PROPOSED PLAN

FORMER FORT CROWDER CHEMICAL WARFARE MATERIEL SITE
NEWTON COUNTY, MISSOURI

FUDS PROJECT NO. B07MO013801

Prepared by

US Army Corps of Engineers – Kansas City District
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List of Abbreviations and Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
ASR	archives search report
BLRA	Base Line Risk Assessment
CAIS	chemical agent identification sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CG	phosgene
CN	chloroacetophenone
CSS	chemical safety submittal
CWM	chemical warfare materiel
DD	Decision Document
DM	Adamsite
DoD	Department of Defense
DERP	Defense Environmental Restoration Act
FS	Feasibility Study
FUDS	Formerly-Used Defense Site
GIS	geographical information system
H	mustard
HD	distilled mustard
HN-1	nitrogen mustard
HN-3	nitrogen mustard
HS	mustard
INPR	Inventory Project Report
L	Lewisite
LTM	long-term management
LUC	land use control
M-1	Lewisite
MDNR	Missouri Dept. of Natural Resources
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
MMRP	Military Munitions Response Program
NPL	National Priorities List
O&M	Operation and Maintenance
PA	Preliminary Assessment
PCO	project closeout
PIP	Public Involvement Plan
PS	chloropicrin
RAO	Remedial Action Objective
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Inspection
TBC	To Be Considered
TEC	U.S. Army Engineer Research and Development Center, Topographic Engineering Center
TEU	U.S. Army Technical Escort Unit
USACE	United States Army Corps of Engineers
USACE-KCD	United States Army Corps of Engineers - Kansas City District

USAESCH	U.S. Army Engineering and Support Center, Huntsville
USEPA	United States Environmental Protection Agency

1 Introduction

The United States Army (Army), as the lead agency under the **Formerly-Used Defense Sites** (FUDS) program, on behalf of the Department of Defense (DoD), is issuing this **Proposed Plan** for the former Fort Crowder **Chemical Warfare Materiel** (CWM) site to solicit public participation as required under Section 117a of the **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA) and Section 300.430(f)(2) of the **National Contingency Plan** (NCP). The public participation process, as required by CERCLA and the NCP, affords the public a reasonable opportunity for submittal of written or oral comments and for a public meeting near the former Fort Crowder CWM site during the public comment period.

The U.S. Army Corps of Engineers (USACE) has conducted environmental activities at the former Fort Crowder CWM FUDS on behalf of the Army, pursuant to the **Defense Environmental Restoration Program** (DERP). This Proposed Plan was developed by the USACE with support from the Missouri Department of Natural Resources (MDNR). The United States Environmental Protection Agency (USEPA) Region 7 performs regulatory assistance to MDNR. Although the former Fort Crowder CWM site is not on the **National Priorities List** (NPL), the USACE follows the CERCLA process.

This Proposed Plan highlights the **preferred alternative** for CWM at the former Fort Crowder FUDS, and summarizes the other remedial alternatives that were evaluated in greater detail in the *Programmatic **Remedial Investigation** and **Feasibility Study** (RI/FS) for Possible CAIS Sites, CWM Scoping and Security Study* (Parsons, 2007), which is available in the **Administrative Record** file located at the Neosho Public Library in Neosho, Missouri.

The remedy described in this Proposed Plan is the preferred alternative for remediation at the former Fort Crowder CWM FUDS. The Army may decide to modify the preferred alternative or select another remedial alternative from the Feasibility Study if comments from MDNR or the public or additional data indicate that such a change will result in a more appropriate remedy. Opportunities for public participation are explained in detail in Section 10 of this Proposed Plan.

DATES TO REMEMBER	MARK YOUR CALENDARS
PUBLIC COMMENT PERIOD: June 6, 2012 – July 6,2012	USACE will accept written comments on the Proposed Plan during the public comment period. Refer to Section 10 for information on how to submit written comments.
PUBLIC MEETING: June 13, 2012 Starting at 7:00pm	USACE will hold a public meeting to explain the Preferred Remedial Alternative. The meeting will be held at the Neosho Fish Hatchery Visitors Center
For additional information, review the Administrative Record file at:	Neosho/Newton County Library 201 West Spring St. Neosho, MO 64850 (417) 451-4231

All terms initially shown in bold font are defined in a glossary at the end of this Proposed Plan.

2 Site Background

2.1 Site Location

The former Fort Crowder is located in Newton County, Missouri, approximately three miles southeast of the City of Neosho (Fig. 2-1).

