241945.8	2003291.6	Cultural Debris	RRD(3)
E1J9C1-UXO15_00030-00003	241944.594	2003294.871	Cultural Debris	
E1J9C1-UXO15_00030-00004	241945.8247	2003303.865	Cultural Debris	RRD(4)
E1J9C1-UXO15_00030-00005	241946.6	2003306.6	Cultural Debris	Pallet
E1J9C2-UXO15_00030-00001	241948.6	2003323.4	Cultural Debris	

Table 2  
**Subsurface Anomaly Investigation Results**  
*UXO 15 Remedial Investigation Status Report*  
*Former Vieques Naval Training Range*  
*Vieques, Puerto Rico*

Item/Feature #	Northing	Easting	Group	Comments
E1J9C2-UXO15 00030-00002	241948.6	2003326.8	Cultural Debris	
E1J9C3-UXO15 00030-00001	241948.9489	2003356.408	Cultural Debris	
E1J9C3-UXO15 00030-00002	241947.2527	2003360.953	Cultural Debris	
E1J9C3-UXO15 00030-00003	241946.6	2003363.6	Cultural Debris	
E1J9C4-UXO15 00029-00001	241933	2003391.2	Cultural Debris	
E1J9C4-UXO15 00030-00001	241948	2003382	QC Seed	Seed
E1J9C4-UXO15 00030-00002	241947.2	2003385.6	Cultural Debris	
E1J9C5-UXO15 00029-00001	241930.2	2003414	Cultural Debris	RRD(2)
E1J9C5-UXO15 00029-00002	241933.4	2003427.8	Cultural Debris	RRD(2)
E1J9C5-UXO15 00030-00001	241946.6	2003402.4	RRD	
E1J9C5-UXO15 00030-00002	241947	2003414.4	Cultural Debris	Pallet
E1J9C5-UXO15 00030-00003	241946.6	2003418	Cultural Debris	
E1J9C6-UXO15 00008-00001	241954.75	2003458.57	Cultural Debris	
E1J9C7-UXO15 00008-00001	241955.4	2003460.2	Cultural Debris	
E1J9C7-UXO15 00008-00002	241960	2003464.8	Cultural Debris	
E1J9D0-UXO15 00031-00001	241966	2003266.2	Cultural Debris	
E1J9D0-UXO15 00031-00002	241967.4	2003276.2	RRD	
E1J9D0-UXO15 00031-00003	241969	2003279.6	RRD	
E1J9D1-UXO15 00031-00001	241973.6	2003286	Cultural Debris	
E1J9D1-UXO15 00031-00002	241972.6	2003289.8	Cultural Debris	
E1J9D1-UXO15 00031-00003	241971.69	2003292.18	Cultural Debris	
E1J9D1-UXO15 00031-00004	241970.25	2003293.88	RRD	residual reading from debris off transect
E1J9D1-UXO15 00031-00005	241968.6	2003299.8	Residual Reading	Source outside investigation area/dig radius
E1J9D1-UXO15 00032-00001	241985.96	2003286.69	Cultural Debris	RRD (1)
E1J9D1-UXO15 00032-00002	241986	2003289.2	MD	106mm CART CASE
E1J9D1-UXO15 00032-00003	241986	2003294	MD	106mm CART CASE
E1J9D1-UXO15 00032-00004	241986.02	2003298.14	RRD	
E1J9D2-UXO15 00031-00001	241969.8	2003332.8	Residual Reading	Source outside investigation area/dig radius
E1J9D2-UXO15 00032-00001	241986	2003314	Cultural Debris	
E1J9D3-UXO15 00031-00001	241968.8	2003357	Cultural Debris	
E1J9D3-UXO15 00032-00001	241985.4	2003352.8	Cultural Debris	
E1J9D3-UXO15 00032-00002	241985.2	2003358.8	Cultural Debris	
E1J9D3-UXO15 00032-00003	241985.24	2003364.74	Cultural Debris	
E1J9D4-UXO15 00032-00001	241984.6	2003375.4	Cultural Debris	
E1J9D4-UXO15 00032-00002	241983.8	2003388.6	RRD	
E1J9D5-UXO15 00031-00001	241968.4	2003414.8	Cultural Debris	RRD (2)
E1J9D5-UXO15 00031-00002	241968.4	2003416	Cultural Debris	
E1J9D5-UXO15 00031-00003	241967.8	2003424.6	Cultural Debris	
E1J9D5-UXO15 00031-00004	241968	2003426.2	Cultural Debris	
E1J9D5-UXO15 00032-00001	241983.8	2003406.4	Cultural Debris	RRD (2)
E1J9D5-UXO15 00032-00002	241984.4	2003408.2	Cultural Debris	
E1J9D5-UXO15 00032-00003	241985	2003424.6	Cultural Debris	RRD (2)
E1J9D6-UXO15 00031-00001	241968.2	2003435.4	Cultural Debris	
E1J9D6-UXO15 00031-00002	241967.2	2003455	Cultural Debris	
E1J9D6-UXO15 00031-00003	241967.2	2003458.2	Cultural Debris	
E1J9D6-UXO15 00032-00001	241984.4	2003432	RRD	
E1J9D6-UXO15 00032-00002	241984.8	2003438.8	Cultural Debris	RRD (1)
E1J9D6-UXO15 00032-00003	241985.2	2003444.8	Cultural Debris	RRD (3)
E1J9D6-UXO15 00032-00004	241985.8	2003447.2	RRD	
E1J9D6-UXO15 00032-00005	241987.4	2003452.8	Cultural Debris	RRD (19)
E1J9D7-UXO15 00008-00001	241962.8	2003472.2	Cultural Debris	RRD (1)
E1J9D7-UXO15 00031-00001	241966.6	2003461.4	MD	
E1J9D7-UXO15 00031-00002	241967	2003471.2	Cultural Debris	
E1J9D7-UXO15 00031-00003	241965.6	2003476.8	Cultural Debris	
E1J9D7-UXO15 00031-00004	241966.4	2003481.8	Cultural Debris	
E1J9D7-UXO15 00031-00005	241967.8	2003489.4	Cultural Debris	
E1J9D7-UXO15 00032-00001	241986	2003473.4	RRD	
E1J9D8-UXO15 00031-00001	241968.8	2003498.4	Cultural Debris	
E1J9D8-UXO15 00031-00002	241969.2	2003505.4	Cultural Debris	
E1J9D8-UXO15 00032-00001	241986.2	2003495.6	Cultural Debris	Fork lift tine
E1J9D8-UXO15 00032-00002	241984.6	2003513.6	Cultural Debris	
E1J9D8-UXO15 00032-00003	241984.84	2003516.08	Cultural Debris	
E1J9D8-UXO15 00032-00004	241985.4	2003518.6	RRD	Matting (Left in Place)
E1J9E0-UXO15 00021-00001	242015.6	2003579.4	Cultural Debris	
E1J9E0-UXO15 00033-00001	242013.4	2003550.8	Cultural Debris	
E1J9E0-UXO15 00033-00002	242015.8	2003554.6	Cultural Debris	
E1J9E1-UXO15 00035-00001	242018.4	2003295	Residual Reading	Source outside investigation area/dig radius
E1J9E1-UXO15 00035-00002	242017.71	2003297.05	Residual Reading	Source outside investigation area/dig radius
E1J9E3-UXO15 00033-00001	242006.6	2003353	Cultural Debris	fence post
E1J9E3-UXO15 00033-00002	242007.8	2003356.6	Cultural Debris	wire
E1J9E3-UXO15 00033-00003	242008.6	2003359.2	Cultural Debris	
E1J9E3-UXO15 00033-00004	242009.4	2003364.8	Cultural Debris	
E1J9E4-UXO15 00033-00001	242007.6	2003373.6	Cultural Debris	

Table 2

**Subsurface Anomaly Investigation Results**  
**UXO 15 Remedial Investigation Status Report**  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

Item/Feature #	Northing	Easting	Group	Comments
E1J9E4-UXO15 00033-00002	242007.13	2003379.11	Cultural Debris	RRD(1)
E1J9E7-UXO15 00033-00001	242004.8	2003469.6	Cultural Debris	
E1J9E7-UXO15 00033-00002	242004.8	2003471.4	Cultural Debris	
E1J9E7-UXO15 00033-00003	242004.2	2003473.6	Cultural Debris	
E1J9E7-UXO15 00033-00004	242003.28	2003477.72	Residual Reading	Source outside investigation area/dig radius
E1J9E7-UXO15 00033-00005	242004	2003479.8	Cultural Debris	fence post
E1J9E7-UXO15 00033-00006	242005.6	2003486.8	Cultural Debris	pallet
E1J9E8-UXO15 00033-00001	242004.4	2003508.8	RRD	
E1J9E9-UXO15 00033-00001	242009.91	2003534.68	Cultural Debris	
E1J9E9-UXO15 00033-00002	242011.8	2003543.8	Cultural Debris	
E1J9E9-UXO15 00033-00003	242012.2	2003546	Cultural Debris	
E1J9F0-UXO15 00036-00001	242044.2	2003569.2	Cultural Debris	
E1J9F1-UXO15 00017-00001	242030.8	2003299.8	Cultural Debris	
E1J9F1-UXO15 00017-00002	242034.28	2003302.05	Cultural Debris	
E1J9F1-UXO15 00036-00001	242043	2003580.4	Cultural Debris	
E1J9F1-UXO15 00036-00002	242043	2003581.6	Cultural Debris	
E1J9F1-UXO15 00036-00003	242043.2	2003585.8	Cultural Debris	
E1J9F1-UXO15 00037-00001	242043.27	2003301.56	Cultural Debris	
E1J9F1-UXO15 00037-00002	242042.77	2003304.48	Other	moved soil, area disturbed during adjacent excavation and removal
E1J9F2-UXO15 00035-00001	242021.37	2003336.15	Cultural Debris	fence post
E1J9F2-UXO15 00035-00002	242022.4	2003338.4	Cultural Debris	auto part
E1J9F2-UXO15 00037-00001	242045	2003315.6	Cultural Debris	
E1J9F2-UXO15 00037-00002	242045.54	2003321.9	Cultural Debris	
E1J9F2-UXO15 00037-00003	242045.27	2003325.5	RRD	
E1J9F2-UXO15 00037-00004	242044.4	2003337.4	RRD	
E1J9F3-UXO15 00035-00001	242023.8	2003340.8	Cultural Debris	
E1J9F3-UXO15 00035-00002	242024.4	2003341.8	Cultural Debris	wire
E1J9F3-UXO15 00035-00003	242025.42	2003343.12	Cultural Debris	fence post
E1J9F3-UXO15 00035-00004	242023	2003349.6	Residual Reading	Source outside investigation area/dig radius
E1J9F3-UXO15 00035-00005	242023	2003352.2	Cultural Debris	wire
E1J9F3-UXO15 00035-00006	242022.8	2003356.6	Cultural Debris	RRD(3)
E1J9F3-UXO15 00037-00001	242043.91	2003341.56	Cultural Debris	
E1J9F3-UXO15 00037-00002	242043.6	2003344.8	Cultural Debris	
E1J9F3-UXO15 00037-00003	242044	2003349.6	RRD	
E1J9F4-UXO15 00035-00001	242022.4	2003376.2	Cultural Debris	
E1J9F4-UXO15 00035-00002	242022.6	2003385.2	Cultural Debris	
E1J9F4-UXO15 00035-00003	242024.2	2003391.4	Cultural Debris	
E1J9F4-UXO15 00035-00004	242025.17	2003396.56	Cultural Debris	
E1J9F4-UXO15 00035-00005	242025.4	2003398.2	Cultural Debris	RRD(1)
E1J9F4-UXO15 00037-00001	242043.6	2003386.2	Cultural Debris	
E1J9F4-UXO15 00037-00002	242043.2	2003388.6	Cultural Debris	long bolt
E1J9F4-UXO15 00037-00003	242043.2	2003390.4	RRD	
E1J9F4-UXO15 00037-00004	242043.4	2003394.6	Cultural Debris	pallet
E1J9F4-UXO15 00037-00005	242043.4	2003396.8	Cultural Debris	pallet
E1J9F5-UXO15 00035-00001	242025.6	2003408.4	Cultural Debris	
E1J9F5-UXO15 00035-00002	242025	2003411.4	Cultural Debris	
E1J9F5-UXO15 00035-00003	242022.8	2003420.6	Cultural Debris	
E1J9F5-UXO15 00035-00004	242023.4	2003426.8	RRD	
E1J9F5-UXO15 00037-00001	242045	2003412.4	RRD	
E1J9F5-UXO15 00037-00002	242045.32	2003415.05	RRD	
E1J9F6-UXO15 00035-00001	242024	2003452.4	Cultural Debris	
E1J9F6-UXO15 00035-00002	242023.6	2003459.4	Cultural Debris	
E1J9F6-UXO15 00037-00001	242044	2003432	Cultural Debris	
E1J9F6-UXO15 00037-00002	242044	2003434.8	RRD	
E1J9F6-UXO15 00037-00003	242043.68	2003438.94	Cultural Debris	
E1J9F6-UXO15 00037-00004	242043.8	2003445.4	Cultural Debris	fence post
E1J9F6-UXO15 00037-00005	242042.6	2003458.2	RRD	
E1J9F7-UXO15 00035-00001	242023.6	2003462.2	Cultural Debris	
E1J9F7-UXO15 00035-00002	242023.2	2003467.4	Cultural Debris	
E1J9F7-UXO15 00035-00003	242023.6	2003485.4	Cultural Debris	
E1J9F7-UXO15 00037-00001	242042.2	2003461.4	RRD	
E1J9F7-UXO15 00037-00002	242043	2003480.6	RRD	
E1J9F7-UXO15 00037-00003	242042.6	2003483.8	RRD	left in place fence post
E1J9F7-UXO15 00037-00004	242041.8	2003487.8	Cultural Debris	fence post
E1J9F8-UXO15 00035-00001	242022.8	2003492.6	Cultural Debris	fence post
E1J9F8-UXO15 00035-00002	242022.65	2003502.24	Cultural Debris	
E1J9F8-UXO15 00035-00003	242022.4	2003503.4	Cultural Debris	
E1J9F8-UXO15 00035-00004	242023.6	2003517	Cultural Debris	
E1J9F8-UXO15 00035-00005	242023.6	2003518.2	Cultural Debris	
E1J9F8-UXO15 00037-00001	242042.13	2003491.5	Cultural Debris	
E1J9F8-UXO15 00037-00002	242042.6	2003494	Cultural Debris	fence post
E1J9F8-UXO15 00037-00003	242042.4	2003495.37	Cultural Debris	fence post
E1J9F8-UXO15 00037-00004	242041.9	2003496.5	Cultural Debris	fence post

Table 2

**Subsurface Anomaly Investigation Results**  
**UXO 15 Remedial Investigation Status Report**  
Former Vieques Naval Training Range  
Vieques, Puerto Rico

Item/Feature #	Northing	Easting	Group	Comments
E1J9F8-UXO15 00037-00005	242041.59	2003500.92	Cultural Debris	fence post
E1J9F8-UXO15 00037-00006	242042.4	2003503.2	Cultural Debris	fence post
E1J9F8-UXO15 00037-00007	242042.13	2003505.15	Cultural Debris	fence post
E1J9F8-UXO15 00037-00008	242041.68	2003510.97	Cultural Debris	from nearby fence, left in place
E1J9F9-UXO15 00035-00001	242023.2	2003532.4	MD	Smoke Grenade
E1J9F9-UXO15 00035-00002	242022	2003539.2	Cultural Debris	
E1J9F9-UXO15 00036-00001	242041	2003537.8	Cultural Debris	
E1J9F9-UXO15 00036-00002	242042.2	2003540.4	Cultural Debris	
E1J9F9-UXO15 00036-00003	242042.7442	2003545.193	RRD	
E1J9F9-UXO15 00036-00004	242043	2003546.6	Cultural Debris	
E1J9G1-UXO15 00009-00001	242071.41	2003302.74	Cultural Debris	
E1J9G1-UXO15 00009-00002	242073.06	2003303.59	Residual Reading	Source outside investigation area/dig radius
E1J9G2-UXO15 00039-00001	242065.8	2003331.6	Cultural Debris	
E1J9G2-UXO15 00039-00002	242064.4	2003338	Cultural Debris	
E1J9G3-UXO15 00039-00001	242065.2	2003342.2	Cultural Debris	Pallets (2)
E1J9G3-UXO15 00039-00002	242066.38	2003344.58	Cultural Debris	wire line
E1J9G3-UXO15 00039-00003	242069.2	2003359.2	Cultural Debris	
E1J9G5-UXO15 00039-00001	242062.8	2003401.2	Cultural Debris	fence post
E1J9G5-UXO15 00039-00002	242062	2003414.6	Cultural Debris	
E1J9G5-UXO15 00039-00003	242062	2003425	Cultural Debris	Metal Wheel
E1J9G6-UXO15 00039-00001	242063.63	2003437.24	Cultural Debris	
E1J9G6-UXO15 00039-00002	242062.8	2003439.6	Cultural Debris	
E1J9G6-UXO15 00039-00003	242062.8	2003442.4	Cultural Debris	
E1J9G7-UXO15 00039-00001	242063.2	2003468.4	Cultural Debris	
E1J9G7-UXO15 00039-00002	242062.8	2003483.6	Cultural Debris	
E1J9G7-UXO15 00039-00003	242064.47	2003489.66	Cultural Debris	
E1J9G8-UXO15 00039-00001	242064.2	2003492	Cultural Debris	
E1J9G8-UXO15 00039-00002	242064.11	2003493.84	Cultural Debris	
E1J9H0-UXO15 00038-00001	242081.44	2003562.83	RRD	
E1J9H0-UXO15 00038-00002	242080.2	2003567.4	Cultural Debris	
E1J9H2-UXO15 00041-00001	242081.13	2003324.78	Cultural Debris	
E1J9H2-UXO15 00041-00002	242081	2003329.8	Cultural Debris	fence post
E1J9H2-UXO15 00041-00003	242080.98	2003331.72	Cultural Debris	
E1J9H2-UXO15 00041-00004	242081.2	2003334.4	Cultural Debris	
E1J9H2-UXO15 00041-00005	242082.71	2003337.94	Cultural Debris	
E1J9H3-UXO15 00041-00001	242083.48	2003339.93	Cultural Debris	
E1J9H3-UXO15 00041-00002	242083.4	2003342.6	Cultural Debris	RRD(1)
E1J9H3-UXO15 00041-00003	242082.8	2003345	Cultural Debris	
E1J9H3-UXO15 00041-00004	242082.51	2003347.89	Cultural Debris	
E1J9H3-UXO15 00041-00005	242081.2	2003355.6	Cultural Debris	
E1J9H3-UXO15 00043-00001	242099.6	2003354.6	Cultural Debris	RRD (2)
E1J9H3-UXO15 00043-00002	242099.48	2003357.93	Residual Reading	Source outside investigation area/dig radius
E1J9H3-UXO15 00043-00003	242099.8	2003364.6	Residual Reading	Source outside investigation area/dig radius
E1J9H4-UXO15 00041-00001	242081.84	2003370.24	Cultural Debris	
E1J9H4-UXO15 00041-00002	242082	2003379.6	Cultural Debris	
E1J9H4-UXO15 00041-00003	242084.5	2003390.65	Cultural Debris	pallet part
E1J9H4-UXO15 00041-00004	242083.8	2003394.8	Cultural Debris	rebar
E1J9H4-UXO15 00041-00005	242082.6	2003398.2	Cultural Debris	
E1J9H4-UXO15 00043-00001	242099	2003379.6	Cultural Debris	Pallet (RRD 1)
E1J9H4-UXO15 00043-00002	242100	2003391.8	Cultural Debris	
E1J9H4-UXO15 00043-00003	242100.4	2003397	Cultural Debris	
E1J9H4-UXO15 00043-00004	242100.66	2003398.87	Cultural Debris	
E1J9H5-UXO15 00041-00001	242082	2003401.4	Cultural Debris	
E1J9H5-UXO15 00041-00002	242081.6	2003406.4	Cultural Debris	
E1J9H5-UXO15 00043-00001	242101.2	2003416.2	Cultural Debris	
E1J9H6-UXO15 00041-00001	242084	2003434.4	Cultural Debris	
E1J9H6-UXO15 00043-00001	242100.2	2003437.6	Cultural Debris	
E1J9H7-UXO15 00041-00001	242083.2	2003476	Cultural Debris	
E1J9H7-UXO15 00041-00002	242083.88	2003485	Cultural Debris	
E1J9H7-UXO15 00041-00003	242082.76	2003488.22	Cultural Debris	from nearby fence, left in place
E1J9H7-UXO15 00043-00001	242103.6	2003470.8	Cultural Debris	
E1J9H7-UXO15 00043-00002	242104.6	2003475	RRD	
E1J9H7-UXO15 00043-00003	242103.74	2003476.88	Cultural Debris	
E1J9H7-UXO15 00043-00004	242101.8	2003482.4	Cultural Debris	
E1J9H7-UXO15 00043-00005	242100.4	2003486.8	Cultural Debris	
E1J9H8-UXO15 00038-00001	242081.2	2003503.2	Cultural Debris	
E1J9H9-UXO15 00013-00001	242102.07	2003526.37	Cultural Debris	
E1J9H9-UXO15 00013-00002	242104	2003526.2	Cultural Debris	
E1J9H9-UXO15 00038-00001	242081.6	2003539.8	Cultural Debris	RRD(2)
E1J9H9-UXO15 00040-00001	242100	2003527.8	Cultural Debris	
E1J9H9-UXO15 00040-00002	242100.8894	2003535.699	RRD	
E1J9H9-UXO15 00040-00003	242101.4	2003541.2	RRD	
E1J9H9-UXO15 00040-00004	242101.6	2003543.6	Cultural Debris	

Table 2  
**Subsurface Anomaly Investigation Results**  
*UXO 15 Remedial Investigation Status Report*  
*Former Vieques Naval Training Range*  
*Vieques, Puerto Rico*

Item/Feature #	Northing	Easting	Group	Comments
E1J9H9-UXO15_00040-00005	242101.5394	2003547.181	RRD	
E1J9H9-UXO15_00040-00006	242101.6	2003548.6	MD	
E1J9I0-UXO15_00042-00001	242121.6	2003579.8	RRD	
E1J9I2-UXO15_00009-00001	242121	2003337.4	Cultural Debris	
E1J9I3-UXO15_00045-00001	242121.19	2003341.95	Cultural Debris	RRD (1)
E1J9I3-UXO15_00045-00002	242121.2	2003344.2	Cultural Debris	FENCE POST LIP
E1J9I3-UXO15_00045-00003	242121.08	2003345.65	Cultural Debris	FENCE POST LIP
E1J9I3-UXO15_00045-00004	242121.05	2003347.32	Cultural Debris	PALLET LIP
E1J9I3-UXO15_00045-00005	242120.9	2003351.31	Cultural Debris	
E1J9I3-UXO15_00045-00006	242121	2003352.4	Cultural Debris	
E1J9I3-UXO15_00045-00007	242120.8	2003355	Cultural Debris	
E1J9I3-UXO15_00045-00008	242120.4	2003364.6	RRD	
E1J9I3-UXO15_00047-00001	242136	2003352.6	Cultural Debris	
E1J9I4-UXO15_00045-00001	242119.6	2003395	Cultural Debris	
E1J9I4-UXO15_00045-00002	242120.4	2003398.4	RRD	
E1J9I4-UXO15_00047-00001	242138.6	2003378.8	Cultural Debris	
E1J9I5-UXO15_00047-00001	242139.4	2003405.8	Cultural Debris	
E1J9I5-UXO15_00047-00002	242139	2003407.8	Cultural Debris	
E1J9I5-UXO15_00047-00003	242138.4	2003411.2	Cultural Debris	RRD (1)
E1J9I7-UXO15_00045-00001	242120.4	2003468	Other	
E1J9I7-UXO15_00045-00002	242121.2	2003480.6	Cultural Debris	
E1J9I7-UXO15_00045-00003	242121.52	2003483.51	Cultural Debris	
E1J9I7-UXO15_00047-00001	242139.28	2003477.03	Cultural Debris	PALLET LIP
E1J9I7-UXO15_00047-00002	242139.49	2003478.6	Cultural Debris	PALLET LIP
E1J9I7-UXO15_00047-00003	242139.75	2003481.15	Cultural Debris	PALLET LIP
E1J9I9-UXO15_00013-00001	242099.69	2003526.82	Cultural Debris	
E1J9I9-UXO15_00013-00002	242112.6	2003523	Cultural Debris	RRD (2)
E1J9I9-UXO15_00013-00003	242115.24	2003523.26	Cultural Debris	RRD (2)
E1J9I9-UXO15_00013-00004	242117	2003523.8	RRD	
E1J9I9-UXO15_00013-00005	242122.24	2003523.82	Cultural Debris	
E1J9I9-UXO15_00013-00006	242124.2	2003523.8	Cultural Debris	ROD LIP
E1J9I9-UXO15_00013-00007	242127.8	2003523.4	MD	105mm CART CASE
E1J9I9-UXO15_00042-00001	242120.4	2003527.4	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
E1J9I9-UXO15_00042-00002	242121.5799	2003532.178	RRD	
E1J9I9-UXO15_00042-00003	242121.6	2003535.2	MD	
E1J9I9-UXO15_00042-00004	242120.2799	2003538.028	RRD	
E1J9I9-UXO15_00042-00005	242121.309	2003542.415	RRD	
E1J9I9-UXO15_00042-00006	242121.8	2003544.4	QC Seed	
E1J9I9-UXO15_00042-00007	242122.6	2003548.2	RRD	
E1J9I5-UXO15_00049-00001	242159	2003406.6	Cultural Debris	Barbed wire left in place
E1J9I5-UXO15_00049-00002	242158	2003417.8	Cultural Debris	
E1J9I6-UXO15_00049-00001	242157.61	2003436.08	Cultural Debris	
E1J9I6-UXO15_00049-00002	242157.4	2003438	Cultural Debris	
E1J9I6-UXO15_00049-00003	242157.6	2003439.2	Cultural Debris	
E1J9I8-UXO15_00013-00001	242141.31	2003519.65	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
E1J9I8-UXO15_00013-00002	242143.2	2003518.4	RRD	
E1J9I8-UXO15_00013-00003	242145.4	2003516.8	RRD	
E1J9I8-UXO15_00013-00004	242146.76	2003515.82	RRD	
E1J9I8-UXO15_00013-00005	242149.2	2003516	MD	RRD (6) & CD (1) - 106mm CART CASE
E1J9I8-UXO15_00013-00006	242161.39	2003519.94	Cultural Debris	
E1J9I9-UXO15_00013-00001	242140	2003520.8	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
E1J9I9-UXO15_00013-00002	242164.62	2003521.44	Cultural Debris	
E1J9I9-UXO15_00044-00001	242141	2003529.8	RRD	
E1J9I9-UXO15_00044-00002	242141.6	2003532.8	RRD	
E1J9I9-UXO15_00044-00003	242141.8	2003535.2	Cultural Debris	
E1J9I9-UXO15_00044-00004	242143.2	2003540.8	RRD	
E1J9I9-UXO15_00044-00005	242143.6786	2003543.553	RRD	
E1J9I9-UXO15_00044-00006	242145	2003546.4	RRD	
E1J9I9-UXO15_00044-00007	242145.6	2003549	Cultural Debris	
E1J9I9-UXO15_00084-00001	242158.6	2003521.6	RRD	
E1J9I9-UXO15_00084-00002	242158.59	2003529.88	Cultural Debris	
E1J9I9-UXO15_00084-00003	242156.8	2003532.8	No Find	
E1J9I9-UXO15_00084-00004	242156.56	2003535.22	Residual Reading	Source outside investigation area/dig radius
E1J9I9-UXO15_00084-00005	242157	2003536.6	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
E1J9I9-UXO15_00084-00006	242157.31	2003538.1	Residual Reading	Source outside investigation area/dig radius
E1J9I9-UXO15_00084-00007	242158.4	2003541.6	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
E1J9I9-UXO15_00084-00008	242159.66	2003547.28	Cultural Debris	
E1J9I9-UXO15_00084-00009	242159.8	2003549	Cultural Debris	
F1A0A1-UXO15_00046-00001	242178.6	2003589.8	Cultural Debris	
F1A9A0-UXO15_00086-00001	242195.2	2003577	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
F1A9A4-UXO15_00010-00001	242173	2003389	Cultural Debris	
F1A9A5-UXO15_00051-00001	242177.03	2003401.03	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
F1A9A6-UXO15_00051-00001	242177	2003407.6	Cultural Debris	PALLET LIP

Table 2

**Subsurface Anomaly Investigation Results**  
**UXO 15 Remedial Investigation Status Report**  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

Item/Feature #	Northing	Easting	Group	Comments
F1A9A6-UXO15_00053-00001	242197.4	2003416	Cultural Debris	
F1A9A6-UXO15_00053-00002	242197.4	2003417.4	Cultural Debris	
F1A9A9-UXO15_00046-00001	242178.6	2003528.8	RRD	
F1A9A9-UXO15_00046-00002	242178.6	2003533.2	Cultural Debris	
F1A9A9-UXO15_00046-00003	242177.6	2003540.8	Cultural Debris	HIT OFF TRANSECTS
F1A9A9-UXO15_00046-00004	242177.6	2003542.2	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
F1A9A9-UXO15_00086-00001	242197.8	2003537.6	Cultural Debris	
F1A9A9-UXO15_00086-00002	242197.56	2003540.24	Cultural Debris	
F1A9B5-UXO15_00010-00001	242222	2003411.6	Residual Reading	Source outside investigation area/dig radius
F1A9B5-UXO15_00055-00001	242217.6	2003422	Cultural Debris	RRD (2)
F1A9B9-UXO15_00048-00001	242214.78	2003529.38	Residual Reading	Source outside investigation area/dig radius
F1A9B9-UXO15_00048-00002	242213.76	2003530.71	Cultural Debris	RRD (1) & HIT OFF TRANSECT
F1A9B9-UXO15_00048-00003	242213.57	2003532.91	Cultural Debris	HIT OFF TRANSECT
F1A9B9-UXO15_00048-00004	242213.8	2003535.1	Cultural Debris	
F1A9B9-UXO15_00048-00005	242216	2003547	Cultural Debris	
F1A9B9-UXO15_00086-00001	242200.2	2003528.4	Cultural Debris	
F1A9C0-UXO15_00050-00001	242237.4	2003568.6	Cultural Debris	RRD (3)
F1A9C0-UXO15_00052-00001	242252.2	2003566.6	Cultural Debris	
F1A9C5-UXO15_00010-00001	242240.6	2003419	RRD	FENCE POST LIP
F1A9C5-UXO15_00010-00002	242243.4	2003420.4	Cultural Debris	FENCE POST LIP
F1A9C5-UXO15_00010-00003	242245.41	2003421.95	Dug to Depth	HIT DEEPER THAN 24"
F1A9C6-UXO15_00011-00001	242258.2	2003448.2	Cultural Debris	
F1A9C6-UXO15_00057-00001	242235.8	2003438.6	Cultural Debris	RRD (1)
F1A9C6-UXO15_00059-00001	242252.6	2003438.2	Cultural Debris	
F1A9C6-UXO15_00059-00002	242253.4	2003441	QC Seed	
F1A9C8-UXO15_00014-00001	242234.8	2003513.6	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
F1A9C8-UXO15_00050-00001	242234.2	2003516.2	Cultural Debris	
F1A9C8-UXO15_00052-00001	242254.04	2003511.2	Cultural Debris	
F1A9C8-UXO15_00052-00002	242254.2	2003513.4	Cultural Debris	
F1A9C9-UXO15_00050-00001	242236.2	2003527.4	Cultural Debris	
F1A9C9-UXO15_00050-00002	242238.2	2003536.6	RRD	
F1A9C9-UXO15_00052-00001	242256.04	2003523.92	Cultural Debris	HIT OFF TRANSECT
F1A9C9-UXO15_00052-00002	242256.4	2003525.2	Cultural Debris	RRD (4)
F1A9D8-UXO15_00054-00001	242273.36	2003505.7	Cultural Debris	
F1A9D8-UXO15_00054-00002	242276	2003510.6	Dug to Depth	hole investigated to prescribed depth source of anomaly not found
F1A9D9-UXO15_00054-00001	242274.8	2003531.4	Cultural Debris	
F1A9E0-UXO15_00056-00001	242294.72	2003556.24	Cultural Debris	RRD (2)
F1A9E0-UXO15_00056-00002	242294.4	2003558.6	Cultural Debris	TRASH PIT
F1A9E6-UXO15_00063-00001	242293.2	2003440.2	Cultural Debris	
F1A9E6-UXO15_00063-00002	242292.2	2003444.2	Cultural Debris	
F1A9E6-UXO15_00063-00003	242292.6	2003448.4	Cultural Debris	
F1A9E8-UXO15_00015-00001	242305.4	2003518.8	MD	
F1A9E8-UXO15_00056-00001	242295.75	2003511.28	Cultural Debris	PALLET LIP
F1A9E8-UXO15_00058-00001	242312	2003509.4	Cultural Debris	
F1A9E8-UXO15_00058-00002	242311.89	2003513.36	Reacquired Below Threshold	reacquired reading was below 2.5mV item not investigated
F1A9E9-UXO15_00056-00001	242292	2003533.2	Cultural Debris	
F1A9F6-UXO15_00067-00001	242332.4	2003437	Cultural Debris	FENCE POST LIP
F1A9F6-UXO15_00067-00002	242331.4	2003440.4	Cultural Debris	
F1A9F8-UXO15_00060-00001	242327.43	2003510.05	Cultural Debris	
F1A9F8-UXO15_00060-00002	242328.2	2003513.6	Cultural Debris	PALLET LIP
F1A9F8-UXO15_00062-00001	242349.49	2003504.91	Cultural Debris	
F1A9F8-UXO15_00062-00002	242349.44	2003508.04	Cultural Debris	RRD(1)
F1A9F8-UXO15_00062-00003	242349.49	2003509.36	Cultural Debris	
F1A9F8-UXO15_00062-00004	242349.49	2003510.77	Cultural Debris	
F1A9F9-UXO15_00062-00005	242349.4	2003523.97	Cultural Debris	
F1A9G6-UXO15_00071-00001	242368.6	2003432	Cultural Debris	FENCE POST, BARBED WIRE LIP
F1A9G6-UXO15_00071-00002	242368.55	2003434.86	RRD	
F1A9G6-UXO15_00071-00003	242368.58	2003436.01	Cultural Debris	RRD (1)
F1A9G8-UXO15_00016-00001	242353.4	2003504.42	Cultural Debris	
F1A9G8-UXO15_00016-00002	242357.07	2003501.97	Cultural Debris	
F1A9G8-UXO15_00016-00003	242358.46	2003500.58	Cultural Debris	
F1A9G8-UXO15_00016-00004	242364.4	2003498	Cultural Debris	
F1A9G8-UXO15_00064-00001	242370.8	2003499.6	Cultural Debris	
F1A9G8-UXO15_00064-00002	242369.4	2003514.8	Cultural Debris	
F1A9G8-UXO15_00064-00003	242370.31	2003517.41	Cultural Debris	
F1A9H5-UXO15_00073-00001	242386.4	2003423.2	Cultural Debris	BARBED WIRE LIP
F1A9H5-UXO15_00073-00002	242387.4	2003430	Cultural Debris	PALLET LIP
F1A9H5-UXO15_00075-00001	242407.4	2003413.6	Cultural Debris	BARBED WIRE LIP
F1A9H6-UXO15_00012-00001	242385.32	2003446.53	RRD	
F1A9H8-UXO15_00016-00005	242382.2	2003501.4	Cultural Debris	
F1A9H8-UXO15_00016-00006	242403.03	2003492.88	Cultural Debris	
F1A9H8-UXO15_00066-00001	242389.2	2003501.2	Cultural Debris	
F1A9I6-UXO15_00012-00001	242410.8	2003436.4	MD	105 CART BASE

Table 2

**Subsurface Anomaly Investigation Results**  
*UXO 15 Remedial Investigation Status Report*  
*Former Vieques Naval Training Range*  
*Vieques, Puerto Rico*

Item/Feature #	Northing	Easting	Group	Comments
F1A9J5-UXO15_00079-00001	242443	2003406.8	Cultural Debris	PALLET LIP
F1A9J5-UXO15_00079-00002	242444.48	2003412.17	Cultural Debris	
F1B9C4-UXO15_00070-00001	242550.4	2003392.2	QC Seed	
F1B9D3-UXO15_00074-00001	242583.6	2003356.6	Cultural Debris	
F1B9D4-UXO15_00072-00001	242567.2	2003372.8	Cultural Debris	
F1B9E3-UXO15_00076-00001	242604	2003346.8	Cultural Debris	
F1B9E3-UXO15_00076-00002	242605.4	2003348.2	Cultural Debris	
F1B9F2-UXO15_00078-00001	242621.74	2003337.41	Cultural Debris	
F1B9G1-UXO15_00081-00001	242658.8	2003306.2	Cultural Debris	
F1B9G1-UXO15_00081-00002	242659.4	2003308.6	Cultural Debris	Silt Fence
F1B9G1-UXO15_00082-00001	242679.6	2003283	Cultural Debris	
F1B9H1-UXO15_00082-00002	242680.2	2003288.8	Cultural Debris	
F1G9G6-UXO15_00012-00001	242374.2	2003448.8	Reacquired Below Threshold	reaquired reading was below 2.5mV item not investigated

