

**Final  
Action Memorandum:  
RVAAP-28 Suspected Mustard Agent Burial Site at  
Camp Ravenna Joint Military Training Center  
Portage and Trumbull Counties, Ohio**

**July 27, 2017**



***Prepared by:***

U.S. Army Corps of Engineers, Louisville District  
600 Dr. Martin Luther King Jr. Place  
Louisville, Kentucky 40202



***Prepared for:***

National Guard Directorate  
(ARNG- Installations and Environment)  
111 South George Mason Drive  
Arlington, Virginia 22204-1373

**Final Action Memorandum**  
**No Further Action for the**  
**RVAAP-28 Suspected Mustard Agent Burial Site**  
Camp Ravenna Joint Military Training Center/  
Former Ravenna Army Ammunition Plant  
Portage and Trumbull Counties, Ohio

This Action Memorandum presents the selected alternative (No Action Alternative) as recommended in the Engineering Evaluation and Cost Analysis (EE/CA) (USACE, 2016) for the RVAAP-28 Suspected Mustard Agent Burial Site (SMABS) area of concern (AOC) at the Camp Ravenna Joint Military Training Center (Camp Ravenna) (formerly the Ravenna Army Ammunition Plant - RVAAP) in Portage and Trumbull counties, Ohio. The US Army is the lead agency under the Defense Environmental Restoration Program (DERP) at the Ravenna Army Ammunition Plant, and developed this Action Memorandum consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, and consistent with the National Oil and Hazardous Substances Contingency Plan (NCP). This decision document will be incorporated into the larger Administrative Record file for the former Ravenna Army Ammunition Plant, which is available for public view at 1438 State Route 534 SW, Newton Falls, Ohio 44444.

This document, presenting a selected No Action Alternative with no present worth cost estimate, is approved by the undersigned, pursuant to:

- Memorandum, DAIM-ZA, 9 Sept 2003, subject: Policies for Staffing and Approving Decision Documents (DDs);
- Memorandum, 18 Jan 2017, subject: Department of the Army Decision Document Policy; and
- Memorandum, Assistant Chief of Staff for Installation Management (ACISM), DAIM-ZB, 16 Apr 08, subject: Army Environmental Compliance-related Cleanup Policy Guidance.

APPROVED:



---

Mark Leeper  
Restoration Program Manager  
Army National Guard Directorate

27 July 17

---

Date

## TABLE OF CONTENTS

<b>LIST OF FIGURES .....</b>	<b>iv</b>
<b>ACRONYMS AND ABBREVIATIONS .....</b>	<b>v</b>
<b>SECTION 1: INTRODUCTION .....</b>	<b>1</b>
<b>1.1 PURPOSE .....</b>	<b>1</b>
<b>1.2 GENERAL FACILITY DESCRIPTION .....</b>	<b>1</b>
<b>1.3 FORMER RVAAP OPERATIONAL HISTORY AND MISSION .....</b>	<b>1</b>
<b>1.4 CURRENT STATUS.....</b>	<b>2</b>
<b>1.5 RVAAP-28 SUSPECTED MUSTARD AGENT BURIAL SITE DESCRIPTION.....</b>	<b>3</b>
<b>1.6 DETERMINATION OF THREATS TO PUBLIC, SAFETY, AND ENVIRONMENT.....</b>	<b>4</b>
<b>1.7 ADDITIONAL MEASURES .....</b>	<b>4</b>
<b>SECTION 2: SITE DESCRIPTION AND HISTORY .....</b>	<b>5</b>
<b>2.1 SMABS BACKGROUND AND CAIS DESCRIPTION .....</b>	<b>5</b>
<b>2.2 PREVIOUS INVESTIGATIONS.....</b>	<b>6</b>
2.2.1 Army Excavation (1969).....	6
2.2.2 Surface Soil Sampling (1996).....	6
2.2.3 Geophysical Survey (1998).....	7
2.2.4 Groundwater Investigations (2006; 2012) .....	7
2.2.5 Employee Interviews and Geophysical Survey (2006).....	7
2.2.6 Geophysical Survey (2010).....	8
2.2.7 Probability Assessment (2013) .....	8
2.2.8 Site Inspection Report (2015) .....	9
<b>SECTION 3: STATEMENT OF BASIS AND JUSTIFICATION.....</b>	<b>10</b>
<b>SECTION 4: ENDANGERMENT DETERMINATION .....</b>	<b>11</b>
<b>SECTION 5: ALTERNATIVES CONSIDERED .....</b>	<b>12</b>
<b>4.2 ALTERNATIVE 1 – NO ACTION.....</b>	<b>12</b>
<b>4.3 ALTERNATIVE 2 – LAND USE CONTROLS: ACTIVITY USE RESTRICTIONS .....</b>	<b>12</b>
<b>4.4 ALTERNATIVE 3 – LAND USE CONTROLS: SECURITY FENCE .....</b>	<b>13</b>
<b>4.5 ALTERNATIVE 4 – INTRUSIVE INVESTIGATION AND REMOVAL ACTIONS.....</b>	<b>13</b>
<b>SECTION 6: AGENCY COORDINATION AND PUBLIC INVOLVEMENT .....</b>	<b>15</b>
<b>SECTION 7: RESPONSIVENESS SUMMARY .....</b>	<b>16</b>
<b>SECTION 8: DESCRIPTION OF THE SELECTED ALTERNATIVE.....</b>	<b>17</b>

**SECTION 9: EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN ..... 19**

**SECTION 10: OUTSTANDING POLICY ISSUES AND ENFORCEMENT ..... 20**

**10.1 OUTSTANDING POLICY ISSUES .....20**

**10.2 ENFORCEMENT.....20**

**SECTION 11: RECOMMENDATIONS ..... 21**

**SECTION 12: REFERENCES ..... 22**

**LIST OF FIGURES**

- FIGURE 1. Camp Ravenna Location Map.
- FIGURE 2. Camp Ravenna Facility Map.
- FIGURE 3. Suspected Mustard Agent Burial Site Map.
- FIGURE 4. 1998 Geophysical Investigation Area and Results.
- FIGURE 5. 2006 Geophysical Investigation Area and Results.
- FIGURE 6. 2010 Geophysical Investigation Area and Results.

## ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ARNG	Army National Guard
CAIS	Chemical Agent Identification Sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRJMTC	Camp Ravenna Joint Military Training Center
CWM	chemical warfare materiel
DD	Decision Document
DERP	Defense Environmental Restoration Program
DERR	Division of Environmental Response and Revitalization
DFFO	Director's Final Findings and Orders
DGM	digital geophysical mapping
DOD	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EQM	Environmental Quality Management, Inc.
ft	feet
IRP	Installation Restoration Program
LUCs	Land Use Controls
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
NACA	National Advisory Committee on Aeronautics
NAD	North American Datum
NCP	National Contingency Plan
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
RAO	Remedial Action Objective
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation (now Leidos)

Shaw	Shaw Environmental & Infrastructure, Inc. (now CB&I)
SI	Site Inspection
SMABS	Suspected Mustard Agent Burial Site
sq ft	square feet
USEPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAESC	United States Army Engineering and Support Center

## **SECTION 1: INTRODUCTION**

---

### **1.1 PURPOSE**

The United States Army Corps of Engineers, Louisville District (USACE) prepared this Action Memorandum to document approval for the selection of the No Action Alternative as recommended in the Engineering Evaluation and Cost Analysis (EE/CA) (USACE, 2016). The EE/CA was completed for the RVAAP-28 Suspected Mustard Agent Burial Site (SMABS) area of concern (AOC) at the Camp Ravenna Joint Military Training Center (Camp Ravenna) (formerly the Ravenna Army Ammunition Plant - RVAAP) in Portage and Trumbull counties, Ohio.

The U.S. Army is the lead agency under the Defense Environmental Restoration Program (DERP) at the Ravenna Army Ammunition Plant, and developed this Action Memorandum consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended, and consistent with the National Oil and Hazardous Substances Contingency Plan (NCP). This decision document will be incorporated into the larger Administrative Record file for the former Ravenna Army Ammunition Plant, which is available for public view at 1438 State Route 534 SW, Newton Falls, Ohio 44444.

### **1.2 GENERAL FACILITY DESCRIPTION**

The former RVAAP (Federal Facility Identification [ID] No. OH213820736) is located in northeastern Ohio within Portage County and Trumbull County, approximately 3 miles east-northeast of the city of Ravenna (**Figure 1**). The Installation is approximately 11 miles long and 3.5 miles wide. The facility is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide. It is bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick, and Berry Roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (**Figure 2**). The Installation is surrounded by several communities: Windham on the north, Garrettsville 6 miles to the northwest, Newton Falls 1 mile to the southeast, Charlestown to the southwest, and Wayland 3 miles to the south.

As of September 2013, administrative accountability for the entire 21,683-acre facility has been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio and the property subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site, Camp Ravenna. The restoration program at the former RVAAP involves cleanup of former production/operational areas throughout the facility related to activities that were conducted there.

### **1.3 FORMER RVAAP OPERATIONAL HISTORY AND MISSION**

Constructed in 1940, production at the former RVAAP began in December 1941, with the primary missions of depot storage and ammunition loading. The Installation was divided into two separate units: the Portage Ordnance Depot and the Ravenna Ordnance Plant. The depot's primary mission was storage of munitions and components, while the mission of the ordnance

plant was loading and packing major caliber artillery ammunition and the assembly of munitions-initiating components that included fuzes, boosters, and percussion elements. In August 1943, the Installation was re-designated as the Ravenna Ordnance Center, and in November 1945, it was re-designated as the Ravenna Arsenal.

Industrial operations at the former RVAAP consisted of 12 munitions-assembly facilities referred to as "load lines." Operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Other load lines were used to manufacture fuzes, primers, and boosters. From 1946 to 1949, one facility (Load Line 12) was used to produce ammonium nitrate for explosives and fertilizers. Demilitarization activities were also conducted at RVAAP that included disassembly of hot water or steam melt extraction of explosive compounds from varied-sized military projectiles. Periodic demilitarization of various munitions continued through 1992.

Other areas at RVAAP were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consisted of large parcels of open space or abandoned quarries. Several landfills also exist at RVAAP. Principal contaminants include explosives, propellants, metals, and semivolatile organics.