The former Fort Crowder CWM site is the Chemical Exercise Area, which consists of approximately 58 acres and includes two adjacent areas, the No. 110 Gas Chambers Area and the area around the Former Pistol Ranges (Fig. 2-2). These areas are separated by Mink Road (formerly June Road).

2.2 Site History

2.2.1 Military Operations, 1941-1967

Fort Crowder, originally called Camp Crowder, was constructed during 1941 to 1942 on approximately 42,800 acres of land in Newton and McDonald Counties, Missouri. From 1942 until deactivated in 1946, it operated as a Signal Corps Replacement Training Center. The fort was reactivated in 1951 as an Army Reception Center for the Korean conflict. From 1953 to 1958, the fort was used as a U.S. Branch Disciplinary Barracks. From 1958 to 1967, an area in the northern part of the fort was used as U.S. Air Force Plant 65. Starting in 1962, the bulk of the land comprising the former Fort Crowder was declared excess property and sold.

2.2.2 Chemical Warfare Training

During World War II, chemical warfare training at the former Fort Crowder was conducted at the Chemical Exercise Area, which included the No. 110 Gas Chambers Area and the area around the Former Pistol Ranges (TCT-St. Louis, 1992) (Fig. 2-2). Two of the three gas chambers built at Fort Crowder for gas mask proficiency training were located at the No. 110 Gas Chambers area. Chemical warfare training also included field exercises where soldiers were exposed to **chemical agents** in settings that simulated actual battlefield conditions (TCT-St Louis, 1992).

Chemical agent identification sets (CAIS) were expendable training aids used by all branches of the military to train soldiers in the safe identification, handling, and decontamination of chemical agents and industrial chemicals used in chemical warfare. CAIS consist of small glass containers filled with various chemical agents, which were packed in metal shipping containers or wooden boxes. More than 100,000 CAIS were produced from 1928 to 1969.

At Fort Crowder, chemical training materials, **munitions**, and explosive simulators were stored in quonset huts and igloos located in the vicinity of the Chemical Exercise Area. After World War II, these buildings were declared surplus and sold. Historical records do not include any information on the final disposal of the CAIS.

2.2.3 Nearby Land Use

The City of Neosho (population 10,505) is the county seat of Newton County. Land use in the vicinity of the former Fort Crowder is primarily agricultural and woodland. Approximately

4,358 acres of the former Fort Crowder now comprises the Missouri Army National Guard Fort Crowder facility (Fig. 2-1), which trains several thousand troops each year. As an active National Guard facility, this property is not included in the FUDS program and was not evaluated as part of this Proposed Plan. Commercial, educational, and industrial facilities occupy other portions of the former Fort Crowder.

The No. 110 Gas Chambers Area is currently residential property and horse pasture. The former Pistol Ranges is currently the site of a privately-owned pullet chicken farm. Future land use is anticipated to remain similar with respect to agriculture. However, the potential exists that development will extend farther south from Neosho.

2.2.4 Environmental History and Investigations

2.2.4.1 1981 incident at the former Magazine Area

In July 1981, three National Guard soldiers were excavating near the location of a former storage igloo in the former Magazine Area of the National Guard facility (Fig 2-1), when they were overcome by vapors apparently coming from the ground (Parsons, 2003). They experienced difficulty breathing, burning eyes, and nausea, and were treated and released from a local hospital with no apparent long-term effects. A follow-up investigation did not reveal the source of the vapors.

The soldiers doing the excavation work in 1981 may have encountered some of the former igloo contents. Their injuries were consistent with exposure to phosgene gas. Descriptions from witnesses and the patient report for one of the injured soldiers suggest that components of a CAIS were disturbed.

2.2.4.2 1986 incident at the former Pistol Ranges

In June 1986, a bulldozer operator preparing a site on the former Pistol Ranges (Fig. 2-2) for new building construction uncovered several vials of unidentified liquid and metallic material of military nature. A white gaseous cloud filled the air behind the bulldozer after it ran over some of the vials. The operator's eyes became watery and he had difficulty breathing. After resting a while, he returned to work. The next day, he reported the incident.

The U.S. Army Technical Escort Unit (TEU) responded and removed military-related debris, including mine fuzes and mine fuze components, surface trip flares, grenade fuzes, an aircraft signal, and 30 glass vials containing chemical agent or chemical agent **simulants**. Nine vials were confirmed as components of K951 CAIS, and three vials contained mustard (H). The TEU carefully cleared the site of munitions and vials by sifting the loose soil moved by the bulldozer. The area was then decontaminated with calcium hypochlorite.