Note:

RRD - Range Related Debris. The () associated with each RRD signifies the number of RRD items found at each location  
 CD - Cultural Debris. The () associated with each CD signifies the number of CD items found at each location

Table 3  
**Validated Surface Soil Exceedance Analytical Data, March 2013**  
 UXO 15 Remedial Investigation Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

Sample ID	East SS Bkg TI	RSL Residential Soil Adjusted	SSL	ECO Soil ESVs	Debris Pile B	Debris Pile C	Debris Pile C	Debris Pile D
					VEUXO15-SS02-06I-0313 3/15/13	VEUXO15-SS03-06I-0313 3/15/13	VEUXO15-SS03P-06I-0313 3/15/13	VEUXO15-SS04-06I-0313 3/15/13
<b>Chemical Name</b>								
<b>Explosives (UG/KG)</b>								
No Detections								
<b>Total Metals (MG/KG)</b>								
Aluminum	35,000	7,700	23,000	-	52,300	43,300	42,900	52,000
Arsenic	9.2	0.61	0.29	18	6.8	11	11.6	12.6
Barium	212	1,500	82	330	80	74.3	71.4	81.5
Beryllium	0.95	16	3.2	40	1.1	1.4	1.5	1.7
Cadmium	2.4	7	0.38	32	1.7 U	0.23 J	0.21 J	2.5 J
Calcium	417,000	-	-	-	6,430 J	8,430 J	6,330 J	2,750 J
Chromium	70	0.29	180,000	64	75 J	115 J	117 J	130 J
Cobalt	16	2.3	0.21	13	12.6	19.3	20	20.7
Copper	94	310	46	70	26.3	37.9	35.4	41.7
Iron	38,100	5,500	270	-	47,800	60,500	61,100	66,700
Lead	16	400	14	120	18.3	66.5	51.6	24
Magnesium	22,200	-	-	-	4,710	3,560	3,340	3,210
Manganese	1,630	180	21	220	1,410	1,640	1,640	1,810
Nickel	41	150	20	38	35.2	24.5	24.2	27.4
Potassium	10,800	-	-	-	7,720	5,110	4,940	4,780
Selenium	1.3	39	0.26	0.52	3.3 J	4.6 J	2.6 J	3.8 J
Silver	0.22	39	0.6	560	1.4 J	0.7 J	0.45 J	0.39 J
Sodium	1,590	-	-	-	218	377	370	274
Thallium	0.13	0.078	0.14	1	0.37	0.47	0.45	0.56
Vanadium	56	39	63	130	75.3	99.3	103	110
Zinc	32	2,300	290	120	61.4	565 J	338 J	804
<b>Wet Chemistry</b>								
pH (pH units)	-	-	-	-	7.6	7.6	NS	6.4
Redox (MV)	-	-	-	-	168	168	NS	235
Total organic carbon (TOC) (UG/G)	-	-	-	-	46,000	60,000	NS	25,000

<b>Exceeds Background UTL</b>
<b>Exceeds Background UTL and Adjusted RSL for Residential Soil</b>
<b>Exceeds Background UTL and ECO (E)</b>
<b>Exceeds Background UTL and SSL (DAF=1)</b>
<b>Exceeds Background UTL, Adjusted RSL for Residential Soil and ECO (E)</b>
<b>Exceeds Background UTL, Adjusted RSL for Residential Soil and SSL (DAF=1)</b>
<b>Exceeds Background UTL, ECO (E) and SSL (DAF=1)</b>
<b>Exceeds Background UTL, Adjusted RSL for Residential Soil, ECO (E) and SSL (DAF=1)</b>

**Notes:**  
 J - Estimated results  
 NS - Not sampled  
 R - Rejected result  
 U - Non-detect  
 MG/KG - Milligrams per kilogram  
 MV - Millivolts  
 UG/G - Micrograms per gram  
 UG/KG - Micrograms per kilogram

Table 4  
**Validated Sediment Exceedance Analytical Data, March 2013**  
 UXO 15 Remedial Investigation Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

Sample ID Sample Date	East SS Bkg TI	RSL Residential Soil Adjusted	Marine Sediment ESVs	Debris Pile A	Debris Pile A	Debris Pile F
				VEUXO15-SD01-06I-0313 3/15/13	VEUXO15-SD01P-06I-0313 3/15/13	VEUXO15-SD06-06I-0313 3/15/13
<b>Chemical Name</b>						
<b>Explosives (UG/KG)</b>						
No Detections						
<b>Total Metals (MG/KG)</b>						
Aluminum	35,000	7,700	18,000	11,400	10,400	6,100
Antimony	NA	3.1	2	0.55 UJ	0.47 UJ	4 J
Arsenic	9.2	0.61	8.2	<b>33.3 J</b>	<b>19.2 J</b>	1.4
Barium	212	1,500	48	91.1 J	88.3 J	162 J
Beryllium	0.95	16	-	0.12 J	0.11 J	0.04 J
Cadmium	2.4	7	1.2	0.33 U	0.28 U	0.69
Calcium	417,000	-	-	6,600	5,270	2,140
Chromium	70	0.29	81	12.3 J	8.3 J	13.2 J
Cobalt	16	2.3	10	2.5	1.9	2.4
Copper	94	310	34	85.8 J	23.8 J	<b>560 J</b>
Iron	38,100	5,500	220,000	11,000 J	9,460 J	13,400 J
Lead	16	400	46.7	1.9	1.7	<b>528</b>
Magnesium	22,200	-	-	3,390	2,810	4,920
Manganese	1,630	180	260	202 J	142 J	183
Nickel	41	150	20.9	1.5	1.3	19.6
Potassium	10,800	-	-	2,280	2,120	1,020
Silver	0.22	39	1	0.44 U	0.38 U	0.07 J
Sodium	1,590	-	-	<b>6,180</b>	<b>5,190</b>	<b>5,350</b>
Thallium	0.13	0.078	-	0.02 J	0.02 J	0.01 J
Vanadium	56	39	57	21.9	17.9	15.2
Zinc	32	2,300	150	14.6 J	13.2 J	<b>3,710 J</b>
<b>Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOL/G)</b>						
Acid volatile sulfide	-	-	-	0.051 J	NS	0.084 U
Cadmium	-	-	-	7.03E-04 J	NS	0.00122
Copper	-	-	-	0.805	NS	1.28
Lead	-	-	-	0.0032	NS	0.318
Mercury	-	-	-	0.000019 U	NS	1.82E-05 J
Nickel	-	-	-	0.00302 J	NS	0.00762
Zinc	-	-	-	0.0247	NS	21.7
<b>Wet Chemistry</b>						
pH (pH units)	-	-	-	8.1	NS	8
Redox (MV)	-	-	-	167	NS	195
Total organic carbon (TOC) (UG/G)	-	-	-	2,800	NS	1,900
<b>Grain Size (PCT)</b>						
COARSE SAND (%)	-	-	-	1.8	NS	1.9
FINE SAND (%)	-	-	-	34.4	NS	38.8
FINES (%)	-	-	-	35	NS	36
GRAVEL (%)	-	-	-	3.5	NS	2
MEDIUM SAND (%)	-	-	-	25.3	NS	21.3
SAND (%)	-	-	-	61.5	NS	62
GS03 SIEVE 3" (75 MM)	-	-	-	100	NS	100
GS05 SIEVE 2" (50 MM)	-	-	-	100	NS	100
GS06 SIEVE 1.5" (37.5 MM)	-	-	-	100	NS	100
GS07 SIEVE 1" (25.0 MM)	-	-	-	100	NS	100
GS08 SIEVE 0.75" (19.0 MM)	-	-	-	100	NS	100
GS10 SIEVE 0.375" (9.5 MM)	-	-	-	97.2	NS	100
SIEVE NO. 004 (4.75 MM)	-	-	-	96.5	NS	98
SIEVE NO. 010 (2.00 MM)	-	-	-	94.7	NS	96.1
SIEVE NO. 020 (850 UM)	-	-	-	84.9	NS	88.1
SIEVE NO. 040 (425 UM)	-	-	-	69.4	NS	74.8
SIEVE NO. 060 (250 UM)	-	-	-	56.8	NS	62.9
SIEVE NO. 080 (180 UM)	-	-	-	48.6	NS	53.8
SIEVE NO. 100 (150 UM)	-	-	-	44.8	NS	49.2
SIEVE NO. 200 (75 UM)	-	-	-	35	NS	36

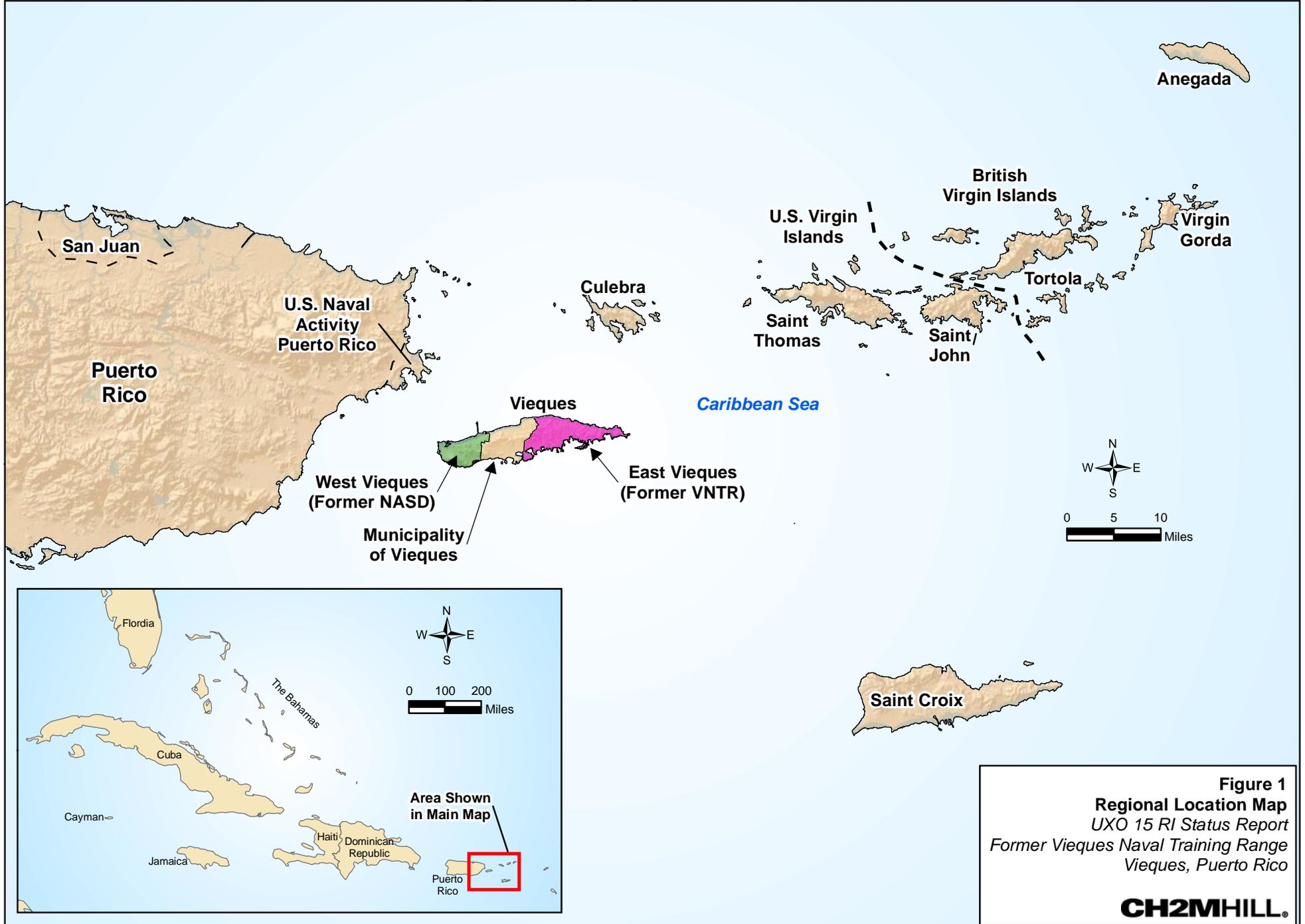
Exceeds Background UTL  
 Exceeds Background UTL and Adjusted RSL for Residential Soil  
 Exceeds Background UTL and ECO (E)  
 Exceeds Background UTL, Adjusted RSL for Residential Soil and ECO (E)

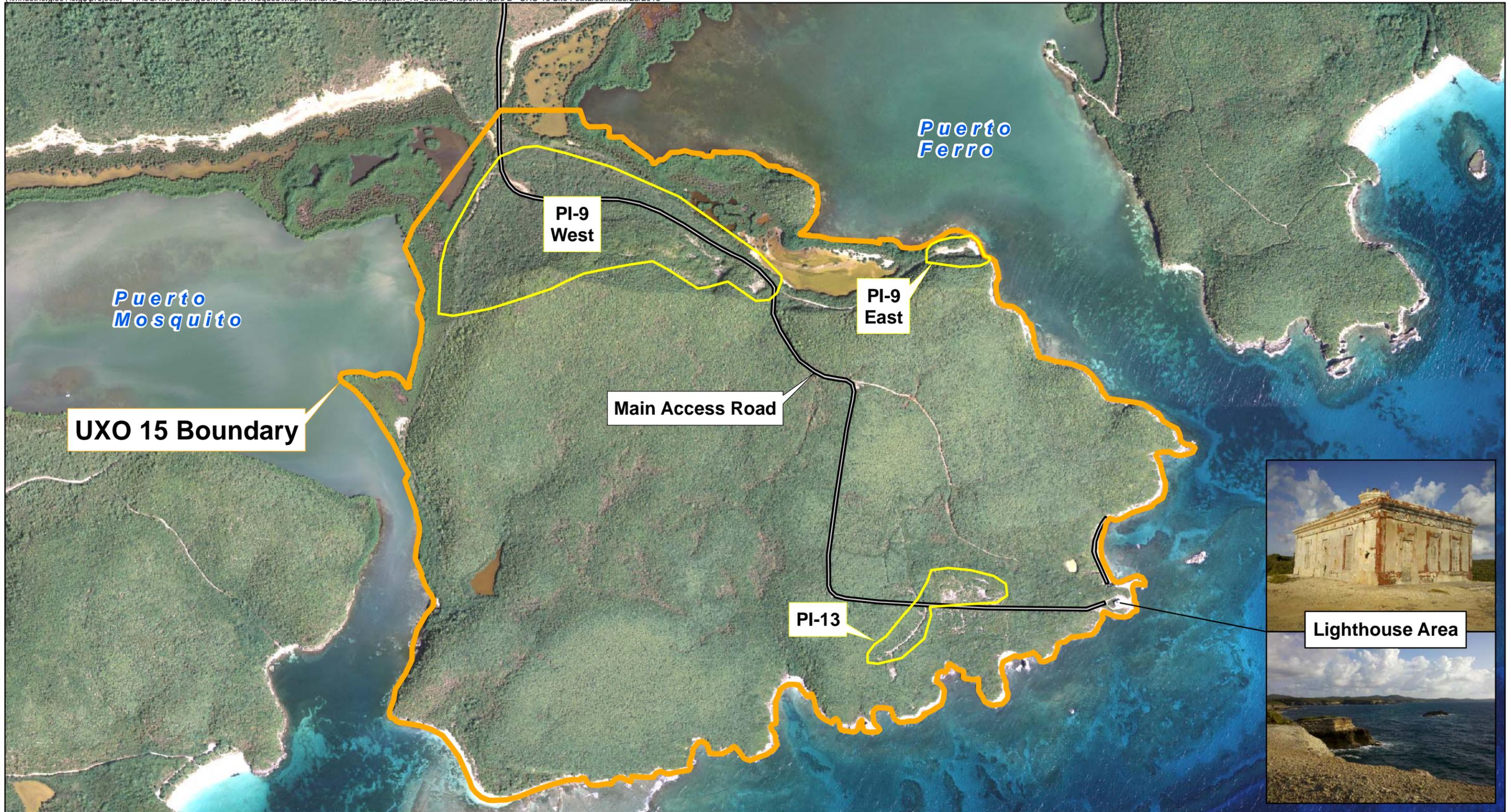
**Notes:**  
 J - Estimated result  
 NS - Not sampled  
 U - Non-detect  
 UJ - Non-detect, quantitation limit may be inaccurate  
 UG/G - Micrograms per gram  
 UG/KG - Micrograms per kilogram

MG/KG - Milligrams per kilogram  
 MV - Millivolts  
 PCT - Percent  
 UMOL/G - Micromoles per gram  
**Bold text indicates detection**

**Figures**

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**Legend**

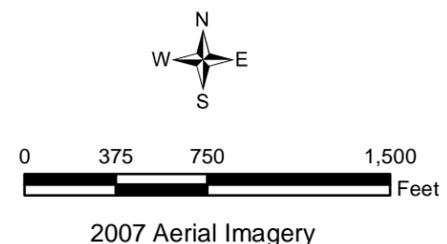
- PI Areas
- UXO 15



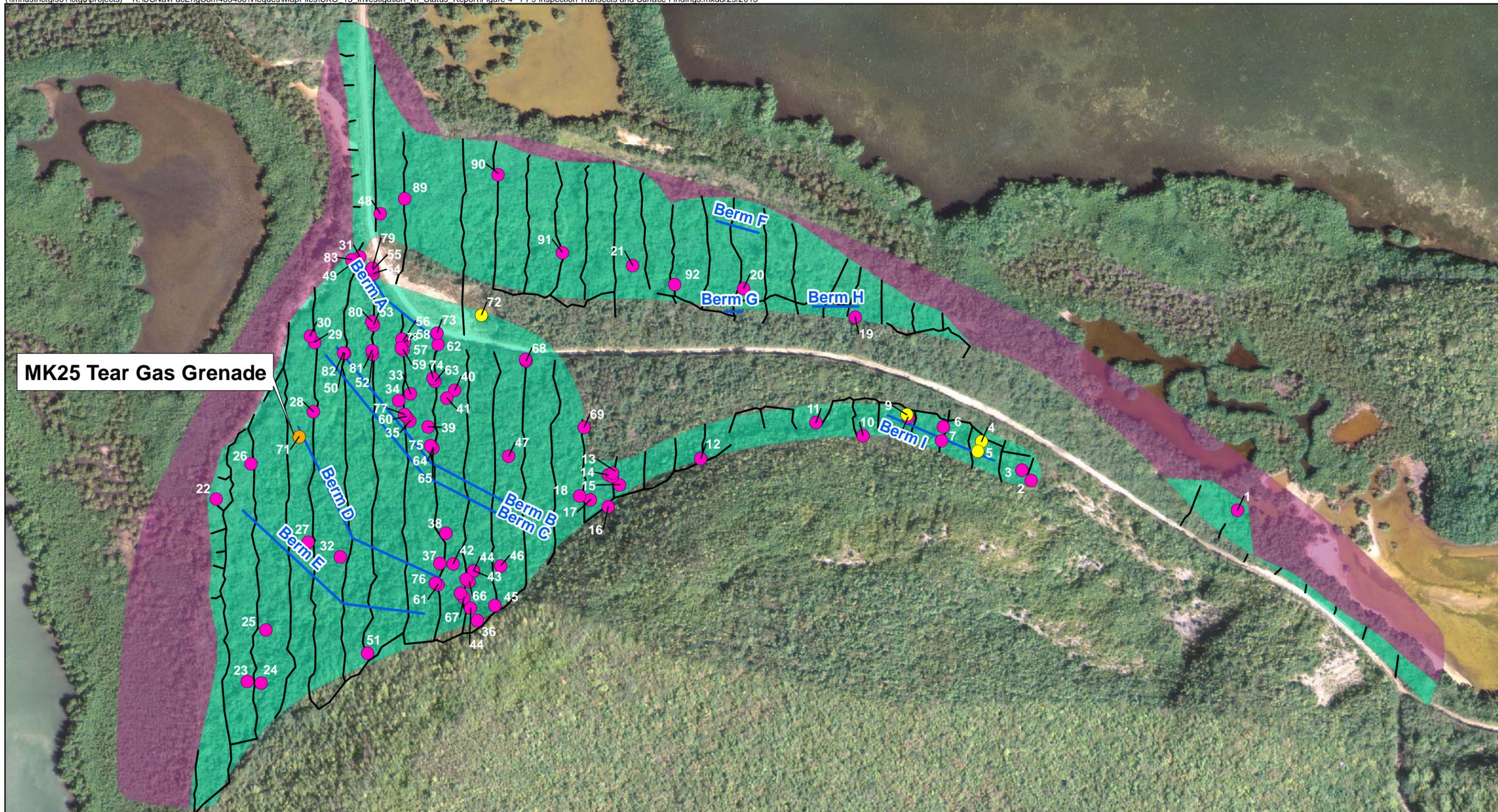
**Figure 2**  
**UXO 15 Site Features**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico



- Legend**
- Debris Pile
  - MPPEH Item
  - Transect
  - Elevated Anomaly Density Area (EADA)
  - PI Areas
  - UXO 15



**Figure 3**  
**Findings from Previous Investigations**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

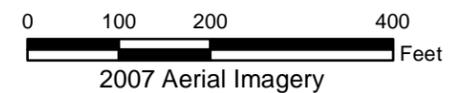


**MK25 Tear Gas Grenade**

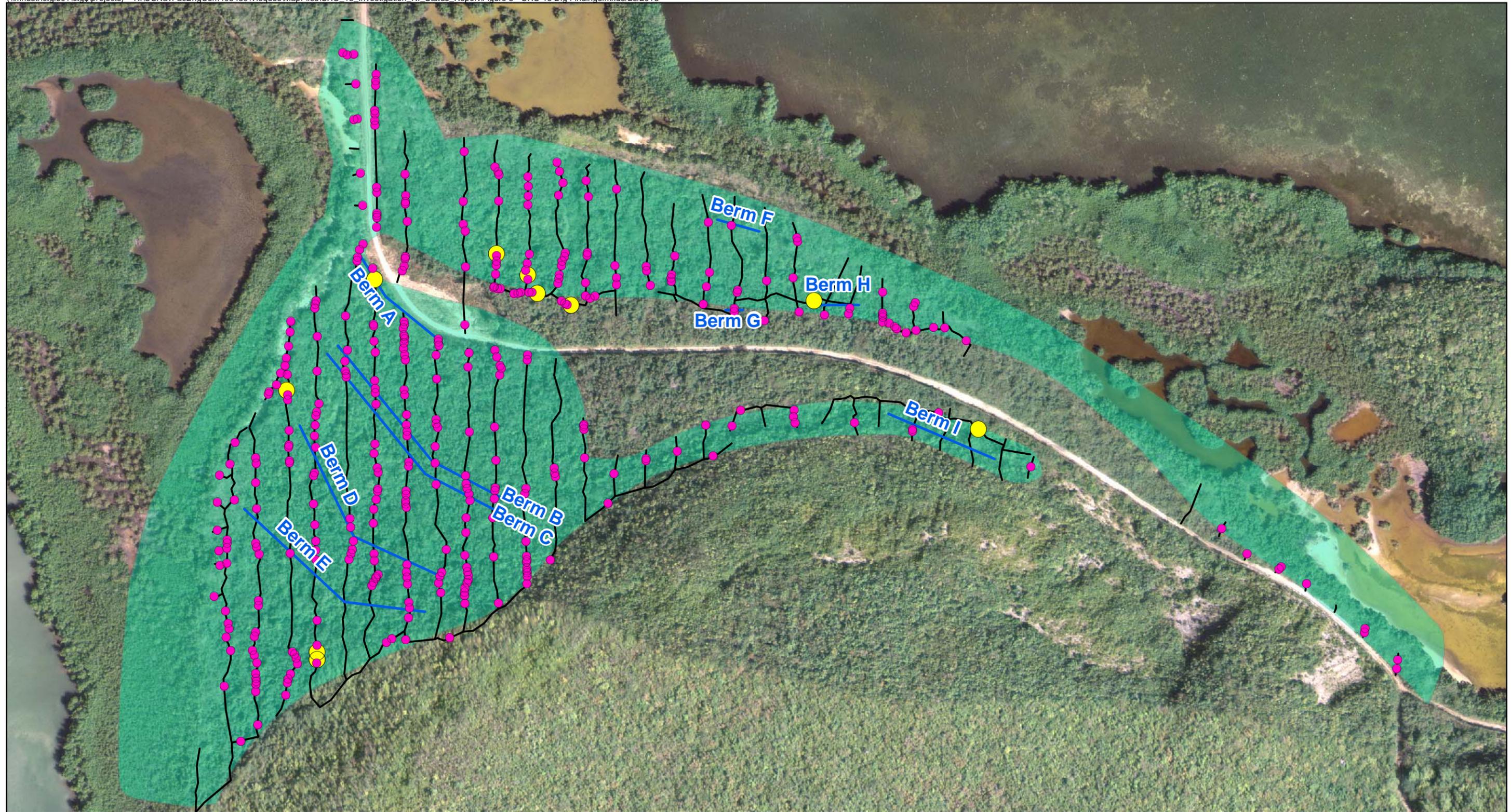
**Legend**

- MPPEH Item
- MD Item
- Range Related Debris/Cultural Debris
- Berm Location
- Surveyed Transect
- Inaccessible Area
- Proposed DGM Area

Note:  
The number above the item identified corresponds with the Item # in Table 1.



**Figure 4**  
**PI-9 Inspection Transects and Surface Findings**  
UXO 15 RI Status Report  
Former Vieques Naval Training Range  
Vieques, Puerto Rico



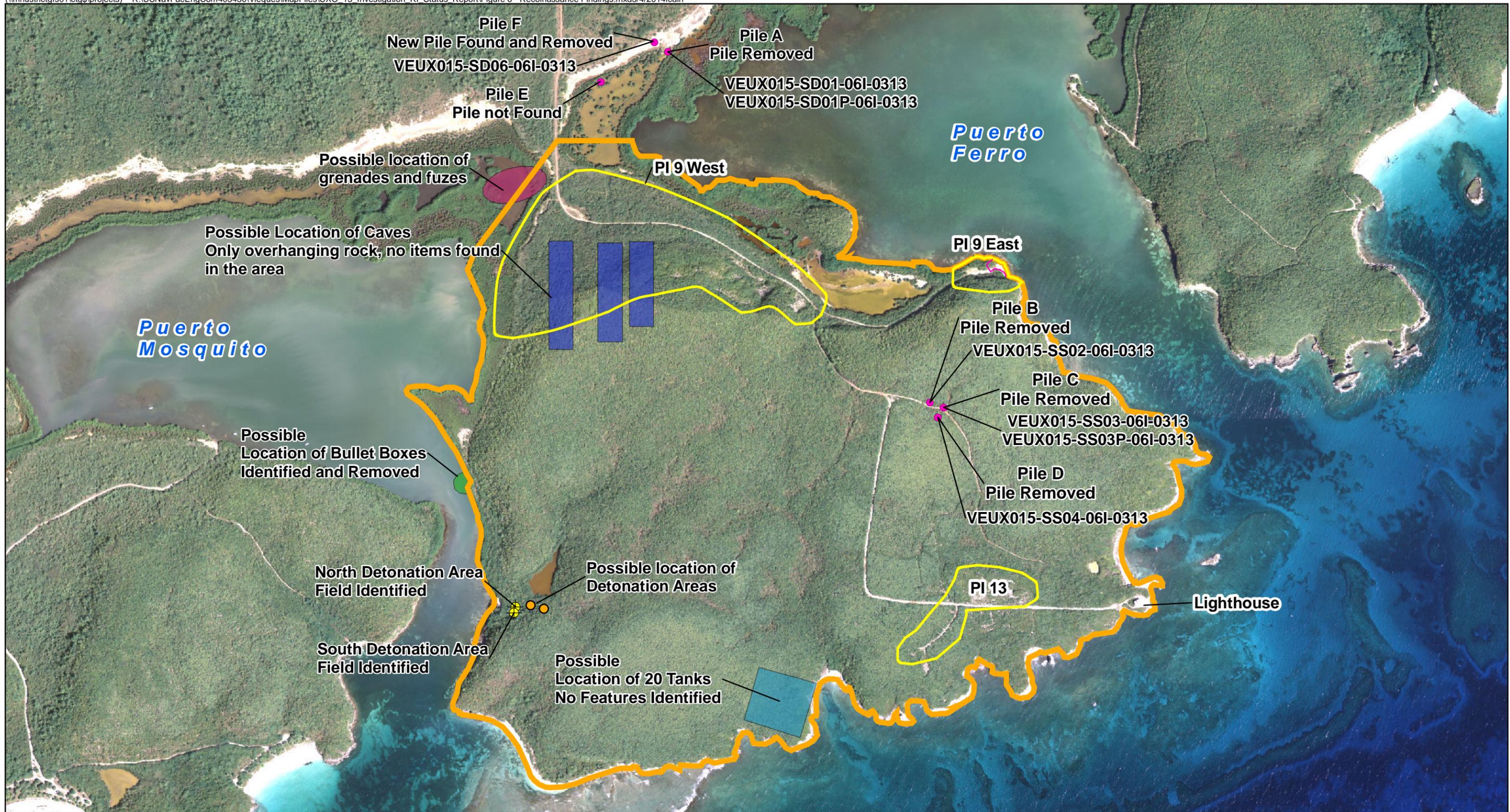
- Legend**
- MD Item
  - Range-Related Debris/Cultural Debris
  - Berm Location
  - Surveyed Transect
  - Proposed DGM Area

2007 Aerial Imagery



**Figure 5**  
**UXO 15 Dig Findings**  
UXO 15 RI Status Report  
Former Vieques Naval Training Range  
Vieques, Puerto Rico

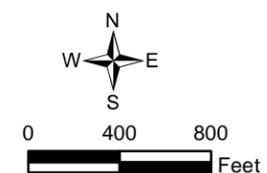




- Legend**
- Debris Pile
  - PI-9 East Terrestrial Debris Delineation Line
  - PI Site
  - UXO15

**Community-member Identified Areas**

- Possible location of caves
- Possible location of grenades and fuzes
- Possible location of 20 Tanks
- Possible location of bullet boxes
- ⊕ Recon Pit Location
- Possible Detonation Point

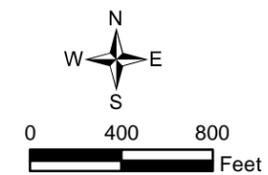


**Figure 6**  
**Reconnaissance Findings**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

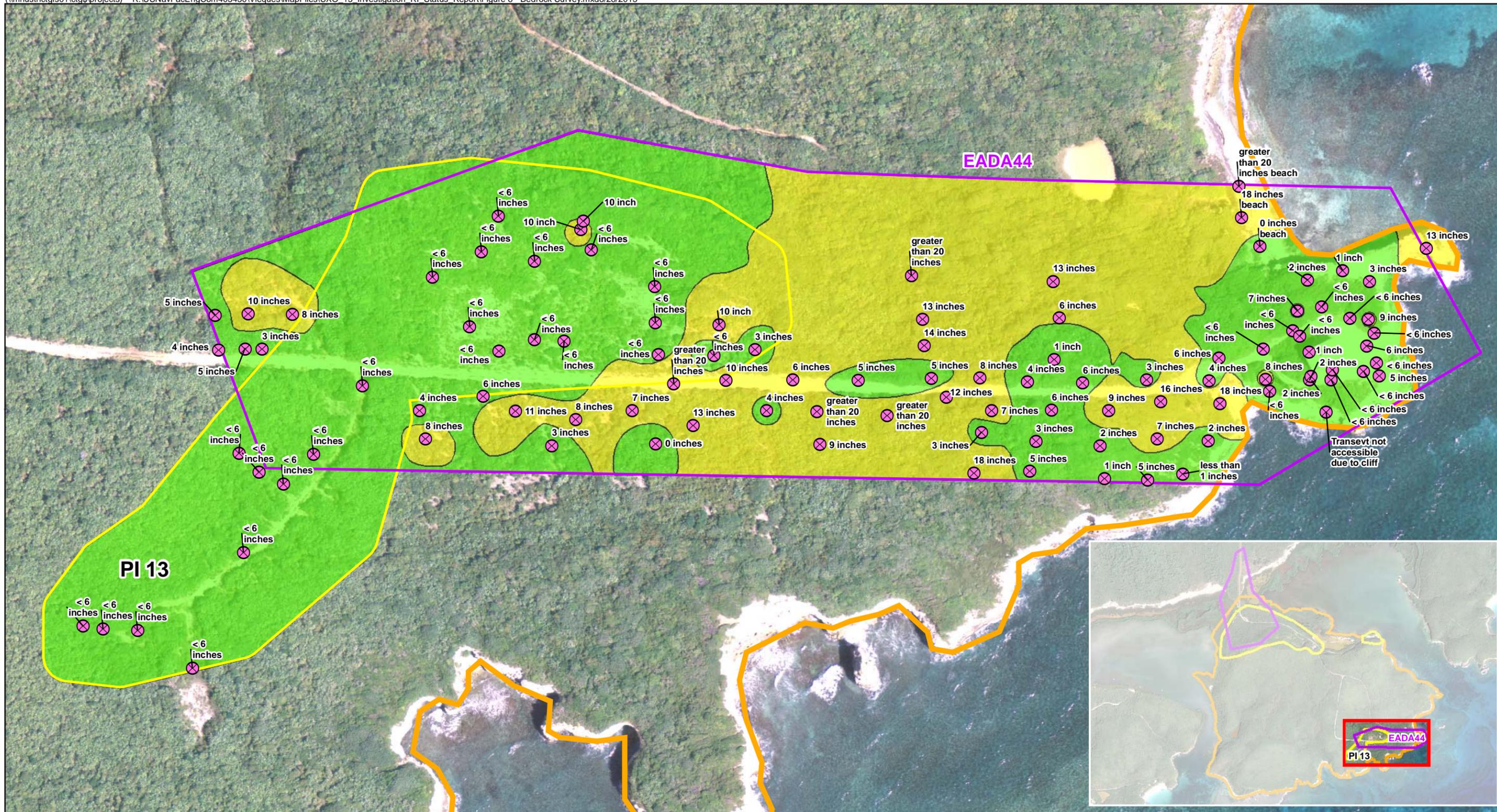


- Legend**
- ▲ Munitions Debris
  - ◆ Material Potentially Presenting an Explosive Hazard
  - Transect
  - PI Site
  - UXO15

Note:  
Number next to item indicates the quantity of Item.