The plant was placed in standby status in 1950 and reactivated during the Korean Conflict to load and pack major caliber shells and components. All production ended in August 1957, and in October 1957 the Installation again was placed in a standby condition. In October 1960 the ammonium nitrate line was renovated for demilitarization operations, which involved melting explosives out of bomb casings for subsequent recycling. These operations began in January 1961. In July 1961, the plant was deactivated again. In November 1961, the Installation was divided into the Ravenna Ordnance Plant and an industrial section, with the entire Installation designated as the former RVAAP.

In May 1968, loading, assembling, and packing munitions began on three load lines and two component lines to support the Southeast Asia conflict. These facilities were deactivated in August 1972. The destruction of M71A1 90-millimeter (mm) projectiles extended from June 1973 until March 1974. Destruction of various munitions was conducted from October 1982 through 1992.

Until 1993, the former RVAAP maintained the capability to load, assemble, and pack military ammunition. As part of the former RVAAP mission, the U.S. Army maintained inactive facilities in a standby status by keeping equipment in a condition to allow resuming production within prescribed limitations. In September 1993, the U.S. Army placed the former RVAAP in inactive caretaker status, which subsequently changed to modified caretaker status. The load lines and associated real estate were determined to be excess by the U.S. Army.

#### **1.4 CURRENT STATUS**

The OHARNG currently uses Camp Ravenna as a military training site. The RVAAP Restoration Program encompasses investigation and cleanup of past activities over the 21,683-acre facility. The Ohio Environmental Protection Agency (Ohio EPA) is the lead regulatory agency for the investigation and remediation conducted by the U.S. Army under

the U.S. Department of Defense (DOD) IRP. Additionally, the U.S. Army is required to follow CERCLA/NCP processes, etc. for the RVAAP Restoration Program per the Ohio EPA Director's Final Findings and Orders (DFFOs) dated June 10, 2004 (Ohio EPA, 2004).

### **1.5 RVAAP-28 SUSPECTED MUSTARD AGENT BURIAL SITE DESCRIPTION**

Unlike most of the AOCs on the former RVAAP, the SMABS AOC has never been part of the defined operational history. The site was identified as an AOC based on statements made by employees of the former RVAAP and some of their family members.

The SMABS is referred to as the "suspected" mustard agent burial site because the use of sulfur mustard agent at the former RVAAP, and specifically at this AOC, has never been confirmed. A former RVAAP employee indicated that an area within the former National Advisory Committee for Aeronautics (NACA) Test Area was excavated and one 55-gallon drum and 7 small cans (allegedly mustard agent) were removed and identified as nontoxic. This excavation and removal was performed in 1969 and the former employee who identified the location where the materials were buried, was the person who actually buried and treated them with 'quicklime' after World War II. The remaining potential for buried mustard agent areas is based solely on verbal-historical accounts taken from unconfirmed and undocumented sources.

The sulfur mustard agent (dichlorodiethyl sulfide) is suspected to have been buried at the SMABS AOC prior to the 1950s, but after World War II. Based on unconfirmed verbal evidence, this sulfur mustard agent may have been present in the form of Chemical Agent Identification Sets (CAIS) which typically consisted of glass vials or bottles that contained very small amounts of a chemical agent. However, there is no hypothesis as to why these test kits would ever have been shipped to the former RVAAP employee where none of the personnel were trained to handle mustard agent and where there was no need for such materials. In addition, because mustard agent are considered to be Chemical Warfare Materials - CWM or Chemical Warfare Agents (CWA), there would have likely been some type of shipping record generated as was done for explosives and other hazardous materials. Unfortunately, no such records have been found. See Attachment A of the EE/CA for information regarding the 1969 excavation. After this excavation, several utility work reports continued to mention that someone said there was potentially another area where materials were buried. This other area was near the area where the original excavation had occurred.

Three separate areas were identified as potential locations where the mustard agent was allegedly buried. These three areas were investigated and evaluated to determine the presence of mustard agent and or test kits. A Site Inspection (SI) was completed by the USACE Huntsville District in 2015 which concluded that the presence of mustard agent could not be completely ruled out for the SMABS AOC and that there is a slight potential (Seldom Probability) for mustard agent to be buried at the AOC.

## **1.6 DETERMINATION OF THREATS TO PUBLIC, SAFETY, AND ENVIRONMENT**

There is no documented evidence of any use or release of mustard agent at the AOC. Based on the information and the results presented in the EE/CA, no release or use of mustard agent occurred on the AOC. Therefore, the EE/CA recommended No Further Action. Information and results presented in the EE/CA, clearly demonstrated that there has not been a release at the AOC. Additionally, the AOC does not meet the definition of a site under CERCLA Section 101(41). Therefore, no removal action is warranted. The requirements as to when a removal action is warranted can be found in 40 CFR §300.415.

Four Alternatives were assessed in the EE/CA, Alternative 1 - No Action (under CERCLA) was selected as the best Alternative. This Alternative recognizes that the Army has the ability to proactively and effectively manage the SMABS, while ensuring any CAIS or mustard agent if encountered, is properly addressed and handled by Army CWM experts. In addition, as done at other facilities where mustard agent was suspected but never found, the Contingency Plan that has been prepared and implemented at Camp Ravenna includes a stop work provision if a mustard agent or CAIS is encountered. The identified CAIS or mustard agent would be evaluated and if necessary, the SMABS area would be re-entered into the CERCLA process and the evaluation process would be re-initiated to assess the source.

## **1.7 ADDITIONAL MEASURES**

The Probability Assessment is a standard DOD-document that is used by the Army to determine if and how to use an area where CWM may have been used. The SMABS was determined to be Seldom - D rating category. Given that the DOD and the Army have well-documented, protective measures and proven regulations in place to fully protect the soldiers and have demonstrated this successfully, the Alternative (No Action) would provide reasonable safety and protective measures that are required regardless of CERCLA. These requirements are mandatory and would be fully implemented. The SMABS AOC will continue to be managed according to Army Regulations and safe practices as stated in the Contingency Plan but will no longer be assessed under CERCLA.

The Army prepared and implemented a Contingency Plan based on recommendations of the CWM experts who evaluated the SMABS. The Conclusions and Summary of the Probability Assessment indicate that “work in the area can be conducted as non-CWM, with the following conditions:

- Mission-related activities shall include Contingency Plans for emergency response should CWM be encountered.
- The Contingency Plan must be approved by the Commander or designated representative.
- If CAIS or an intact item filled with liquid be encountered in the field, then work shall cease and the Contingency Plan will be implemented.
- Users and planners should remain aware of potential to encounter mustard agent in the area.

## **SECTION 2: SITE DESCRIPTION AND HISTORY**

---

### **2.1 SMABS BACKGROUND AND CAIS DESCRIPTION**

The SMABS AOC is located in the southwestern portion of the former RVAAP (**Figure 2**). There are three areas identified by former RVAAP employees where CAIS (mustard agent) may have been buried. The origin of each of the three areas is discussed separately in the following sections and the three areas are named by the year when they were investigated. The three areas (1998, 2006, and the 2010 Geophysical Investigation Areas) are shown on **Figure 3**. The Universal Transverse Mercator coordinates for the SMABS AOC are 4557923.53 meters north, 489003.15 meters east, Zone 17T (based on the approximate location of the 1969 U.S. Army excavation area described below). The 1998 Army Excavation Area is approximately 24,329 ft<sup>2</sup>. The 2006 Geophysical Investigation Area is approximately 29,644 ft<sup>2</sup> and the 2010 Geophysical Survey area is 26,622 ft<sup>2</sup>. The three investigation areas, located both north and south of Hinkley Creek, cover approximately 1.8 acres total.

Based on historical accounts taken from former site personnel, sulfur mustard agent (dichlorodiethyl sulfide) is suspected to have been buried at the AOC, possibly in the form of CAIS. The CAIS test kits typically consisted of glass vials or bottles that contain small amounts of chemical agents. These kits were used by the DOD from 1928 to 1969 for training in the detection, handling, and familiarization with chemical warfare agents. Appendix A of the EE/CA contains some photographs and other information relative to CAIS and mustard agent.

Prior to the early 1970s, one of the approved procedures for disposing of CAIS was burial on training ranges or areas according to unexploded ordnance (UXO) safety information on the DOD Environment, Safety, and Occupational Health Network and Information Exchange (DENIX) website (<https://www.denix.osd.mil/>). When buried, CAIS were either buried in their original containers (steel shipping cylinders called PIGs) or loose. Normally, CAIS vials were broken before being buried and were decontaminated to neutralize any chemical agent that could be present. The DENIX website references wooden containers rather than the steel ones. Based on the Description of Chemical Agent Identification Set Types, 2004, the only CAIS packed in nonmetallic (wooden) containers was K945; however, all K945 kits were accounted for by the U.S. Army and destroyed (EQM, 2008). There is no definitive documentation of whether or not CAIS was onsite, so the procedures mentioned above are generic and based on the methods generally used prior to burying CAIS. However, all three accounts suggested that the CAIS would have been buried.

As documented in a 1985 Memo prepared by a former RVAAP Safety Engineer, the person who was actually responsible for burying materials confirmed that he covered the items with lime to ensure they were neutralized. The area where the former employee stated he buried the neutralized material is the area where the 1969 excavation occurred. The 1985 Memo is provided in Appendix A of the EE/CA. Former employees stated that the neutralized materials were buried by hand but the depth was not known.

Of the various types of CAIS glass containers that have been identified as potentially containing mustard agent, all are believed to have been packed in metal containers, such as paint- or coffee-type cans, 55-gallon drums, or in the PIGs (steel shipping cylinders) (EQM, 2008). The DOD had an extensive training program for soldiers. It seems unlikely mustard agent test kits would have been sent to the former RVAAP since they did not handle or package these materials and the personnel would not have been trained in handling any such materials. The CAIS test kits were sets of glass vials or bottles that contained small amounts of chemical agents. They were employed by all branches of the U.S. Armed Forces from 1928–1969 for the purpose of training in detection, handling, and familiarization with chemical warfare. Most CAIS were destroyed in the 1980s, but the U.S. Army Chemical Materials Agency still occasionally demilitarizes CAIS that are found buried.

As presented in the Preliminary Assessment report for the RVAAP (SAIC, 1996), and supported by subsequent investigation activities described in SI Report and the Probability Assessment (USACE, 2015), the SMABS AOC was scored as a low relative risk designation under the DOD’s relative risk site evaluation method. This method is similar to the USEPA’s Hazard Ranking System Prioritization Model (SAIC, 1996). However, the investigation was limited because only two surface soil samples were collected, and mustard agent buried at depth is unlikely to exhibit a surface expression of agent breakdown products.