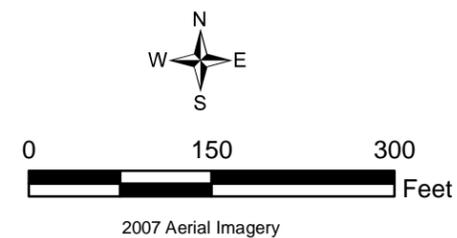


**Figure 7**  
**ERA/SI Munitions Items Removed**  
UXO 15 RI Status Report  
Former Vieques Naval Training Range  
Vieques, Puerto Rico



**Legend**

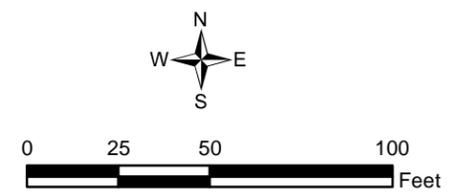
- Survey Point
- Elevated Anomaly Density Area (EADA)
- Soil Depth < 6"
- Soil Depth 6" - 24"
- UXO15
- Photo Identified Site



**Figure 8**  
**Bedrock Survey**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico



- Legend**
- Extent of Munitions Debris
  - PI Site
  - UXO15

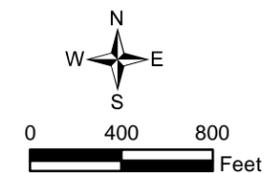


**Figure 9**  
**Extent of Munitions Debris**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico



- Legend**
- RI**
  - MD Item
  - MPPEH Item
  - ERA/SI**
  - ▲ MD Item
  - ▲ MPPEH Item
  - Transect
  - PI Site
  - UXO15

2007 Aerial Imagery



**Figure 10**  
**UXO 15 Transects and Finds**  
 UXO 15 RI Status Report  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

**Attachment 1**

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ATTACHMENT 1

# Photo Log

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PHOTO 1

Tear gas grenade (MK25) classified as DMM (subsequently removed)



PHOTO 2

Surface Debris at PI 9 West



**PHOTO 3**  
**DGM Survey**



**PHOTO 4**  
**Re-acquiring DGM Anomalies for Subsurface Soil Excavation**



PHOTO 5

Subsurface Munitions Debris (8-inch propellant can) dug up and later disposed



**PHOTO 6A**  
**Pre-debris Removal Conditions at Debris Pile A**



**PHOTO 6B**  
**Post-debris Removal Conditions at Debris Pile A**



PHOTO 7A  
Pre-debris Removal Conditions at Debris Pile B



PHOTO 7B  
Post-debris Removal Conditions at Debris Pile B



**PHOTO 8A**  
**Pre-debris Removal Conditions at Debris Pile C**



**PHOTO 8B**  
**Post-debris Removal Conditions at Debris Pile C**



PHOTO 9A  
Pre-debris Removal Conditions at Debris Pile D



PHOTO 9B  
Post-debris Removal Conditions at Debris Pile D



**PHOTO 10A**  
**Debris Found at Debris Pile F**



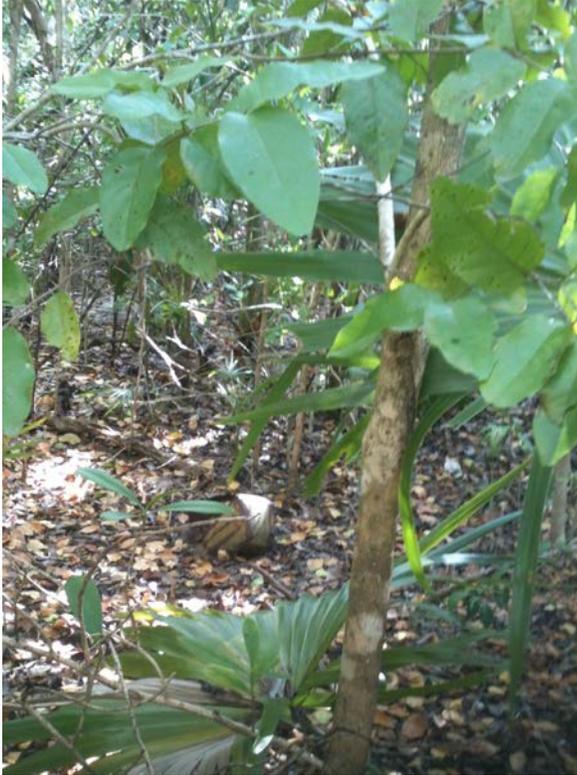
**PHOTO 10B**  
**Debris Removal at Debris Pile F**



PHOTO 10C  
Debris Removal at Debris Pile F



**PHOTO 11**  
**Community Identified Feature – Bullet Box Area**



**PHOTO 12**  
**Community Identified Feature – Northernmost Potential Detonation Pit**



**PHOTO 13**  
**Community Identified Feature – Southernmost Potential Detonation Pit**



PHOTO 14  
Community Identified Feature – “Cave” Formation



**Attachment 2**

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**Weather Conditions:**

Date: 08-28-12

Temperature: 89°F; Barometric Pressure: 30.1

Date: 08-29-12

Temperature: 89°F; Barometric Pressure: 30.0

Date: 08-30-12

Temperature: 88°F; Barometric Pressure: 30.0

Date: 08-31-12

Temperature: 88°F; Barometric Pressure: 30.0

Date: 09-01-12

Temperature: 89°F; Barometric Pressure: 30.0

Date: 09-02-12

Temperature: 90°F; Barometric Pressure: 29.9

Date: 09-03-12

Temperature: 90°F; Barometric Pressure: 30.0

Date: 09-04-12

Temperature: 90°F; Barometric Pressure: 30.0

Date: 09-05-12

Temperature: 90°F; Barometric Pressure: 30.0

Date: 09-06-12

Temperature: 90°F; Barometric Pressure: 30.0

Date: 09-07-12

Temperature: 91°F; Barometric Pressure: 30.1

Date: 09-08-12

Temperature: 90°F; Barometric Pressure: 30.0

Date: 09-09-12

Temperature: 90°F; Barometric Pressure: 30.0

### Survey Control Stations:

The Horizontal values shown in this report are provided in North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM), Zone 20. The Vertical values shown in this report are in PRVD02 Datum current adjustment.

All coordinates shown in meters.

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
1	2003511.890	242088.441	3.413	cp1
2	2003516.778	242041.466	1.385	cp2
3	2003566.322	242018.179	0.856	cp3
13	2003473.118	242358.679	2.918	cp13
101	2003493.119	242082.135	3.391	cp101
102	2003485.255	242138.790	4.136	cp102
103	2003487.373	242283.961	3.291	cp103
104	2003479.528	242341.220	2.992	cp104
105	2003446.347	242425.505	2.404	cp105
106	2003372.310	242542.606	1.733	cp106
107	2003361.400	242562.469	1.668	cp107
108	2003336.496	242611.942	1.710	cp108
109	2003303.336	242654.221	1.918	cp109
130	2003595.549	242019.580	0.813	cp130
131	2003627.173	242018.991	0.651	cp131
132	2003674.569	242017.855	0.561	cp132
133	2003697.675	242017.781	0.544	cp133
171	2003391.260	242005.311	3.658	cp171
180	2003336.811	242003.832	5.813	cp180
185	2003304.169	242002.699	7.509	cp185
189	2003276.851	242006.328	10.279	cp189
196	2003261.955	241993.171	9.223	cp196
205	2003301.358	242030.517	11.744	cp205
208	2003308.482	242044.056	11.861	cp208
209	2003301.113	242061.397	15.099	cp209
211	2003309.089	241985.708	5.057	cp211
219	2003343.491	241985.172	3.721	cp219
227	2003390.730	241983.942	2.746	cp227

229	2003400.612	241981.862	2.401	cp229
231	2003418.220	241984.736	1.850	cp231
233	2003441.790	241984.563	1.580	cp233
238	2003468.487	241986.583	0.742	cp238
241	2003496.219	241986.591	0.696	cp241
244	2003496.233	241968.285	0.122	cp244
252	2003453.514	241966.523	0.696	cp252
257	2003444.417	241945.952	0.427	cp257
260	2003427.001	241945.960	0.652	cp260
263	2003420.939	241928.311	0.381	cp263
273	2003390.386	241931.213	0.556	cp273
280	2003373.007	241928.357	0.487	cp280
301	2003287.943	241930.742	0.792	cp301
304	2003272.804	241926.024	0.694	cp304
323	2003350.526	241948.712	1.193	cp323
327	2003311.955	241948.933	1.805	cp327
328	2003348.903	241969.961	2.665	cp328
334	2003293.854	241945.121	1.684	cp334
339	2003265.916	241946.696	1.925	cp339
344	2003247.780	241948.096	2.741	cp344
352	2003396.432	241968.964	1.835	cp352
356	2003374.154	241967.281	2.295	cp356
360	2003348.902	241969.990	2.656	cp360
382	2003407.404	242024.667	3.366	cp382
391	2003499.967	242022.826	1.848	cp391
406	2003484.403	242042.389	2.858	cp406
407	2003499.495	242063.159	2.392	cp407
415	2003444.566	242042.964	3.825	cp415
422	2003407.338	242043.743	4.424	cp422
428	2003365.912	242043.316	6.413	cp428
443	2003325.446	242066.287	11.711	cp443
448	2003336.877	242064.169	10.901	cp448
459	2003475.801	242061.950	3.638	cp459
463	2003442.818	242063.487	4.411	cp463
478	2003543.289	242081.641	2.015	cp478
487	2003407.968	242082.121	6.976	cp487
491	2003380.949	242083.597	9.202	cp491
495	2003354.689	242081.163	11.384	cp495
499	2003333.236	242082.374	12.565	cp499
508	2003321.601	242103.861	17.734	cp508

514	2003336.909	242121.285	17.121	cp514
517	2003351.527	242099.954	12.171	cp517
522	2003401.222	242100.292	8.567	cp522
525	2003428.740	242100.429	6.337	cp525
528	2003462.779	242100.608	5.553	cp528
531	2003486.464	242121.269	4.258	cp531
539	2003414.599	242118.502	8.190	cp539
550	2003342.976	242121.318	16.087	cp550
551	2003378.973	242138.975	10.294	cp551
560	2003358.409	242139.149	15.286	cp560
561	2003423.485	242137.907	8.217	cp561
566	2003443.361	242156.749	7.939	cp566
573	2003398.914	242158.042	9.210	cp573
580	2003392.014	242176.028	12.929	cp580
600	2003433.294	242251.614	8.570	cp600
603	2003447.357	242255.468	6.554	cp603
607	2003451.799	242274.879	6.023	cp607
608	2003459.142	242393.770	2.715	cp608
612	2003442.699	242392.288	3.481	cp612
619	2003426.779	242405.510	4.665	cp619
637	2003457.342	242329.759	4.354	cp637
643	2003458.456	242310.912	4.809	cp643
657	2003426.426	242422.509	2.964	cp657
663	2003425.847	242428.229	2.934	cp663
683	2003630.834	242042.783	0.200	cp683
690	2003589.721	242082.671	1.083	cp690
693	2003526.692	242100.559	3.475	cp693
701	2003524.055	242120.451	3.838	cp701
706	2003598.153	242103.322	0.850	cp706
712	2003544.874	242121.126	2.650	cp712
716	2003520.406	242139.104	3.996	cp716
721	2003563.485	242123.279	1.948	cp721
733	2003549.814	242145.361	2.414	cp733
739	2003570.037	242138.709	1.441	cp739
754	2003540.488	242157.896	3.458	cp754
764	2003525.481	242178.271	3.905	cp764
775	2003592.005	242179.285	1.190	cp775
782	2003510.044	242186.013	3.860	cp782
783	2003522.499	242200.133	3.814	cp783
784	2003525.620	242203.530	3.138	cp784

790	2003542.165	242197.726	3.208	cp790
791	2003522.791	242212.149	3.690	cp791
795	2003566.259	242197.335	1.682	cp795
805	2003552.659	242216.090	1.740	cp805
818	2003545.334	242238.997	1.816	cp818
831	2003520.037	242275.141	2.527	cp831
832	2003543.319	242259.338	1.394	cp832
842	2003530.465	242291.909	1.688	cp842
860	2003473.119	242358.678	2.918	cp860
866	2003507.286	242349.132	1.676	cp866
873	2003502.850	242388.857	0.255	cp873
884	2003542.272	242337.654	0.142	cp884
899	2003518.437	242313.841	1.949	cp899

Control Points 1, 2 and 3 were established with a Pro Mark 3 Base Rover GPS System referencing base station NGS Esperanza, Vieques Island Puerto Rico with the following UTM Zone 20 coordinates, Northing: 2002321.353, Easting: 238448.311. The rest of the control was tied to Grid using the permanent control points 1, 2 and 3 previously established. Leica TCR 407 total station was then used to stake out each point. Raw survey data collected in UTM Zone 20 Coordinates NAD83/PRVD02. The following checks were made throughout the survey.

435	2003308.448	242043.968	11.910	PT 208 CHECK
346	2003239.492	241948.592	3.616	PT 308 CHECK
473	2003388.706	242064.082	7.041	PT 452 CHECK
549	2003336.863	242121.305	17.118	PT 514 CHECK
613	2003483.419	242402.307	0.597	PT 613 CHECK
900	2003517.009	242299.863	2.392	PT 851 CHECK

Upon review of field control data, the accuracies obtained on horizontal control work complied with Second Order Class II (1:20,000) or better, as outlined in the FGDC Geospatial Positioning Accuracy Standards. The accuracies obtained on vertical control work complied with the Second Order Class II (0.35 VM [M in miles]) or better, as outlined in the FGDC Geospatial Positioning Accuracy Standards.

**Surface Metal Locations:**

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
157	2003544.087	242010.899	0.706	sm
164	2003485.897	242004.714	1.274	sm
204	2003294.36	242019.561	11.224	sm
389	2003485.151	242022.947	1.852	sm
395	2003504.077	242023.416	1.658	sm
398	2003536.876	242023.335	1.011	sm
400	2003539.282	242022.799	1.132	sm
408	2003493.886	242042.475	2.485	sm
409	2003493.457	242042.803	2.478	sm
410	2003492.902	242043.2	2.474	sm
411	2003488.001	242042.401	2.645	sm
418	2003445.592	242044.439	3.682	sm
446	2003338.147	242064.672	10.541	sm
455	2003491.645	242064.739	2.89	sm
461	2003468.185	242062.939	3.752	sm
468	2003425.469	242061.436	4.592	sm
470	2003425.512	242061.384	4.602	sm
498	2003339.898	242084.553	12.401	sm
501	2003329.984	242081.39	12.505	sm
535	2003481.053	242121.306	4.56	sm
568	2003438.631	242158.407	7.913	sm
582	2003407.255	242176.426	9.373	sm

**Transect Layout:**

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
308	2003239.48	241948.573	3.616	30-01/1-01
306	2003235.604	241931.489	1.846	29-06/1-02cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
290	2003331.235	241925.817	1.157	29-17/2-01cp
292	2003329.462	241922.376	1.944	2-02
293	2003329.505	241919.363	0.852	2-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
286	2003348.001	241927.817	1.701	29-21/3-01cp
291	2003350.067	241920.752	0.24	3-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
284	2003359.37	241928.549	2.306	29-23/4-01cp
287	2003358.389	241922.72	0.446	4-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
281	2003373.92	241928.935	0.816	29-25/5-01
282	2003370.676	241919.155	0.48	5-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
277	2003385.101	241927.201	0.857	29-27/6-01cp
278	2003389.57	241922.157	0.548	6-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
269	2003407.65	241931.779	0.826	29-32/7-01cp
274	2003405.197	241928.454	0.822	7-02
275	2003406.517	241923.969	0.81	7-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
248	2003476.651	241965.559	0.705	31-26/8-01cp
253	2003468.122	241960.515	0.583	8-02
254	2003464.323	241959.433	0.562	8-03
255	2003461.528	241956.254	0.629	8-04
256	2003455.331	241953.032	0.716	8-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
207	2003307.167	242042.293	12.202	37-02/8A-01
206	2003298.151	242028.37	12.101	8A-02
203	2003293.219	242026.007	12.085	8A-03
194	2003289.64	242020.177	11.591	35-01/8A-04cp
193	2003280.715	242013.935	11.063	8A-05
192	2003278.924	242008.839	10.742	8A-06

191	2003276.016	242005.181	10.436	33-01/8A-07
195	2003263.222	241995.24	9.666	8A-08
197	2003258.461	241988.181	9.026	8A-09/32-01

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
548	2003338.24	242121.276	17.131	45-01/9-01
513	2003335.562	242120.303	17.499	9-02
512	2003333.238	242116.709	17.065	9-03
511	2003325.433	242109.261	18.036	9-04
510	2003323.239	242106.975	17.989	9-05
509	2003321.572	242102.809	17.732	43-01/9-06
507	2003318.115	242098.399	17.71	9-07
442	2003312.315	242093.577	18.673	9-08
440	2003307.481	242086.526	18.519	9-09
439	2003306.818	242080.145	17.431	41-01/9-10
438	2003301.157	242067.875	16.186	9-11
437	2003302.683	242063.553	15.122	9-12
436	2003301.888	242061.903	15.186	39-01/9-13
434	2003300.121	242043.436	14.514	37-01/9-14

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
599	2003427.29	242252.553	11.954	10-01cp
595	2003420.253	242243.3	12.839	10-02cp
594	2003417.274	242237.141	13.394	10-03
593	2003417.172	242234.577	12.967	57-01/10-04cp
592	2003412.133	242224.127	13.168	10-05
589	2003410.206	242215.932	12.917	55-01/10-06cp
586	2003404.996	242212.135	13.786	10-07cp
585	2003399.572	242201.863	13.98	10-08
584	2003398.801	242196.736	13.763	10-09/53-01cp
579	2003393.352	242177.607	13.262	51-01/10-10
578	2003385.912	242169.713	13.475	10-11
577	2003377.482	242158.44	13.439	49-01/10-12cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
646	2003449.789	242292.77	5.948	63-03/11-01cp
606	2003451.805	242274.875	6.024	11-02
605	2003449.977	242271.359	6.192	61-02/11-03cp
604	2003450.929	242268.812	6.123	11-04
602	2003447.357	242255.468	6.552	59-02/11-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
664	2003420.24	242444.305	2.943	12-01
661	2003426.006	242427.454	3.214	77-04/12-02
658	2003423.276	242426.151	3.477	77-03/12-03
656	2003430.905	242416.056	3.258	12-04
655	2003434.055	242413.736	3.204	12-05
618	2003439.035	242407.447	3.22	12-06/75-04
617	2003441.382	242406.071	3.224	12-07
616	2003443.226	242395.345	3.501	12-08
610	2003442.667	242391.94	3.648	73-04/12-09
620	2003444.321	242387.095	3.728	12-10
621	2003447.049	242384.934	3.735	12-11
622	2003449.222	242370.373	4.2	71-04/12-12cp
623	2003449.905	242366.325	4.211	12-13
628	2003453.502	242360.929	4.134	12-14
624	2003453.999	242356.972	4.246	12-15cp
629	2003454.455	242347.753	4.392	12-16/69-02
631	2003456.334	242345.575	4.355	12-17
632	2003457.275	242338.372	4.487	12-18
633	2003455.902	242331.378	4.636	12-19/67-06
640	2003457.762	242328.993	4.657	12-20
641	2003456.163	242325.451	4.78	12-21
642	2003455.303	242318.034	5.142	12-22/65-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
763	2003525.065	242177.749	4.232	13-01/46-02
750	2003523.769	242169.78	4.261	13-02
749	2003519.138	242160.118	4.295	13-03
736	2003515.462	242158.529	4.297	13-04cp
735	2003516.865	242150.42	4.299	13-05
734	2003515.324	242147.716	4.392	13-06

715	2003522.98	242136.474	4.308	13-07/44-01
714	2003521.214	242133.146	4.233	13-08
713	2003523.224	242128.709	4.187	13-09
902	2003524.024	242119.518	4.133	13-10/42-01
700	2003522.988	242112.889	3.984	13-11
699	2003525.914	242105.586	3.926	13-12
694	2003526.785	242099.829	3.721	40-01/13-13

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
819	2003509.462	242255.207	3.753	52-02/14-01cp
814	2003510.377	242250.2	3.728	14-02
813	2003512.196	242245.775	3.762	14-03
809	2003513.775	242233.95	3.787	50-01/14-04cp
808	2003518.073	242226.685	3.819	14-05
807	2003519.474	242222.135	3.868	14-06
788	2003522.454	242216.581	3.961	48-02/14-07
786	2003522.138	242215.154	4.035	14-08/48-03
785	2003524.14	242205.29	3.757	14-09

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
888	2003516.207	242328.795	1.572	60-02/15-01cp
892	2003518.452	242313.849	1.951	15-02/58-03
895	2003519.674	242309.702	2.116	15-03
896	2003520.9	242307.917	1.864	15-04
897	2003518.529	242304.953	2.181	15-05
898	2003518.07	242301.738	2.171	15-06
851	2003516.931	242299.833	2.44	15-07cp
850	2003518.398	242294.137	2.482	56-02/15-08
841	2003523.15	242281.416	2.32	15-09
840	2003522.109	242277.524	2.605	15-10
829	2003519.564	242274.05	2.883	15-11/54-04
828	2003518.625	242268.939	2.886	15-12
827	2003520.021	242263.294	2.801	15-13
826	2003518.54	242254.29	2.635	52-04/15-14cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
881	2003490.081	242405.861	0.293	68-02/16-01
879	2003496.673	242398.933	0.518	16-02
878	2003499.066	242394.051	0.788	16-03
877	2003502.011	242392.13	0.611	16-04
875	2003500.371	242388.914	0.606	16-05/66-01
874	2003500.161	242385.42	0.751	16-06
869	2003501.351	242382.555	0.894	16-07
867	2003498.749	242370.809	1.591	16-08/64-01
861	2003497.47	242365.391	2.044	16-09cp
862	2003499.656	242359.128	2.142	16-10
863	2003503.562	242355.532	2.059	16-11
864	2003504.873	242352.645	2.126	16-12

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
142	2003579.41	242014.555	0.65	21-01
143	2003579.43	242010.495	0.289	21-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
144	2003599.988	242013.567	0.32	22-01
145	2003598.913	242009.452	0.194	22-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
146	2003615.393	242012.826	0.216	23-01
147	2003615.915	242007.268	0.01	23-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
148	2003634.661	242011.54	0.253	24-01
149	2003633.704	242007.784	0.118	24-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
150	2003657.092	242010.526	0.397	25-01
151	2003656.871	242004.625	0.264	25-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
152	2003676.14	242010.463	0.55	26-01
153	2003675.597	242005.573	0.461	26-02
154	2003677.063	242002.195	0.594	26-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
155	2003697.996	242009.341	0.794	27-01
156	2003698.046	242001.972	0.431	27-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
312	2003191.341	241908.402	1.641	29-01/28-01cp
313	2003196.813	241908.414	1.504	28-02
314	2003200.377	241908.875	1.328	28-03
315	2003203.713	241908.252	1.225	28-04
316	2003209.798	241909.894	1.352	28-05
317	2003220.73	241909.125	0.8	28-06
318	2003232.042	241910.913	0.706	28-07

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
312	2003191.341	241908.402	1.641	29-01/28-01cp
311	2003197.495	241913.804	1.805	29-02
310	2003211.556	241930.795	3.29	29-03cp
309	2003219.852	241929.996	3.095	29-04cp
307	2003225.884	241932.134	2.329	29-05
306	2003235.604	241931.489	1.846	29-06/1-02cp
305	2003256.366	241927.693	1.196	29-07
303	2003276.768	241926.176	1.043	29-08
302	2003281.107	241928.837	1.125	29-09
300	2003288.782	241930.828	1.108	29-10
299	2003293.573	241930.821	1.092	29-11
298	2003299.009	241929.345	1.141	29-12
297	2003302.093	241927.4	1.031	29-13
296	2003307.118	241929.758	1.081	29-14cp
295	2003320.032	241927.112	1.084	29-15
294	2003324.454	241928.262	1.144	29-16
290	2003331.235	241925.817	1.157	29-17/2-01cp
904	2003334.334	241924.889	2.642	29-18

289	2003341.42	241928.163	0.982	29-19
288	2003343.778	241926.983	1.24	29-20
286	2003348.001	241927.817	1.701	29-21/3-01cp
285	2003354.111	241928.618	2.069	29-22
284	2003359.37	241928.549	2.306	29-23/4-01cp
283	2003367.287	241928.227	1.043	29-24
281	2003373.92	241928.935	0.816	29-25/5-01
279	2003382.096	241926.663	0.755	29-26
277	2003385.101	241927.201	0.857	29-27/6-01cp
276	2003391.692	241933.161	0.937	29-28
272	2003397.997	241931.175	0.861	29-29
271	2003402.005	241933.497	0.846	29-30
270	2003405.08	241931.66	0.789	29-31
269	2003407.65	241931.779	0.826	29-32/7-01cp
268	2003412	241931.912	0.849	29-33
267	2003414.844	241929.368	0.764	29-34
266	2003419.831	241929.148	0.683	29-35
265	2003426.432	241930.54	0.502	29-36
264	2003428.513	241934.043	0.591	29-37
262	2003434.424	241936.82	0.488	29-38
261	2003437.193	241941.199	0.456	29-39

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
308	2003239.48	241948.573	3.616	30-01/1-01
345	2003244.42	241947.361	3.2	30-02
343	2003253.225	241948.78	2.99	30-03
342	2003259.27	241947.727	2.706	30-04
341	2003263.774	241946.006	2.162	30-05
340	2003268.64	241946.347	3.001	30-06
338	2003273.671	241947.03	1.84	30-07
337	2003280.764	241946.326	3.106	30-08
336	2003284.493	241948.368	2.171	30-09
335	2003288.811	241946.616	2.922	30-10
333	2003295.294	241944.441	1.515	30-11
332	2003299.145	241946.221	1.632	30-12
331	2003305.198	241945.833	2.224	30-13
330	2003310.096	241949.036	2.133	30-14
329	2003325.794	241948.452	1.794	30-15
326	2003331.312	241950.057	2.646	30-16

325	2003348.673	241947.999	1.502	30-17
324	2003353.649	241949.921	1.571	30-18
322	2003361.461	241947.019	1.428	30-19
321	2003370.082	241945.331	1.342	30-20
320	2003380.26	241948.372	1.393	30-21
12	2003384.524	241947.003	1.275	30-22cp
11	2003390.391	241947.61	1.331	30-23
10	2003394.53	241946.172	1.223	30-24
9	2003403.833	241946.636	1.067	30-25
8	2003415.289	241946.944	1.064	30-26
7	2003421.89	241945.649	0.988	30-27
6	2003429.326	241946.346	0.973	30-28
259	2003437.401	241942.917	0.645	30-29
258	2003446.591	241946.717	0.899	30-30

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
373	2003252.881	241960.126	4.201	31-01
372	2003257.401	241963.253	4.289	31-02cp
371	2003265.262	241965.737	5.332	31-03
370	2003278.125	241967.602	5.185	31-04cp
369	2003285.569	241973.253	5.677	31-05cp
368	2003291.241	241972.25	5.075	31-06
367	2003296.901	241967.82	4.481	31-07cp
365	2003305.067	241970.013	4.647	31-08
364	2003311.96	241970.011	4.376	31-09
363	2003323.893	241970.169	3.649	31-10
362	2003338.516	241969.3	3.098	31-11
361	2003347.503	241970.225	2.937	31-12
359	2003357.146	241968.675	2.768	31-13
358	2003363.21	241969.228	2.75	31-14
357	2003366.133	241968.255	2.658	31-15
355	2003379.605	241967.245	2.469	31-16
354	2003390.114	241967.378	2.145	31-17
353	2003392.493	241968.857	2.2	31-18
351	2003399.793	241969.315	2.077	31-19
350	2003422.256	241967.812	1.569	31-20
349	2003440.065	241968.217	1.353	31-21
348	2003452.129	241966.17	0.951	31-22
347	2003456.653	241967.88	0.974	31-23

251	2003460.503	241966.401	0.918	31-24
250	2003466.493	241968.122	0.864	31-25
248	2003476.651	241965.559	0.705	31-26/8-01cp
249	2003495.239	241968.55	0.428	31-27
247	2003505.448	241969.099	0.711	31-28

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
197	2003258.461	241988.181	9.026	8A-09/32-01
198	2003264.668	241982.606	7.039	32-02
199	2003273.55	241981.614	7.095	32-03
200	2003278.615	241982.347	6.631	32-04
220	2003281.149	241985.1	6.946	32-05
213	2003284.254	241985.864	6.714	32-06cp
214	2003297.547	241986.121	6.036	32-07
215	2003305.933	241984.724	5.349	32-08
216	2003316.148	241986.199	5.304	32-09
217	2003320.192	241984.714	5.016	32-10
218	2003324.643	241986.026	5.228	32-11
221	2003328.932	241983.074	4.447	32-12
222	2003347.985	241985.745	3.93	32-13
223	2003363.7	241984.932	3.707	32-14
224	2003366.458	241985.779	3.434	32-15
225	2003368.944	241984.346	3.325	32-16
226	2003383.821	241984.731	3.165	32-17
228	2003399.755	241981.479	2.54	32-18
230	2003411.233	241985.353	2.425	32-19
232	2003432.934	241984.434	1.866	32-20
234	2003446.225	241985.166	1.663	32-21
235	2003448.427	241986.705	1.617	32-22
236	2003454.674	241987.631	1.466	32-23
237	2003457.533	241985.608	1.329	32-24
239	2003462.695	241985.368	1.279	32-25
240	2003488.353	241987.109	1.008	32-26
242	2003504.85	241984.745	0.854	32-27
245	2003520.724	241985.847	0.609	32-29
246	2003527.682	241985.486	0.341	32-30

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
191	2003276.016	242005.181	10.436	33-01/8A-07
190	2003279.753	242003.703	9.785	33-02
188	2003293.829	242005.228	9.134	33-03
184	2003303.554	242002.475	7.644	33-04
187	2003308.623	242003.319	7.638	33-05
186	2003314.971	242002.817	6.948	33-06
183	2003321.483	242004.573	7.033	33-07
182	2003325.88	242003.801	6.676	33-08
181	2003334.294	242003.07	6.173	33-09
179	2003342.695	242005.412	5.92	33-10
178	2003350.868	242005.743	5.409	33-11
177	2003357.711	242008.211	5.747	33-12
176	2003367.647	242009.796	4.767	33-13-cp
175	2003374.193	242007.353	4.605	33-14
174	2003387.975	242006.959	3.959	33-15
173	2003403.164	242004.662	3.287	33-16
172	2003413.388	242006.337	2.988	33-17
170	2003418.283	242005.376	2.809	33-18
169	2003434.417	242005.129	2.271	33-19
168	2003457.708	242005.624	1.853	33-20-cp
167	2003471.654	242004.644	1.558	33-21
166	2003477.021	242003.021	1.638	33-22-cp
165	2003482.388	242004.745	2.587	33-23
163	2003492.742	242006.444	1.554	33-24-cp
162	2003498.001	242004.599	1.437	33-25
161	2003512.5	242004.312	1.078	33-26-cp
160	2003516.486	242006.356	1.023	33-27
159	2003531.619	242008.399	0.919	33-28
158	2003536.398	242010.684	0.991	33-29
135	2003549.42	242012.655	0.893	33-30cp
134	2003556.277	242016.548	0.888	33-31

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
136	2003563.841	242024.805	1.214	34-01
137	2003588.779	242024.738	0.818	34-02
138	2003613.795	242023.833	0.778	34-03
139	2003638.873	242023.184	0.72	34-04
140	2003662.817	242024.103	0.198	34-05

141	2003669.768	242024.006	0.19	34-06
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Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
194	2003289.64	242020.177	11.591	35-01/8A-04cp
201	2003301.108	242016.308	9.378	35-02
202	2003307.343	242017.256	9.231	35-03
374	2003317.135	242023.025	9.277	35-04
210	2003327.13	242019.696	8.416	35-05cp
375	2003337.386	242021.606	8.066	35-06
377	2003343.218	242025.601	7.382	35-07
376	2003345.125	242023.393	6.957	35-08
378	2003364.484	242022.223	5.443	35-09
379	2003386.198	242022.442	4.422	35-10cp
380	2003393.028	242024.579	4.41	35-11
381	2003405.106	242026.259	3.783	35-12
383	2003420.328	242022.898	3.482	35-13
385	2003435.085	242023.694	3.132	35-14
384	2003443.925	242022.71	2.786	35-15cp
386	2003450.828	242024.053	2.719	35-16
387	2003461.611	242023.475	3.45	35-17
388	2003468.204	242022.946	2.572	35-18
390	2003489.369	242023.611	2.185	35-19
392	2003495.56	242021.988	2.057	35-20
393	2003499.144	242023.333	2.054	35-21
394	2003504.148	242022.106	1.88	35-22
396	2003509.779	242023.448	1.734	35-23
397	2003527.764	242023.962	1.356	35-24
399	2003538.413	242022.014	1.233	35-25

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
474	2003530.43	242037.797	1.303	36-01cp
669	2003536.067	242039.357	1.22	36-02
670	2003538.796	242041.974	1.399	36-03
671	2003545.889	242042.794	1.366	36-04
672	2003553.169	242044.404	1.182	36-05cp
673	2003562.683	242043.174	1.018	36-06
674	2003568.522	242044.259	1.082	36-07
675	2003576.377	242042.717	1.068	36-08

676	2003583.894	242043.087	1.62	36-09
677	2003593.488	242043.058	0.9	36-10
678	2003601.142	242042.565	0.815	36-11cp
679	2003607.857	242044.773	0.829	36-12
680	2003613.022	242042.371	0.769	36-13
681	2003620.754	242043.196	0.623	36-14
682	2003626.945	242042.205	0.514	36-15
684	2003649.628	242045.422	0.591	36-16

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
434	2003300.121	242043.436	14.514	37-01/9-14
207	2003307.167	242042.293	12.202	37-02/8A-01
433	2003317.694	242045.791	10.631	37-03cp
432	2003328.372	242045.177	10.096	37-04
431	2003346.48	242043.464	8.073	37-05
430	2003352.3	242044.97	7.653	37-06
429	2003363.132	242044.075	6.858	37-07
427	2003372.095	242041.665	6.13	37-08
426	2003377.212	242043.314	6.046	37-09
425	2003390.225	242043.074	5.472	37-10
424	2003398.749	242043.438	4.531	37-11
423	2003408.102	242044.141	4.589	37-12
421	2003417.009	242045.723	4.311	37-13
420	2003422.343	242044.557	4.228	37-14
419	2003438.878	242043.668	4.894	37-15
417	2003444.399	242043.752	4.048	37-16
416	2003450.196	242042.733	3.735	37-17
414	2003464.42	242042.119	3.227	37-18
413	2003470.268	242043.706	3.271	37-19
412	2003477.982	242043.423	3.176	37-20
405	2003489.261	242041.686	2.784	37-21
404	2003494.543	242042.714	2.799	37-22
403	2003499.419	242040.968	2.598	37-23
402	2003503.081	242042.293	2.548	37-24
401	2003510.577	242041.671	1.85	37-25

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
475	2003497.576	242081.406	3.561	38-01
476	2003517.958	242080.235	3.175	38-02
477	2003538.093	242081.076	2.662	38-03
908	2003542.744	242082.254	N/A	38-04
685	2003554.512	242079.709	1.922	38-05
687	2003563.148	242081.379	1.66	38-06
686	2003571.22	242079.161	1.376	38-07cp
688	2003585.934	242080.52	1.111	38-08
689	2003589.719	242082.673	1.081	38-09
691	2003605.846	242080.904	0.967	38-10
692	2003622.57	242080.614	0.622	38-11

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
436	2003301.888	242061.903	15.186	39-01/9-13
441	2003318.564	242066.155	12.207	39-02
444	2003330.83	242065.688	11.878	39-03
445	2003336.881	242064.17	10.902	39-04
447	2003342.439	242065.405	10.95	39-05
449	2003348.972	242068.368	9.701	39-06
450	2003364.308	242069.385	8.985	39-07cp
451	2003375.342	242062.021	7.541	39-08
452	2003388.743	242064.085	6.994	39-09cp
472	2003405.441	242062.27	6.876	39-10
471	2003413.081	242062.501	5.679	39-11
469	2003419.287	242060.365	5.319	39-12cp
467	2003435.127	242064.351	4.951	39-13
466	2003439.611	242062.753	4.884	39-14
465	2003445.291	242062.614	4.525	39-15
464	2003448.728	242061.383	4.407	39-16
462	2003457.962	242063.679	4.212	39-17
460	2003471.42	242063.099	3.968	39-18
458	2003480.434	242061.945	3.677	39-19
457	2003485.823	242062.957	3.557	39-20
456	2003488.643	242064.72	3.121	39-21
454	2003493.646	242064.21	2.677	39-22

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
694	2003526.785	242099.829	3.721	40-01/13-13
695	2003539.295	242101.289	3.026	40-02
696	2003555.271	242101.696	2.173	40-03
697	2003561.8	242101.247	1.854	40-04
698	2003571.145	242101.951	1.504	40-05cp
702	2003574.767	242102.934	1.475	40-06
703	2003586.954	242102.983	1.945	40-07
704	2003595.511	242103.054	1.078	40-08
705	2003600.128	242102.94	1.014	40-09
707	2003603.281	242100.475	0.868	40-10
708	2003611.687	242100.187	0.626	40-11
709	2003620.94	242102.124	0.78	40-12

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
439	2003306.818	242080.145	17.431	41-01/9-10
503	2003320.471	242082.689	14.345	41-02
502	2003324.366	242081.057	13.723	41-03
500	2003333.391	242080.871	12.54	41-04
497	2003339.785	242083.517	12.436	41-05
496	2003352.083	242082.028	11.746	41-06
453	2003360.424	242079.712	11.847	41-07
493	2003366.657	242082.347	10.321	41-08
492	2003375.403	242081.141	9.684	41-09
490	2003391.698	242084.698	8.97	41-10
489	2003399.079	242082.269	8.08	41-11
488	2003410.85	242081.076	6.949	41-12
486	2003430.573	242084.225	6.088	41-13
485	2003447.273	242083.255	5.377	41-14
484	2003451.202	242084.383	5.195	41-15
483	2003458.512	242083.529	4.839	41-16cp
482	2003466.243	242084.58	4.323	41-17
481	2003478.969	242083.05	4.127	41-18
480	2003483.311	242084.372	4.535	41-19
479	2003487.75	242082.9	4.236	41-20

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
902	2003524.024	242119.518	4.133	13-10/42-01
710	2003533.768	242121.795	3.854	42-02
711	2003538.441	242120.294	3.498	42-03
718	2003550.56	242123.219	2.819	42-04
719	2003555.217	242122.509	2.381	42-05
720	2003563.486	242123.277	1.945	42-06
722	2003569.124	242122.485	1.796	42-07
723	2003572.808	242123.169	1.665	42-08
724	2003577.688	242121.622	1.577	42-09
727	2003596.176	242121.699	1.224	42-10
725	2003599.554	242121.044	1.044	42-11cp
726	2003602.276	242122.517	0.928	42-12
728	2003607.323	242122.525	0.815	42-13
729	2003609.915	242122.01	0.745	42-14
730	2003612.292	242123.427	0.618	42-15

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
509	2003321.572	242102.809	17.732	43-01/9-06
515	2003332.853	242101.851	14.992	43-02
516	2003339.263	242099.88	13.746	43-03
519	2003359.864	242099.388	11.358	43-04
518	2003362.167	242100.541	11.34	43-05
520	2003366.167	242099.014	11.014	43-06
521	2003384.834	242098.89	10.197	43-07
523	2003404.928	242101.363	7.173	43-08
524	2003425.389	242101.011	6.865	43-09
526	2003444.446	242099.712	5.72	43-10
527	2003462.779	242100.606	5.554	43-11
529	2003473.835	242104.774	6.109	43-12
530	2003486.406	242100.535	4.502	43-13

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
715	2003522.98	242136.474	4.308	13-07/44-01
731	2003528.192	242140.689	5.672	44-02
732	2003543.167	242143.516	3.635	44-03
737	2003548.216	242145.86	3.138	44-04
738	2003561.241	242140.386	2.144	44-05

740	2003575.91	242139.512	1.659	44-06
741	2003579.505	242141.056	1.657	44-07
742	2003583.942	242140.536	1.64	44-08
743	2003593.712	242144.203	1.533	44-09cp
744	2003607.539	242140.312	0.816	44-10

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
548	2003338	242121.3	17.131	45-01/9-01
547	2003357	242120.7	14.247	45-02
546	2003370	242119.8	12.847	45-03
544	2003376	242119.9	12.017	45-04cp
545	2003389	242118.1	10.449	45-05
543	2003400	242120.9	9.091	45-06
542	2003412	242118	8.553	45-07
541	2003420	242120.3	8.43	45-08
540	2003432	242120.2	8.106	45-09
538	2003436	242118.8	6.592	45-10
537	2003456	242119.4	6.811	45-11
536	2003474	242120.7	4.826	45-12
534	2003484	242121.6	4.642	45-13

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
765	2003508.985	242178.327	4.169	46-01
763	2003525.065	242177.749	4.232	13-01/46-02
766	2003532.123	242178.684	4.164	46-03
767	2003539.782	242177.523	3.995	46-04
768	2003549.868	242177.342	2.5	46-05
769	2003559.326	242177.833	2.178	46-06
770	2003568.895	242177.876	1.83	46-07
771	2003573.6	242177.693	1.75	46-08cp
772	2003579.495	242179.18	1.658	46-09
773	2003585.953	242178.025	1.688	46-10
774	2003592.022	242179.263	1.19	46-11
776	2003597.138	242177.795	1.097	46-12
777	2003601.401	242178.214	0.977	46-13
778	2003608.456	242177.352	0.719	46-14

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
562	2003350.952	242135.114	16.209	47-01
552	2003358.407	242139.153	15.286	47-02
553	2003365.613	242139.934	13.884	47-03
554	2003382.616	242138.055	10.173	47-04
555	2003386.896	242139.664	9.828	47-05
556	2003398.122	242139.376	9.399	47-06
557	2003400.953	242140.304	9.381	47-07
558	2003415.975	242137.185	8.559	47-08
559	2003420.646	242137.833	8.437	47-09
563	2003440.156	242136.779	8.165	47-10cp
564	2003447.58	242142.072	8.082	47-11
567	2003454.651	242143.084	7.386	47-12
533	2003470.768	242138.431	5.203	47-13cp
532	2003481.233	242139.756	4.602	47-14

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
806	2003517.967	242217.039	3.95	48-01
788	2003522.454	242216.581	3.961	48-02/14-07
786	2003522.138	242215.154	4.035	14-08/48-03
798	2003527.344	242216.317	3.948	48-04
799	2003530.741	242213.745	3.801	48-05
800	2003536.269	242213.566	3.704	48-06
801	2003540.479	242215.094	3.457	48-07
802	2003542.81	242215.103	3.333	48-08
803	2003547.801	242216.014	2.334	48-09
810	2003550.603	242214.515	2.063	48-10
804	2003555.647	242216.383	1.904	48-11
797	2003566.857	242213.924	1.468	48-12
811	2003573.059	242214.746	1.446	48-13
812	2003580.481	242215.248	1.153	48-14

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
577	2003377.482	242158.44	13.439	49-01/10-12cp
576	2003392.331	242158.528	10.017	49-02
575	2003396.234	242157.034	9.683	49-03
574	2003405.25	242159.481	9.413	49-04
572	2003409.934	242157.536	9.549	49-05

571	2003424.44	242158.518	8.58	49-06
570	2003433.697	242156.754	8.315	49-07
569	2003435.933	242157.635	8.259	49-08
565	2003443.444	242157.113	8.246	49-09

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
809	2003513.775	242233.95	3.787	50-01/14-04cp
815	2003524.495	242234.523	3.873	50-02
816	2003530.042	242237.613	3.39	50-03
817	2003546.596	242239.043	2.027	50-04
820	2003557.401	242237.55	1.614	50-05
821	2003572.215	242237.131	1.398	50-06
822	2003586.297	242233.512	1.061	50-07

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
579	2003393.352	242177.607	13.262	51-01/10-10
581	2003405.2	242176.658	9.88	51-02
583	2003419.656	242179.392	8.954	51-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
824	2003506.748	242254.513	3.75	52-01
819	2003509.462	242255.207	3.753	52-02/14-01cp
825	2003511.873	242253.971	3.647	52-03
826	2003518.54	242254.29	2.635	52-04/15-14cp
830	2003532.983	242259.06	2.387	52-05
901	2003544.807	242259.15	1.658	52-06
823	2003556.501	242252.719	1.503	52-07
834	2003566.348	242252.095	2.297	52-08
835	2003572.418	242254.053	1.354	52-09
836	2003584.993	242254.396	0.825	52-10

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
584	2003398.801	242196.736	13.763	10-09/53-01cp
587	2003410.816	242196.853	10.967	53-02
588	2003422.798	242197.535	8.655	53-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
837	2003505.125	242273.018	3.714	54-01
838	2003510.569	242276.033	3.648	54-02
839	2003517.123	242274.952	3.394	54-03
829	2003519.564	242274.05	2.883	15-11/54-04
843	2003524.967	242275.432	2.203	54-05
844	2003535.582	242274.255	1.97	54-06
845	2003544.458	242274.95	1.832	54-07
846	2003561.614	242275.183	1.415	54-08
847	2003566.511	242273.896	1.63	54-09
848	2003571.872	242275.044	1.094	54-10
849	2003578.138	242273.818	0.938	54-11

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
589	2003410.206	242215.931	12.92	55-01
590	2003421.81	242217.424	10.59	55-02
591	2003431.478	242216.638	9.032	55-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
852	2003511.107	242295.763	3.402	56-01
850	2003518.398	242294.137	2.482	56-02/15-08
853	2003526.111	242293.216	2.17	56-03
854	2003531.985	242291.744	1.993	56-04
855	2003537.599	242293.575	1.701	56-05
856	2003540.221	242292.658	1.601	56-06
857	2003555.109	242294.797	1.401	56-07
858	2003562.612	242293.9	1.441	56-08cp
859	2003568.243	242291.82	1.037	56-09

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
593	2003417	242234.6	12.967	57-01/10-04cp
596	2003428	242234.3	10	57-02
597	2003432	242235.7	8.961	57-03
598	2003440	242235.8	7.446	57-04

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
894	2003508.831	242311.955	3.156	58-01
893	2003513.701	242311.889	2.873	58-02
892	2003518.452	242313.849	1.951	15-02/58-03
890	2003532.411	242321.109	1.235	58-04
891	2003545.848	242327.373	0.718	58-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
601	2003435.506	242251.494	8.248	59-01
602	2003447.357	242255.468	6.552	59-02/11-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
889	2003509.66	242327.213	3.041	60-01
888	2003516.207	242328.795	1.572	60-02/15-01cp
887	2003527.763	242332.893	1.021	60-03
886	2003529.869	242334.47	0.956	60-04
885	2003540.444	242335.946	0.512	60-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
650	2003438.241	242274.211	6.725	61-01
605	2003449.977	242271.359	6.192	61-02/11-03cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
865	2003504.645	242349.499	2.419	62-01
882	2003521.765	242349.307	0.879	62-02
883	2003532.346	242349.354	0.461	62-03cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
648	2003437.7	242294.636	6.611	63-01
647	2003442.425	242291.925	6.409	63-02
646	2003449.789	242292.77	5.948	63-03/11-01cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
867	2003498.749	242370.809	1.591	16-08/64-01
868	2003505.151	242368.953	0.907	64-02

870	2003507.796	242369.771	0.816	64-03
871	2003512.975	242368.778	0.72	64-04
872	2003517.575	242370.396	0.659	64-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
645	2003440.187	242310.685	5.773	65-01
644	2003448.726	242315.862	5.314	65-02
642	2003455.303	242318.034	5.142	12-22/65-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
875	2003500.371	242388.914	0.606	16-05/66-01
876	2003511.175	242388.207	0.586	66-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
639	2003432.795	242333.545	7.86	67-01
638	2003437.908	242331.69	7.503	67-02
636	2003444.557	242330.732	5.161	67-03
635	2003446.153	242332.68	4.999	67-04
634	2003451.4	242330.713	4.754	67-05
633	2003455.902	242331.378	4.636	12-19/67-06

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
880	2003482.953	242401.668	0.959	68-01
881	2003490.081	242405.861	0.293	68-02/16-01

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
630	2003438.246	242346.891	6.775	69-01
629	2003454.455	242347.753	4.392	12-16/69-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
110	2003375.991	242541.052	2.015	70-01
111	2003380.378	242543.585	1.893	70-02
112	2003383.643	242546.952	1.603	70-03
113	2003401.017	242553.762	0.476	70-04

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
627	2003429.089	242368.287	5.852	71-01
626	2003437.037	242368.638	4.538	71-02
625	2003444.112	242371.48	4.197	71-03
622	2003449.222	242370.373	4.2	71-04/12-12cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
114	2003367.828	242565.44	0.866	72-01
115	2003372.31	242566.823	0.401	72-02
116	2003376.684	242569.643	0.32	72-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
615	2003423.118	242386.475	6.91	73-01
614	2003428.449	242386.689	5.905	73-02
611	2003435.4	242390.562	3.815	73-03
610	2003442.667	242391.94	3.648	73-04/12-09
609	2003449.496	242392.804	3.428	73-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
117	2003352.822	242581.872	1.904	74-01
118	2003357.19	242584.09	1.548	74-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
654	2003412.669	242407.189	8.552	75-01
653	2003416.27	242407.745	7.741	75-02
652	2003429.733	242404.948	5.527	75-03
618	2003439.035	242407.447	3.22	12-06/75-04

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
119	2003344.666	242601.523	1.911	76-01
120	2003348.396	242605.69	1.3	76-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
660	2003403.691	242426.266	8.244	77-01
659	2003410.754	242424.344	6.753	77-02

658	2003423.276	242426.151	3.477	77-03/12-03
661	2003426.006	242427.454	3.214	77-04/12-02
662	2003429.951	242428.571	3.032	77-05

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
121	2003333.036	242620.871	2.029	78-01
122	2003337.659	242621.697	1.418	78-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
668	2003405.269	242442.646	4.704	79-01
667	2003408.458	242443.167	4.927	79-02
666	2003412.958	242444.78	3.199	79-03
665	2003418.597	242446.637	2.885	79-04cp

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
123	2003319.395	242639.67	2.085	80-01
124	2003321.86	242640.632	1.911	80-02
125	2003323.744	242640.596	1.635	80-03

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
126	2003303.402	242657.814	2.179	81-01
127	2003310.955	242660.101	0.496	81-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
128	2003279.031	242678.814	2.322	82-01
129	2003292.72	242680.737	1.237	82-02

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
752	2003520.374	242158.53	4.281	84-01
753	2003529.055	242159.096	4.229	84-02
910	2003534.151	242155.89	N/A	84-03
755	2003544.102	242159.394	3.886	84-04
756	2003553.55	242159.976	2.654	84-05
758	2003565.784	242159.33	2.192	84-06
759	2003571.446	242160.658	1.806	84-07

760	2003576.807	242159.982	1.536	84-08
761	2003583.875	242160.342	3.218	84-09
762	2003589.957	242160.216	1.508	84-10
745	2003595.504	242158.892	1.393	84-11
746	2003600.731	242160.347	1.159	84-12
747	2003603.431	242159.107	1.263	84-13
748	2003605.526	242161.355	0.858	84-14

Shot #	UTM_North_m	UTM_East_m	Elev_m	ID1
787.00	2003527.11	242200.42	4.00	86-01
789.00	2003539.18	242197.36	3.97	86-02
792.00	2003547.99	242198.60	2.52	86-03
793.00	2003556.60	242196.89	2.10	86-04
794.00	2003566.26	242197.34	1.68	86-05
796.00	2003574.17	242195.01	1.52	86-06
781.00	2003585.13	242195.64	1.31	86-07
779.00	2003595.91	242194.24	1.00	86-08
780.00	2003600.75	242196.34	0.95	86-09



September 14, 2012

Dennis R. Ballam, Jr.  
Environmental Scientist  
CH2M HILL  
5700 Cleveland Street Suite 101  
Virginia Beach, VA 23462

**RE: Archeological Investigation of PI-09, Former Vieques Naval Training Range, Vieques Island, Puerto Rico – End of Fieldwork Summary**

Dear Mr. Ballam:

R. Christopher Goodwin & Associates is pleased to provide CH2M Hill with this summary of field investigations for archeological investigations related to the above-cited project. This summary presents preliminary findings of archeological testing and assessment for the PI-09 survey area located within the former Vieques Naval Training Range (VNTR), Vieques Island, Puerto Rico.

### **Project Location and Description**

The PI-09 survey area measures approximately 46.7 acres in size and is located immediately south of the mangrove swamps that line the western interior coast of Puerto Ferro, and the eastern interior coast of Puerto Mosquito. The area is situated on a gradual north-facing slope with a maximum elevation of 9.1 m (30 ft) amsl near the southern boundary, falling to an elevation at or below sea level in the north. A dirt two-track road that continues on to the Puerto Ferro lighthouse crosses the area from west to east, following the base of the natural slope.

Portions of the area and its surroundings were covered by the 1978 cultural resource reconnaissance survey conducted by Ecology and Environment, Inc. (Tronolone et al. 1984). A previously identified historic archeological site, Vi094, is located within the southwestern portion of the PI-9 survey area. This site consists of a small surface scatter of mid-nineteenth to early twentieth century domestic artifacts located near a dirt road. This site was not considered significant at the time it was recorded (Tronolone et al. 1984).

### **Methodology**

Archeological investigations for PI-09 began on September 11, 2012 and concluded on September 14, 2012. Phase I testing was conducted along pre-cut transects spaced approximately 30 meters apart; all transects were subjected to shovel testing, pedestrian reconnaissance or a combination of testing strategies. A total of 172 shovel tests were planned for the PI-09 area; 113 tests were excavated, 47 were

Mr. Dennis Ballam  
September 14, 2012  
Page 2 of 2

not excavated due to excessive slope, wetlands, or previous disturbance. As a result of survey, one previously identified site was relocated, and one possible historic period resource was identified.

### **Results of Testing**

For the majority of the surveyed area, no significant pre-modern sites, features, or deposits were encountered during testing. The previously recorded site Vi-094 was relocated, and one potential historic period resource was noted. The expression of Vi-094 was a small number of historic artifacts in two shovel tests in the mapped location of the previously identified site. Additional delineation tests failed to produce additional materials or associated features or deposits. A second potential resource, a portion of an earthen berm was identified crossing several of the survey transects. This earthen berm may be associated with either pre-military sugar processing, or with 20<sup>th</sup> century military activity. No additional artifacts, features or deposits were noted in association with this feature that would aid in determining its function or association.

Neither Vi-094 nor the newly identified feature appears to possess the qualities of significance and integrity defined in the NRHP Criteria for Evaluation (36 CFR 60.4 [a-d]). No additional pre-modern resources, sites, features or deposits that possess the qualities of significance and integrity defined in the NRHP Criteria for Evaluation (36 CFR 60.4 [a-d]) were identified in the surveyed area. As a result no further archeological investigations are recommended for the PI-09 survey area, for the newly identified feature, or for the previously identified site (Vi-094).

A more detailed Executive Summary will be submitted September 17. We look forward to continuing to assist CH2M Hill and the U.S. Navy with their cultural resources compliance needs. Please feel free to contact us if you have any questions concerning this summary of findings. We are at your service.

Sincerely,



Suzanne L. Sanders, M.A.  
Senior Project Manager

SS

**Attachment 4**

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**Final**

**Digital Geophysical Mapping Report  
UXO 15**

**Atlantic Fleet Weapons Training Facilities-Vieques  
Former Vieques Naval Training Range  
Vieques, Puerto Rico**

**Contract Task Order 006**

**May 2014**

Prepared for

**Department of the Navy  
Naval Facilities Engineering Command  
Atlantic Division**

Under the

**NAVFAC CLEAN 8012 Program  
Contract N62470-11-D-8012**

Prepared by



**CH2MHILL**

Virginia Beach, Virginia

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# Acronyms and Abbreviations

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ASCII	American Standard Code for Information Interchange
cm	Centimeter
DGM	Digital Geophysical Mapping
DOI	Department of the Interior
ECA	Eastern Conservation Area
EMA	Eastern Maneuver Area
ft	Feet
FTP	File Transfer Protocol
GPS	Global Positioning System
GSV	Geophysical System Verification
ha	hectare
in	Inch
ISO	Industry Standard Object
IVS	Instrument Verification Strip
LIA	Live Impact Area
m	Meter
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MPC	Measurement Performance Criteria
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objective
MRA	Munitions Response Area
MRP	Munitions Response Program
mV	MilliVolt
NAD83	North American Datum 1983
NAVFAC	Naval Facilities Engineering Command
NRL	Naval Research Laboratory
NTRCA WP	Non-Time Critical Removal Action Work Plan
OB/OD	Open Burn/Open Detonation
PDF	Portable Document Format
PI	Photo Identified
PLS	Professional Land Surveyor
QC	Quality Control
RTK	Real-time kinematic
SIA	Surface Impact Area
TDEM	Time-Domain Electromagnetic
USFWS	United States Fish and Wildlife Service
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VNTR	Vieques Naval Training Range

# Digital Geophysical Mapping Report

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This report presents the results of digital geophysical mapping (DGM) conducted by CH2M HILL at UXO 15 at the former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico. Work was performed under Navy CLEAN Contract N62470-11-D-8012, Contract Task Order (CTO) 006.

The objective of the DGM was to identify geophysical anomalies that may be indicative of munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH). Previous investigations at UXO 15 had identified munitions debris (MD) and MPPEH at the site. The DGM was conducted in order to evaluate the lateral extent to which subsurface anomalies were present within the area of investigation. Follow-up intrusive investigations were conducted at the identified geophysical anomalies. The results of the DGM and intrusive investigation will assist the project team's decision making process in determining the need for further investigations at UXO 15.

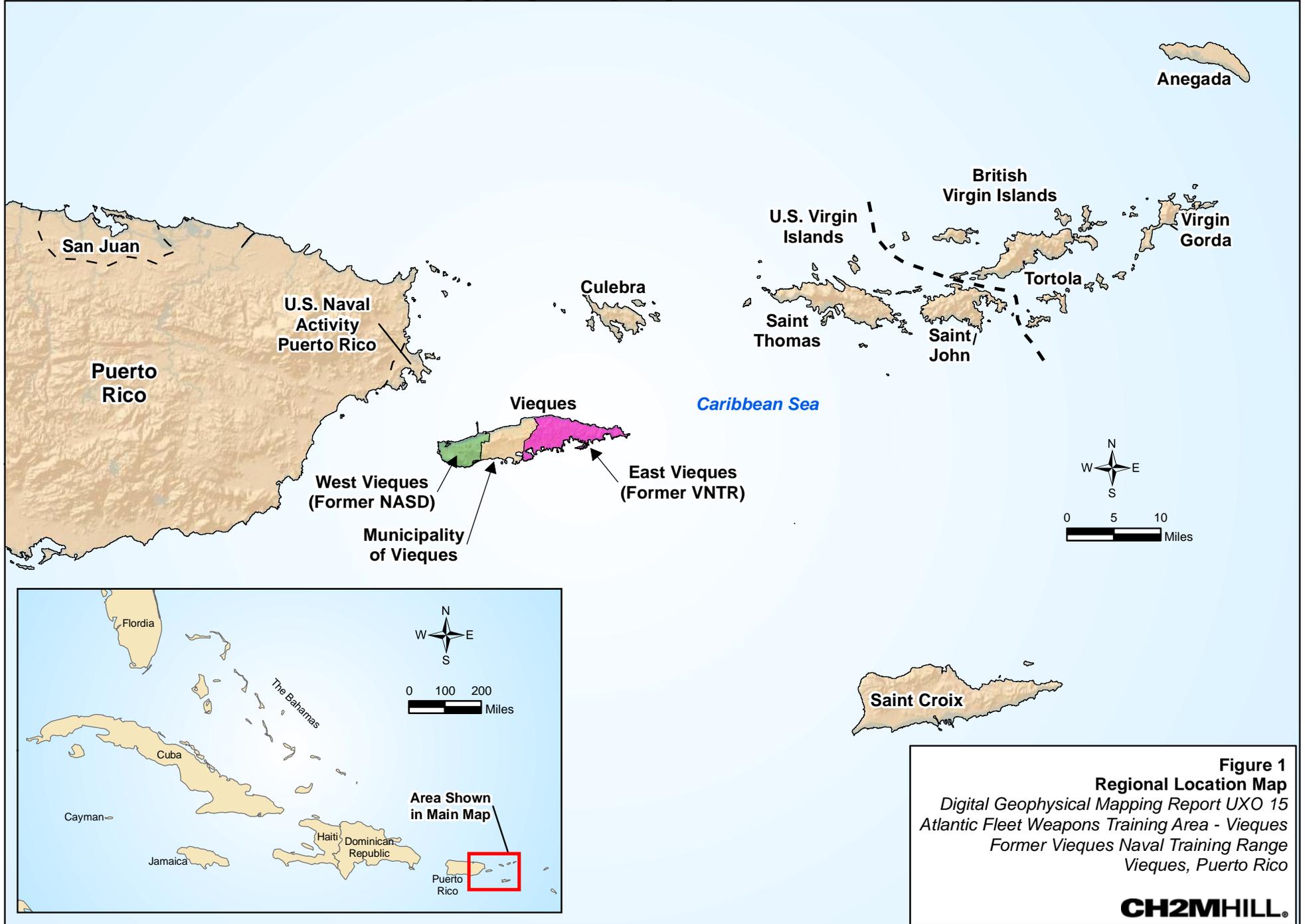
## 1.1 Site Description

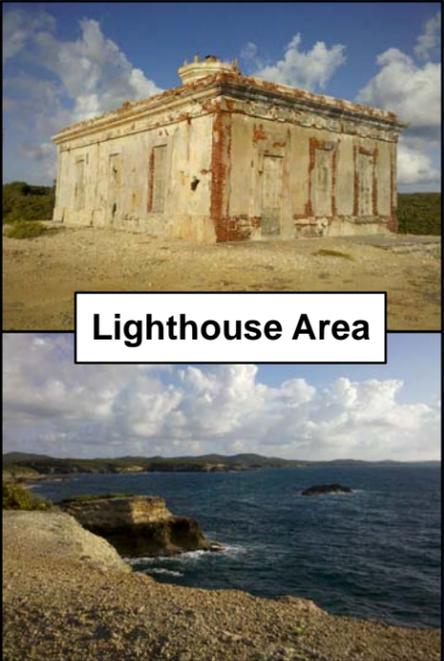
The former VNTR consists of approximately 14,600 acres and is divided operationally into four Munitions Response Areas (MRAs) that comprise (from west to east): the 11,000-acre Eastern Maneuver Area (EMA); the 2,500-acre Surface Impact Area (SIA); the 900-acre Live Impact Area (LIA); and the 133-acre Eastern Conservation Area (ECA). The former VNTR was transferred from the Navy to the Department of Interior (DOI) in 2003 to be managed by United States Fish and Wildlife Service (USFWS) as part of the National Wildlife Refuge System. While all military activities have ceased at the former VNTR, the Navy retains responsibility for any MEC and/or environmental contaminant concerns attributable to past Navy activities that may exist. Additional information on the history and conditions at VNTR can be found in the *Final Munitions and Explosives of Concern (MEC) Master Work Plan, Former Vieques Naval Training Range* (CH2M HILL, 2006).

UXO-15 is located in the southwestern corner of the VNTR (**Figure 1**) and comprises approximately 217 hectares (536 acres). It includes Photo Identified (PI) 9 and 13 (**Figure 2**). These two areas were identified through aerial photo analysis during a 2003 Preliminary Range Assessment by CH2M HILL as warranting further evaluation for the potential presence of MEC and MPPEH. An Expanded Range Assessment/Site Inspection conducted in 2010 by CH2M HILL identified munitions debris (MD) and MPPEH contained in debris piles as well as in the offshore portion of PI9. PI9 and PI13 represent locations within UXO 15 where historic military operations may have occurred, although it is not clear what activities specifically may have taken place. The 2003 Environmental Baseline Study at UXO 15 indicated that PI9 may have been used for munitions disposal and storage and as an open burn/open detonation (OB/OD) area and that PI13 may have been used as a firing point for rockets ordnance into the LIA/SIA. However, subsequent investigations and research of the site history indicate that OB/OD activities likely did not occur at PI9 and that PI13 was not used a firing point (CH2M HILL, 2012a).

DGM was conducted only in the western portion of the PI9 area shown in **Figure 3**. The area of investigation for the DGM is shown in **Figure 3** and comprises approximately 12 hectares (30 acres). The highlighted area in **Figure 3** represents the area to be investigated using DGM. The black lines represent the idealized transect locations, spaced 18 meters (60 feet) apart throughout the investigation area.

The DGM area shown in **Figure 3** consisted of dense woods and vegetation and was bounded on the west and northeast by lagoons. Soft mud, dense low-hanging vegetation and general swamp conditions characterized the transition from firm ground to water in these areas. A gravel access road bisects the Site A metal fence extends along the southern edge of the road from the north to the gate. The topography was generally flat except near the southern boundary of the investigation area. This portion of the site contains relatively steep and rocky slopes with loose soils. Although the topography across the majority of the site was overall flat, the ground surface within the investigation area posed numerous walking hazards due to the abundance of tree roots, vines, localized mounds and depressions and rock outcrops.

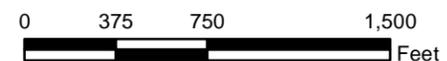




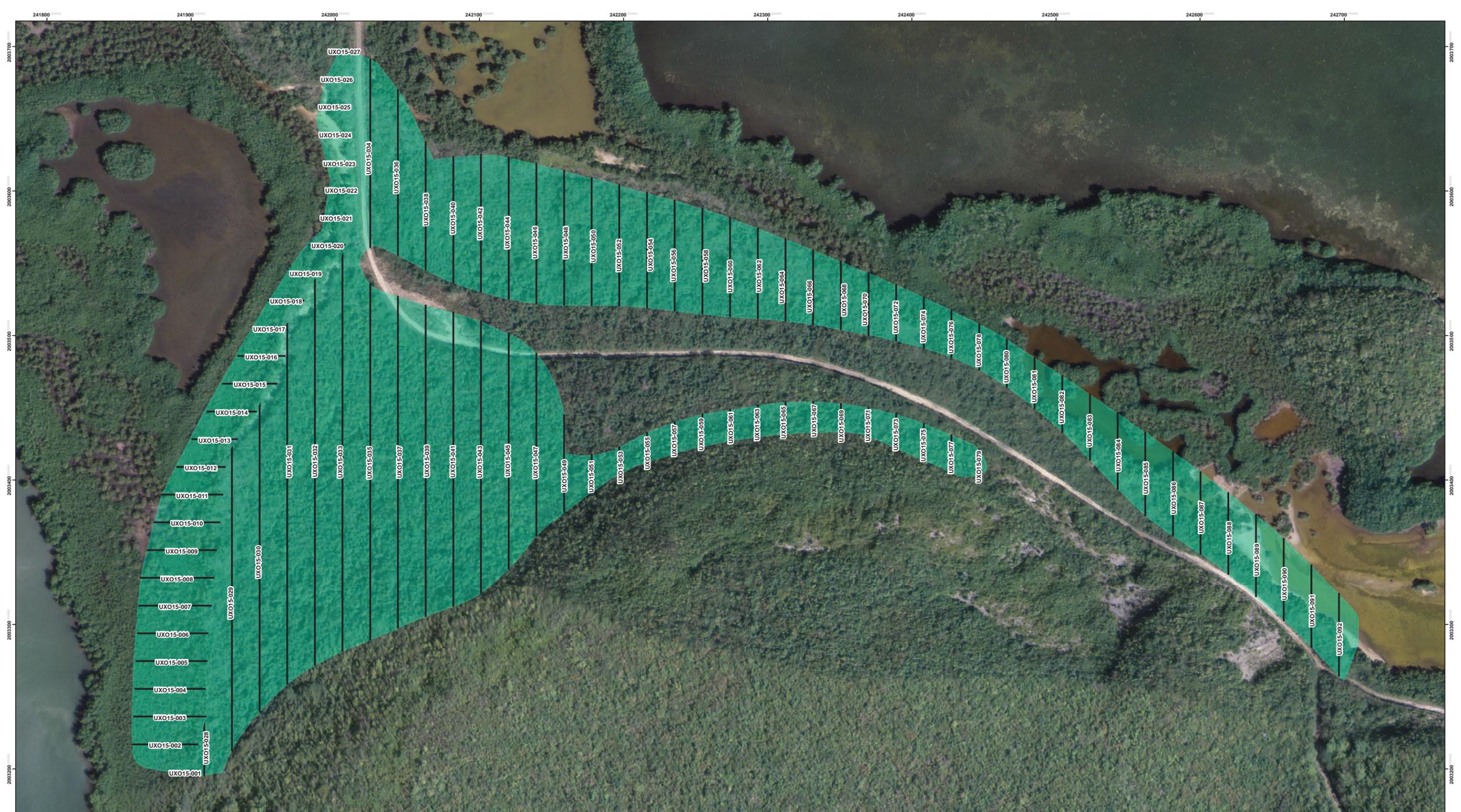
Lighthouse Area

**Legend**

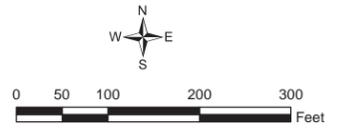
- UXO 15 Main Road
- PI Areas
- UXO 15



**Figure 2**  
**UXO 15 Site Features**  
 Digital Geophysical Mapping Report UXO 15  
 Atlantic Fleet Weapons Training Area - Vieques  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico



**Legend**  
 Idealized Transect Location  
 Proposed DGM Area



**Figure 3**  
**DGM Investigation Area**  
 Digital Geophysical Mapping Report UXO 15  
 Atlantic Fleet Weapons Training Area - Vieques  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico



## 1.2 Site Preparation Activities

Prior to conducting DGM, vegetation clearance was performed along the proposed transects by USA Environmental, Inc. During the vegetation clearance, surface clearance for MEC and MPPEH was performed in order to minimize the potential risks of the DGM personnel unexpectedly encountering these items. In some instances, metallic surface debris was identified as safe by unexploded ordnance (UXO) personnel, but could not be physically removed from the ground during surface clearance. In these instances, flags were placed in the ground to denote that the debris was inspected and determined to not be MEC or MPPEH.

After completion of the vegetation clearance and surface clearance, survey stakes were placed along these transects to assist with location control for the DGM. The surveying was performed by ECLS, a North Carolina based land surveying firm licensed and registered in Puerto Rico. CH2M HILL UXO personnel provided subsurface anomaly avoidance support during the placement of the stakes. Stakes were labeled with a unique identifier consisting of the transect ID and a sequential number that re-started at "1" with each new transect. Stakes were placed at a maximum spacing of 25 meters (82 feet) or at shorter distances, as necessary, to maintain both line of sight from one stake to the next as well as a straight-line walking segment between successive stakes for the DGM system. The start and end locations of each transect was identified with flagging tape. The tape was labeled with the transect ID as well as whether it represented the transect start or end location. The results and details of the surveying activities are presented in the surveyor report (ECLS, 2012). **Figure 4** presents the locations of the "as-surveyed" transects. Differences between the survey coverage in the idealized transect layout (**Figure 3**) and actual surveyed transect locations (**Figure 4**) near the lagoons are the result of inaccessible or unsafe site conditions due to deep mud or standing water at the time of the vegetation clearance. Transect IDs in **Figure 4** contain the prefix "UXO15". The total length of surveyed transects for the DGM at UXO 15 was 5,550 linear meters (18,209 linear feet).

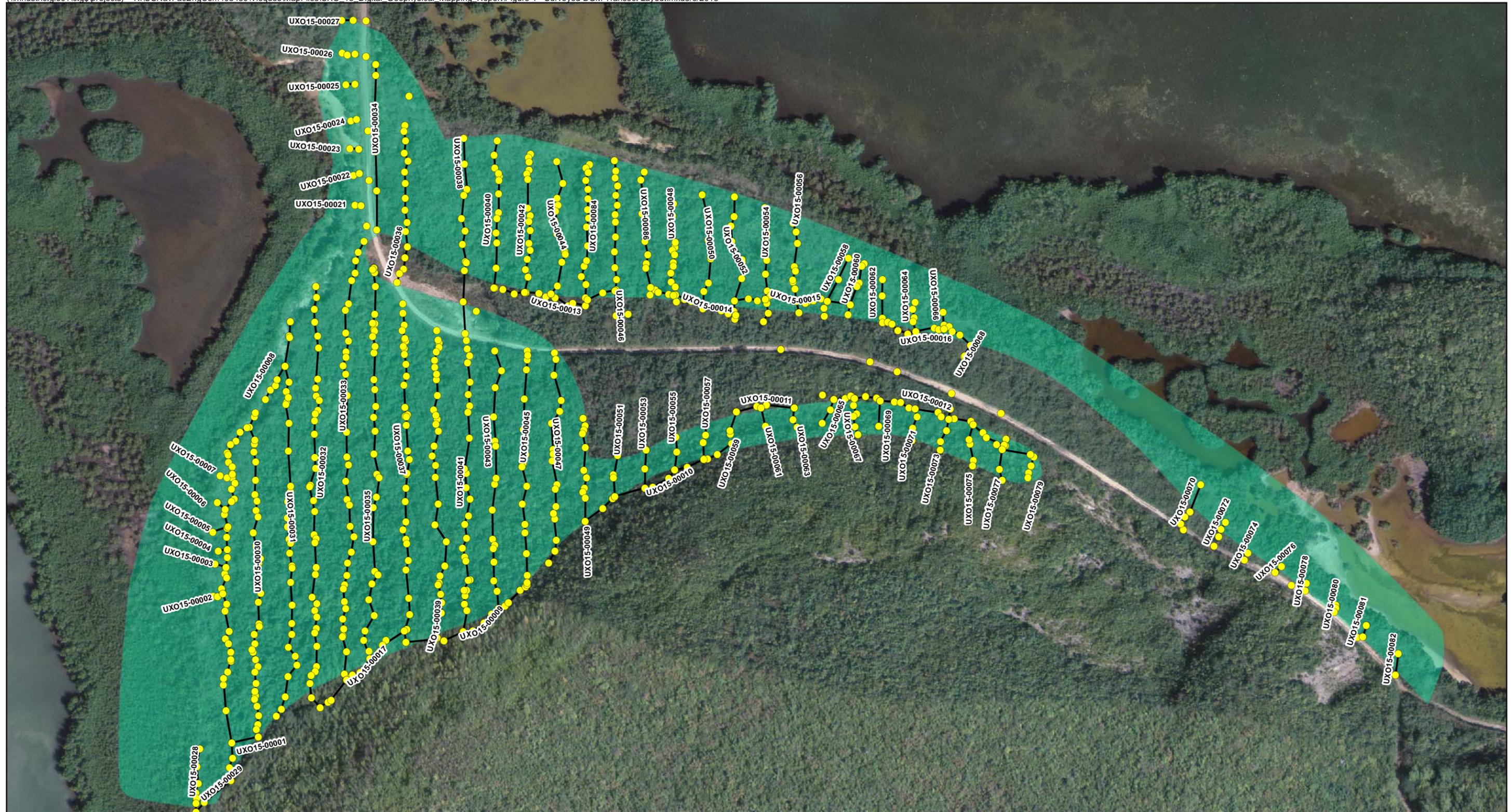
During the land surveying activities, CH2M HILL UXO personnel placed four quality control (QC) seed items for the DGM. The QC seeds consisted of small industry standard objects (ISOs) buried at a vertical orientation and approximately 15 centimeters (6 inches) below ground surface. Additional details on the procedures for the placement of QC seeds can be found in the Non-Time Critical Removal Action Work Plan [NTCRA WP], Surface Munitions and Explosives of Concern at Munitions Response Area-Surface Impact Area Munitions Response Sites 1-7, Former Vieques Naval Training Range (VNTR), Vieques, Puerto Rico (CH2M HILL, 2009). ECLS recorded the locations of the QC seeds and provided the information to the CH2M HILL QC Geophysicist.

## 1.3 DGM Equipment

The Geonics Ltd. EM61-MK2 time-domain electromagnetic (TDEM) metal detector was presumptively-selected and used to conduct the DGM at UXO 15. An Allegro CX field computer was used to operate the system and for data storage. The EM61-MK2 was selected because its widespread use at VNTR and ability to detect anomalies associated with small munitions items (e.g. 20mm projectiles).