Precautionary interim restrictions (Seibert stakes) were previously used on SMABS to prohibit access and intrusive activities at the AOC until all investigations were completed. These restrictions were utilized to mitigate any potential exposure until the CERCLA investigative process for the AOC was completed. As of now, the Seibert stakes are no longer needed since the EE/CA showed there was little or no potential for any reactive mustard agent to be present on the SMABS AOC or on Ravenna. However, as a safety measure required by the Contingency Plan, the OHARNG provides awareness training to Range Control staff to detail what actions should be taken if any chemical material is encountered during use of the AOC.

## **2.2 PREVIOUS INVESTIGATIONS**

### **2.2.1 Army Excavation (1969)**

In 1969, the U.S. Army excavated a suspected burial site immediately west of the NACA Test Area (EQM, 2008). One 55-gallon drum and seven small rusted cans were recovered from the excavation. All recovered items were empty and no evidence of the presence of mustard agent was observed, as summarized in an internal Army Memorandum dated March 14, 1985 (Appendix A of the EE/CA). It should be noted, however, that the original documentation regarding the excavation is no longer available, so it is unknown what exactly occurred during the investigation. See **Figure 3** detailing the area that was excavated.

### **2.2.2 Surface Soil Sampling (1996)**

An unidentified and undocumented source reported that the first site excavated in 1969 was incorrectly identified, and that the mustard agent was buried in the wooded area approximately 500 feet south of Hinkley Creek, along an abandoned power line right-of-way (SAIC, 1996).

This second suspected site, measuring 270 ft<sup>2</sup>, was marked and fenced. However, only remnants of the fence existed in 2006 and the area has since been marked with Seibert stakes to restrict access. See **Figure 4** for location of the 1996 survey area.

In 1996, another suspected burial site located in the wooded area approximately 500 feet south of Hinkley Creek along an abandoned power line right-of-way was investigated (SAIC, 1996). This area, measuring approximately 270 ft<sup>2</sup>, was marked and enclosed by a cyclone fence (**Figure 3**). Two surface soil samples were collected from this area during the Relative Risk Site Evaluation conducted by the U.S. Army Center for Health Promotion and Preventive Medicine (1996). The surface soil samples were analyzed for thiodiglycol, a mustard agent decomposition product, and no concentrations were detected at or above the method detection limit (22.5 parts per million) (SpecPro, 2004).

### **2.2.3 Geophysical Survey (1998)**

In 1998, SAIC conducted a digital geophysical mapping (DGM) survey of an approximately 18,900-square-foot area along the abandoned power line right-of-way centered around the 270-square-foot formerly fenced area where the surface soil samples were collected in 1996 (**Figure 4**). The DGM survey identified several anomalies that were determined to most likely have been the result of metallic objects or cultural features located at or near the ground surface. Metal fencing embedded in trees and buried fallen fence posts were discovered during the DGM survey. Some of the anomalies were attributed to a barbed wire fence that once existed in the area. The results of the DGM survey indicated that it was difficult to discriminate these interferences from any potential buried waste containers. The survey did not produce evidence of any signature indicating the presence of disturbed soils or numerous buried metallic objects that would clearly delineate a former burial site (SAIC, 1998).

### **2.2.4 Groundwater Investigations (2006; 2012)**

Between 2004 and 2005, SpecPro conducted a groundwater investigation under a facility-wide groundwater program that included the installation of six monitoring wells around the perimeter, including locations hydraulically downgradient of the portion of the SMABS AOC located along the abandoned power line right-of-way, as shown on **Figure 4**. Mustard agent breakdown products were not detected in any of the groundwater samples collected from the downgradient wells during the sampling events (SpecPro 2006). In October 2011, an additional groundwater sampling event was conducted with no detections of mustard agent breakdown products reported from the analyses of the samples drawn from the six monitoring wells (EQM, 2012).

### **2.2.5 Employee Interviews and Geophysical Survey (2006)**

In July 2006, three former facility workers claiming to have knowledge of suspected mustard agent burial areas at the facility were interviewed. One of the former workers interviewed identified a potential area adjacent to the concrete pad at the west end of the former National Advisory Committee for Aeronautics (NACA) Test Area. See **Figure 5** to identify the location of the area investigated.

Historical records research helped to determine the location and extent of the SMABS AOC. These records included historical USGS topographic maps and aerial photographs. Based on features identified on these maps and aerial photographs, along with the documented interviews with the former RVAAP employees, a possible burial area was identified measuring approximately one acre and encompassing the original 1969 excavation area (EQM, 2008).

In 2006, EQM conducted a series of geophysical surveys of the area to investigate the possible presence of mustard agent CAIS packaged in metal containers (**Figure 5**). Metallic anomalies buried in the investigation area and a trench-shaped anomaly located at the western edge of the NACA Test Area concrete pad and extending to the west were identified in the surveys. The investigation report noted that most of the metallic anomalies in the area appeared to be buried within 5 feet of the ground surface. This report also noted that steel mill slag was commonly used as fill at the facility and could possibly be the source of the metallic anomalies. The survey did not delineate the horizontal extent of the affected area, and the nature of the metallic anomalies could not be conclusively determined without intrusive investigation (EQM, 2008).

#### **2.2.6 Geophysical Survey (2010)**

One of the accounts from the 2006 interviews indicated that the western concrete pad of the NACA Test Area may cover part of the suspected burial site. In 2010, Shaw conducted a non-intrusive DGM survey to further evaluate the area around the concrete test pad. The survey areas included locations north, south, and east of the concrete pad to an approximate depth of 5 feet below ground surface. The survey area extended approximately 115 feet east of the concrete pad along the north and south sides of the former NACA crash strip. See **Figure 6** for the location of the 2010 investigation area.

The survey data indicated anomalies related to anthropogenic features, and identified two areas south and southeast of the suspected burial site characterized by relatively denser aggregates of individual anomalies (**Figure 6**). The survey data also identified anomalies beyond the northern edge of the concrete pad that appeared to be linear in nature and possibly related to subsurface utilities. Maps illustrating the NACA Test Area utility locations were not available to compare the results from the DGM survey (Shaw, 2011).

#### **2.2.7 Probability Assessment (2013)**

In 2013, the U.S. Army Engineering and Support Center (USAESC), in coordination with the Army National Guard (ARNG) and OHARNG, prepared a Probability Assessment to document the probability of encountering CWM (e.g., mustard agent gas) prior to conducting intrusive activities at the site. The Probability Assessment utilized the information collected from the previous investigations, DGM surveys conducted at the SMABS AOC, and from the research of available archived records.

Based primarily on the historical accounts of former RVAAP personnel, the Probability Assessment concluded that the probability of encountering CWM or CAIS at the SMABS AOC was “Seldom.” A “Seldom” probability is defined as “remotely possible (and) could

occur at some time.” The Probability Assessment recommended that any intrusive activity at the SMABS AOC can be conducted as non-CWM without Munitions and Explosives of Concern (MEC) support. The Probability Assessment also recommended the incorporation of a Contingency Plan in the facility standard operation plans for emergency response actions in the event that a CAIS or an intact item with an unknown liquid fill is encountered during intrusive activities at the SMABS AOC (USAESC, 2013). The Contingency Plan was finalized in December 2014.

### **2.2.8 Site Inspection Report (2015)**

In 2015, the USACE prepared a Site Inspection (SI) report based on the investigations and information collected to date on the SMABS AOC. The SI report recommended an EE/CA and Action Memorandum to determine the cost of investigation of the anomalies detected during the DGM surveys versus the cost of evaluating and selecting remedial Alternatives, such as the installation of a security fence as a Land Use Control (USACE, 2015). The SI report was approved by the Ohio EPA on April 20, 2015.

### **SECTION 3: STATEMENT OF BASIS AND JUSTIFICATION**

---

The U. S. Department of Army (US Army) is the lead agency and has chosen the No Action Alternative for SMABS AOC in accordance with the CERCLA of 1980. The No Action Alternative and the implementation of appropriate military safety regulations and response through the finalized Contingency Plan was shown to be the most appropriate alternative (not a remedy since it is no action) for SMABS. As shown in the EE/CA, there is no justification for a remedial action at the SMABS since the No Action Alternative was selected. However, the following rationale and discussion supports the original need to complete the EE/CA and why the No Action Alternative is appropriate for the SMABS AOC.

Before completion of the EE/CA which included an additional investigation of historical of mustard agents and review of critical information, prior accounts from former employees of the RVAAP facility, CAIS containing sulfur mustard agent was suspected to be buried at the SMABS AOC. However, the investigations in the EE/CA showed the unlikely potential for CAIS or mustard agent-related material to be present at the SMABS. This Action Memorandum documents the selection of the No Action Alternative.

In accordance with the Probability Assessment (USAESC, 2013) and as an Army-required safety measure, a site-specific Contingency Plan for encountering items with unknown liquid fill was developed and finalized for SMABS for potential emergency response actions in the rare event that CWM would be encountered. If disturbance is required in these areas, users and planners of activities in these areas are briefed on what actions to take in the event of encountering CAIS/mustard agent. The site-specific Contingency Plan was also integrated into Installation standard operation plans and the SMABS continues to be managed according to Army Regulations and requirements.

Although unsubstantiated, three areas were previously identified at the SMABS AOC that could have reportedly have had CAIS/mustard agent buried there. All three of these areas will be used for military training that could involve intrusive training activities as well as vehicle traffic. This could pose a safety issue due to the Seldom Probability to encounter CAIS/mustard gas, but awareness of the potential hazard and appropriate knowledge of response actions if needed, greatly decreases any hazard. Evaluation through an EE/CA ensured the selected Alternative met all criteria.

The EE/CA demonstrated that there is no rationale or justification for a remedial action. The investigation into historical documentation of the SMABS as well as the historical use of CAIS and mustard agent in the US indicated that it was very unlikely any mustard agent was used or buried on the former RVAAP. The historical record and memorandum evaluated in the EE/CA showed that whatever materials that were mis-identified as CAIS or mustard agent were removed in 1969 and the other reports and statements were unfounded.

## **SECTION 4: ENDANGERMENT DETERMINATION**

---

Based on the results of the EE/CA, there are no actual or threatened releases of contaminants from this AOC that present an imminent and substantial endangerment to public health, or welfare, or the environment. The EE/CA showed that it is unlikely that any mustard agent or CAIS was used on the former RVAAP, and more unlikely it was buried on the Installation in any location.

The No Action Alternative selected in the EE/CA was considered protective because there is no evidence to substantiate the presence of any mustard agent or related materials. The OHARNG has implemented a Contingency Plan. Given that the DOD and the Army have well-documented, protective measures and proven regulations in place to fully protect the soldiers and have demonstrated this successfully, the alternative (No Action) would provide reasonable safety and protective measures that are required regardless of CERCLA. These are mandatory and would be fully implemented. The SMABS AOC will continue to be managed according to Army Regulations and safe practices as stated in the Contingency Plan but no remedial action is warranted and no endangerment exists.

## **SECTION 5: ALTERNATIVES CONSIDERED**

---

This section briefly describes the Alternatives developed for the SMABS AOC and the individual analysis of each. Removal Action Alternatives should assure adequate protection of human health and the environment, achieve Remedial Action Objectives (RAOs), meet Applicable or Relevant and Appropriate Requirements (ARARs), and if applicable, permanently and significantly reduce the volume, toxicity, and/or mobility of contaminants.

The four Alternatives considered in this EE/CA are:

- Alternative 1 – No Action;
- Alternative 2 – Land Use Controls: Activity Use Restrictions;
- Alternative 3 – Land Use Controls: Security Fence;
- Alternative 4 – Intrusive Investigations and Removal Action.

### **5.1 ALTERNATIVE 1 – NO ACTION**

This Alternative would involve no further CERCLA response action at the SMABS AOC except to document the decision. Implementation of this Alternative would eliminate current management practices of the site as restricted access. Although this Alternative is labeled as “No Action”, the Army would continue to manage the AOC according to the recommendations made in the Probability Assessment and developed in the Contingency Plan as per Army and DOD Regulations. Additionally, applicable Army Regulations and requirements as deemed necessary for occupational health and safety will be followed for persons using the SMABS. Management and demarcation of the AOC would be in compliance with Army Regulations and Range Management directives as required in the Contingency Plan. Under this Alternative, Five-Year Reviews would not be conducted as stated in CERCLA 121(c).

No additional removal actions would be taken at the SMABS AOC under this Alternative. This Alternative would not provide additional protection of human health and the environment; compliance with ARARs; long- or short-term effectiveness; or reduction of toxicity, mobility, or volume. However, the Army has protective measures in place such as the Contingency Plan as well as occupational exposure requirements and other DOD regulations that under the circumstances, would limit/reduce/and or eliminate any hazards from inadvertent exposure or a release.

### **5.2 ALTERNATIVE 2 – LAND USE CONTROLS: ACTIVITY USE RESTRICTIONS**

Under this Alternative, the Army would assume that there is a potential that mustard agent is buried on the AOC in at least one of the three locations. This Alternative would involve the implementation of Land Use Controls (LUCs) as an administrative control and would also include some type of demarcation (i.e., Seibert stakes) to identify areas where activities are restricted. The LUCs developed for this Alternative would allow non-intrusive training activities while preventing vehicular traffic and the use of heavy equipment on the AOC in any of the three areas. Limiting physical access to the AOC ensures that use of the AOC will be controlled and only used as allowed. Additional actions regarding land use controls and

mechanisms to develop and regulate activity and use restrictions would be established. The implementation of this Alternative would include continued management and maintenance some type of demarcation to indicate areas where activities are restricted. Additionally, Five-Year Reviews would be conducted as stated in CERCLA 121(c). The estimated present worth of this Alternative is \$601,618. For cost estimating purposes, a detailed cost estimate for this Alternative is provided in Appendix C. Cost are based on a thirty- year period with 30 Annual Inspections and six Five-Year Reviews. Costs were developed without consideration of the extensive Army/DOD/ and Occupational Safety and Health Administration (OSHA) requirements for worker safety and for the requirements developed specifically by CWA Army experts for the SMABS as presented in the Contingency Plan.

### **5.3 ALTERNATIVE 3 – LAND USE CONTROLS: SECURITY FENCE**

Under this Alternative, the Army would assume that there is a likely potential that mustard agent is buried as the AOC in at least one of the three locations. This Alternative would involve the implementation of access controls at the SMABS AOC. Implementation of this Alternative would involve the installation of a security fence (and signage) around all three areas of the SMABS AOC where mustard agent or CAIS may have been buried. The fence will consist of a combination of chain link security fence or something comparable, but will fully restrict access and use. The fence will also include gates so maintenance activities such as mowing and other non-intrusive activities (e.g., sampling, surveying, natural resource management, etc.) per the LUCs can occur. Placement of the gates would be determined during the design phase of the gate installation. Additional actions regarding land use controls, monitoring, or access restrictions will also be required as part of this Alternative. All personnel using and accessing the AOC within the fenced area will be briefed on the hazard and use restrictions. Under this Alternative, Five-Year Reviews would be conducted. The primary cost drivers for this Alternative would be the labor and materials associated with the installation and continued maintenance of the fence. The estimated present worth of this Alternative is \$806,733.

### **5.4 ALTERNATIVE 4 – INTRUSIVE INVESTIGATION AND REMOVAL ACTIONS**

This Alternative would involve an extensive multi-phased approach to fully investigate and destroy/eliminate any mustard agent or CAIS materials that are uncovered in any of the three areas. This Alternative would include an additional historical review to identify any existing records relative to the use, location, transportation, and destruction of mustard agent on RVAAP or similar facilities. Under this Alternative, intensive intrusive and removal actions would be completed at each of the three areas on the SMABS AOC. Before this Alternative can be implemented, numerous Army Safety Regulations and requirements such as those established for CWM handling and removal must be addressed. These Regulations are in addition to those requirements for worker protection and measures required by OSHA and The National Institute for Occupational Safety and Health (NIOSH) for CERCLA actions. This Alternative requires extra worker protection and safety requirements because this Alternative could pose potential exposure to mustard agent and would be considered hazardous working conditions to personnel performing the extensive investigations.

This Alternative would require mandatory additional Army and contractor experts such as Health and Safety, Medical, and other specialized experts including but limited to the following:

- U.S. Army Edgewood Chemical Biological Center = (ECBC)
- Chemical, Biological, Radiological, Nuclear and Explosives = (CBRNE)
- U.S. Army CBRNE Analytical and Remediation Activity = (CARA).

Under this Alternative for Phase I and Phase II, an on-site medical emergency facility, decontamination process area, a mustard agent on-site testing lab/area as well as in-situ testing equipment and process areas for decontamination/destruction activities. The extra personnel and requirements are necessary because of the potential exposure to workers. It is highly unlikely that any mustard agent or material would be encountered but these precautions are needed because of the nature of mustard agent being a CWM and for worker protection. It is imperative to ensure worker protection in the event of an unexpected exposure, accident, or release regardless of how negligible the likelihood of encountering mustard agent is for the AOC.

Two types of removal actions would be completed as part of this Alternative. The Phase I component of this Alternative will involve trenching and/or test pits followed by removal and treatment (destruction or decontamination) of the any materials in the 1998 and the 2006 Geophysical Investigation Areas, will be completed on-site. The Phase II of this Alternative would be conducted in the 2010 Geophysical Investigation Area would be handled differently because of the numerous anomalies buried in the area. Each anomaly would be dug out and removed by hand (if it can be done safely) and then would be identified to determine its origin. Soil around each anomaly will be tested for mustard agent. The anomalies would be treated as necessary, stockpiled, and then properly disposed if they are not part of a CAIS or contain chemical agent. Any chemical agents (mustard agent or CAIS) discovered would be treated (destruction or decontamination) on-site. Both types of removal actions would also require confirmation sampling and testing of the soil to ensure that it does not contain mustard agent before being put back in place. The estimated present worth of Phase I of this Alternative is \$1,289,946. The estimated present worth of Phase II of this Alternative is \$1,309,504. The combined estimated present worth of Phase I and Phase II of this Alternative is \$2,599,450. For cost estimating purposes, it is assumed that the interim removal actions would be completed within 1 year.

## **SECTION 6: AGENCY COORDINATION AND PUBLIC INVOLVEMENT**

---

The Ohio EPA is the lead regulatory agency for the restoration activities at the former RVAAP. The Army coordinated the preparation of the EE/CA as required under the DFFOs. The Ohio EPA approved the Final EE/CA (dated September 19, 2016) along with the No Further Action Alternative on October 25, 2016. The Final (approved) EE/CA was published for public review and comment as described in the following.

Community involvement is a necessary part of the CERCLA process and the DFFOs. The NCP requires that a public notice describing the EE/CA and announcing a public comment period be published in a major local newspaper. In March 2017, the Army notified several local newspapers to announce the availability of the Final EE/CA for public review. The public review period began on March 16, 2017 and ended April 16, 2017. The public comment period provided the public appropriate opportunity for involvement in site-related decisions.

No specific comments were received on the EE/CA from the public during the review period. The Army did receive inquiries from James F. McCarty, a reporter from *The Plain Dealer* (Cleveland, Ohio). The questions from the reporter and the responses that were provided by the Army (OHARNG) are provided in Section 7: Responsiveness Summary.

In addition to providing the EE/CA to the public for comment, CERCLA 42 U.S.C. 9617(a) requires that an Administrative Record be established “at or near the facility at issue.” Relevant documents regarding the RVAAP Restoration Program have been made available to the public. The Administrative Record for this project is available at the following location:

Camp Ravenna Joint Military Training Center (Camp Ravenna)  
Environmental Office  
1438 State Route 534 SW  
Newton Falls Ohio 44444  
(330) 872-8003

Note: Access is controlled to Camp Ravenna, but the file can be obtained or viewed with prior notice to Camp Ravenna.

An Information Repository of current information and final documents is also available to any interested reader at the following libraries:

Reed Memorial Library  
167 East Main Street  
Ravenna, Ohio 44266

Newton Falls Public Library  
204 South Canal Street  
Newton Falls, Ohio 44444-1694

The RVAAP Restoration Program has an online resource for documents, restoration news and information. This website can be viewed at [www.rvaap.org](http://www.rvaap.org).