The EM61-MK2 is a high-resolution, TDEM instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. The standard EM61-MK2 system consists of two air-cored, 1-meter by 0.5-meter (3.3 feet by 1.6 feet) coils, a digital data recorder, batteries and operating electronics. The EM61-MK2 transmitter generates a pulsed primary magnetic field, which induces eddy currents in nearby metallic objects.

For the DGM at UXO 15, the EM61-MK2 was operated in four-channel mode. In this mode, the system measures the eddy currents at four distinct time intervals recorded by the bottom coil. The four-channel mode of operation was used at UXO 15, and is generally used in DGM operations related to munitions, because responses from potential surface and near-surface items are desired. In addition, the fourth interval from the bottom coil provides data that enhances evaluation of response decay over suspected individual munitions. In this mode, earlier time gates provide enhanced detection of smaller metallic objects. The EM61-MK2 was operated in person-portable mode with the system mounted on its standard wheels. In this mode, the bottom coil measured approximately 42 centimeters (16 inches) above the ground surface.



**Legend**

- Surveyed Stake Point Location
- Surveyed Transect
- Proposed DGM Area



**Figure 4**  
**Surveyed DGM Transect Layout**  
 Digital Geophysical Mapping Report UXO 15  
 Atlantic Fleet Weapons Training Area - Vieques  
 Former Vieques Naval Training Range  
 Vieques, Puerto Rico

Positioning of the EM61-MK2 was maintained using fiducial markers inserted in the data at the staked intervals along each transect because Global Positioning System (GPS) satellite coverage is not possible beyond the road at UXO 15. Because data were collected in four-channel mode, the top coil of the EM61-MK2 was not utilized.

## 1.4 Geophysical System Verification

CH2M HILL followed the Geophysical System Verification (GSV) process for the DGM at UXO 15. This process compares signal strength and sensor performance to known response curves of ISOs to validate DGM systems before and during site surveys. The GSV process, the Measurement Quality Objectives (MQOs) and Measurement Performance Criteria (MPC) are discussed in detail in the NTCRA WP (CH2M HILL, 2009).

CH2M HILL constructed an Instrument Verification Strip (IVS) for the UXO 15 DGM near Camp Garcia after first conducting an initial background survey to verify that the location was suitable (i.e. minimal existing geophysical anomalies) for construction of an IVS. Initial testing was conducted along the IVS transects to verify that the along-transect distances were accurately tracked by the EM61-MK2 wheel encoder. The IVS data were collected on September 4, 2012 and were submitted to the CH2M HILL data processor. The CH2M HILL QC Geophysicist reviewed the results and confirmed that the MQOs were being met prior to the start of the production survey at UXO 15.

The Geophysical System Verification Report is included as **Appendix A** to this report. It presents the location of the IVS, the IVS construction details, blind seed results and EM61-MK2 validation results from the GSV process for UXO 15.

## 1.5 DGM Field Investigation

Data collection at UXO 15 was performed from September 12 to 19, 2012. DGM data were collected with a single 1-meter wide (i.e. width of coil) pass of the EM61-MK2 along each transect, where the DGM field crew attempted to maintain the straight-line path from one stake to the next. This procedure resulted in a total footprint coverage of approximately 0.57 hectares (1.4 acres) with the EM61-MK2 at UXO 15. Fiducial markers were added in the data when the center of the EM61-MK2 coil passed over each stake. Using the known surveyed coordinates of the stakes and the fiducial markers, the DGM data were able to be geo-referenced during data processing to Universal Transverse Mercator (UTM) coordinates. The photos included in this section depict data collection procedures at UXO 15.

CH2M HILL utilized a Munitions Response Program (MRP) Enterprise personal digital assistant (PDA) to record the start and end stake IDs for each transect. The PDA was also used to track the locations of impassable obstructions. This information was submitted each day along with the raw DGM data to the CH2M HILL data processor.

Daily QC tests were conducted in accordance with the NTCRA WP and included an instrument warm-up period, static test measurements of background values and response values with a small ISO, collection of the seeded IVS transect, and collection of repeat data profiles. Descriptions of the QC tests and MQOs for each are included in the NTCRA WP. Additional field information (e.g. QC test file names, weather conditions, general survey notes) was recorded using the MRP Enterprise PDA.



UXO 15 Data Collection with Fiducial Positioning



UXO 15 Data Collection Along Transects

## 1.6 Information Management

DGM data were collected in transect “blocks”, where one block was comprised of several transects. No single block contained more than 10 transects. The block ID was simply one of the transect IDs within that block. This data collection procedure was intended to mimic 100% coverage surveys at VNTR using the site-wide grid network. However, because many of the transects at UXO 15 spanned multiple grids, the use of the grid system for data collection was not practical. QC tests were conducted in between each transect block, thereby “opening” and “closing” each data collection block. This procedure allowed for effective QC of the DGM data because if a problem was identified, it might only negatively impact a group of transects rather than an entire day’s worth of data.

Raw data, field notes, and other relevant information were posted daily to the project file transfer protocol (FTP) site. The PDA was synchronized daily with the master MRP Enterprise DGM database stored on the project FTP site. Data packages were assembled and packaged in accordance with NTCRA WP and in a format consistent with previous delivery of DGM results under the Navy CLEAN program.

## 1.7 Data Processing

Data processing was completed in the following steps: QC review of DGM field forms, fiducial positioning, DGM pre-processing, and DGM final processing.

### 1.7.1 QC of DGM Field Forms

Daily QC of the DGM field forms was completed by the CH2M HILL Data Processor. This QC process was intended to check that MRP Enterprise was updated each day with the required information and that the relevant field information (e.g. survey notes, QC test file names, EM61-MK2 battery levels, weather conditions, etc.) was effectively captured.

### 1.7.2 Fiducial Positioning

Raw EM61-MK2 data files were imported into DAT61MK2 (issued by Geonics, Ltd.), where the individual transect start, end and internal fiducial markers were manually entered or adjusted by the Data Processor. The software interpolated between the points along each transect to refine the local (X,Y) coordinates for each measurement. The resulting files were subsequently exported as .XYZ files in the American Standard Code for Information Interchange Two (ASCII) format. These .XYZ files contained the adjusted positions, the sensor responses for each of the four channels and the corresponding time stamp.

### 1.7.3 DGM Pre-Processing

Positioned .XYZ files were subsequently imported into Oasis Montaj (issued by Geosoft) for pre-processing. DGM pre-processing steps included the following:

- Evaluate QC tests (static, cable shake and personnel) prior to processing DGM survey data;
- Conversion/warping of the local (X,Y) coordinate system to North American Datum 1983 (NAD83) UTM Zone 20 North coordinates (meters) by matching fiducial marker locations with surveyed stake locations provided by ECLS;
- Application of auto leveling and instrument drift corrections for EM61-MK2 data;
- Application of an appropriate lag correction (from daily seeded IVS transect collection);
- Gridding of all four time gates using the Oasis Montaj minimum curvature algorithm;
- Generation of preliminary contour maps from gridded data;
- Preliminary comparison of original versus repeat data;

- Generation of formatted ASCII files containing preprocessed data.

Following completion of the above steps, the pre-processed data were reviewed by the CH2M HILL QC Geophysicist. Once approved by the QC Geophysicist, a Raw Data Delivery report was generated from MRP Enterprise.

## 1.8 DGM Final Processing

Final DGM processing steps included the following:

- Target selection from contoured data for each transect in UXO 15;
- Generation of formatted ASCII files containing processed data;
- Generation of a final map for UXO 15 transect blocks showing contoured, gridded data, target locations and surveyor stake locations;
- Preparation of target lists.

Following completion of the above steps, the final processed data were reviewed by the CH2M HILL QC Geophysicist. Once approved by the QC Geophysicist, a Final Data Delivery report was generated from MRP Enterprise.

## 1.9 Target Selection

The target anomaly threshold of 2.5 millivolts (mV) on Channel 3 was utilized for UXO 15 because of the uncertainty of the specific types and sizes of munitions that could be present at UXO 15. In addition, this threshold is the program threshold utilized at VNTR for the interim removal action (in non-elevated anomaly density areas) due to the historic use of 20mm projectiles. The results of the GSV process and QC test results have demonstrated that the EM61-MK2 used for UXO 15 is validated for selecting targets at this threshold.

Initial target selections were made using the automatic peak picking module (Blakely Test) in the Oasis Montaj UX-Detect module to identify peak amplitude responses in the gridded Channel 3 data that appeared to be indicative of potential MEC or MPPEH. Data profiles for all four channels were reviewed by the data processor to evaluate the validity and position of the auto-selected targets. Targets found to be invalid or incorrectly located were adjusted and/or removed from the final selection list. This review was performed by evaluating the decay in mV responses laterally from a peak response as well as the general shapes of the response curves for each channel at the selected anomaly locations. The intent of this evaluation was to identify automatically-selected targets that appear to be associated with surface debris or noise spikes. These anomalies typically exhibit different characteristics compared to subsurface anomalies potentially indicative of MEC and MPPEH. This review process also facilitates adding anomalies to the target selection list that may not have been automatically selected by the UX-Detect module but appear to represent potential MEC or MPPEH.

**Table 1** presents the target types generated for the DGM at UXO 15, an explanation of each one and the total number of each type identified in the data. Target lists were generated for each transect and were provided to the QC Geophysicist along with the processed data for approval as part of the DGM Final Processing package.

TABLE 1  
DGM Target Types for UXO 15

Target Type	Explanation
1	Target associated with subsurface anomaly exhibiting peak amplitude of $\geq 2.5$ mV
2	Target associated with subsurface anomaly exhibiting peak amplitude of $< 2.5$ mV
3	Target associated with known or suspected cultural feature (e.g. fence) from DGM field team notes
4	Target selected from within 1-meter radius of surface metal location surveyed by ECLS (from <b>Figure 3</b> )

After target selections were made for each transect, the unique IDs assigned to each target were formatted to be compatible with MRP Enterprise. The master MRP Enterprise MEC database requires that the VNTR grid ID be assigned target IDs to facilitate querying the database and tracking the anomaly life in the database. Prior to import into MRP Enterprise, the transect paths and target locations were superimposed on the VNTR site wide grid system in order to assign them to the correct grids.

The final target IDs provided to USA Environmental, Inc. upon completion of the DGM were in the format depicted in **Table 2**. The Type 2 targets were not included for intrusive investigation as part of this investigation. However, they were assigned unique IDs like those displayed in **Table 2** in the event that they would be imported into MRP Enterprise and investigated at a later time. Final target ID format in column GRIDCELLID is as follows:

**“Grid ID” + “UXO15” + “Transect ID”**

The ID column in Table 2 is a sequential number assigned to each target in the specific grid. In other words, this number resets to “1” with each new grid ID. If an ID is skipped (e.g. E1J0F0 in **Table 2**), it is because there was a Type 2 target selected in that grid but not imported into MRP Enterprise.

TABLE 2  
Representative DGM Target List for UXO 15

ID	GRIDCELLID	X1	Y1	X2	Y2	X3	Y3	X4	Y4	TYPE	AMPLITUDE	UNITS
1	E1J9E0-UXO15_00021	242015.60	2003579.40	0	0	0	0	0	0	3	195.250	mV
1	E1J0E2-UXO15_00022	242014.23	2003600.12	0	0	0	0	0	0	3	126.690	mV
1	E1J0E4-UXO15_00024	242009.66	2003634.20	0	0	0	0	0	0	1	13.960	mV
2	E1J0E2-UXO15_00024	242011.90	2003634.74	0	0	0	0	0	0	3	45.090	mV
1	E1J0E3-UXO15_00025	242010.86	2003657.13	0	0	0	0	0	0	1	25.7	mV
1	E1J0E4-UXO15_00026	242002.46	2003676.94	0	0	0	0	0	0	1	12.610	mV
2	E1J0E4-UXO15_00026	242005.40	2003675.40	0	0	0	0	0	0	1	52.540	mV
3	E1J0E4-UXO15_00026	242009.60	2003676.00	0	0	0	0	0	0	1	14.290	mV
4	E1J0E4-UXO15_00026	242011.20	2003676.23	0	0	0	0	0	0	3	39.970	mV
1	E1J0F0-UXO15_00034	242024.45	2003565.42	0	0	0	0	0	0	1	69.530	mV
3	E1J0F0-UXO15_00034	242024.70	2003571.66	0	0	0	0	0	0	1	3.890	mV
4	E1J0F0-UXO15_00034	242024.70	2003573.00	0	0	0	0	0	0	1	4.220	mV
5	E1J0F0-UXO15_00034	242024.70	2003574.41	0	0	0	0	0	0	1	4.030	mV

## 1.10 DGM Quality Control

The MQOs for the DGM at UXO 15 are described in the NTCRA WP (CH2M HILL, 2009). The MQOs for this investigation were met and the final processed data passed the required QC tests. **Table 3** presents the results of the positioning MQO for the EM61-MK2, as evaluated by twice daily data collection along the seeded IVS transect throughout the production survey. The MQO for the DGM positioning is that the

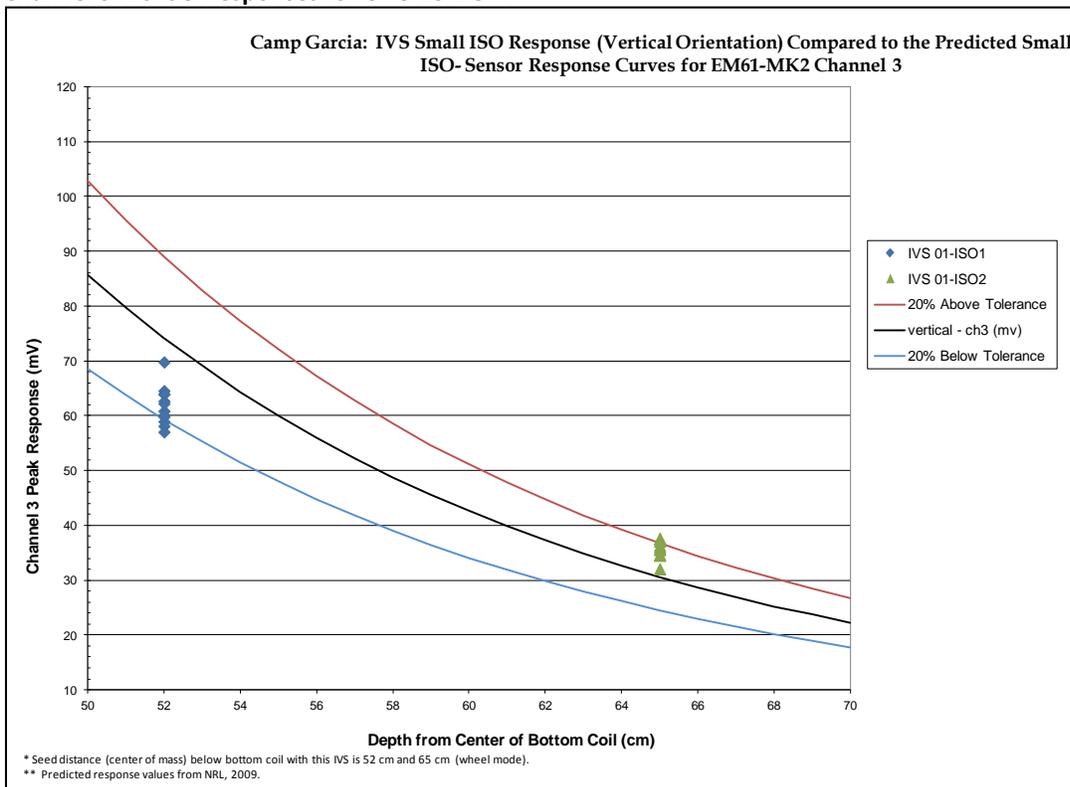
selected peak amplitude response from the kinematic (i.e. in-motion) EM61-MK2 over the small ISOs in the IVS was within ±25 cm (9.8 inches) of the surveyed locations reported during construction of the IVS. The IVS construction details are provided the GSV report included as Appendix A of this report.

TABLE 3  
DGM Positioning QC Results for UXO 15

Date / File Name	GBIVS-ISO-01			GBIVS-ISO-02		
	X_UTM	Y_UTM	Offset (cm)	X_UTM	Y_UTM	Offset (cm)
091212IVS	244352.83	2005009.77	4.123	244352.30	2005004.84	9.487
091212IVS	244352.83	2005009.77	4.123	244352.30	2005004.84	9.487
091312IVS	244352.81	2005009.59	17.117	244352.30	2005004.84	9.487
091312IVS	244352.83	2005009.76	4.000	244352.30	2005004.81	9.000
091412IVS	244352.84	2005009.89	13.928	244352.31	2005004.89	11.314
091412IVS	244352.83	2005009.82	7.211	244352.31	2005004.94	15.264
091712IVS	244352.82	2005009.70	6.708	244352.31	2005004.89	11.314
091712IVS	244352.83	2005009.77	4.123	244352.30	2005004.84	9.487
091812IVS	244352.83	2005009.82	7.211	244352.31	2005004.94	15.264
091812IVS	244352.83	2005009.82	7.211	244352.29	2005004.76	11.180
091912IVS	244352.83	2005009.76	4.000	244352.30	2005004.81	9.000
091912IVS	244352.85	2005009.95	19.925	244352.30	2005004.81	9.000

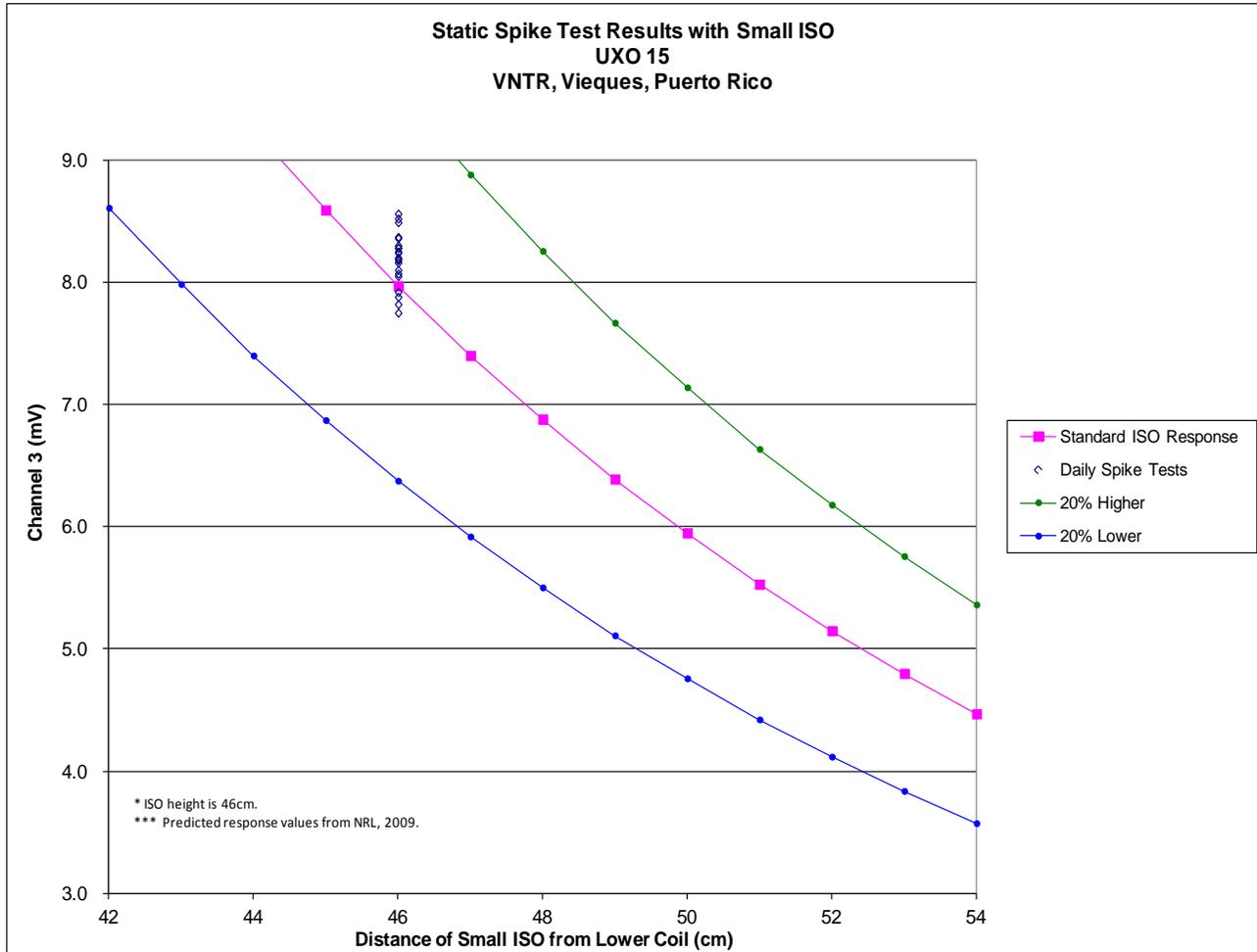
Figure 5 presents the twice daily Channel 3 responses from the small ISOs in the IVS compared to the predicted response curves from NRL, 2009. There was good correlation with the predicted responses. Minor variations in the actual peak responses are likely attributable to movement of the EM61-MK2 coils on the standard wheels (e.g. bouncing) or instances where the center of the coil did not precisely pass over the ISO.

FIGURE 5  
Channel 3 IVS ISO Responses for UXO 15 DGM



**Figure 6** presents the results of the daily static tests conducted throughout the production survey (September 12-19, 2012) at UXO 15 in order to evaluate the DGM system functionality and consistency. The MQO for this test was that the response of a small ISO placed at a fixed height above the center of the stationary transmit coil would be within  $\pm 20\%$  of the predicted responses from NRL, 2009. The average response from a small ISO placed horizontally above the coil at a height of 46 centimeters (18 inches) was 8.19 mV. Standard deviation was 0.22. The predicted Channel 3 response from NRL (2009) for this item at this height is 8.0 mV.

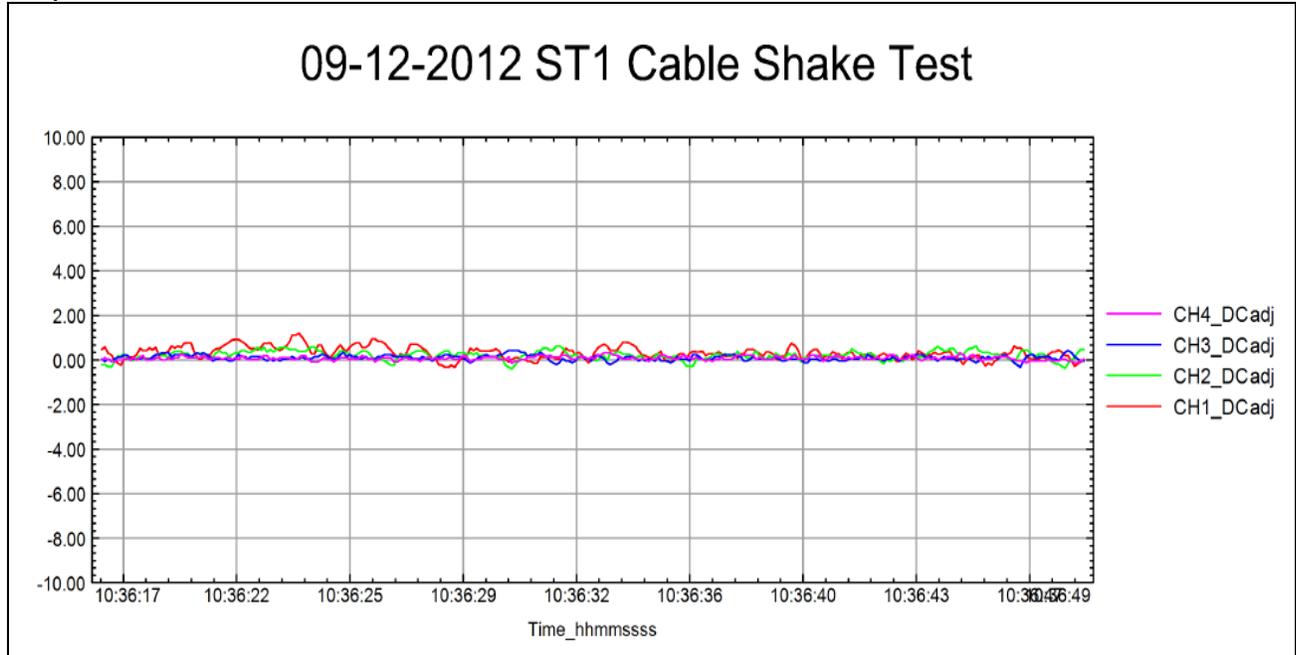
FIGURE 6  
Channel 3 Small ISO Static Test Results for UXO 15 DGM



Additional QC tests performed for the DGM at UXO 15 included personnel, vibration (i.e. cable shake) and repeat data tests. **Figures 7 through 9** demonstrate representative graphs generated for each QC test. The final processed data used for target selection met the QC requirements for the DGM. Some of the vibration and personnel QC test results depicted a higher degree of noise impacting Channel 1. This noise was closely monitored each day by the field team, data processor and QC Geophysicist. It was determined that the noise was limited to only Channel 1 and did not impact the data quality or target selection process for UXO 15. The results of the GSV process and the results presented in **Figures 5 and 6** are diagnostic of the system performance and indicate that the EM61-MK2 was consistently providing high-quality DGM data.

The QC seeds were successfully detected and selected as Type 1 targets by the data processor. The results of the blind seeding program are presented in the GSV report.

**FIGURE 7**  
**Sample Vibration QC Test Results for UXO 15 DGM**



**FIGURE 8**  
**Sample Personnel QC Test Results for UXO 15 DGM**

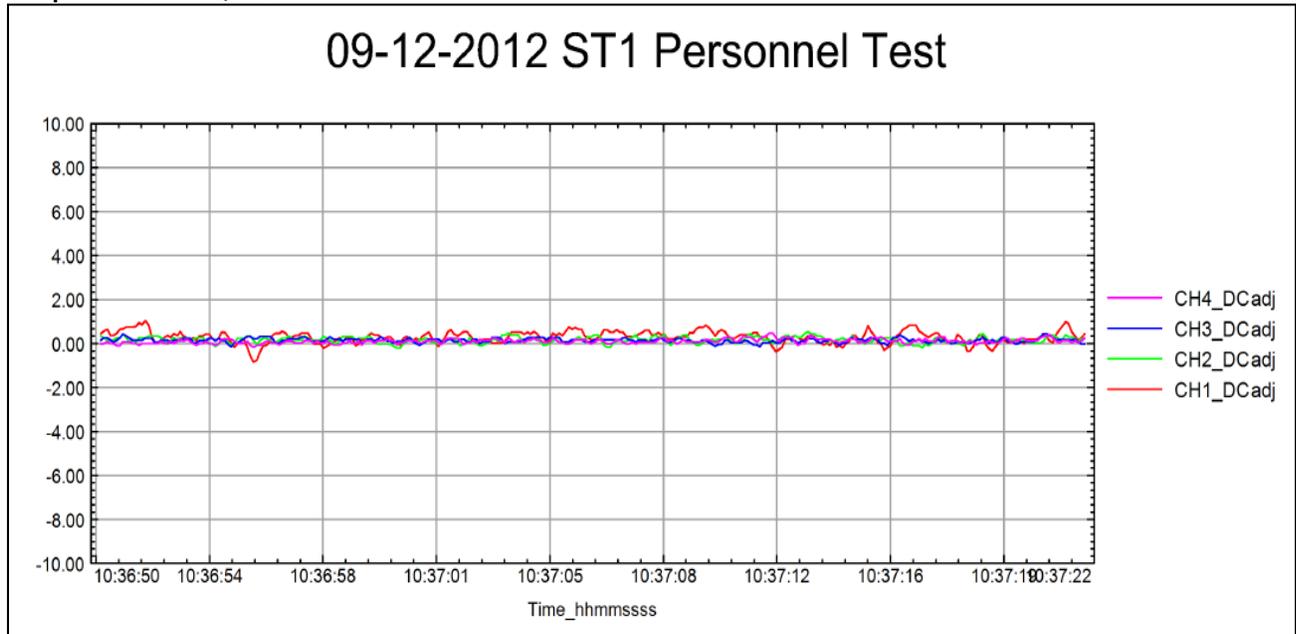
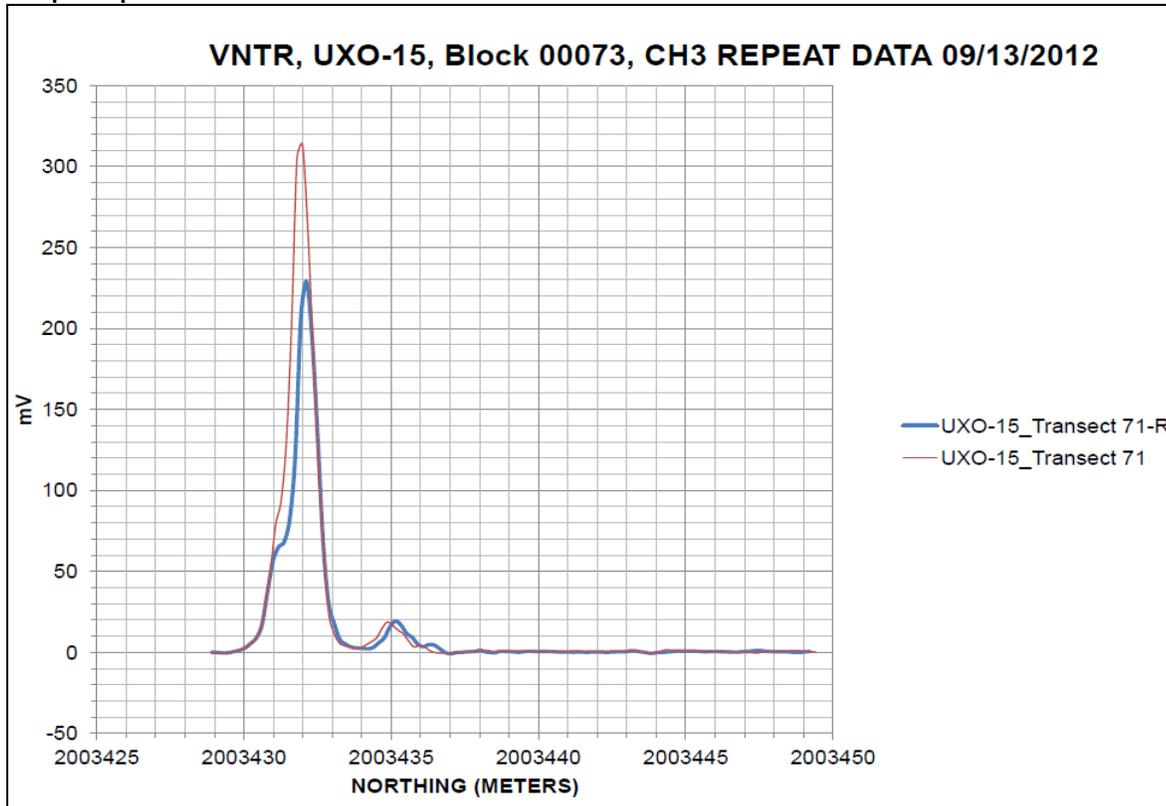


FIGURE 9  
**Sample Repeat Data Collection for UXO 15 DGM**



## 1.11 DGM Results

A total of 521 discrete targets were selected in the DGM data for UXO 15. **Table 4** summarizes the counts for each of the four target types utilized in MRP Enterprise (from **Table 1**). Transect 23, located in the northwest portion of the survey area, was not collected because of high water at the time of the DGM survey.

TABLE 4  
**UXO 15 DGM Target Count by Type**

Target Type	Count
1	435
2	68
3	4
4	14

The data delivery packages for UXO 15 include raw data files, pre-processed data files and final processed data files. These packages include QC test data and production data. The final processed data include maps of the UXO 15 transects and target lists organized by block.

In an effort to consolidate these results for this report, the UXO 15 survey area was divided into two general areas: north of the access road and south of the access road. **Figures 10 and 11** depict these consolidated DGM results. The yellow line in **Figures 10 and 11** represents the UXO 15 survey area and the numbers displayed in bold yellow font are the transect IDs. Additionally, the targets displayed in **Figures 10 and 11** were organized by response amplitude. The DGM contours are superimposed on the aerial imagery of the site, where the contours depicted by the gray colors represent Channel 3 amplitudes less than 2.5 mV.

Type 1 targets with Channel 3 amplitudes between 2.5 mV and 8 mV and those with amplitudes greater than 8 mV were split and shown with different symbols in **Figures 10 and 11**. This split was performed in an attempt to provide the project team with an assessment of the distribution of targets with relatively low amplitudes versus high amplitudes. An amplitude of 8 mV was selected for this effort because it is consistent with the threshold used for intrusive investigations in elevated anomaly density areas elsewhere on VNTR.

Type 2 targets are displayed with yellow triangles and Type 3 and 4 targets were combined and are denoted by a white solid-filled rectangle. **Table 5** summarizes the target counts as displayed in **Figures 10 and 11**.

TABLE 5  
**UXO 15 DGM Target Count by Type and Amplitude**

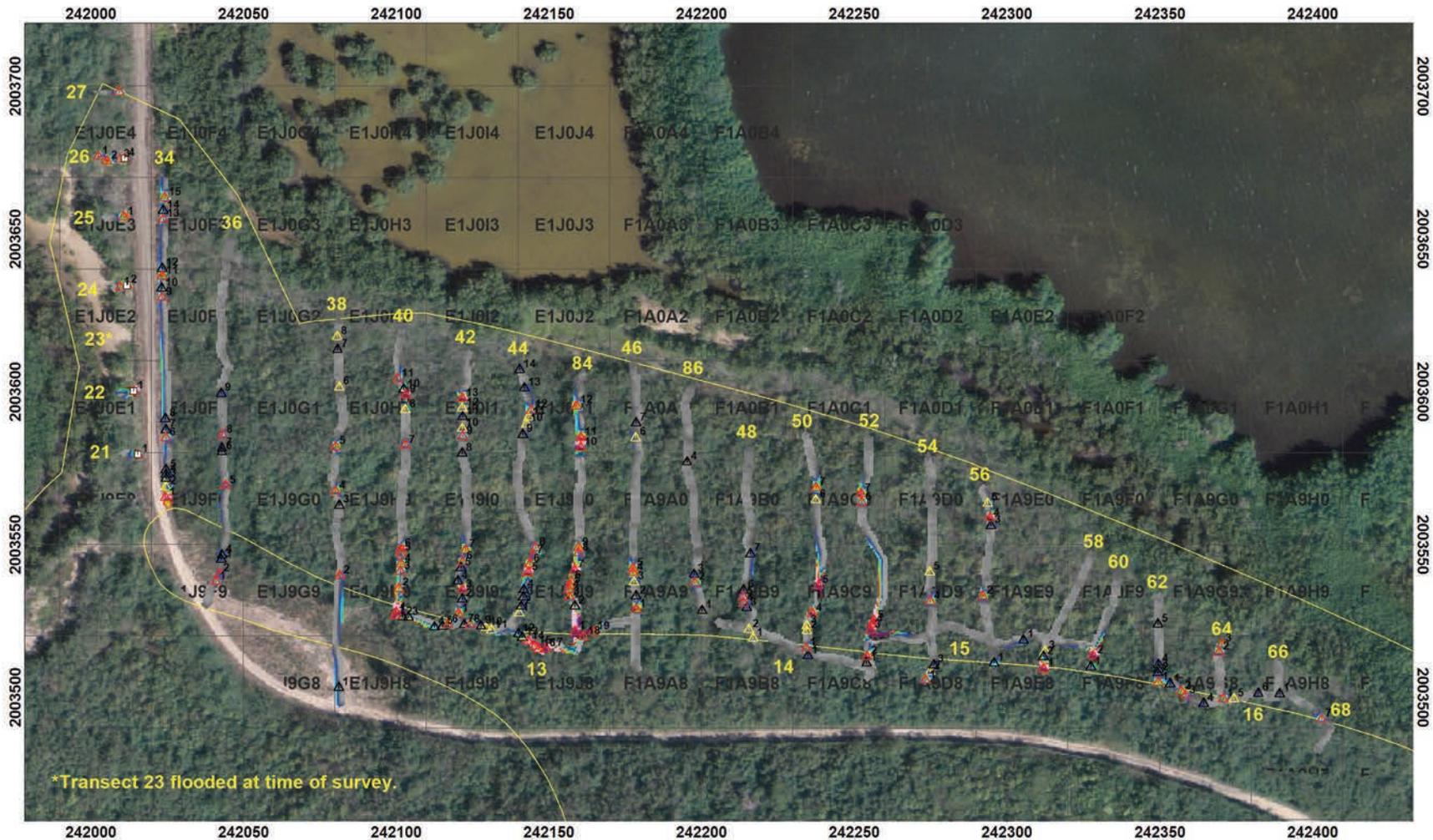
Target Type	Explanation	Count
1	≥2.5 mV and >8 mV	176
1	≥8 mV	259
2	<2.5 mV	68
3 and 4	Known and suspected culture or surface metal	18

The DGM has identified anomalies indicative of potential MEC and MPPEH throughout the entire area of investigation at UXO 15 (PI9). The distribution of the anomalies does not provide a clear indication of what type of disposal practices may have occurred at the site, although the southern portions of Transects 40, 42, 44 and 84 (**Figure 10**) appear to have relatively more anomalies compared to the remainder of the investigation area north of the access road. South of the access road, anomalies appear across the full extent of the investigation area. No elevated anomaly density areas (i.e. areas where discrete anomalies could not be selected) were identified.