## **SECTION 7: RESPONSIVENESS SUMMARY**

---

No specific comments were received on the EE/CA from the public during the review period (March 16, 2017 to April 16, 2017). The Army did receive inquiries from Mr. James F. McCarty, a reporter from The Plain Dealer (Cleveland, Ohio). The questions from the reporter and the responses that were provided by the Army (OHARNG) are provided in the following:

***I. Army Statement and responses submitted to Mr. McCarty by:***

Stephanie Beougher  
Public Information Officer  
The Adjutant General's Department  
Office of Public Affairs

***"After years of investigation, no evidence of mustard gas contamination has been found at the facility. The recommended alternative of no further action has been reviewed and approved by the Ohio EPA and is now open to public comment. Comments may be submitted by email, telephone or through the mail.***

***II. Questions from Mr. McCarty and Army Responses that were submitted to Mr. McCarty during the public comment period:***

**1.) Are members of the public submitting comments on the plan?**

Yes, members of the public are invited to submit comments via email, telephone or through the mail. To date, we have received one public inquiry during the open comment period.

**2.) Can you provide a link to a comments site that I could check out?**

We do not have a specific comments site link for this project. Once the public comment period is over, we will provide a responsiveness summary in the Action Memorandum that will document the final remedy and the comments and responses received during the comment period. The Action Memorandum will be reviewed by the Ohio EPA and posted on the public cleanup website for Ravenna at [rvaap.org](http://rvaap.org).

**3.) Who conducted the investigation that generated the Sept. 2016 report?**

The U.S. Army Corps of Engineers, Louisville District.

**4.) Are there other Ohio EPA clean-up sites there?**

There is a restoration program to cleanup former production/operational areas throughout the facility related to former activities conducted under the Ravenna Army Ammunition Plant. A complete list of the efforts is available at <http://www.rvaap.org>.

**5.) What is Camp Ravenna used for?**

The facility is licensed to the Ohio Army National Guard for use as a training site. The Installation consists of about 21,000 acres, with various small arms weapons ranges, and permanent facilities to support weekend and annual training events.

**6.) Is Camp Ravenna open for deer hunting, when and who?**

Current members of the active and reserve components of the Army, Navy, Air Force, Marines and Coast Guard, as well as military retirees, may apply to the Camp Ravenna Controlled Deer Hunt Drawing. Each applicant drawn is also authorized to bring a guest, who may be another current or retired service member, military dependent or civilian guest. A separate civilian drawing is conducted by the Ohio Department of Natural Resources Division of Wildlife. The hunt takes place in the fall. This year's date has not been determined yet.

## **SECTION 8: DESCRIPTION OF THE SELECTED ALTERNATIVE**

---

Alternative 1 (No Action) is the recommended action for the SMABS AOC. This recommendation is based on several pieces of information and the findings from the previous investigations conducted at the AOC. The presence of mustard agent or CAIS has never been verified and is based on undocumented assertions and statements that contradict historical records, standards, and practices followed by DOD and other agencies. Accordingly, there is no evidence of a source, release, or any indication that mustard agent was ever used on the former RVAAP that would require additional CERCLA investigation or actions. This is further supported in the Probability Assessment completed by Army experts in CWM and mustard agent.

Given that no conclusive or documented evidence beyond personal accounts has been presented to confirm the presence of CAIS or other sulfur mustard agent-related materials at the SMABS AOC, there is low probability for the existence of buried mustard agent at the SMABS, which would eliminate the need for any additional removal actions by the Army. Although the anomalies identified from the DGM surveys have not yet been investigated, the nature of the anomalies appears to be non-hazardous and related to cultural or anthropogenic features. Analyses of the groundwater and soil samples collected in and around the SMABS AOC did not indicate the presence of sulfur mustard agent or its breakdown products. Therefore, this Alternative is effective (provides adequate protection of the human health and the environment) in conjunction with maintaining the Contingency Plan and following applicable Army Regulations for range management.

According to Lyribozo, *“to the best of our knowledge, there are no recent reports of exposure to MG in the United States. In fact, the only reported exposures to MG in the United States are the volunteer servicemen exposed in military experiments in the early 1940s. In Europe, however, there are ongoing accidental exposures from leftover artillery shells.[4,11,12] In the United States, Public Law 99-145 required the destruction of all US MG stockpiles by September 1994.[7] This was later postponed to 2004. The nearest stockpile of MG to our area of exposure is Pine Bluff Arsenal in Arkansas”* in a recent article published online at the following: (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1480580/>). *Accordingly, the U.S. stockpile of sulfur mustard, currently stored at seven military installations (Aberdeen Proving Ground, Maryland; Anniston Army Depot, Alabama; Lexington Blue Grass Army Depot, Kentucky; Pine Bluff Arsenal, Arkansas; Pueblo Depot Activity, Colorado; Tooele Army Depot, Utah; Umatilla Depot Activity, Oregon) and one location in the South Pacific (Johnston Island, U.S. Pacific Territory), is under congressional mandate for destruction (Carnes, 1989; Carnes and Watson, 1989). The concentration and quantity of mustard agent in test kits was a low concentration. If the test kits were broken the mustard agent would be a slowly released. Personnel properly trained in the safety, reporting, and handling of such materials would be able to avoid injury and exposure. Since there has not been a reported mustard agent exposure to CAIS in the US, it appears that the DOD and Army Regulations and procedures have been successful. Incidental exposure to buried mustard agent kits has not been reported in the US. The Army and DOD safe practices and awareness training for personnel that may encounter such materials has been protective and effective.*

The No Action Alternative would be technically and administratively feasible, and would require no services or materials to be implemented. After several investigations and one excavation at the AOC which were all based on hearsay, no indication or sign of mustard agent was discovered. The Army has determined that CAIS and other sulfur mustard agent-related materials are unlikely to be present at the SMABS AOC based on the historical records review, previous investigations, and DOD policy. There have been no reported injuries in the US from incidental exposure to CAIS which supports that the No Action Alternative would be implementable and would allow usage of the SMABS as long as proper safety protocols are implemented through the Contingency Plan for disturbance at these sites. Additionally, the Army has ongoing Regulations and requirements such as the Contingency Plan already in place (implemented as well as mandated) that will allow the State and community to accept this Alternative. Because the Contingency Plan is already in-place and has been fully implemented, this Alternative is implementable.

The present value cost to complete Alternative 1 is zero. There is no capital cost associated with No Action Alternative. Any costs relative to the continued use and management of the AOC per the Contingency Plan and Army regulations are not a function of CERCLA or of the EE/CA and are not considered further.

## **SECTION 9: EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN**

---

If the No Further Action Alternative is not implemented, negative impacts to the current usability of the AOC for training purposes will occur. The No Action Alternative as presented in the EE/CA, allows the OHARNG to remove the restrictions and use the AOC for training.

The Army has determined that CAIS and other sulfur mustard agent-related materials are unlikely to be present at the SMABS AOC based on the historical records review, previous investigations, and DOD policy. There have been no reported injuries in the United States from incidental exposure to CAIS which supports that the No Action Alternative would be implementable and would allow usage of the SMABS as long as proper safety issues are addressed for the OHARNG personnel. Additionally, the Army has ongoing Regulations and requirements such as the Contingency Plan already in place (implemented as well as mandated) that will allow the State and community to accept this Alternative. Because the Contingency Plan is already in-place, this Alternative allows the AOC to be removed from the CERCLA process and used as needed.

The No Action is the best Alternative and this Alternative recognizes the ability of the Army to proactively and effectively manage the SMABS, while ensuring any CAIS or mustard agent encountered is properly and safely addressed and handled by Army CWM experts. In addition, as done at other facilities where mustard agent was suspected but never found, the Contingency Plan includes a stop work provision if a mustard agent or CAIS is encountered. The identified CAIS or mustard agent would be evaluated and if necessary, the SMABS area would be re-entered into the CERCLA process and the evaluation process would be re-initiated to assess the source.

The Conclusions and Summary of the Probability Assessment indicate that “work in the area can be conducted as non-CWM, with the following conditions:

- Mission-related activities shall include Contingency Plans for emergency response should CWM be encountered.
- The Contingency Plan must be approved by the Commander or designated representative.
- If CAIS or an intact item filled with liquid be encountered in the field, then work shall cease and the Contingency Plan will be implemented.
- Users and planners should remain aware of potential to encounter mustard agent in the area.

## **SECTION 10: OUTSTANDING POLICY ISSUES AND ENFORCEMENT**

### **10.1 OUTSTANDING POLICY ISSUES**

There are no outstanding policy issues.

### **10.2 ENFORCEMENT**

Camp Ravenna (inclusive of the RVAAP-28 AOC) is a federal facility that is licensed to the OHARNG for use as a military training site. The ARNG/OHARNG are responsible for continuing the management of the site per the Contingency Plan and other applicable Army Regulations and policies. Because the No Action Alternative is not a remedial action, there are no enforcement components.

## **SECTION 11: RECOMMENDATIONS**

---

- The No Action Alternative was approved by the Army and the Ohio EPA.
- The recommendation for this Action Memorandum is to implement the No Action, which is consistent with guidelines under CERCLA.
- The Army will proactively and effectively manage the SMABS area, while ensuring any CAIS or mustard agent encountered is properly and safely addressed and handled by Army CWM experts.
- In addition, as done at other facilities where mustard agent was suspected but never found, the Contingency Plan includes a stop work provision if a mustard agent or CAIS is encountered.
- The identified CAIS or mustard agent would be evaluated and if necessary, the SMABS area would be re-entered into the CERCLA process and the evaluation process would be re-initiated to assess the source.

## SECTION 12: REFERENCES

---

- Center for Disease Control (CDC). 1985. Agency for Toxic Substances & Disease Registry (ATSDR). 2003. Public Health Statement, Sulfur Mustard.
- Department of Defense Environment, Safety and Occupational Health Network and Information Exchange (DENIX). <http://www.denix.osd.mil/>
- Environmental Quality Management, Inc. (EQM). 2008. Final Report on the Geophysical Investigation of RVAAP-28 the Suspected Mustard Agent Burial Site. May.
- EQM. 2012. Final Facility-Wide Groundwater Monitoring Program, Report on the October 2011 Sampling Event, Ravenna Army Ammunition Plant, Ravenna, Ohio, May 10.
- International Agency for Research on Cancer (IARC). 1975. IARC Monographs on the evaluation of carcinogenic risk of chemicals to man. Vol 9. Some aziridines, N-, S-, and O-Mustards and Selenium. Lyon, France.
- Ohio Environmental Protection Agency (Ohio EPA). 2004. Director's Final Findings and Orders in the matter of US Army, Ravenna Army Ammunition Plant. June 2004.
- Perrotta, Dennis. 1996. Long-term Health Effects Associated with Sub-clinical Exposures to GB and Mustard. <http://www.gulflink.osd.mil/agent.html>
- Science Applications International Corporation (SAIC). 1996. Preliminary Assessment for the Characterization of Areas of Contamination, Ravenna Army Ammunition Plant, Ravenna, Ohio. February.
- SAIC. 1998. Final RVAAP Geophysical Survey Results, Suspected Mustard Agent Burial Site (RVAAP-28), April 17.
- Shaw Environmental & Infrastructure, Inc. (Shaw). 2009. Final Data Quality Objectives for the RVAAP-28 Mustard Agent Burial Site at Ravenna Army Ammunition Plant, Version 1.0, May.
- Shaw. 2010. Final Geophysical Prove-Out Report for Environmental Services at RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site, Version 1.0, March.
- Shaw. 2011. Final Digital Geophysical Mapping Report for the RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area #1, and RVAAP-28 Mustard Agent Burial Site, January 11.
- SpecPro, Inc. (SpecPro). 2004. Final Work Plan and Sampling and Analysis Addenda for the Groundwater Monitoring Well Installation and Groundwater Sampling at the Suspected RVAAP-28 Mustard Agent Burial Site. November.