Two targets with amplitudes greater than 2.5 mV on Transect 52 (**Figure 10**) were incorrectly assigned as Type 2 during data processing and were therefore not submitted for intrusive investigation during the initial investigation. These two items were investigated in March or 2013 as part of the Expanded SAPP Investigation. On **Figure 10**, they are Targets #3 and #6 on Transect 52. The targets should have been assigned as Type 1. The counts in Tables 4 and 5 as well as the target lists included in the data packages correctly account for these targets as Type 1.

## 1.12 References

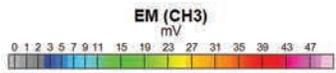
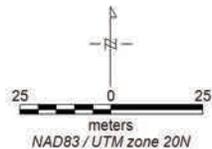
- CH2M HILL, 2012a. Expanded Site Inspection, Sampling and Analysis Plan Addendum for the Remedial Investigation at UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico. July.
- CH2M HILL, 2009. Non-Time Critical Removal Action Work Plan, Surface Munitions and Explosives of Concern at Munitions Response Area – Surface Impact Area Munitions Response Sites 1-7, Former Vieques Naval Training Range, Vieques, Puerto Rico. January.
- CH2M HILL, 2006. Final Munitions and Explosives of Concern (MEC) Master Work Plan, Former Vieques Naval Training Range. December.
- ECLS, 2012. CH2M HILL Surveyor Report, Site UXO-15, Former Vieques Naval Training Range, Vieques, Puerto Rico. September.
- Naval Research Laboratory, 2009. EM61-MK2 Response of Three Surrogates, NRL/MR/6110-09-9183. March.
- Naval Research Laboratory, 2008. Final Report for the Evaluation of UXO Detection Technology at the Standardized UXO Test Sites Aberdeen and Yuma Proving Grounds, Standardized UXO Technology Demonstration Site Program, SERDP. NRL/MR/6110-08-9155 (EM61-MK2 Response of Standard Munitions Items). October.



\*Transect 23 flooded at time of survey.

**Legend**

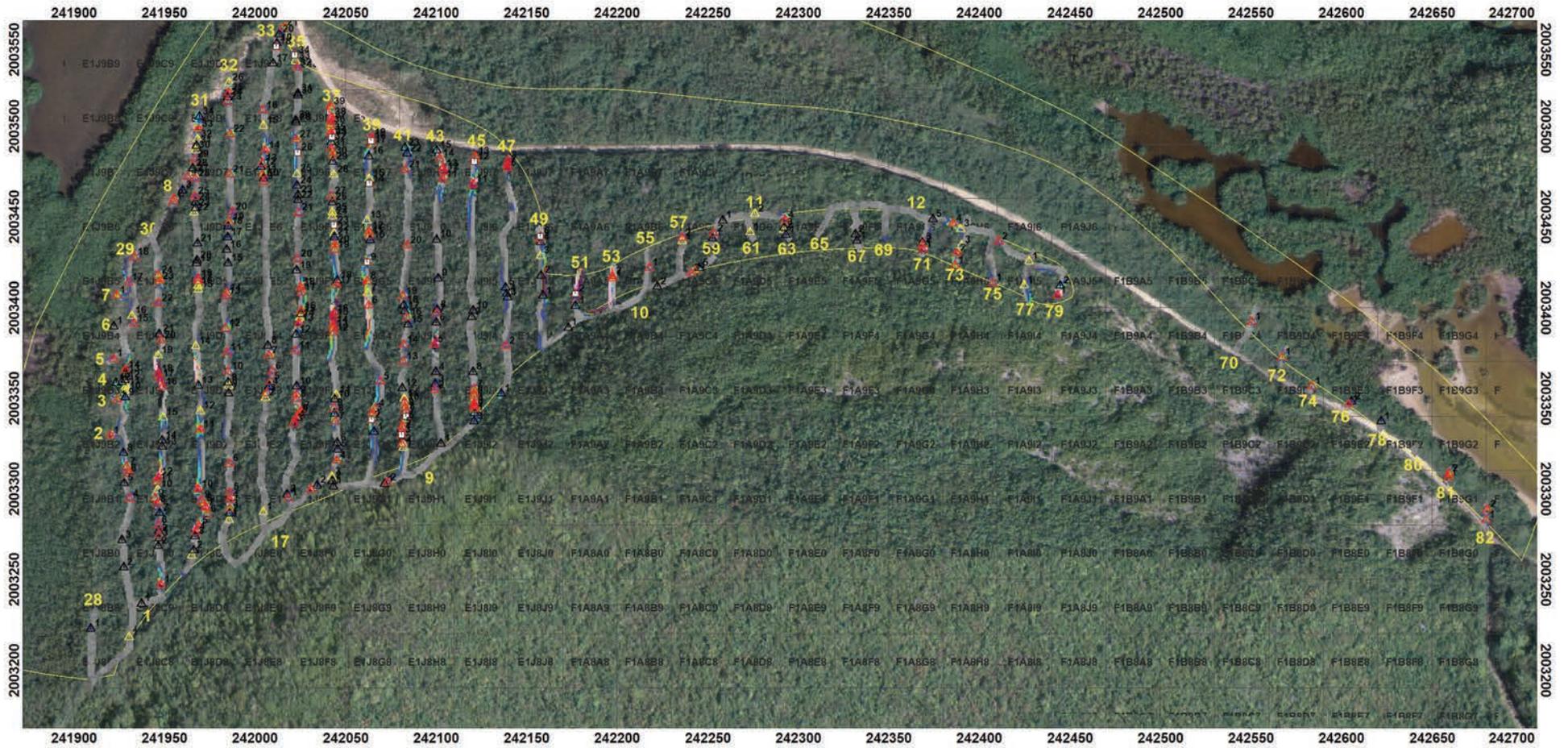
- UXO-15 DGM Boundary
- ▲ Selected Target, < 2.5 mV
- ▲ Selected Target, ≥ 2.5 - < 8 mV
- ▲ Selected Target, ≥ 8 mV
- Selected Target, Culture



DGM Survey Area:	0.46 acres	Survey Date(s):	9/12/2012 - 9/19/2012
Linear Survey Distance:	1869.3 meters	Map Creation Date:	12/3/2012
Targets < 2.5 mV:	23	Map Creator:	J. Weller
Targets ≥ 2.5 - < 8 mV:	61	Map Approver:	M. Barner
Targets ≥ 8 mV:	87		
Targets Cultural:	4		

\*Displayed target IDs include only the number along the transect, the full ID prefix includes the grid cell, transect number, and area, e.g. "E1J9G2-UXO15\_00039-001".

**FIGURE 10**  
**Digital Geophysical Mapping Report UXO 15**  
**DGM Findings PI-9 North**  
*Former VNTR, Vieques, Puerto Rico*

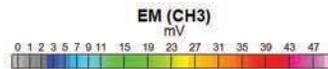
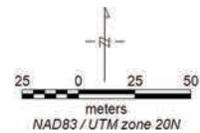


**Legend**

- UXO-15 DGM Boundary
- ▲ Selected Target, < 2.5 mV
- ▲ Selected Target, ≥ 2.5 - < 8 mV
- ▲ Selected Target, ≥ 8 mV
- Selected Target, Culture



\*Displayed target IDs include only the number along the transect, the full ID prefix includes the grid cell, transect number, and area, e.g. "E1J9G2-UXO15\_00039-001".



DGM Survey Area:	0.91 acres	Survey Date(s):	09/12/2012 - 09/19/2012
Linear Survey Distance:	3680.52 meters	Map Creation Date:	12/3/2013
Targets < 2.5 mV:	45	Map Creator:	J. Weller
Targets ≥ 2.5 - < 8 mV:	115	Map Approver:	M. Barner
Targets ≥ 8 mV:	172		
Targets Cultural:	14		

**FIGURE 11**  
**Digital Geophysical Mapping Report UXO 15**  
**DGM Findings PI-9 South**  
*Former VNTR, Vieques, Puerto Rico*

**Appendix A**

**UXO 15 Geophysical System Verification Report**

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**Final**

**Appendix A**

**Atlantic Fleet Weapons Training Facilities-Vieques  
Geophysical System Verification Report  
UXO 15**

**Former Vieques Naval Training Range  
Vieques, Puerto Rico**

**Contract Task Order**

**May 2014**

Prepared for

**Department of the Navy  
Naval Facilities Engineering Command  
Atlantic Division**

Under the

**NAVFAC CLEAN 8012 Program  
Contract N62470-11-D-8012**

Prepared by



**CH2MHILL**

Virginia Beach, Virginia

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# Geophysical System Verification

CH2M HILL implemented the Geophysical System Verification (GSV) process for the digital geophysical mapping (DGM) conducted for the site investigation at UXO-15 at the Former Vieques Naval Training Range (VNTR) in Vieques, Puerto Rico. The DGM was conducted in accordance with the current GSV Plan (CH2M HILL, 2012).

The GSV process compares signal strength and sensor performance to known response curves of industry standard objects (ISOs) to validate DGM systems before and during site surveys. Validation is initially performed along an Instrument Verification Strip (IVS) and followed by a blind seeding program.

For the DGM at VNTR, the Geonics, Ltd. EM61-MK2 was presumptively-selected and validated. Positioning data were recorded using the fiducial method. This report documents the results of the DGM system verification process for the investigation at UXO-15.

## Section 1: Instrument Verification Strip (IVS) Location

Two new IVS locations were constructed in August and September 2012, for various planned DGM projects at VNTR beginning in summer 2012. One IVS was constructed near Camp Garcia and the other near the down-range Staging Area (**Figure 1**); these locations are referred to as IVS 01 and IVS 02, respectively. IVS seed items from previous investigations at Camp Garcia and the Staging Area were removed prior to construction of the new IVS locations. At each new IVS location, new ISOs were buried along the center strip of each IVS in accordance with the current GSV Plan (CH2M HILL, 2012).

For the investigation at UXO-15, the Camp Garcia IVS (IVS 01) was used for validation of the EM61-MK2. The IVS transect start and end points as well as the ISO locations were recorded by CH2M HILL using a Trimble R8 real-time kinematic GPS (RTK GPS). **Table 1** summarizes the seeded IVS transect at the Camp Garcia IVS.

FIGURE 1  
**IVS Locations**  
 VNTR, Vieques, Puerto Rico



TABLE 1  
**IVS 01 Seeded Transect Details**  
*VNTR, Vieques, Puerto Rico*

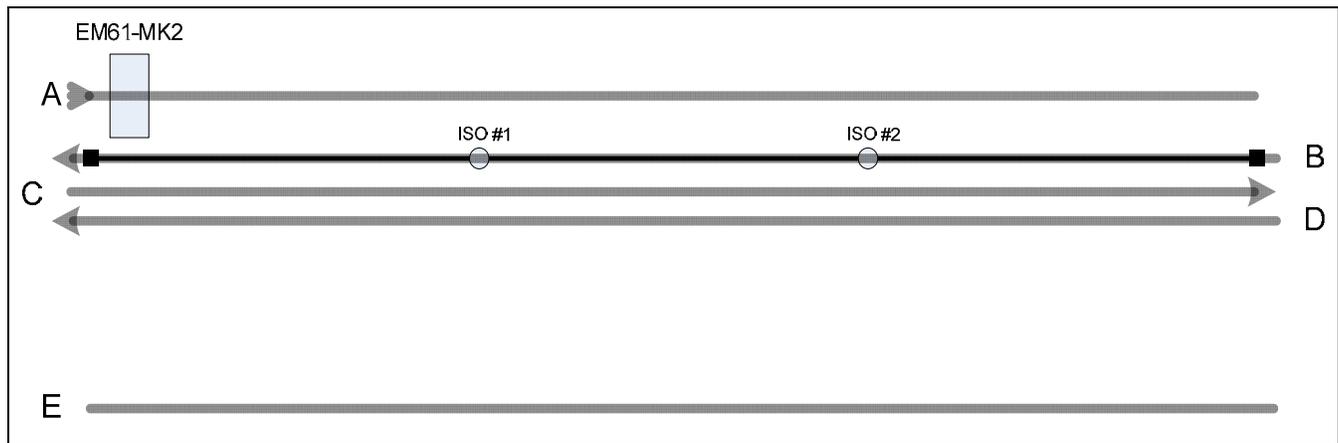
Location	Seeded Transect Point ID	Easting (meters)	Northing (meters)	ISO Orientation
Camp Garcia (IVS 01)	L2_Start	244353.355	2005014.701	N/A
	ISO_01	244352.789	2005009.765	V; 10 cm deep
	ISO_02	244352.386	2005004.812	V; 23 cm deep
	L2_End	244351.87	2005000.816	N/A

Note 1: Coordinates are UTM Zone 20N, NAD-83

Note 2: Depths reflect depth below ground surface (in centimeters [cm]) to approximate ISO center of mass; V = Vertical Orientation

The IVS consisted of five individual transects as shown in the generalized IVS transect layout in **Figure 2** and in the GSV Plan (CH2M HILL, 2012).

FIGURE 2  
**Generalized IVS Transect Layout**  
*VNTR, Vieques, Puerto Rico*

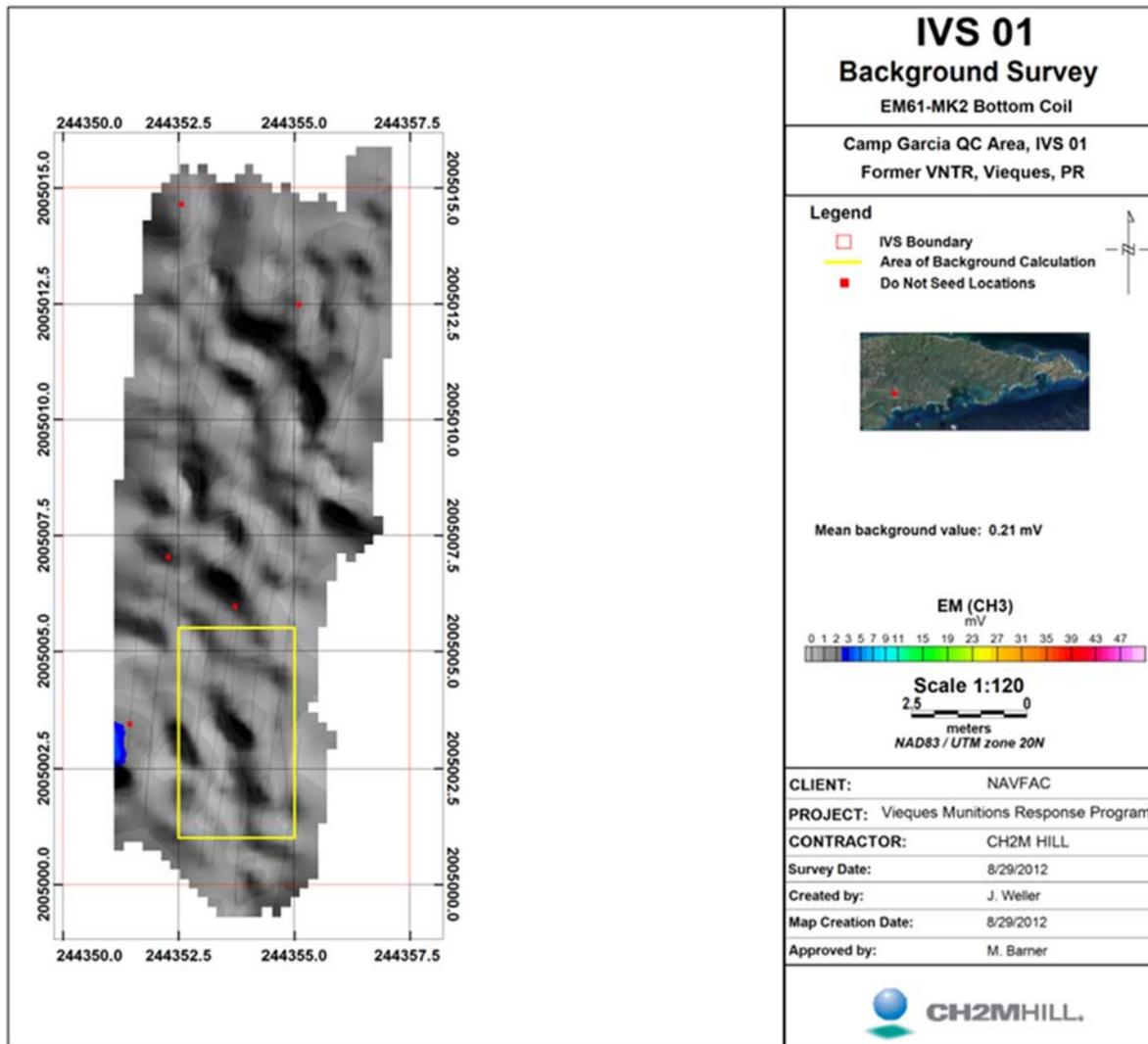


The IVS plot measured approximately 10 meters x 20 meters (approximately 33 feet by 66 feet). The ISOs buried along the IVS center strip consisted of 1-inch (2.54 centimeters [cm]) by 4-inch (10.16 cm) Schedule 40 threaded pipe segments (McMaster-Carr part number 44615K466) in accordance with the GSV Plan (CH2M HILL, 2012). Prior to digging, CH2M HILL UXO personnel conducted avoidance for Munitions and Explosives of Concern (MEC) at the ISO locations using analog geophysical instruments.

## Section 2: Initial Background Surveys

Prior to constructing the new IVS at Camp Garcia, CH2M HILL conducted an initial background survey on August 29, 2012 with the EM61-MK2 (after removal of any old ISOs from the general area). The objective of the background survey was to assess the suitability of the area for an IVS by evaluating background conditions and identifying potential anomalies to avoid during placement of the ISOs. The background survey was completed in accordance with the GSV Plan (CH2M HILL, 2012). **Figure 3** depicts the results of the background survey at the proposed Camp Garcia IVS. The background survey was completed using RTK GPS, where the track path of the EM61-MK2 is depicted by the thin grey lines in **Figure 3**.

**FIGURE 3**  
**IVS 01 Background Survey**  
 VNTR, Vieques, Puerto Rico



The results of the background survey indicated suitable conditions for construction of an IVS. A small portion of the southwestern corner of the survey area yielded responses above 2.5 mV on Channel 3 (the current VNTR program target selection threshold). A statistical analysis was conducted on the background data from within the areas identified by the yellow rectangle on **Figure 3**. The mean Channel 3 response was 0.21 mV.

In order to optimize the signal-to-noise ratio of the response from the ISOs, CH2M HILL identified several locations where decay was consistent with potential targets but the peak amplitude was within the established noise range for Channel 3. These locations are depicted as red dots on **Figures 3**. These coordinates were provided to the DGM field team in order to avoid them during ISO burial, along with the southwestern corner.

### Section 3: IVS Measurement Quality Objectives

**Table 2** summarizes the Measurement Quality Objectives (MQOs) for the IVS survey. These MQOs provide validation of the IVS field procedures and provide added confidence that the geophysical data are of continuing sufficient quality to meet the requirements of the GSV process. MQOs, measurement performance criteria (MPC) and evaluation methods implemented for the GSV process are summarized in **Table 2**.

TABLE 2  
**IVS MQOs**  
*VNTR, Vieques, Puerto Rico*

MQO	MPC	Test Method
<b>DGM System Positioning</b>		
Accurate ISO locations are obtained from DGM positioning method.	Positional error of ISO seeds will not exceed 25 cm (9.8 in).	DGM survey results compared to surveyed ISO locations evaluated to ensure compliance.
<b>DGM System Munitions Detection</b>		
DGM system response is within industry standards for decision.	Response to ISO is comparable to published or calculated results <sup>1</sup> for that item. Response to standardized item will not vary more than ±20% of predicted value in static test.	Results of IVS surveys over seed items in strip qualitatively reviewed.  Results of daily static tests are quantitatively reviewed to ensure compliance.

<sup>1</sup> NRL/MR/6110--09-9183

## Section 4: IVS Surveys

The 5-line IVS survey was conducted at IVS 01 on September 4, 2012. The 5-line IVS survey was conducted using fiducial positioning methods in order to also validate the approach utilized for the UXO-15 production survey. The data were collected in wheel mode with a coil height of 42 cm. The fiducial data were subsequently warped to Eastings and Northings during data processing using the RTK GPS positions obtained during IVS construction.

As part of the QC program, a small ISO was placed on a wooden stand at 46 cm above the center of transmit coil of the EM61-MK2 and the response was recorded to provide a quantitative measure of the system’s response to the small ISO. This response was subsequently compared against industry standard responses (Naval Research Laboratory [NRL], 2009).

## Section 5: IVS Results

The results of the 5-line IVS surveys are presented as **Figure 4**. The peak responses selected during data processing are depicted as black triangles. The RTK GPS locations of the ISOs are represented by the blue dots in each figure. Background response values are indicated by the gray contours and correspond to values of less than 2.5 mV. The orange symbols in each figure represent the start and end stake locations for each IVS transect and the red dots are the low-amplitude peak responses identified in the initial background survey (**Figure 3**).

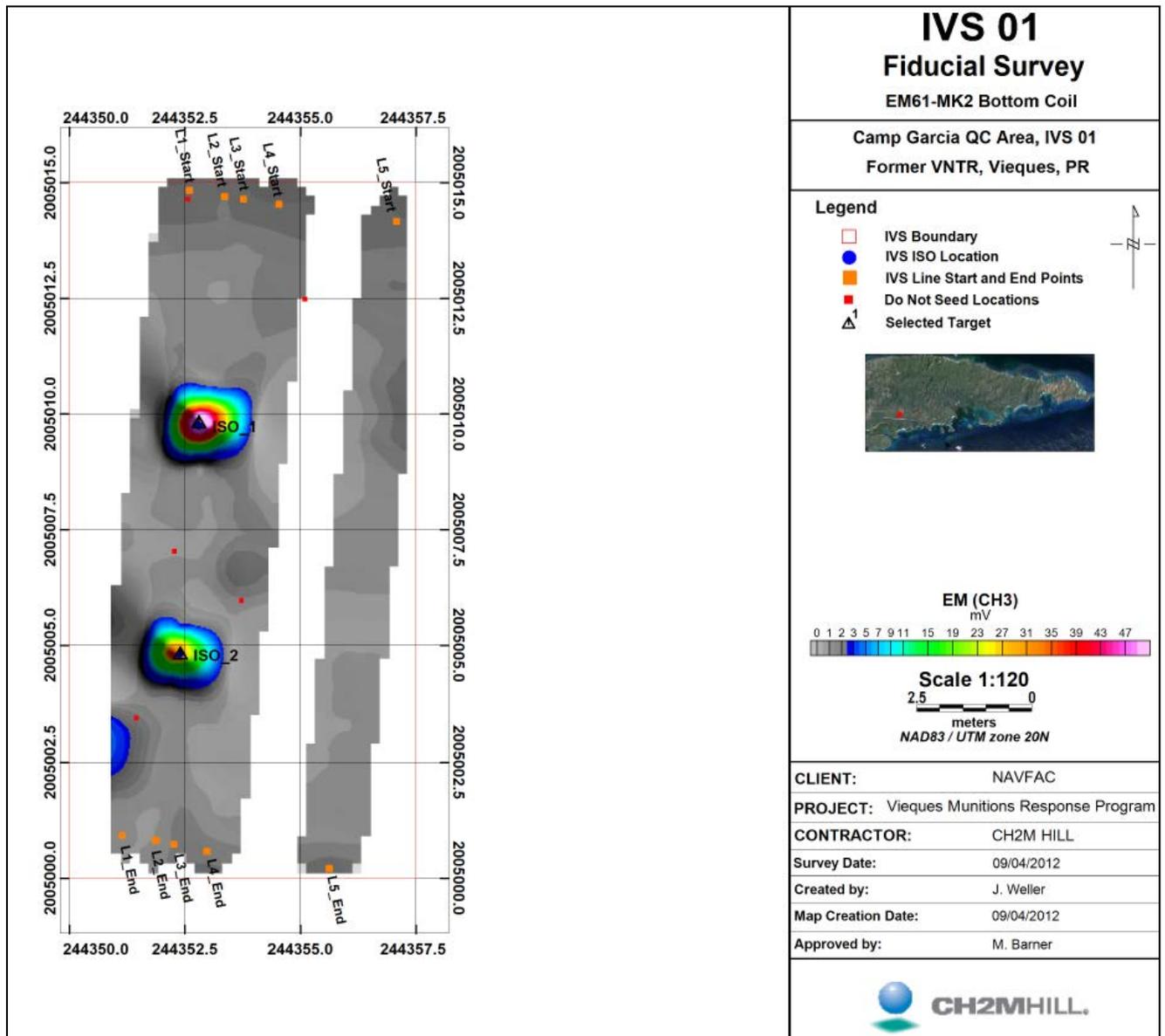
Peak responses from the buried ISOs in the IVS may vary from the predicted values because of variables that intrinsically inject error into the measurement, including the following:

- **Depth measurement:** if terrain is not completely flat around excavated holes, an average of the ground level must be determined in the field, resulting in differences of up to several centimeters;
- **Instrument path:** while the instrument operator attempts to maintain a direct path over the seeded items, slight variation to either side can impact the measured response;
- **Measurement location:** because the instrument records are at set measurement intervals, the actual measured response may not be directly over the item when it is at the measurement location used to predict the response curve
- **Instrument “bounce”:** unless terrain is absolutely flat around the seeded item location, the transmit/receive coil can vary in height above the ground surface by several centimeters from the height used to predict the response curve;

- Inclement weather: the presence of lightning and thunderstorms, even if located miles from the survey area, can have an impact on the performance of an EM61-MK2 due to fluctuations in the ambient electromagnetic field; storms can materialize with little or no warning at VNTR.

Because there is limited ability to control these error variables, the primary measure of the instrument response is the static test with the ISO at a controlled distance from the transmit/receive coil. The survey over the IVS seeds is a secondary measure and can be used to demonstrate kinematic (i.e. in-motion) detection of the ISOs, demonstrate appropriate fall-off of response from deeper items, measure representative background response, and demonstrate positioning system accuracy under kinematic conditions.

FIGURE 4  
**5-Line IVS 01 Results from 9/4/2012**  
 VNTR, Vieques, Puerto Rico



The results of the IVS survey in **Figure 4** indicate that the background responses were relatively low and consistent with the background survey results. The buried ISOs were successfully detected by the EM61-MK2 system and selected as targets during data processing. The DGM System Positioning MQO ( $\pm 25$  cm)

was met for the survey, as presented in **Table 3**. The offsets measured during the daily IVS seeded transect collection for the production DGM will be presented in the final beach dynamics investigation report.

**TABLE 3**  
**IVS 01 ISO Positional Offsets**  
*VNTR, Vieques, Puerto Rico*

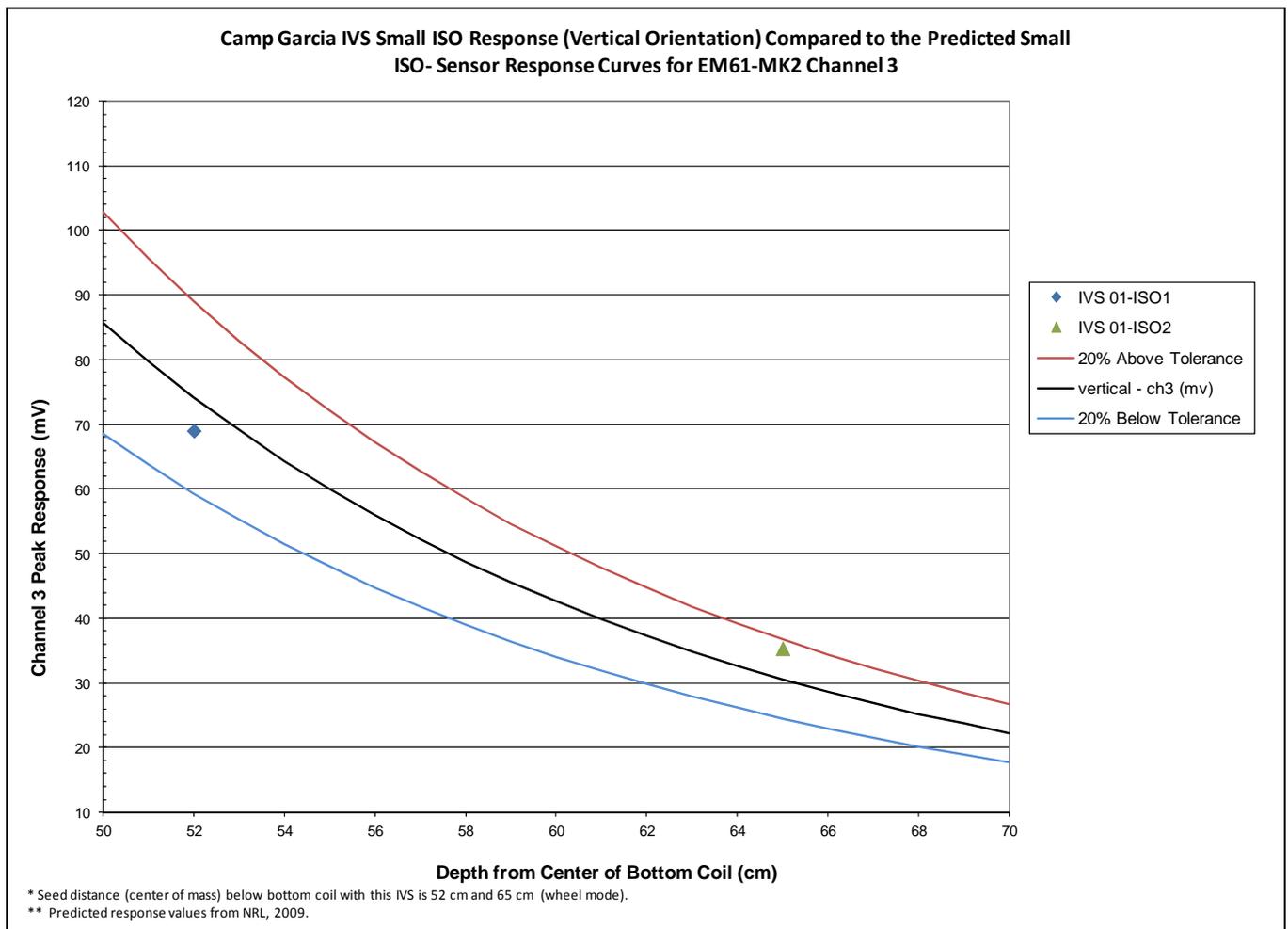
Date	ISO_01 Easting (meters)	ISO_01 Northing (meters)	ISO_01 Offset (centimeters)	ISO_02 Easting (meters)	ISO_02 Northing (meters)	ISO_02 Offset (centimeters)
9/4/2012	244352.84	2005009.82	7.8	244352.29	2005004.76	11.2

Note 1: Coordinates are UTM Zone 20N, NAD-83

Note 2: Offsets measured relative to ISO\_01 and ISO\_02 coordinates in Table 1.

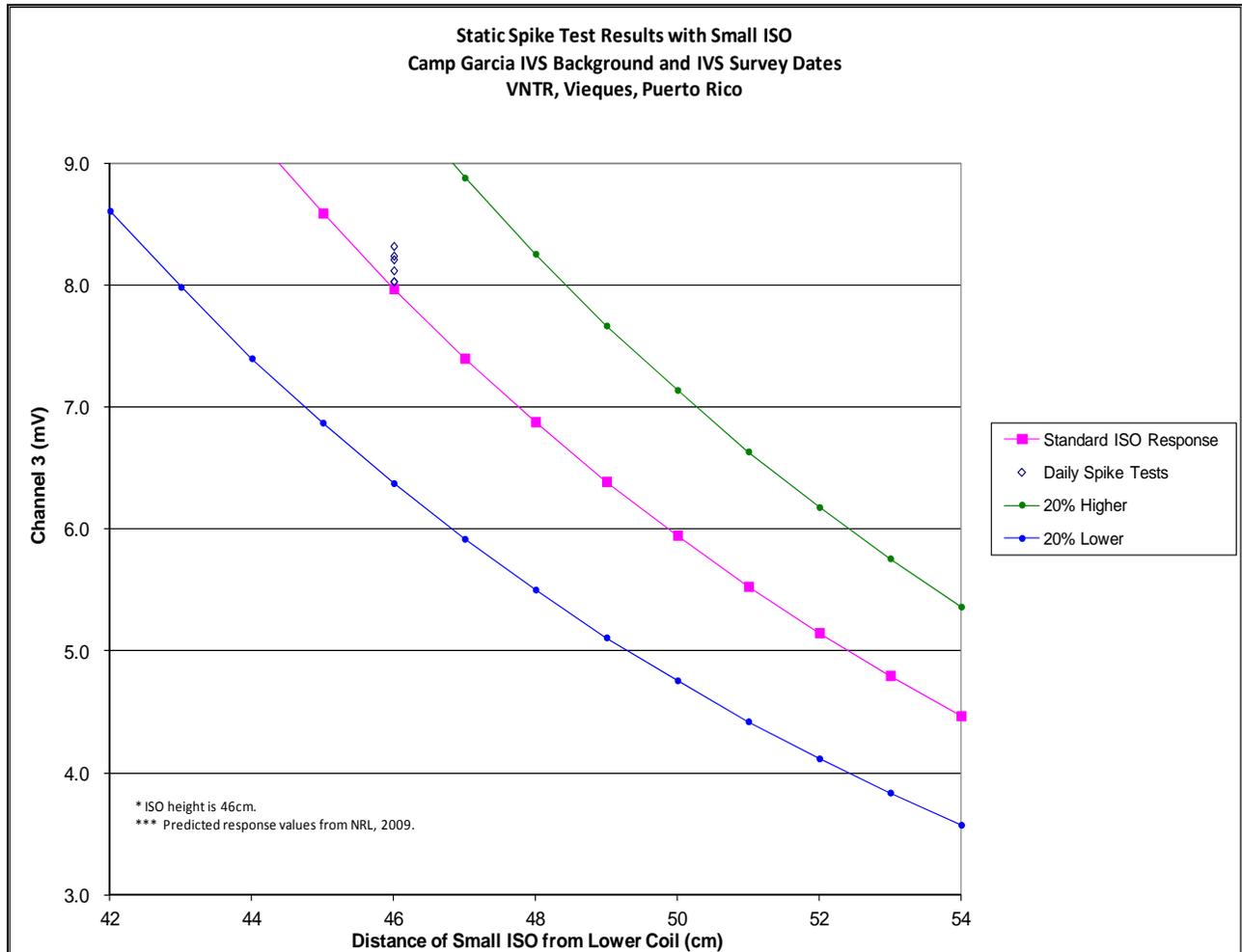
The results of the ISO analysis for the 5-line IVS survey are presented as **Figure 5**. The responses from the ISOs indicate that the EM61-MK2 system detected the items within reasonably acceptable ranges of the predicted values for a kinematic system. The ISO analysis from the daily seeded IVS transect survey for the production DGM will be provided in the final UXO-15 investigation report.

**FIGURE 5**  
**Small ISO Analysis from Kinematic EM61-MK2 Along Seeded Transect at IVS 01**  
*VNTR, Vieques, Puerto Rico*



The results of the static ISO tests from the dates of the background survey and the 5-line IVS survey are presented as **Figure 6**. The results of the daily QC static tests from the production DGM will be provided in the final UXO-15 investigation report.

FIGURE 6  
**ISO Static Test Results, IVS 01**  
 VNTR, Vieques, Puerto Rico



The results of the static spike tests are within the tolerance of the predicted response values and meet the MQO. The average Channel 3 response for the static tests from the dates of the 5-line IVS surveys was 8.2 mV compared to a predicted Channel 3 response of 8.0 mV for a horizontal ISO (orientation on wooden stand) at a height of 46 cm. The standard deviation of the responses from the static tests conducted on the dates of the 5-line surveys was 0.12 mV.

## Section 6: Geophysical Anomaly Selection

The results of the background and 5-line IVS survey conducted by CH2M HILL at IVS 01 indicate that the VNTR program target threshold of 2.5 mV on Channel 3 can continue to be confidently utilized for the investigation at UXO-15. In addition, the results of the background and 5-line IVS surveys indicate that anomalies exhibiting size and decay consistent with potential targets of interest, but that have a peak response of less than 2.5 mV, may also be reliably selected for potential future intrusive investigation and consideration by the VNTR project team. However, decisions regarding these potential targets within the

background noise range will be made on a transect by transect basis due to potential variations in the background conditions across the survey area.

## Section 7: Blind Seed Program

As part of the on-going GSV process, a DGM blind seed program was implemented for the UXO-15 investigation. All DGM seed items were buried in accordance with the GSV Plan (CH2M HILL, 2012), were successfully detected by the EM61-MK2 within the MQO ( $\pm 1$  m) as of October 2012, and were selected as targets during data processing. The results of the blind seed program to date are summarized in **Table 4**.