- SpecPro. 2005. Final Work Plan for the Groundwater Monitoring Well Installation and Groundwater Sampling at the Suspected Mustard Agent Burial Site (AOC-28). September.
- SpecPro. 2006. Final Report on the Additional Groundwater Monitoring Well Installation and Groundwater Sampling at the Suspected RVAAP-28 Mustard Agent Burial Site. May.
- USACE. 2016. Final Engineering Evaluation and Cost Analysis (EE/CA) for RVAAP-28 Suspected Agent Burial Site at the Ravenna Army Ammunition Plant, Ravenna, Ohio. September.
- USACE. 2015. Final Site Inspection Report for RVAAP-28 Suspected Agent Burial Site at the Ravenna Army Ammunition Plant, Ravenna, Ohio. April.
- USACE. 2007. Final Engineering Evaluation/Cost Analysis for the Central Burn Pits. January 2007.
- U.S. Army Engineering & Support Center (USAESC). 2013. Final Probability Assessment for the Mustard Agent Burial Site at the Ravenna Army Ammunition Plant, Ravenna, Ohio. February.
- U.S. Environmental Protection Agency (USEPA). 1989. CERCLA Compliance with Other Laws Manuals: Part II (PDF) (175 pp, 985 K). EPA 540/G-89/009, OSWER 9234.1-02, NTIS: PB90-148461INZ, August 1989.
- USEPA. 1991. Upper bound quantitative risk estimate for populations adjacent to sulfur mustard incineration facilities. Office of Research and Development. EPA/600/8-91/053.
- USEPA. 1993. Guidance on Conducting Non-time-Critical Removal Actions under CERCLA. OSWER Directive No. 9360.0-32. Publication No. EPA 564-R-93-057.
- USEPA. 2000. Use of Non-Time Critical Removal Authority in Superfund Response Actions. Office of Emergency and Remedial Response. Washington, D.C.
- USEPA. 2015. Regional Screening Levels (RSLs). <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016>

# **FIGURES**

**FIGURE 1. Camp Ravenna Location Map.**

**FIGURE 2. Camp Ravenna Facility Map.**

**FIGURE 3. Suspected Mustard Agent Burial Site Map.**

**FIGURE 4. 1998 Geophysical Investigation Area and Results.**

**FIGURE 5. 2006 Geophysical Investigation Area and Results.**

**FIGURE 6. 2010 Geophysical Investigation Area and Results.**



Note:  
The scale is for the Upper Map Only  
Showing the Former RVAAP/Camp  
Ravenna Location



**U.S. ARMY  
CORPS OF ENGINEERS**  
LOUISVILLE DISTRICT

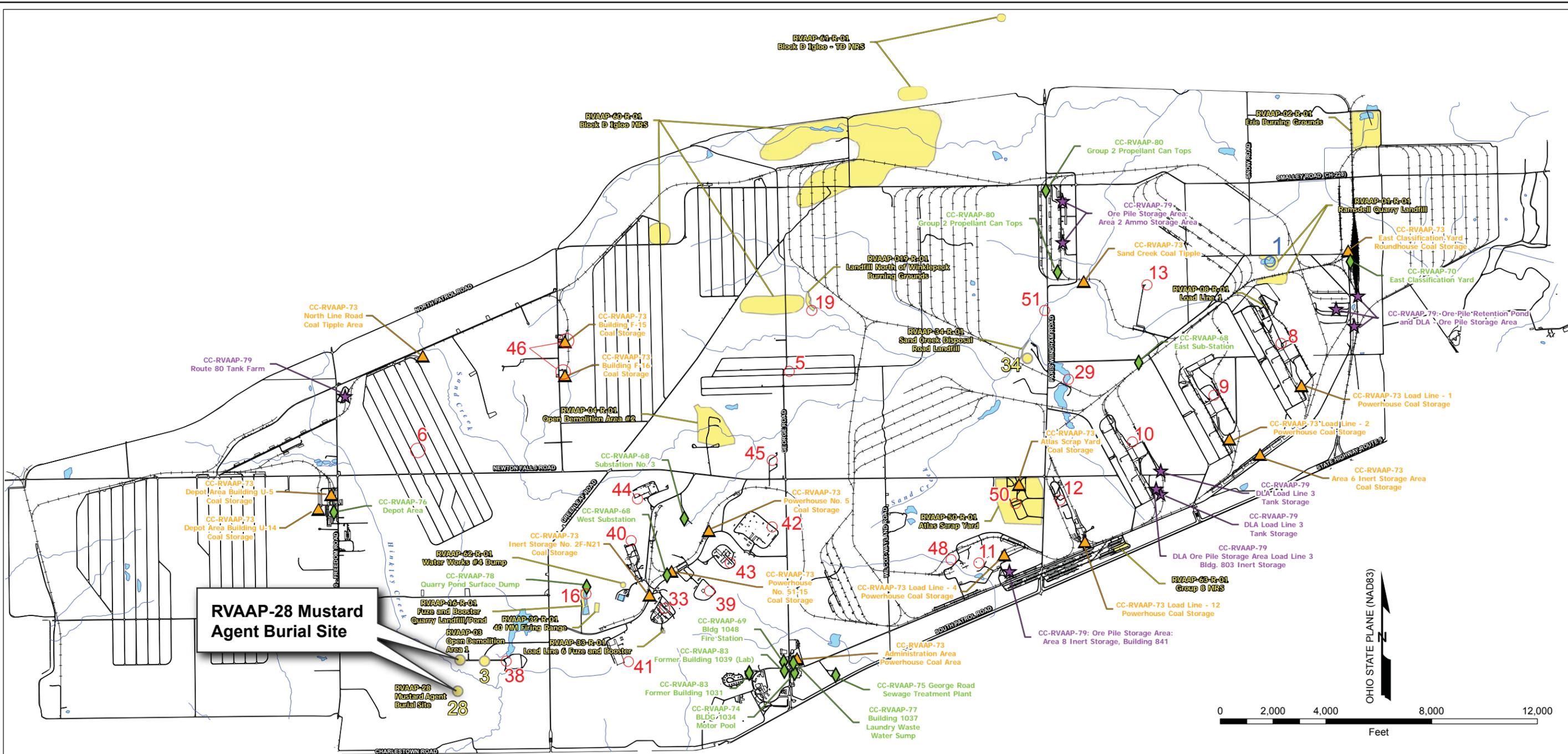
INSTALLATION RESTORATION PROGRAM

CAMP RAVENNA  
RAVENNA, OHIO



Shaw Environmental & Infrastructure, Inc.  
(A CB&I Company)  
150 Royall Street  
Canton, MA 02021

**FIGURE 1 -- CAMP RAVENNA INSTALLATION LOCATION MAP**



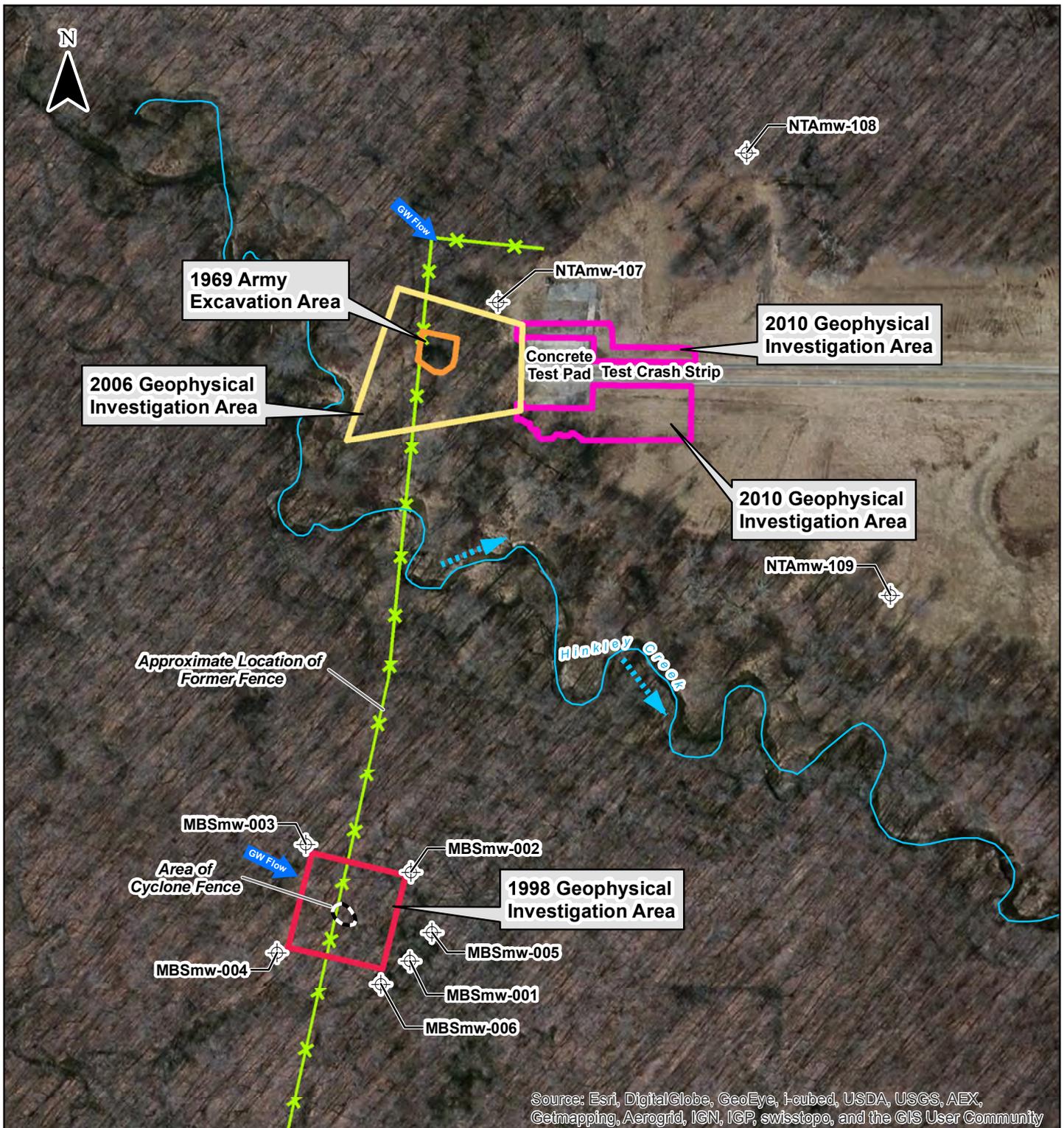
**LEGEND OF SITES**

<b>IRP SITES (29 SITES)</b>		<b>COMPLIANCE RESTORATION SITES (13 SITES)</b>		<b>MMRP SITES (14 SITES)</b>	
RVAAP-01	RAMSDELL QUARRY LANDFILL	RVAAP-33	LOAD LINE 6	RVAAP-001-R-01	RAMSDELL QUARRY LANDFILL MRS
RVAAP-03	OPEN DEMOLITION AREA 1	RVAAP-34	SAND CREEK DISPOSAL ROAD LANDFILL	RVAAP-002-R-01	ERIE BURNING GROUNDS MRS
RVAAP-05	WINKLEPECK BURNING GROUNDS	RVAAP-38	NACA TEST AREA	RVAAP-004-R-01	OPEN DEMOLITION AREA #2 MRS
RVAAP-06	C BLOCK QUARRY	RVAAP-39	LOAD LINE 5	RVAAP-008-R-01	LOAD LINE 1 MRS
RVAAP-08	LOAD LINE 1	RVAAP-40	LOAD LINE 7	RVAAP-013-R-01	FUZE AND BOOSTER QUARRY MRS
RVAAP-09	LOAD LINE 2	RVAAP-41	LOAD LINE 8	RVAAP-019-R-01	LANDFILL NORTH OF WINKLEPECK MRS
RVAAP-10	LOAD LINE 3	RVAAP-42	LOAD LINE 9	RVAAP-023-R-01	40MM FIRING RANGE MRS
RVAAP-11	LOAD LINE 4	RVAAP-43	LOAD LINE 10	RVAAP-033-R-01	FIRESTONE TEST FACILITY MRS
RVAAP-12	LOAD LINE 12	RVAAP-44	LOAD LINE 11	RVAAP-034-R-01	SAND CREEK DUMP MRS
RVAAP-13	BLDG 1200 AND DILLUTION/SETTLING POND	RVAAP-45	WET STORAGE AREA	RVAAP-039-R-01	BLOCK D IGLOO MRS
RVAAP-16	FUZE AND BOOSTER QUARRY LANDFILL/PONDS	RVAAP-46	BUILDINGS F-15 AND F-16	RVAAP-041-R-01	BLOCK D IGLOO -TD MRS
RVAAP-19	LANDFILL NORTH OF WINKLEPECK BURNING GROUND	RVAAP-48	ANCHOR TEST AREA	RVAAP-042-R-01	WATER WORKS #4 DUMP MRS
RVAAP-28	MUSTARD AGENT BURIAL SITE	RVAAP-50	ATLAS SCRAP YARD	RVAAP-063-R-01	GROUP 8 MRS
RVAAP-29	UPPER AND LOWER COBBS POND	RVAAP-51	DUMP ALONG PARIS-WINDHAM ROAD		
		RVAAP-66	FACILITY-WIDE GROUNDWATER		

**CAMP RAVENNA  
RAVENNA, OHIO**

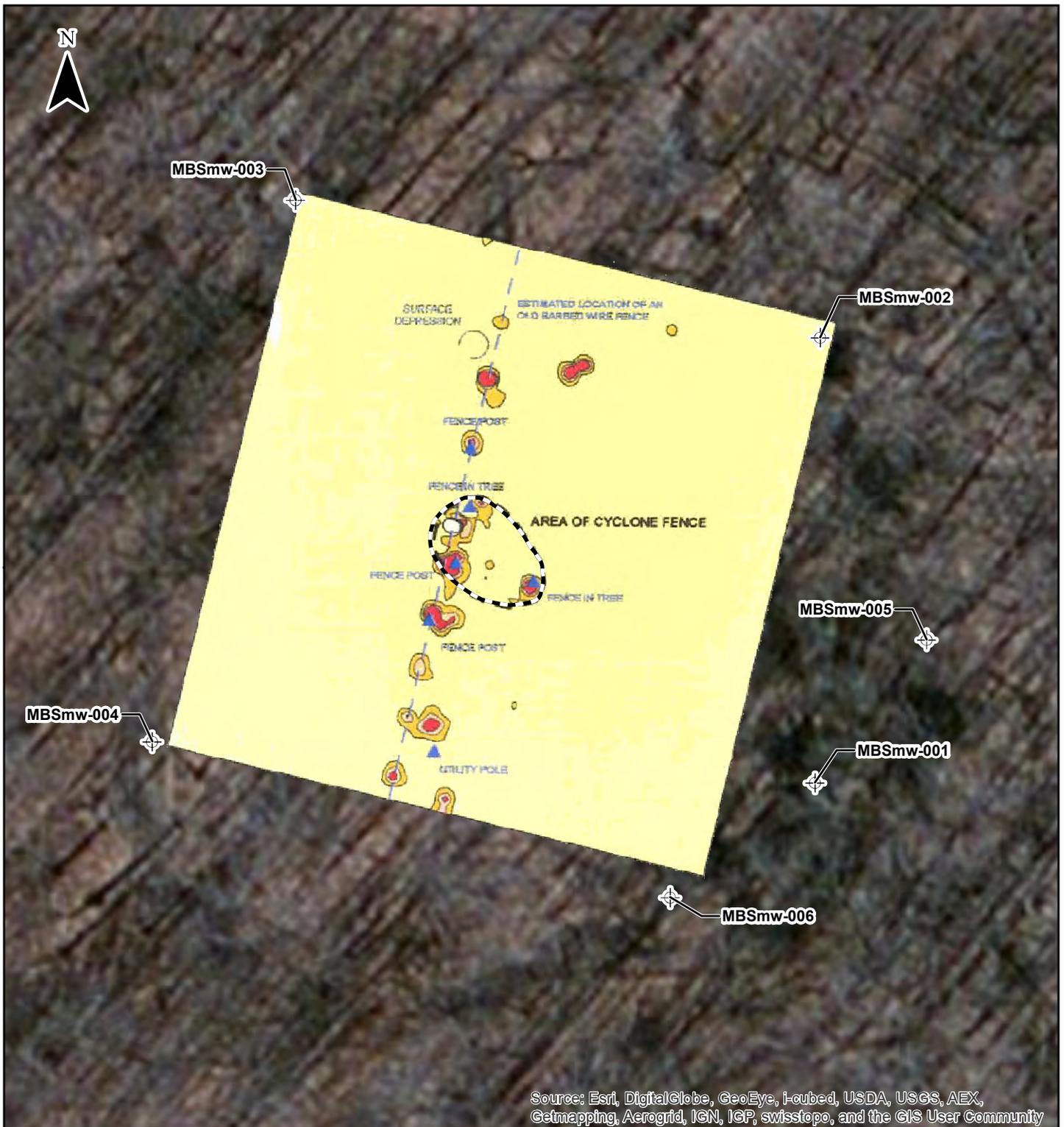
**Figure 2  
Camp Ravenna  
Facility Map**



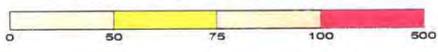
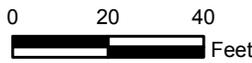


<ul style="list-style-type: none"> <li> Groundwater Monitoring Wells</li> <li> 1969 Army Excavation Area</li> <li> 1998 Geophysical Investigation Area</li> <li> 2006 Geophysical Investigation Area</li> <li> 2010 Geophysical Investigation Area</li> <li> Approximate Location of Former Fence</li> <li> Former Location of Cyclone Fence</li> <li> General Shallow Groundwater Flow Direction</li> <li> Surface Water Flow Direction</li> </ul>	<p>OpenStreetMap and contributors, Creative Commons</p> <p>0 100 200 Feet</p> <p>PROJECTION: NAD83 UTM Zone 17N</p>	 <p><b>U.S. ARMY CORPS OF ENGINEERS</b> LOUISVILLE DISTRICT</p> <hr/> <p>INSTALLATION RESTORATION PROGRAM</p> <p>RVAAP-28</p> <p>SUSPECTED MUSTARD AGENT BURIAL SITE FORMER RVAAP/CAMP RAVENNA PORTAGE AND TRUMBULL COUNTIES, OHIO</p> <hr/>  <p>CB&amp;I Federal Services LLC 150 Royall Street Canton, MA 02021</p>
---	---	--