TABLE 4  
**UXO-15 Blind Seed Results (October 2012)**  
*VNTR, Vieques, Puerto Rico*

QC Seed	DGM Target Easting (meters)	DGM Target Northing (meters)	QC Seed Easting (meters)	QC Seed Northing (meters)	Delta X	Delta Y	Offset (centimeters)
QC-04	242550.4	2003392.2	242550.425	2003391.764	0.025	-0.436	43.7
QC-01	241948	2003382	241947.808	2003382.085	-0.192	0.085	21.0
QC-03	242121.8	2003544.4	242121.649	2003544.08	-0.151	-0.32	35.4
QC-02	242253.4	2003441	242253.417	2003441.234	0.017	0.234	23.5

Note 1: Coordinates are UTM Zone 20N, NAD-83

## Section 8: GSV Conclusions

CH2M HILL performed 5-line IVS surveys at IVS 01 as part of the GSV process for the UXO-15 investigation. Prior to construction of the IVS, a background survey was conducted to evaluate background conditions and the overall suitability of the proposed location. The EM61-MK2 system was successfully validated for use at VNTR and was determined to be capable of meeting the investigation objective.

## Section 9: References

CH2M HILL, 2012. *Geophysical System Verification Plan, Multiple Sites Investigation, Former Vieques Naval Training Range, Vieques, Puerto Rico*. August.

Naval Research Laboratory, 2009. *EM61-MK2 Response of Three Surrogates, NRL/MR/6110-09-9183*. March.

**Attachment 5**

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CTO-037  
 Vieques East UXO 15  
 Validated Sediment Raw Analytical Data  
 March 2013

Sample ID	VEUXO15-SD01-06I-0313	VEUXO15-SD01P-06I-0313	VEUXO15-SD06-06I-0313
Sample Date	3/15/13	3/15/13	3/15/13
Chemical Name			
<b>Explosives (UG/KG)</b>			
1,3,5-Trinitrobenzene	48 U	44 U	44 UJ
1,3-Dinitrobenzene	48 U	44 U	44 UJ
2,4,6-Trinitrotoluene	48 U	44 U	44 U
2,4-Dinitrotoluene	48 U	44 U	44 UJ
2,6-Dinitrotoluene	48 U	44 U	44 UJ
2-Amino-4,6-dinitrotoluene	48 U	44 U	44 UJ
2-Nitrotoluene	48 U	44 U	44 UJ
3,5-Dinitroaniline	48 U	44 U	44 U
3-Nitrotoluene	48 U	44 U	44 U
4-Amino-2,6-dinitrotoluene	48 U	44 U	44 UJ
4-Nitrotoluene	48 U	44 U	44 UJ
HMX	48 U	44 U	44 UJ
Nitrobenzene	48 U	44 U	44 U
Nitroglycerin	380 U	350 U	350 U
Perchlorate	0.49 U	0.47 U	0.43 U
PETN	380 U	350 U	350 U
RDX	48 U	44 U	44 UJ
Tetryl	48 U	44 U	44 U
<b>Total Metals (MG/KG)</b>			
Aluminum	11,400	10,400	6,100
Antimony	0.55 UJ	0.47 UJ	4 J
Arsenic	33.3 J	19.2 J	1.4
Barium	91.1 J	88.3 J	162 J
Beryllium	0.12 J	0.11 J	0.04 J
Cadmium	0.33 U	0.28 U	0.69
Calcium	6,600	5,270	2,140
Chromium	12.3 J	8.3 J	13.2 J
Chromium (hexavalent)	0.43 U	0.43 U	0.38 U
Cobalt	2.5	1.9	2.4
Copper	85.8 J	23.8 J	560 J
Iron	11,000 J	9,460 J	13,400 J
Lead	1.9	1.7	528
MAGNESIUM	3,390	2,810	4,920
Manganese	202 J	142 J	183
Nickel	1.5	1.3	19.6
Potassium	2,280	2,120	1,020
Selenium	0.77 U	0.66 U	0.5 U
Silver	0.44 U	0.38 U	0.07 J
Sodium	6,180	5,190	5,350
Thallium	0.02 J	0.02 J	0.01 J
Vanadium	21.9	17.9	15.2
Zinc	14.6 J	13.2 J	3,710 J
<b>Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOL/G)</b>			

CTO-037  
Vieques East UXO 15  
Validated Sediment Raw Analytical Data  
March 2013

Sample ID	VEUXO15-SD01-06I-0313	VEUXO15-SD01P-06I-0313	VEUXO15-SD06-06I-0313
Sample Date	3/15/13	3/15/13	3/15/13
<b>Chemical Name</b>			
Acid volatile sulfide	0.051 J	NS	0.084 U
Cadmium	7.03E-04 J	NS	0.00122
Copper	0.805	NS	1.28
Lead	0.0032	NS	0.318
Mercury	0.000019 U	NS	1.82E-05 J
Nickel	0.00302 J	NS	0.00762
Silver	0.00077 U	NS	0.00077 U
Zinc	0.0247	NS	21.7
<b>Wet Chemistry</b>			
pH (pH units)	8.1	NS	8
Redox (MV)	167	NS	195
Total organic carbon (TOC) (UG/G)	2,800	NS	1,900
<b>Grain Size (PCT)</b>			
COARSE SAND (%)	1.8	NS	1.9
FINE SAND (%)	34.4	NS	38.8
FINES (%)	35	NS	36
GRAVEL (%)	3.5	NS	2
MEDIUM SAND (%)	25.3	NS	21.3
SAND (%)	61.5	NS	62
GS03 SIEVE 3" (75 MM)	100	NS	100
GS05 SIEVE 2" (50 MM)	100	NS	100
GS06 SIEVE 1.5" (37.5 MM)	100	NS	100
GS07 SIEVE 1" (25.0 MM)	100	NS	100
GS08 SIEVE 0.75" (19.0 MM)	100	NS	100
GS10 SIEVE 0.375" (9.5 MM)	97.2	NS	100
SIEVE NO. 004 (4.75 MM)	96.5	NS	98
SIEVE NO. 010 (2.00 MM)	94.7	NS	96.1
SIEVE NO. 020 (850 UM)	84.9	NS	88.1
SIEVE NO. 040 (425 UM)	69.4	NS	74.8
SIEVE NO. 060 (250 UM)	56.8	NS	62.9
SIEVE NO. 080 (180 UM)	48.6	NS	53.8
SIEVE NO. 100 (150 UM)	44.8	NS	49.2
SIEVE NO. 200 (75 UM)	35	NS	36

C:\Users\sholland\Desktop\Svenfurth EXAMPLES\UXO 15\Attachment 5 - Data Summary Tables\Sediment Sample Results.xlsx], Juliana Dean, 06/12/2013

**Notes:**

- J - Estimated result
- NS - Not sampled
- U - Non-detect
- UJ - Non-detect, quantitation limit may be inaccurate
- UG/G - Micrograms per gram
- UG/KG - Micrograms per kilogram
- MG/KG - Milligrams per kilogram
- MV - Millivolts
- PCT - Percent
- UMOL/G - Micromoles per gram

CTO-037  
Vieques East UXO 15  
Validated Sediment Detected Analytical Data  
March 2013

Sample ID	VEUXO15-SD01-06I-0313	VEUXO15-SD01P-06I-0313	VEUXO15-SD06-06I-0313
Sample Date	3/15/13	3/15/13	3/15/13
Chemical Name			
<b>Explosives (UG/KG)</b>			
No Detections			
<b>Total Metals (MG/KG)</b>			
Aluminum	11,400	10,400	6,100
Antimony	0.55 UJ	0.47 UJ	4 J
Arsenic	33.3 J	19.2 J	1.4
Barium	91.1 J	88.3 J	162 J
Beryllium	0.12 J	0.11 J	0.04 J
Cadmium	0.33 U	0.28 U	0.69
Calcium	6,600	5,270	2,140
Chromium	12.3 J	8.3 J	13.2 J
Cobalt	2.5	1.9	2.4
Copper	85.8 J	23.8 J	560 J
Iron	11,000 J	9,460 J	13,400 J
Lead	1.9	1.7	528
MAGNESIUM	3,390	2,810	4,920
Manganese	202 J	142 J	183
Nickel	1.5	1.3	19.6
Potassium	2,280	2,120	1,020
Silver	0.44 U	0.38 U	0.07 J
Sodium	6,180	5,190	5,350
Thallium	0.02 J	0.02 J	0.01 J
Vanadium	21.9	17.9	15.2
Zinc	14.6 J	13.2 J	3,710 J
<b>Acid Volatile Sulfide/Simultaneously Extractable Metals (UMOL/G)</b>			
Acid volatile sulfide	0.051 J	NS	0.084 U
Cadmium	7.03E-04 J	NS	0.00122
Copper	0.805	NS	1.28
Lead	0.0032	NS	0.318
Mercury	0.000019 U	NS	1.82E-05 J
Nickel	0.00302 J	NS	0.00762
Zinc	0.0247	NS	21.7
<b>Wet Chemistry</b>			
pH (pH units)	8.1	NS	8
Redox (MV)	167	NS	195
Total organic carbon (TOC) (UG/G)	2,800	NS	1,900

CTO-037  
 Vieques East UXO 15  
 Validated Sediment Detected Analytical Data  
 March 2013

Sample ID	VEUXO15-SD01-06I-0313	VEUXO15-SD01P-06I-0313	VEUXO15-SD06-06I-0313
Sample Date	3/15/13	3/15/13	3/15/13
Chemical Name			
Grain Size (PCT)			
COARSE SAND (%)	1.8	NS	1.9
FINE SAND (%)	34.4	NS	38.8
FINES (%)	35	NS	36
GRAVEL (%)	3.5	NS	2
MEDIUM SAND (%)	25.3	NS	21.3
SAND (%)	61.5	NS	62
GS03 SIEVE 3" (75 MM)	100	NS	100
GS05 SIEVE 2" (50 MM)	100	NS	100
GS06 SIEVE 1.5" (37.5 MM)	100	NS	100
GS07 SIEVE 1" (25.0 MM)	100	NS	100
GS08 SIEVE 0.75" (19.0 MM)	100	NS	100
GS10 SIEVE 0.375" (9.5 MM)	97.2	NS	100
SIEVE NO. 004 (4.75 MM)	96.5	NS	98
SIEVE NO. 010 (2.00 MM)	94.7	NS	96.1
SIEVE NO. 020 (850 UM)	84.9	NS	88.1
SIEVE NO. 040 (425 UM)	69.4	NS	74.8
SIEVE NO. 060 (250 UM)	56.8	NS	62.9
SIEVE NO. 080 (180 UM)	48.6	NS	53.8
SIEVE NO. 100 (150 UM)	44.8	NS	49.2
SIEVE NO. 200 (75 UM)	35	NS	36

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**Notes:**

- J -Estimated result
- NS - Not sampled
- U - Non-detect
- UJ - Non-detect, quantitation limit may be inaccurate
- UG/G - Micrograms per gram
- UG/KG - Micrograms per kilogram
- MG/KG - Milligrams per kilogram
- MV - Millivolts
- PCT - Percent
- UMOL/G - Micromoles per gram
- Shading indicates detection

CTO-037  
Vieques East UXO 15  
Validated Surface Soil Raw Analytical Data  
March 2013

Sample ID	VEUXO15-SS02-061-0313	VEUXO15-SS03-061-0313	VEUXO15-SS03P-061-0313	VEUXO15-SS04-061-0313
Sample Date	3/15/13	3/15/13	3/15/13	3/15/13
Chemical Name				
<b>Explosives (UG/KG)</b>				
1,3,5-Trinitrobenzene	49 U	51 U	51 U	49 U
1,3-Dinitrobenzene	49 U	51 U	51 U	49 U
2,4,6-Trinitrotoluene	49 U	51 U	51 U	49 U
2,4-Dinitrotoluene	49 U	51 U	51 U	49 U
2,6-Dinitrotoluene	49 U	51 U	51 U	49 U
2-Amino-4,6-dinitrotoluene	49 U	51 U	51 U	49 U
2-Nitrotoluene	49 U	51 U	51 U	49 U
3,5-Dinitroaniline	49 U	51 U	51 U	49 U
3-Nitrotoluene	49 U	51 U	51 U	49 U
4-Amino-2,6-dinitrotoluene	49 U	51 U	51 U	49 U
4-Nitrotoluene	49 U	51 U	51 U	49 U
HMX	49 U	51 U	51 U	49 U
Nitrobenzene	49 U	51 U	51 U	49 U
Nitroglycerin	390 U	410 U	410 U	390 U
Perchlorate	0.43 U	0.48 U	0.45 U	0.48 U
PETN	390 U	410 U	410 U	390 U
RDX	49 U	51 U	51 U	49 U
Tetryl	49 U	51 U	51 U	49 U
<b>Total Metals (MG/KG)</b>				
Aluminum	52,300	43,300	42,900	52,000
Antimony	2.8 UJ	2.7 UJ	2.8 UJ	2.8 UJ
Arsenic	6.8	11	11.6	12.6
Barium	80	74.3	71.4	81.5
Beryllium	1.1	1.4	1.5	1.7
Cadmium	1.7 U	0.23 J	0.21 J	2.5 J
Calcium	6,430 J	8,430 J	6,330 J	2,750 J
Chromium	75 J	115 J	117 J	130 J
Chromium (hexavalent)	4 R	4.1 UJ	4.2 UJ	0.92 UJ
Cobalt	12.6	19.3	20	20.7
Copper	26.3	37.9	35.4	41.7
Iron	47,800	60,500	61,100	66,700
Lead	18.3	66.5	51.6	24
MAGNESIUM	4,710	3,560	3,340	3,210
Manganese	1,410	1,640	1,640	1,810
Nickel	35.2	24.5	24.2	27.4
Potassium	7,720	5,110	4,940	4,780
Selenium	3.3 J	4.6 J	2.6 J	3.8 J
Silver	1.4 J	0.7 J	0.45 J	0.39 J
Sodium	218	377	370	274
Thallium	0.37	0.47	0.45	0.56
Vanadium	75.3	99.3	103	110
Zinc	61.4	565 J	338 J	804

CTO-037  
 Vieques East UXO 15  
 Validated Surface Soil Raw Analytical Data  
 March 2013

Sample ID	VEUXO15-SS02-06I-0313	VEUXO15-SS03-06I-0313	VEUXO15-SS03P-06I-0313	VEUXO15-SS04-06I-0313
Sample Date	3/15/13	3/15/13	3/15/13	3/15/13
Chemical Name				
<b>Wet Chemistry</b>				
pH (pH units)	7.6	7.6	NS	6.4
Redox (MV)	168	168	NS	235
Total organic carbon (TOC) (UG/G)	46,000	60,000	NS	25,000

C:\Users\sholland\Desktop\Swenfurth EXAMPLES\UXO 15\Attachment 5 - Data Summary Tables(Surface Soil Results.xlsx), Juliana Dean, 06/12/2013

**Notes:**

J - Estimated results

NS - Not sampled

R - Rejected result

U - Non-detect

be inaccurate

MG/KG - Milligrams per kilogram

MV - Millivolts

UG/G - Micrograms per gram

UG/KG - Micrograms per kilogram

CTO-037  
Vieques East UXO 15  
Validated Surface Soil Detected Analytical Data  
March 2013

Sample ID	VEUXO15-SS02-061-0313	VEUXO15-SS03-061-0313	VEUXO15-SS03P-061-0313	VEUXO15-SS04-061-0313
Sample Date	3/15/13	3/15/13	3/15/13	3/15/13
Chemical Name				
Explosives (UG/KG)				
No Detections				
<b>Total Metals (MG/KG)</b>				
Aluminum	52,300	43,300	42,900	52,000
Arsenic	6.8	11	11.6	12.6
Barium	80	74.3	71.4	81.5
Beryllium	1.1	1.4	1.5	1.7
Cadmium	1.7 U	0.23 J	0.21 J	2.5 J
Calcium	6,430 J	8,430 J	6,330 J	2,750 J
Chromium	75 J	115 J	117 J	130 J
Cobalt	12.6	19.3	20	20.7
Copper	26.3	37.9	35.4	41.7
Iron	47,800	60,500	61,100	66,700
Lead	18.3	66.5	51.6	24
MAGNESIUM	4,710	3,560	3,340	3,210
Manganese	1,410	1,640	1,640	1,810
Nickel	35.2	24.5	24.2	27.4
Potassium	7,720	5,110	4,940	4,780
Selenium	3.3 J	4.6 J	2.6 J	3.8 J
Silver	1.4 J	0.7 J	0.45 J	0.39 J
Sodium	218	377	370	274
Thallium	0.37	0.47	0.45	0.56
Vanadium	75.3	99.3	103	110
Zinc	61.4	565 J	338 J	804
<b>Wet Chemistry</b>				
pH (pH units)	7.6	7.6	NS	6.4
Redox (MV)	168	168	NS	235
Total organic carbon (TOC) (UG/G)	46,000	60,000	NS	25,000

C:\Users\sholland\Desktop\Swenfurth EXAMPLEs\UXO 15\Attachment 5 - Data Summary Tables\Surface Soil Results.xlsx], Juliana Dean, 06/12/2013

**Notes:**

- J - Estimated results
- NS - Not sampled
- R - Rejected result
- U - Non-detect
- MG/KG - Milligrams per kilogram
- MV - Millivolts
- UG/G - Micrograms per gram
- UG/KG - Micrograms per kilogram
- Shading indicates detection

**Attachment 6**

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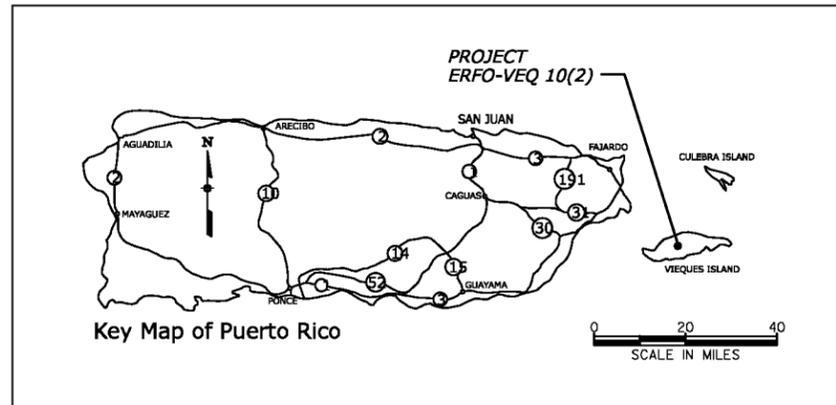
REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
SE	PR	ERFO-VEQ 10(2)	A1	114+164

U.S. DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE

VIEQUES  
NATIONAL WILDLIFE REFUGE

PLANS FOR PROPOSED  
**PROJECT ERFO-VEQ 10(2)**

THE PROJECT CONSISTS OF THE REPAIR OF EXISTING AGGREGATE SURFACED ROADS AND DRAINAGE FEATURES WITHIN THE VIEQUES NATIONAL WILDLIFE REFUGE.  
**VIEQUES, PUERTO RICO**



**INDEX TO SHEETS**

SHEET NO	DESCRIPTION
A1	Title Sheet
A2	Symbols And Abbreviations
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A5-18	Survey Information Sheet
B1	Typical Section
C1-11	Tabulation of Quantities, Schedules and Summaries
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E1-E10	Plans And Profiles and Drainage Cross Sections Rte 103
F1-F7	Plans And Profiles and Drainage Cross Sections Rte 102
G1-G13	Plans And Profiles and Drainage Cross Sections Rte 011
H1-H8	Plans And Profiles and Drainage Cross Sections Rte 012
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V1-V16	Roadway Cross Sections Rte 102
W1-W33	Roadway Cross Sections Rte 011
X1-X23	Roadway Cross Sections Rte 012
Y1-Y45	Roadway Cross Sections Rte 109

**DESCRIPTION OF PROJECT**

**IMPROVEMENT:** Rehabilitation and drainage improvements

**PROJECT LENGTH:** 11.76 Miles (+ 1.06 Miles Access only)

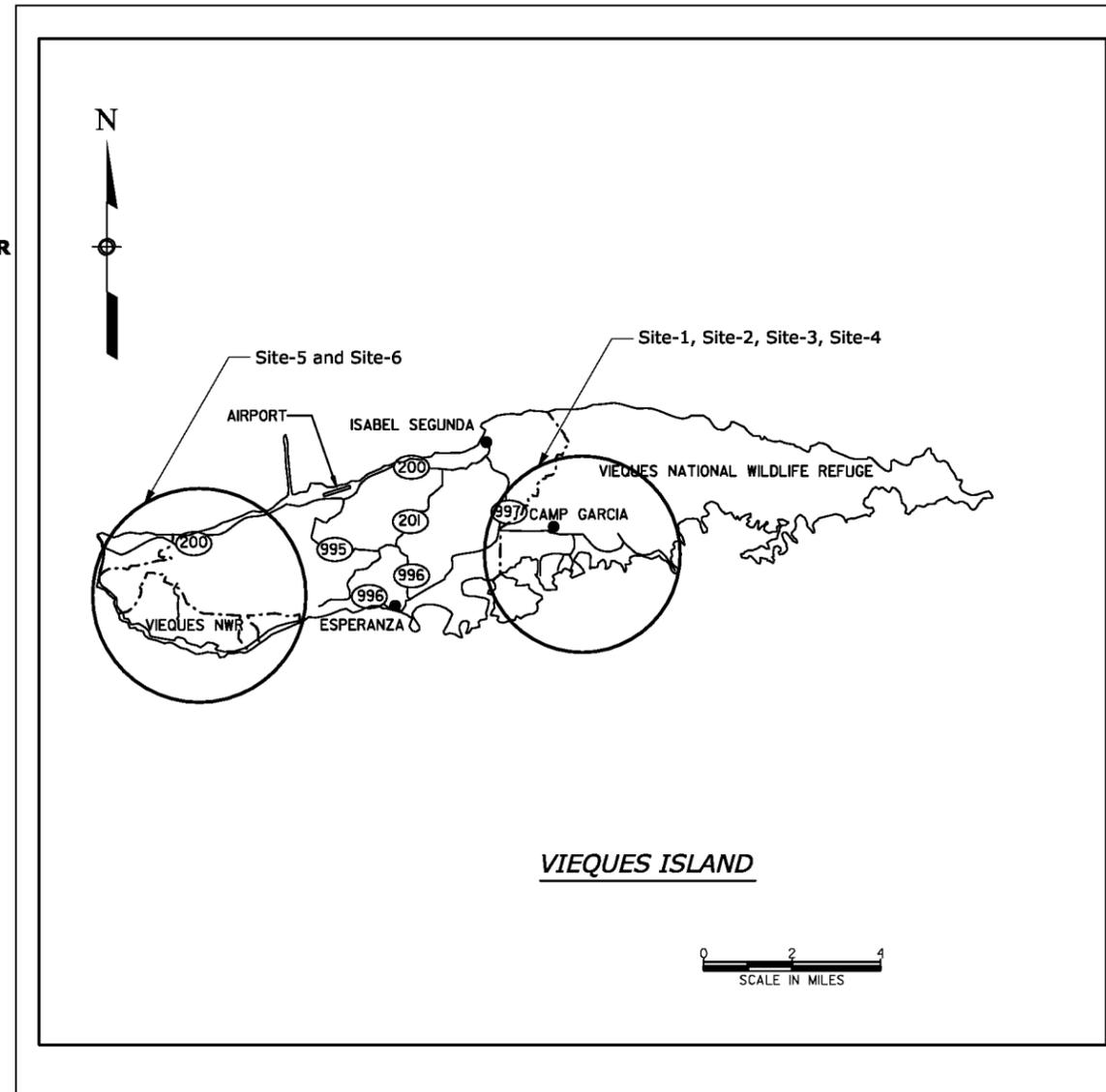
ROAD	LENGTH	WIDTH	SITE	SAMMS ASSET NUMBER
Rte 104 - Blue Beach Rd. (La Chiva Rd.)	1.68 Miles	12'	1	10050015
Rte 103	1.63 Miles	12'	2	10050014
Rte 102 - Puerto Ferro Beach Rd. (Bahia Puerto Ferro Rd.)	1.29 Miles	12'	3	10050010
Rte 011 - Lighthouse Rd. (Puerto Ferro Peninsula Rd.)	2.47 Miles	15'	4	10050056
Rte 012 - Punta Arenas Rd.	1.69 Miles	15'	5	10040183
Rte 109 - Laguna Playa Grande Rd.	3.00 Miles	13'	6	10055546
(Rte 109 Repair for Access only)	1.06 Miles			10055547

**DESIGN DESIGNATION:**

ADT (2007)	100
ADT (2027)	190
D	50/50
V (MPH)	25
e(max)	4%

**SPECIFICATIONS:**

"Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects", FP-03 U.S. Customary Units.



**100% SUBMISSION**

**PLANS PREPARED BY**



**DISASTER NO. PR2004-2-FWS**

6/28/2007 9:47:27 AM m:\proj\hds\erfo\erfo\veg\02\veg\02\111.dgn

<b>PROJECT MANAGER</b>	<b>LEAD DESIGNER</b>
D. Madlansacay	J. Fife

Abutment	Abut. aggr.	Mainline	M.L.
Aggregate Ahead	AH	Material	matl.
Alternate	alt.	Maximum	max.
Average daily traffic	ADT	Mile[Kilometer] post	M.P[K.P.]
Back	BK	Minimum	min.
Balance point	BP	Monument	mon.
Bearing	brg.	Mechanically stabilized embankment	MSE
Beginning	beg.	Original ground	OG
Bench mark	BM	Out to out	o. to o.
Centerline		Outside diameter	OD
Center to center	cc, c-c or c. to c.	On centers	o. c.
Centers	ctrs.	Normal crown	NC or NCR
Clear	clr.	North	N
Column	col.	Pavement	pvmt.
Connection	conn.	Plate	pl.
Construction joint	Constr. jt.	Point of compound curve	PCC
Continuous	cont.	Point of curve	PC
Corrugated metal pipe	CMP	Point of curve to spiral	PCS or CS
Culvert	culv.	Point of intersection	PI
Curve central angle (spiral curve transitions)	$\Delta_c$	Point of spiral to curve	PSC or SC
Curve total angle (curve delta or deflection)	$\Delta$	Point of spiral to reverse spiral	SRS
Design hourly volume	DHV	Point of spiral to tangent	PST or ST
Design speed	V	Point of tangent to spiral	PT
Diagonal	diag.	Point of tangent to curve	PS or TS
Diameter	D, dia., or diaph.	Point on curve	POC
Diaphragm	diaph.	Point on spiral	POS
Distance	dist.	Point on tangent	POT
Drawing(s)	dwg(s), or drwg(s)	Radius	R
Drop Inlet	DI	Range	R.
East	E	Reinforcement (reinforced)	reinf. reqd.
Edge of pavement	EP or EOP	Required	reqd.
Elevation	elev.	Right	Rt., rt. or RT
Elevation with number	El. 94.161 [El. 94.16]	Right-of-way	R/W
Embankment	emb.	Roadway	Rdwy.
End section	ES	Route	Rte.
Equation	EQ or eq.	Section	Sec.
Excavation	exc.	South	S
Expansion joint	exp. jt.	Spacing, spaces or spaced	spa.
Finish	fin.	Spiral central angle	s
Flange	fig.	Standard	std.
Footing	ftg.	Station	Sta.
Galvanized	galv.	Stiffener	stiff.
Gage(gauge)	ga.	Stringer	stgr.
Headwall	hdwl.	Structure	struc.
Hexagon	hex.	Superelevation rate	e
High water	HW	Symmetrical	sym.
Inside diameter	ID	Tangent distance (tangent length)	T
Joint	jt.	Tangent distance (spiral curve transition)	Ts
Lamination	lam.	Temporary benchmark	TBM
Latitude	lat.	Temporary construction easement	TCE
Left	lt., Lt. or LT	Thread	thd.
Length of curve(simple curve)	L	Township	T.
Length of curve (spiral curve transition)	Lc	Typical	typ.
Length of spiral	Ls	Vehicle per hour	vph
Longitudinal(longitude)	long.	Vertical point of intersection	VPI
Low water	LW	West	W

NATIONAL BOUNDARY	
STATE BOUNDARY	
COUNTY BOUNDARY	
CITY BOUNDARY	
TOWNSHIP or RANGE LINE	
SECTION LINE	
1/4 SECTION LINE	
1/16 SECTION LINE	
NATIONAL PARK or FOREST BOUNDARY	
PROPERTY LINE	
TRAVERSE POINT (Horizontal & Vertical) Top of Triangle Points North	
TRAVERSE POINT (Horizontal)	
BRASS CAP	
STEEL PIN	
HUB & TACK	
SPOT ELEVATION	
COORDINATE GRID TICK	

RIGHT-OF-WAY LINE	
RIGHT-OF-WAY LINE with MONUMENT	
SECTION CORNER	
1/4 SECTION CORNER	
1/16 SECTION	
PROPERTY CORNER	
PARCEL NUMBER	
EASEMENT (Permanent - Construction)	
ROUTE NUMBERS	
SLOPE STAKE	
ROADWAY, EXISTING	
RAILROAD	
TRAIL	
INTERMITTENT DRAINAGE/ SMALL CREEK	
SPRING	
LARGE CREEK/RIVER	
LAKE, POND or RESERVOIR; MARSHLAND	
PAVEMENT REMOVAL/ROADWAY OBLITERATION	
FULL DEPTH PAVEMENT	
SIDEWALK ASPHALT/CONCRETE	
MILL AND OVERLAY	
OVERLAY	
SILT FENCE	
DIVERSION BERM	
DIVERSION CHANNEL	
CHECK DAM	
RIPRAP/CULVERT RIPRAP	
BORING LOCATION	
TEST PIT	
NORTH ARROW	
MATERIAL SOURCE	

FENCE	
GATE with FENCE	
CATTLEGUARD	
GUARDRAIL	
MEDIAN & SIDE (CONCRETE) BARRIER	
SIGNS	
RETAINING WALL	
OVERHEAD(POWER POLE) UTILITIES	
SUPPORT POLE with ANCHOR	
TELEPHONE BOOTH or PEDESTAL	
STREET LIGHT	
UNDERGROUND UTILITIES	
BRIDGE	
PIPE CULVERT (arrow shows flow)	
PIPE CULVERT with END SECTION	
PIPE CULVERT with HEADWALL	
CULVERT with DROP INLET	
BOX CULVERT	
UNDERDRAIN	
BUILDING	
TREELINE; TREE	

**PROJECT SPECIFIC SYMBOLS AND ABBREVIATIONS:-**

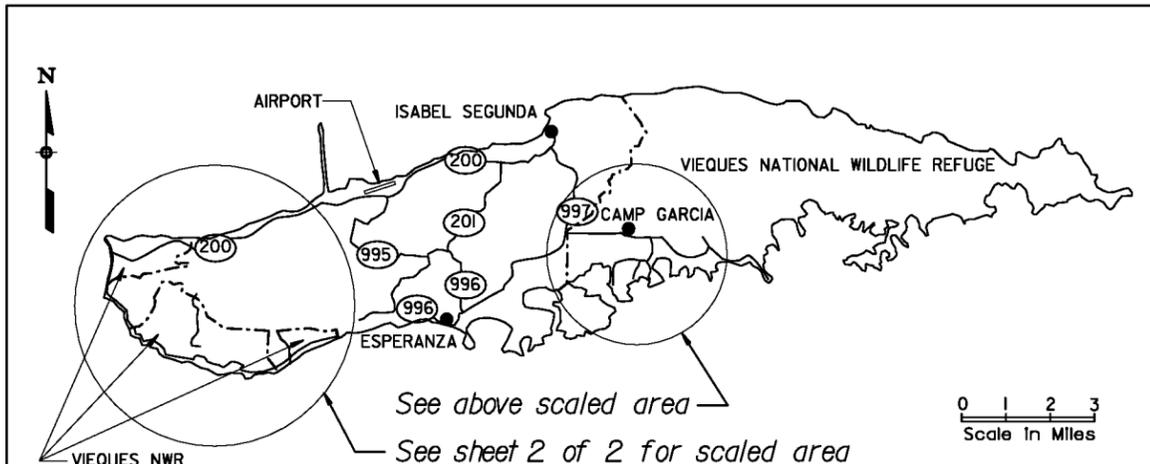
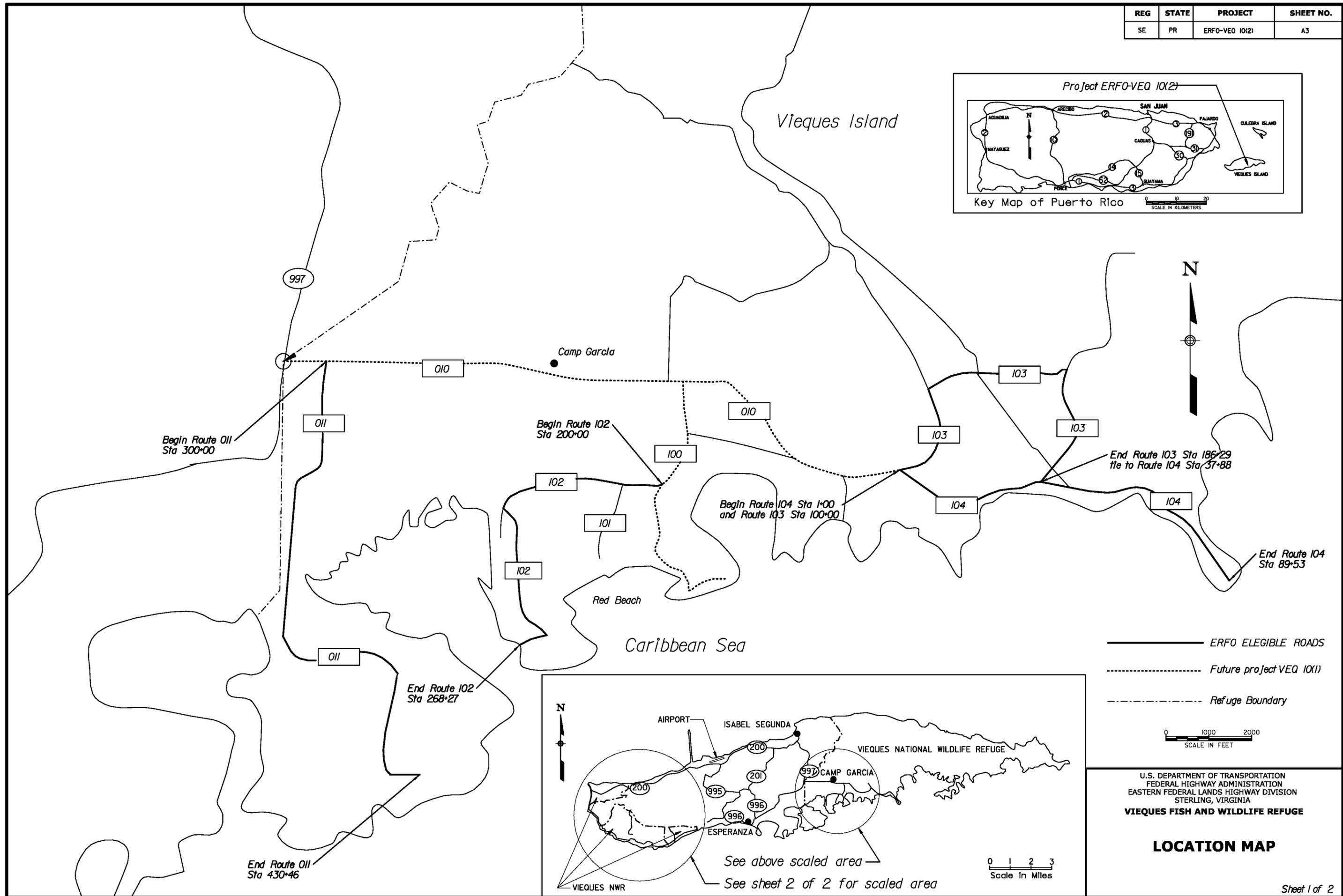
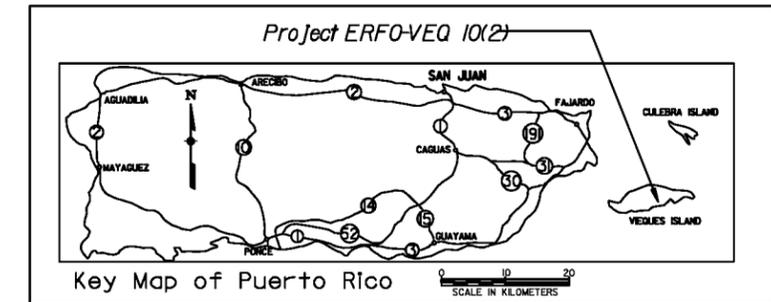
U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

**VIQUES FISH AND WILDLIFE REFUGE**

**SYMBOLS AND ABBREVIATIONS**

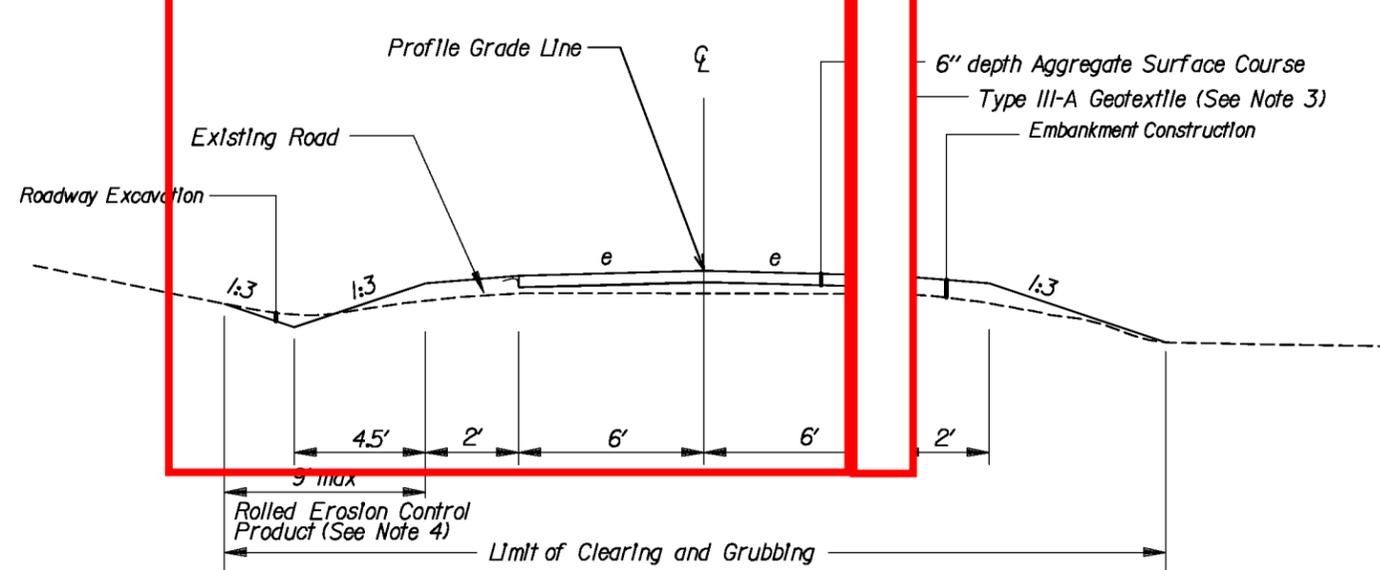
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REG	STATE	PROJECT	SHEET NO.
SE	PR	ERFO-VEQ 10(2)	A3



6/26/2007 9:47:38 AM m:\proj\hds\erfo\erfo\erfo10(2)\proj\_dh\erfo10(2)\VEQ10(2)\_loc.dgn

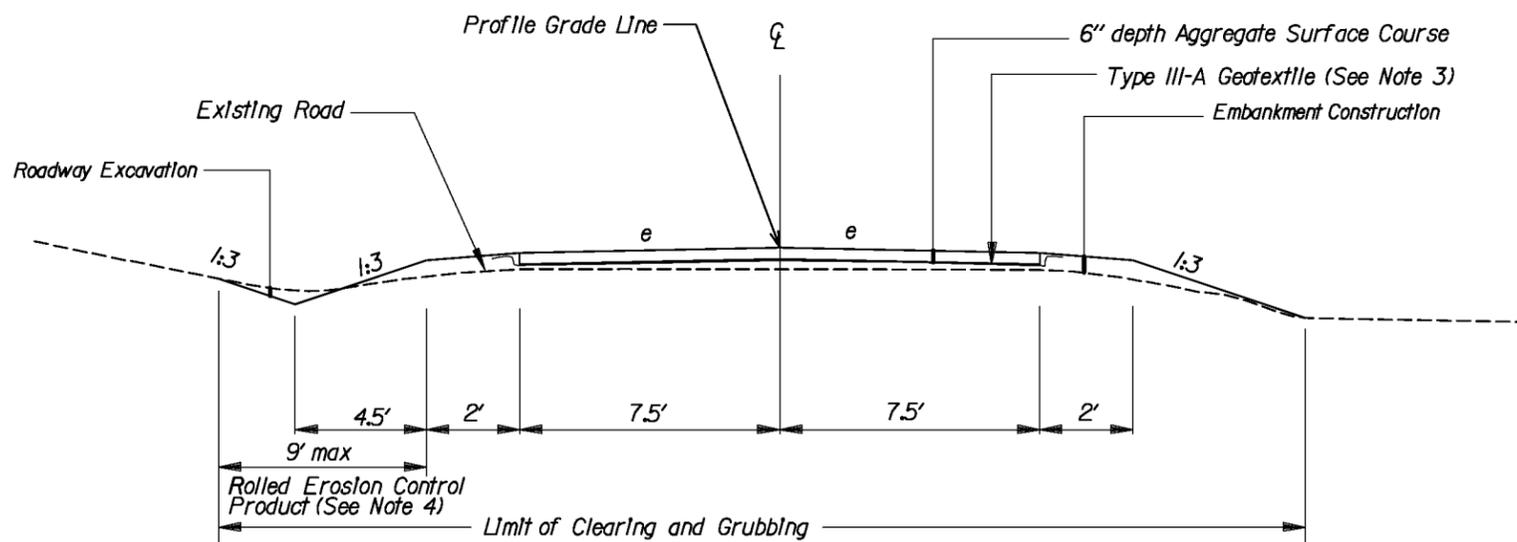
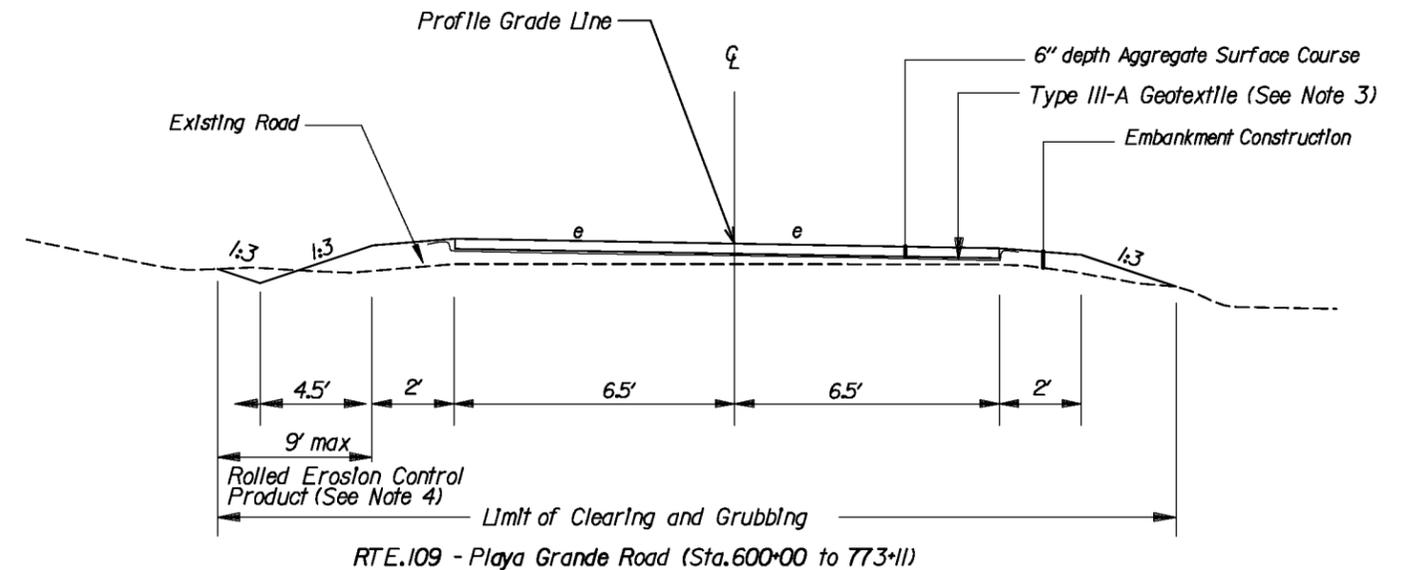
REG	STATE	PROJECT	SHEET NO.
SE	PR	ERF0-VE0 10(2)	BI



RTE.104 - Blue Beach Road (Sta.1+00 to 89+53)

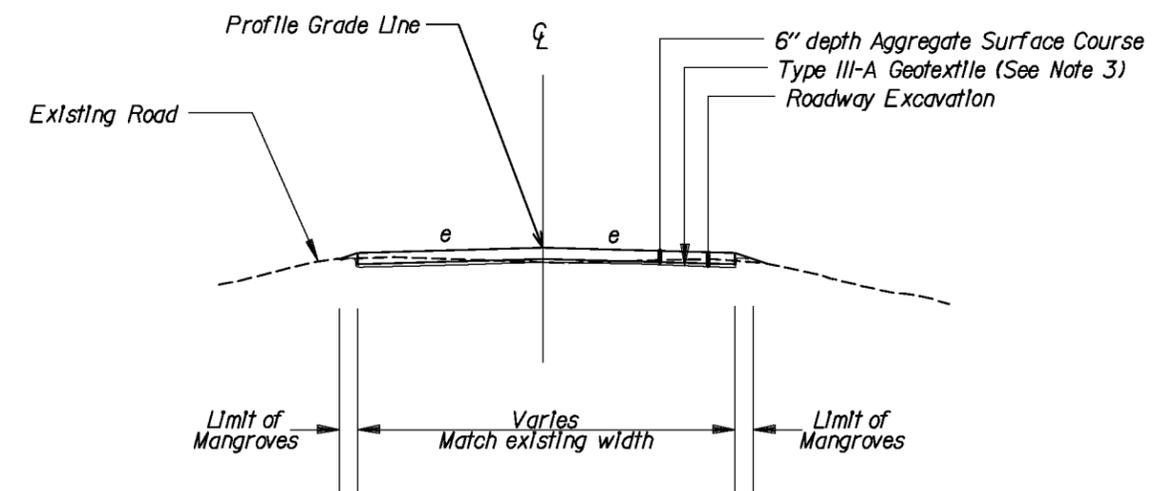
RTE.102 - Puerto Ferro Beach Road (Sta.200+00 to 245+00)

RTE.103 - (Sta.100+00 to 186+29)



RTE.012 - Punta Arena Road (Sta.500+00 to 521+00) (See Note 1)

RTE.011 - Light House Road (Sta.300+00 to 430+46)



Typical Section near Mangroves (See Note 2)

RTE.102 - Puerto Ferro Beach Road (Sta.245+00 to 268+27)

RTE.012 - Punta Arena Road (Sta.521+00 to 589+34)

Notes:

1. Contact utility companies to mark underground utilities prior to digging.
2. Do not disturb Mangroves.
3. See Earthwork Summary for location of Geotextile.
4. See Soil Erosion Control Summary and Detail 629-A for placement of Rolled Erosion Control Product.

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA  
VIEQUES FISH AND WILDLIFE REFUGE

**TYPICAL SECTIONS**



**Final Responses to EPA Comments on the  
Technical Memorandum  
Draft Remedial Investigation Status Report and Path Forward  
UXO 15**

**Atlantic Fleet Weapons Training Area-Vieques  
Former Vieques Naval Training Range  
Vieques, Puerto Rico  
September 6, 2013**

Presented below are review comments on the *Technical Memorandum, Draft Remedial Investigation Status Report and Path Forward UXO 15, Atlantic Fleet Weapons Training Area-Vieques, Former Vieques Naval Training Range, Vieques, Puerto Rico*; dated September 6, 2013 (hereinafter referred to as the Tech Memo).

**General Comments**

1. The discussion of the Debris Pile Removal indicates Pile C covered an area of 400 square feet (ft) and Pile D covered an area of 600 square ft, but only one soil sample was collected beneath these removal areas. The Tech Memo does not discuss the sufficiency of characterizing the former debris piles using one soil sample compared to the size of the debris piles. The *Final Expanded Site Inspection Sampling and Analysis Plan Addendum for the Remedial Investigation at UXO 15*, dated July 2012 (SAP), indicates that one soil sample collected beneath each debris pile was deemed sufficient based on the small size of the piles of less than 10 ft by 10 ft (Worksheet #10). In addition, Worksheet #11 indicates that multiple soil samples should have been collected at 10 ft by 10 ft increments when larger debris piles were found. Revise the Tech Memo to discuss this SAP deviation during the characterization of Piles C and D. Also, ensure that the additional samples for characterizing these piles will be collected during the next phase of the Remedial Investigation (RI) activities.

***Navy Response:***

The following has been added after the first sentence under "*Soil Sampling*": "As stated in the SAP (CH2M HILL, 2012), a single soil/sediment sample was planned beneath each debris pile due to their relatively small size. Although Piles C and D covered an area greater than approximately 100 ft<sup>2</sup>, the debris was relatively scattered (vs piled) and relatively uniform in its composition. Therefore, a single soil sample was sufficient to characterize whether a release had occurred. However, additional samples associated with the debris piles are planned for the supplemental RI, as discussed under "*Planned Path Forward*."

2. The Tech Memo does not provide figures to represent where the soil samples were collected from each debris pile. Revise the Tech Memo to include figures for the locations of the soil/sediment samples collected beneath the former debris piles.

***Navy Response:***

The first sentence under "*Soil Sampling*" has been revised as follows: "Surface soil samples were collected from beneath the approximate center of Piles A, B, C, D and F on March 15, 2013, following the removal of the debris . . ."

In addition, Figure 6 has been edited to show the sample IDs at each pile location.

- Attachment 5 to the Tech Memo reports hexavalent chromium results as non-detections (ranging from 0.38 to 4.2 milligrams/kilogram [mg/kg]) that are greater than the Regional Screening Level (RSL) for Residential Soil for hexavalent chromium (0.29 mg/kg). However, the Tech Memo does not discuss this discrepancy. It is understood that the Tech Memo is not intended to be a comprehensive evaluation of the results. However, the Tech Memo should be revised to discuss how the hexavalent chromium results are sufficient to determine that concentrations in soil are less than RSLs, or the Tech Memo should discuss this potential data gap and how it will be addressed during the next phase of the RI activities.

***Navy Response:***

The following has been added at the end of the Soil Sampling subsection: “Hexavalent chromium was not detected in any of the soil samples. However, the non-detect reporting limits for hexavalent chromium (0.38 to 4.2 mg/kg) exceed the RSL (0.29 mg/kg) due to required dilutions and moisture percentage. As noted in Appendix R of the Site Inspection/Expanded Site Inspection Report (CH2M HILL, 2010), naturally occurring chromium across Vieques is predominantly in the trivalent form, based on historical data and evaluation of geochemical characteristics of environmental media. Further, there is no anticipated source of hexavalent chromium at UXO 15. In addition, the RSL is based on a target cancer risk of  $1 \times 10^{-6}$ , and the maximum reporting limit is 4.2 mg/kg, which is associated with a residential scenario cancer risk of approximately  $1 \times 10^{-5}$ . Therefore, although the non-detect reporting limits exceed the RSL, they are within USEPA’s target risk range. Based on all of the above information, hexavalent chromium is not a concern at UXO 15 and will not be included in future RI sampling activities at UXO 15 unless additional information is found or observed that suggests different conditions than those presented above.”

A reference to the Site Inspection/Expanded Site Inspection Report has been added to the References section.

- As has been noted in the past, Explosive D (ammonium picrate) was the energetic filler of the Navy projectiles of 5-inch and over caliber, and the Army/Marine Corps APC (armor piercing-capped) projectiles (sometimes incorrectly referred to as APHE [armor piercing high explosive]) that were in use during a significant portion of the active period of the ranges at Vieques. The Tech Memo, does not state why Explosive D was not sampled for or included in the list of analytes during the investigation. Provide a statement of the reason for this in an appropriate section of the report.

***Navy Response:***

The following has been added after the sentence listing the analytical parameters in the first paragraph under “Soil Sampling”: “The analytical parameter list was jointly selected by the Navy, USEPA, and PREQB and did not include Explosive D (ammonium picrate) because there are no widely-accepted human health or ecological screening values, as stated in Worksheet #17 of the SAP Addendum (CH2M HILL, 2012).”

Please note that when the SAP addendum is prepared, picric acid can be added if the team feels it is warranted at UXO 15.

- The summary of the inorganics identified in the soil and sediment samples collected under the debris piles notes the exceedances identified but then indicates that the “inorganic concentrations are naturally occurring” or that the inorganics are “mainly attributable to natural conditions.” (page 7). Reference is also made that the inorganic concentrations are “likely attributable to natural conditions” on page 9 (Environmental Media). As noted in the third bullet of the Planned Path Forward (page 10), additional sampling will be conducted to confirm whether the inorganics associated with the debris piles

are attributable to background by collecting location-specific background samples or spatially defining the extent of contamination. Therefore any reference to these data representing background conditions should be removed from this report.

***Navy Response:***

Based on existing information, it is appropriate to hypothesize that the inorganics concentrations are likely attributable to natural conditions; therefore, the statements will remain, but the following has been added where these statements are made: “However, this supposition will be further evaluated, as discussed under Planned Path Forward.”

## **Specific Comments**

1. **Munitions Terminology, Page 2:** It is stated that the intent of the definitions provided in this section of the Tech Memo, is to “aid with the various munitions terminology used throughout the document.” However, the shortened definition of the term “UXO” may lead the reader to a conclusion that only items that have been “placed” (e.g., mines, simulators, certain pyrotechnics and flares that are positioned by hand) are included. The shortened definition would be improved if some of the words present in the formal definition (“fired, dropped, launched, projected, or”) were inserted between the words ““have been” and “placed” in the shortened definition. The definition would then read, “UXO – munitions that have been primed, fused, and armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a safety hazard; and remain unexploded.” Make this revision to the cited definition.

***Navy Response:***

The definition of UXO has been edited as stated above to: “UXO – munitions that have been primed, fused, and armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a safety hazard; and remain unexploded.”

2. **Table 2, Subsurface Anomaly Investigation Results, Pages 1 and 3 through 7:** In the “Group” column of the table, a number of items on the noted pages are assigned to the group “RANE.” It appears that no definition of this acronym/term is provided in the Tech Memo. Also, the “Comments” column has a number of range residue (RRD) notations that are difficult to evaluate. For example:

- The varying formats of the following, with the “x” indicating a number or numbers:
  - RRD x
  - RRD (x)
  - RRD(x)

It is not clear what the number represented by the “x” indicates (i.e., is it the quantity of RRD items recovered or some other classification indicator).

Provide a definition of the acronym/term “RANE” at an appropriate location in the document or its attachments. Also, provide an explanation of the RRD classification system used in the table and standardize the format thereof, unless the varying formats have an unidentified purpose. If that is the case, the unstated purpose should also be explained.

***Navy Response:***

RANE has been removed from Table 2 and the RRD notations have been clarified.

- 3. Data Collection Quality Control, Page 5:** This section indicates several quality control (QC) tasks were performed for the digital geophysical mapping (DGM), but only discusses the results of Instrument Verification Strip (IVS). Ensure that the RI Report discusses the results for all QC tasks and whether they were acceptable.

***Navy Response:***

The section entitled Data Collection Quality Control and last sentence of the first paragraph of the section entitled Data Interpretation/Anomaly identification were deleted and replaced by the following section added between the sections entitled Data Interpretation/Anomaly identification and Intrusive Investigation of Geophysical Anomalies and Subsurface Findings. The information will also be included in RI Report.

**DGM Quality Control**

Daily QC tests were conducted in accordance with the NTCRA Work Plan (CH2M HILL, 2009) and included an instrument warm-up period, static test measurements of background values and response values with a small Industry Standard Objective (ISO), collection of the seeded Instrument Verification Strip (IVS) transect, and collection of repeat data profiles. Descriptions of the QC tests and Measurement Quality Objectives (MQOs) for each are included in the NTCRA Work Plan. Additional field information (e.g., QC test file names, weather conditions, general survey notes) was recorded using the Munitions Response Program (MRP) Enterprise Personal Digital Assistant (PDA).

The Geophysical System Verification (GSV) process was followed for the DGM. This process compares signal strength and sensor performance to known response curves of ISOs to validate DGM systems before and during site surveys. The GSV process, the MQOs and Measurement Performance Criteria (MPC) are discussed in detail in the NTCRA Work Plan.

An IVS was also conducted for the DGM near Camp Garcia after first conducting an initial background survey to verify that the location was suitable (i.e., minimal existing geophysical anomalies) for construction of an IVS. Initial testing was conducted along the IVS transects to verify that the along-transect distances were accurately tracked by the EM61-MK2 wheel encoder. The initial IVS data were collected on September 4, 2012 and were submitted to the data processor. The QC Geophysicist reviewed the results and confirmed that the MQOs were being met prior to the start of the production survey.

The IVS was also used to verify positioning of the EM61-MK2 system by evaluating through the twice daily measurements along the seeded transect that seed items buried within the IVS were detected within the positioning MQO ( $\pm 9.8$  inches [25 centimeters]) of the surveyed locations at the time of seed emplacement). The positioning MQO was met during the DGM at UXO 15.

Additional QC measures performed on a daily basis included monitoring the system for noise spikes ( $>2$  mV from the mean Channel 3 response) during personnel and cable shake tests. These tests were conducted to determine whether the DGM operator or vibration of cables and connectors during movement of the system along the transects introduced noise in the data stream. The data collected during the DGM at UXO 15 met the QC criteria for the personnel and cable shake tests.

Static test measurements were made periodically throughout each production day to evaluate whether the DGM system was responding appropriately to a known reference item (a small ISO). These tests were conducted with the system kept stationary in an area relatively free of metallic response. A small ISO was placed at a fixed height above the EM61-MK2 bottom coil and centered over the coil, and the EM61-MK2 response was recorded. The response from the system used at UXO 15 was within  $\pm 20\%$  of the predicted response value for a small ISO (Naval Research Laboratory, 2009) after background response removal, thereby meeting the MQO for system response during the static tests. Similarly, the response from the ISOs in the IVS was reviewed

during QC in order to demonstrate that responses from the buried ISOs were within acceptable tolerances. Unlike the static tests, evaluation of the IVS seed response was performed on a qualitative basis because of the inherent variables that cannot be strictly controlled with the EM61-MK2 in motion.

During each production day, a portion of the survey area was re-collected and the data compared against the initial production survey data. This test was performed in order to evaluate repeatability of the DGM survey along the transects. Similar to the IVS seed response, evaluation of these data was performed on a qualitative basis due to the inherent variables that cannot be controlled with the EM61-MK2 in motion. The repeat test data were determined to meet the repeatability MQO during the DGM at UXO 15.

Additional details on the DGM data collection procedures, equipment and methodology, data analysis, target selection, findings, and QC measures are provided in **Attachment 4: Digital Geophysical Mapping Report, UXO 15, Former Vieques Naval Training Range, Vieques, Puerto Rico** (CH2M HILL, 2012). “

4. **Soil Sampling, Page 7:** The discussion for Pile F indicates that copper, lead, and zinc were anomalously high compared to the soil/sediment results for the other debris piles and therefore, these constituents may be related to the former small arms debris. It is unclear why antimony is not included in this list, since antimony exceeded screening criteria in the sediment sample collected for Pile F and was not detected in the samples collected from the other debris piles. Revise this discussion to discuss implications of elevated antimony in this debris pile.

**Navy Response:**

The sentence has been revised to include antimony.

5. **Potential Source of a CERCLA Release and Release Mechanism, Page 9:** The second sentence indicates that the former contents of the drums and the nature of material within the berms are not sufficiently known. However, the next paragraph (Nature and Extent of Contamination, MEC/MPPEH) indicates that the nature and extent of MEC/MPPEH have sufficiently been characterized within UXO 15. As the proposed sample analysis for the berms will include explosives, there is a potential for explosives to be identified within these areas. Therefore the statement that MEC/MPPEH has been sufficiently characterized is not supported and should be removed.

**Navy Response:**

The first sentence under *Nature and Extent of Contamination* has been revised as follows: “Based on the findings of the ERA/SI and RI activities (**Figure 10**), and the lack of munitions identified during road construction, the nature and extent of MEC/MPPEH (and related debris) have been characterized sufficiently within most of UXO 15, including the main access road and in the immediate vicinity of the lighthouse. However, it is not known whether MEC/MPPEH is present within the berms identified during the initial RI activities or the beach area adjacent to the historic lighthouse.”

In addition, the second bullet, first sentence under “Prepare a SAP Addendum to” in the *Planned Path Forward* section was revised as follows: “Further characterize the nature of the material (including potential MEC/MPPEH) and potential contamination associated with the berms, especially where subsurface drums were encountered.”

Further, the following has been added as a second bullet under *Planned Path Forward*: “Conduct a NTCRA at Playa Verdiales and associated path for public access from the area around the lighthouse to the beach, in accordance with the NTCRA for the Roads and Beaches (CH2M HILL, 2008).”

The following reference has also been included: "CH2M HILL, 2008. *Final Work Plan for Munitions and Explosives of Concern, Subsurface Interim Removal Action, Beaches and Select Roadways, Former Vieques Naval Training Range and Former NASD Solid Waste Management Unit 4, Vieques, Puerto Rico*. October."

- 6. Nature and Extent of Contamination, Page 9:** The discussion of environmental media states that inorganics were detected at levels that exceeded screening criteria in samples collected beneath debris Piles A, C, D, and F, but Table 3 indicates the soil sample collected beneath Pile B also exceeded screening criteria. Revise this statement to include Pile B.

***Navy Response:***

The sentence has been revised to read: "Inorganics were detected above screening criteria beneath Piles A, B, C, D, and F, but most are likely attributable to natural conditions. However, this supposition will be further evaluated, as discussed under Planned Path Forward."

- 7. Attachment 1, Photo Log:** Please note that photos 6A & 6B are missing from the printed report (Attachment 1, as referenced on page 6).

***Navy Response:***

Photos 6A & 6B have been added to Attachment 1.

- 8. Attachment 4, Draft Digital Geophysical Mapping (DGM) Report, UXO 15, Table 4, UXO 15 DGM Target Count by Type; and Table 5, UXO 15 DGM Target Count by Type and Amplitude; Pages 18 and 19, Respectively:** Both of the cited tables contain Target Types marked with an asterisk. The asterisk is explained in a footnote to the tables that reads, "\*not submitted for intrusive investigation as of December 2012." No further explanation as to why this is the case is provided in Attachment 4. Revise the appropriate portion of Attachment 4 to include the reason for these targets not being submitted for investigation, or provide a reference therein as to where it may be found elsewhere in the Tech Memo, or its attachments.

***Navy Response:***

In Table 1, the Type 1 description was changed to "Target associated with subsurface anomaly exhibiting peak amplitude of  $\geq 2.5$  mV" and the Type 2 description was changed to "Target associated with subsurface anomaly exhibiting peak amplitude of  $< 2.5$  mV."

The asterisk and associated note have been removed from both Tables 4 and 5. Type 2 data are tracked but are not intrusively investigated in accordance with Vieques protocols.

- 9. Attachment 5, Validated Surface Soil Raw Analytical Data, Page 1 of 2:** The result for hexavalent chromium for sample VEUXO15-SS02-06I-0313 is reported as "4 R," indicating it is a rejected result. However, numerical values associated with rejected results should not be reported to ensure the data is not unintentionally used. Revise this table to remove the numerical value for this result, and ensure the RI Report discusses this potential data gap.

***Navy Response:***

The data presented in Attachment 5 are as reported by the analytical laboratory and qualified (as necessary) by the data validator, which is standard protocol for all data, including rejected data. Therefore, the result will remain in the table as presented. Please see the response to General Comment #3 for a discussion of the hexavalent chromium data.

**Final Responses to PREQB Comments on the  
Draft Remedial Investigation Status Report and Path Forward UXO 15  
Atlantic Fleet Weapons Training Area-Vieques  
Former Vieques Naval Training Range  
Vieques, Puerto Rico**

**Page-Specific Comments**

1. Page 8, Terrestrial Extent of Munitions Debris at PI-9 East: Please clarify the criteria that were used to establish the boundary between PI-9 and UXO-16. Figure 9 appears to show the boundary of PI-9 extending into the near shore area; therefore, additional detail on where the boundary is located would be helpful in determining which MD can be addressed as part of the investigation of PI-9 rather than UXO-16.

***Navy Response:***

The following paragraph has been added before the paragraph in Section *Terrestrial Extent of Munitions Debris at PI-9 East*: “The site boundary of PI-9 was established by historical aerial photographs during the Environmental Baseline Survey. Because the shoreline changes over time, the historical boundary may appear to extend into the near shore depending on the particular aerial photograph upon which the site boundary is displayed. However, PI-9 includes only the terrestrial area. UXO 16 is defined as the underwater areas, which includes the near shore area.”

2. Page 9, Nature and Extent of Contamination, MEC/MPPEH: Please clarify the following statement, “... the nature and extent of MEC/MPPEH (and related debris) have sufficiently been characterized within UXO 15...” in light of other statements made concerning the need for additional characterization, such as, “...The former contents of the drums and the nature of material within the berms are not sufficiently known...”, and “...However, there may be the potential for MEC amongst the munitions debris encountered within PI 9 East, as only the lateral extent of the encrusted debris was delineated...” Also, additional characterization is described in Page 9 and 10 under “Planned Path Forward.” Please revise the first statement above indicating that MEC/MPPEH within UXO 15 are sufficiently characterized to note that additional characterization is required and is planned.

***Navy Response:***

The sentence has been revised as follows: “Based on the findings of the ERA/SI and RI activities (Figure 10), and the lack of munitions identified during road construction, the nature and extent of MEC/MPPEH (and related debris) have been characterized sufficiently within most of UXO 15, including the main access road and in the immediate vicinity of the lighthouse. However, it is not known whether MEC/MPPEH is present within the berms identified during the initial RI activities or the beach area adjacent to the historic lighthouse.”

In addition, the following has been added as a second bullet under Planned Path Forward: “Conduct a NTCRA at Playa Verdiales and associated path for public access from the area around the lighthouse to the beach, in accordance with the NTCRA for the Roads and Beaches (CH2M HILL, 2008).”

3. Page 10, Nature and Extent of Contamination: The first to bullets on Page 10 describe further characterization of the berms and PI 9 East but the descriptions of the additional characterization are limited to environmental sampling and characterization. Please clarify whether an MEC/MPPEH investigation will be included in this planned effort.

***Navy Response:***

It appears the comment is intended for the Planned Path Forward, rather than the Nature and Extent of Contamination as stated. Based on that assumption, the first bullet under "Prepare a SAP Addendum to" in the Planned Path Forward section was revised as follows: "Further characterize the nature of the material (including potential MEC/MPPEH) and potential contamination associated with the berms, especially where subsurface drums were encountered."

The information collected to date suggests MEC/MPPEH may be encrusted in PI 9 East; therefore, any removal/remedial determination would be made based on that conservative assumption, so no further characterization of encrusted munitions in PI 9 East as part of the RI is necessary.

**Final Responses to US Fish and Wildlife Service Comments on the  
Draft Remedial Investigation Status Report  
and Path Forward UXO-15  
Atlantic Fleet Weapons Training Area-Vieques  
Former Vieques Naval Training Range  
Vieques, Puerto Rico  
September 6, 2013**

Presented below are the US Fish and Wildlife Service (FWS) thoughts and comments on the subject document. The Puerto Ferro peninsula is close to the entrance of the Vieques National Wildlife Refuge (VNWR) and its unique dry forest habitat and historic lighthouse have significant ecological and cultural value as well as public use potential. It is a priority for the FWS to preserve and enhance these natural and cultural resources and allow the public to enter and visit this area.

1. Introduction, page 2: Please revise the document to reflect that the FWS, as well as the Commonwealth, has indicated that the lighthouse and the adjacent areas are important resources and that access by the public is a priority.

***Navy Response:***

The first sentence in the last paragraph of the *Introduction* has been revised as follows: “Since the initiation of the RI activities, the Commonwealth of Puerto Rico and USFWS have indicated that public access to the historic Spanish lighthouse...”.

2. Digital Geophysical Mapping, Data Collection, page 5: it would be useful if the total area of PI 9 West were noted relative to the 1.4 acres investigated using digital geophysical mapping.

***Navy Response:***

The sentence identified above has been edited to read: “This procedure resulted in a total footprint coverage of approximately 1.4 acres within the 47 acres of PI 9 West.”

3. Conceptual Site Model Update, Future Land Use, page 9: It is not clear if the non-time critical removal action (NTCRA) will include the beach area adjacent to the lighthouse (Playa Berdiales). This section states that the NTCRA would include “...the lighthouse and immediate surroundings, the road leading to the lighthouse, and the beach adjacent to the lighthouse...” However, the first bullet in the section on page 9 entitled Planned Path Forward indicates that the NTCRA would include “...the road to the lighthouse and lighthouse area.” The VNWR would like Playa Berdiales and path to the beach from the lighthouse to be accessible by the public and part of the NTCRA.

***Navy Response:***

As concurred upon during the January 2014 Vieques Technical Subcommittee Meeting, the Navy will submit a letter to the agencies stating the beach and path will be included in the existing NTCRA for roads and beaches. Note that the letter will state that no buffer will be included in the path clearance in order to minimize the amount of vegetation cutting necessary. Based on this, the following has been added as a second bullet under Planned Path Forward: “Conduct a NTCRA at

Playa Verdiales and associated path for public access from the area around the lighthouse to the beach, in accordance with the NTCRA for the Roads and Beaches (CH2M HILL, 2008)."

The following reference has also been included: "CH2M HILL, 2008. Final Work Plan for Munitions and Explosives of Concern, Subsurface Interim Removal Action, Beaches and Select Roadways, Former Vieques Naval Training Range and Former NASD Solid Waste Management Unit 4, Vieques, Puerto Rico. October."

4. Whether Playa Berdiales is included as part of the Path Forward or as part of a subsequent action, the following should be incorporated into the investigation:

- a) The appropriate sea turtle monitoring protocol should be implemented. Hawksbill and leatherback sea turtles have been reported to nest on Playa Berdiales and a hawksbill sea turtle false crawl was documented during the September 2013 joint site visit.

***Navy Response:***

Sea turtle nest monitoring will be conducted at Playa Verdiales prior to and during NTCRA activities by a qualified and experienced sea turtle beach monitor. This beach has not been formally classified as either a Zone 1, 2, or 3 work zone as described in Biological Assessment of the Former Live Impact Area within the Former Vieques Naval Training Range, Vieques Puerto Rico (Geo-Marine, 2006). Considering the small size of the beach (approximately 275 feet long) and limited reports of sea turtle nesting, Playa Verdiales will be monitored as a Zone 2 beach (1 to 3 historical sea turtle nesting events have occurred) using procedures described in the 2006 Biological Assessment.

- b) If coastal vegetation needs to be removed, native vegetation (e.g., sea grape) should be planted.

***Navy Response:***

Vegetation avoidance, cutting, removal, and restoration along the beach will be conducted in accordance with the aforementioned Biological Assessment (Geo-Marine, 2006) unless modified through discussions between the Navy and USFWS prior to initiation of NTCRA activities along Playa Verdiales.

- c) Prior to intrusive activities, the trail that leads from the lighthouse to the beach will be marked by the refuge, to ensure a safe access for the public and to determine that no imperiled species are located in the area.

***Navy Response:***

The Navy requests USFWS coordinate the trail marking activity with the Navy to ensure the Navy concurs with the location of the trail since there are logistical considerations associated with being able to perform MEC/MPPEH clearance and so the Navy has the opportunity to observe any imperiled species identified by USFWS.

- d) Habitat for the endangered plant species *Catesbaea melanocarpa* and *Buxus vahlii* and a population of the imperiled plant species *Varronia rupicola* is present in UXO-15. Vegetation clearance activities should be closely coordinated with the FWS to ensure that critical habitat and species of concern are not adversely affected.

The FWS is in the process of listing *V. rupicola* and designating Puerto Ferro as critical habitat for the species. *V. rupicola* is a shrub with alternate ovate to elliptic leaves. When not in flower (grouped white corolla) or fruit (red drupe), this species relatively inconspicuous. The species' habitat consists of forested hills with open to relatively-dense shrub lands, edge of costal shrub forest, open limestone pavement and sand dunes. At present time, six plant individuals have been identified adjacent to the road to the lighthouse and additional individuals are likely to be present in suitable habitat. Thus, any work at the sides of the road or within forested shrub lands should be closely

coordinated with the FWS to ensure that vegetation is carefully searched by qualified personnel, and if individuals or populations are detected, site-specific measures are developed and implemented to minimize possible adverse effects. In addition, the area where the currently known individuals are present should be delineated and excluded from any future work.

***Navy Response:***

All of the work to be performed along the road to the lighthouse during the NTCRA will take place within the road buffer that has already been cleared of vegetation to support road construction. Therefore, the work should not impact the aforementioned species.

- e) Planned Path Forward, page 9: The FWS concurs with the Navy proposal to further evaluate the berms in PI 9 West to fully characterize nature and extent of possible contamination. Any detonation pits in the area should be also included in the investigation.

***Navy Response:***

The following has been added to the Planned Path Forward: "Characterize the nature and extent of contamination at the potential former detonation areas. These samples will be analyzed for explosives, SVOCs, and inorganic constituents."