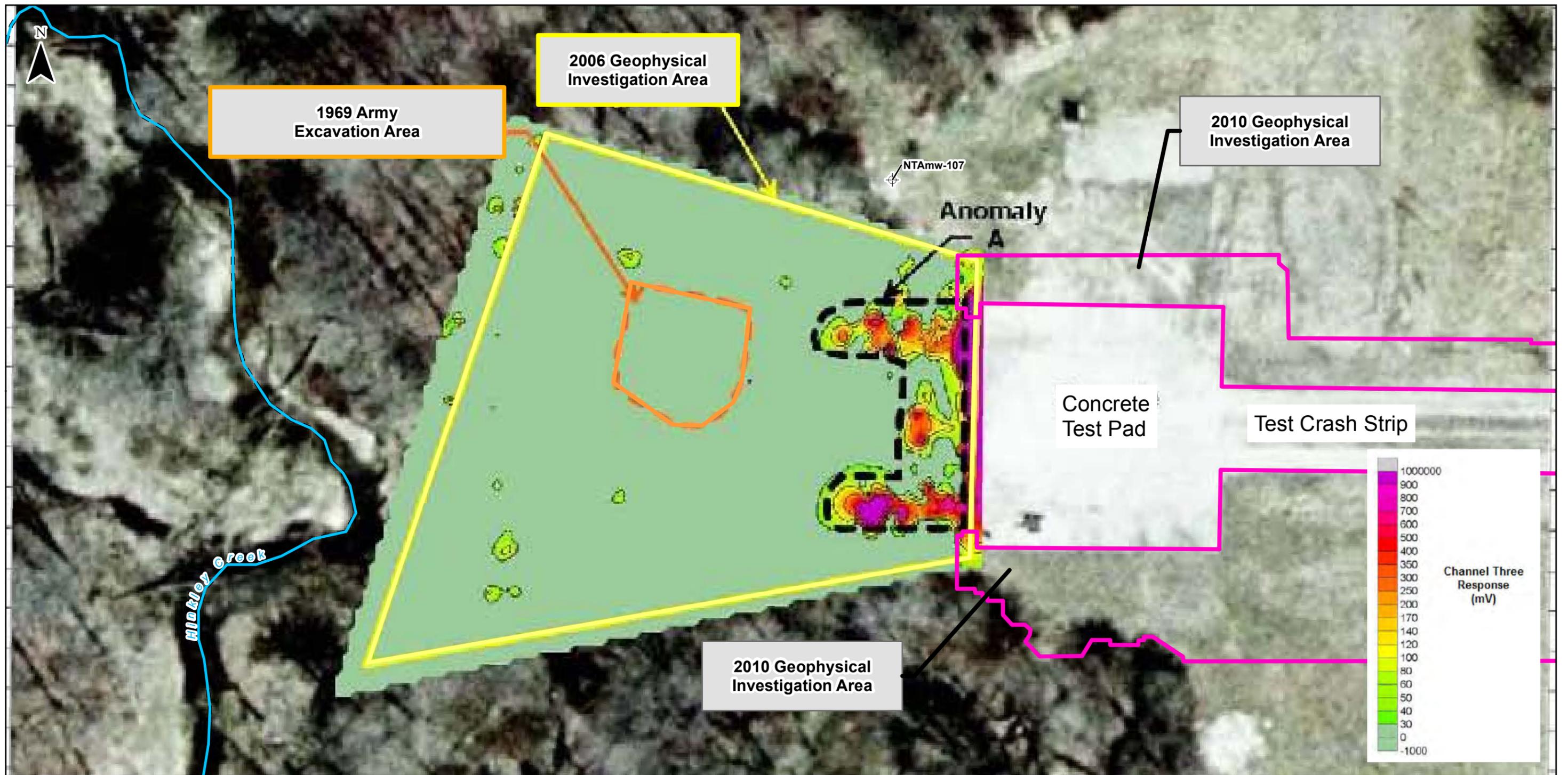
**FIGURE 3 -- SUSPECTED MUSTARD AGENT BURIAL SITE MAP**



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

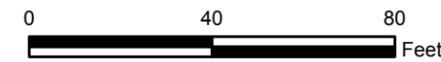
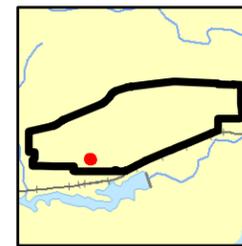
<p>⊕ Groundwater Monitoring Well</p> <p>~ Approximate Location of Former Fence</p>		 <p><b>U.S. ARMY CORPS OF ENGINEERS</b> LOUISVILLE DISTRICT</p>
<p>EM-61 RESPONSE SCALE (millivolts)</p> 		<p>INSTALLATION RESTORATION PROGRAM</p> <p>RVAAP-28 SUSPECTED MUSTARD AGENT BURIAL SITE CAMP RAVENNA RAVENNA, OHIO</p>
<p>Investigation Area and EM-61 Response Legend were obtained from Figure 1 of the Geophysical Survey Results, Suspected Mustard Agent Burial Site, Ravenna Army Ammunition Plant, Ravenna, Ohio (SAIC, 1998).</p>	<p>PROJECTION: NAD83 UTM Zone 17N</p>	 <p>Shaw Environmental &amp; Infrastructure, Inc. (A CB&amp;I Company) 150 Royall Street Canton, MA 02021</p>

**FIGURE 4 -- 1998 GEOPHYSICAL INVESTIGATION AREA AND RESULTS**



- 2010 Geophysical Investigation Area
- 2006 Geophysical Investigation Area
- 1969 Army Excavation Area
- Anomaly A
- + Groundwater Monitoring Well

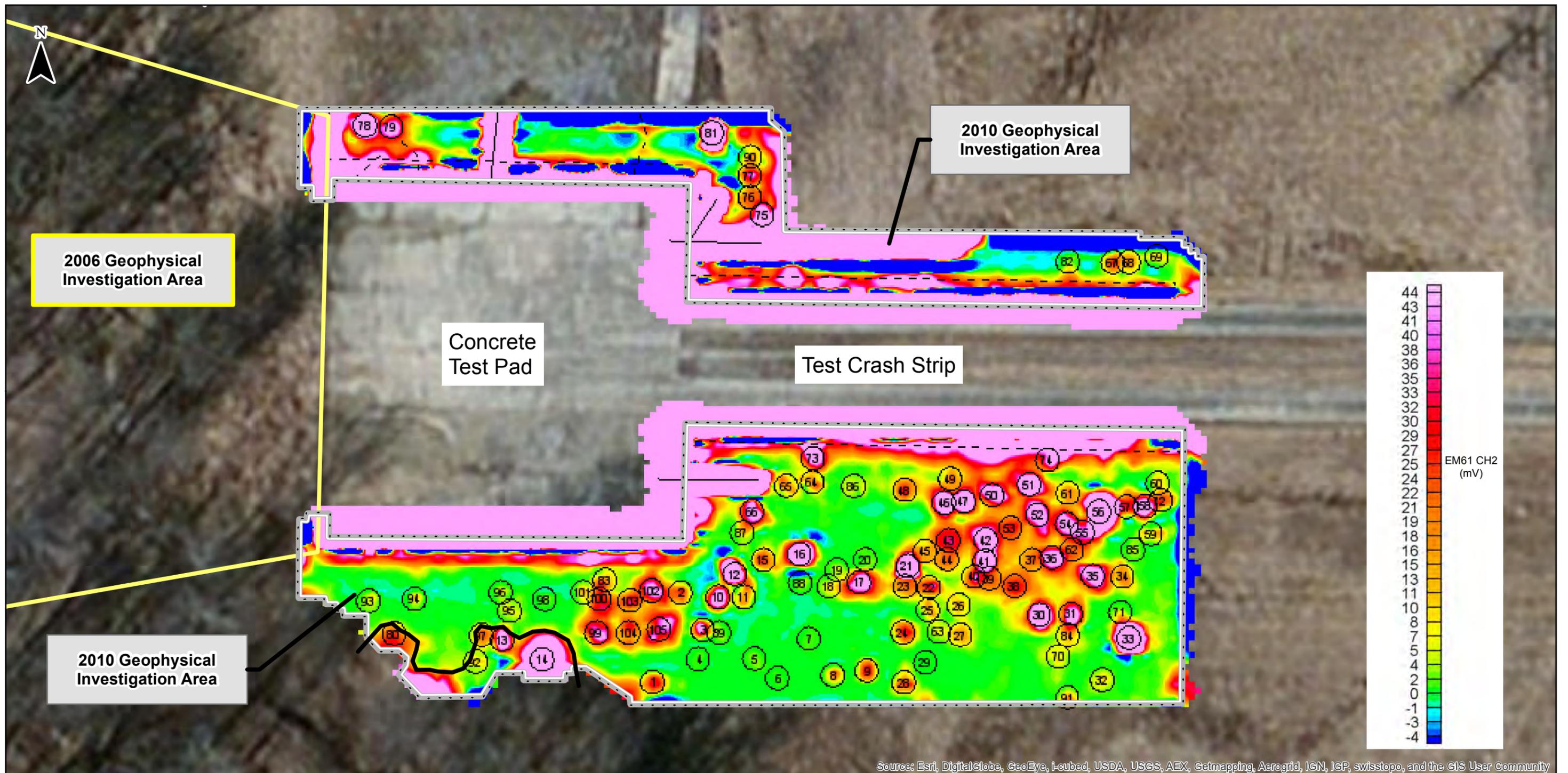
Map and Channel Three Response Legend were obtained from Figure 4 of the Final Report on the Geophysical Investigation, Suspected Mustard Agent Burial Site, Ravenna Army Ammunition Plant, Ravenna, Ohio (Environmental Quality Management, Inc, 2008).



PROJECTION: NAD83 UTM Zone 17N

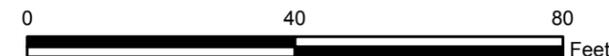
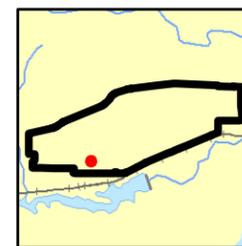
	<b>U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT</b>
INSTALLATION RESTORATION PROGRAM	
RVAAP - 28 SUSPECTED MUSTARD AGENT BURIAL SITE CAMP RAVENNA RAVENNA, OHIO	
	Shaw Environmental & Infrastructure, Inc. (A CB&I Company) 150 Royall Street Canton, MA 02021

**FIGURE 5 -- 2006 GEOPHYSICAL INVESTIGATION AREAS AND RESULTS**



- 2010 Geophysical Investigation Area
- 2006 Geophysical Investigation Area
- Larger Contiguous Area of Increased Anomaly Density
- Anomaly Location and ID

Map and Channel Three Response Legend were obtained from Figure 4 of the Final Report on the Geophysical Investigation, Suspected Mustard Agent Burial Site, Ravenna Army Ammunition Plant, Ravenna, Ohio (Environmental Quality Management, Inc, 2008).



PROJECTION: NAD83 UTM Zone 17N

	<b>U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT</b>
	INSTALLATION RESTORATION PROGRAM
	RVAAP - 28 SUSPECTED MUSTARD AGENT BURIAL SITE CAMP RAVENNA RAVENNA, OHIO
	Shaw Environmental & Infrastructure, Inc. (A CB&I Company) 150 Royall Street Canton, MA 02021

**FIGURE 6 -- 2010 GEOPHYSICAL INVESTIGATION AREA AND RESULTS**