2.2.4.3 1992 Archives Search Report

In 1992, an **Archives Search Report** (ASR) for conventional munitions was compiled by TCT-St. Louis on behalf of the USACE. The ASR was prepared by reviewing all available records, photographs, and reports that documented the history of the site, and conducting site visits and interviews.

The 1992 ASR identified the area around the Former Pistol Ranges and the No. 110 Gas Chambers Area as the Chemical Exercise Area. The two areas are adjacent and separated

by Mink Drive (formerly June Road). An interviewee identified an area about 350 feet east of the gas chambers as the location where training with chemical agents occurred. The training consisted of exposing soldiers to chemical agents in a setting that simulated actual battlefield conditions. The interviewee stated that the agents used at this site included **mustard** (H, HS), **Lewisite** (M-1 or L), **chloropicrin** (PS), and **phosgene** (CG).

2.2.4.4 1993 USACE ASR Addendum

In 1993, the USACE – St. Louis District issued an addendum to the TCT-St. Louis ASR in order to specifically search for evidence of CWM. This ASR addendum is a primary source for information about Fort Crowder and incidents that occurred in the years since it was closed.

In this ASR addendum, another interviewee stated that munitions, explosive simulators, and chemical training materials were stored in twenty-two 30-foot by 30-foot quonset huts or igloos located in the southeast corner of June Corner, in the general area where the former Pistol Ranges were located (USACE, 1993).

2.2.4.5 1993 USACE Inventory Project Report

Also in 1993, the USACE – Kansas City District (USACE-KCD) prepared an Inventory Project Report (INPR) for the former Fort Crowder. The INPR included real estate and historical background searches, and determined that the former Fort Crowder was eligible under the FUDS program as a site potentially containing CWM.

2.2.4.6 2005 Site-specific CWM Scoping and Security Study

In 2005, the U.S. Army Engineering and Support Center, Huntsville (USAESCH) completed a site-specific CWM Scoping and Security study for the former Fort Crowder, which consisted of a two-part phased evaluation and characterization consistent with FUDS Program Policy (ER 200-3-1) and the Preliminary Assessment (PA) and Site Inspection (SI) phases of the CERCLA process.

2.2.4.6.1 Preliminary Assessment Phase

The PA included historical records review, limited aerial photographic analysis, and site data collection.

2.2.4.6.1.1 2003 Aerial Photographic Analysis

In February 2003, the U.S. Army Engineer Research and Development Center, Topographic Engineering Center (TEC) collected and analyzed aerial photographs from July 1938, September 1953, and March of 1996 and 1997 to identify features that could represent disposal areas for CWM, such as ground scars, areas of disturbed ground, berms, and ditches. This information was used to aid in the selection of areas for geophysical survey during the site investigation.

2.2.4.6.2 Site Inspection Phase

The SI included site visits and interviews, geophysical surveys, intrusive investigation, sampling and analysis for munitions constituents, and additional aerial photographic analysis.

2.2.4.6.2.1 2003 Site Visit

On February 20, 2003, USAESCH conducted a site visit to the former Fort Crowder to evaluate current site conditions and to confirm the findings of the ASR. The findings and conclusions of the site visit were as follows:

- The property owner of the former Pistol Ranges identified the location where the vials were found in 1986 by placing a mark on one of the TEC aerial photographs near an E-shaped berm. The identified location was east of both the No. 110 Gas Chambers Area and Mink Drive.
- This area is high ground that is covered with grass and includes a chicken facility. Portions of old berms and several building foundations from the former military installation remain at the site.
- A survey with a magnetic locator indicated a significant magnetic **anomaly** on top of the berm and small magnetic anomalies in the area of the 1986 incident. Bullet casings and an expended fuze from a practice grenade were found on one of the foundations.
- Further investigations, including geophysical methods, were recommended for the areas of the 1986 exposure incident, the chicken facility, and the remaining berms.

2.2.4.6.2.2 2003 Intrusive Investigation

During August to November, 2003, USAESCH conducted an SI to characterize the Chemical Exercise Area, which consists of the No. 110 Gas Chambers Area and the former Pistol Ranges, for the potential presence of CWM. The field investigation included a geophysical survey of approximately 30 acres to detect ferrous metal objects, **intrusive investigation** of selected geophysical anomalies, and analysis of soil samples from excavations for chemical agents or agent breakdown products. Thirty (30) soil samples were collected from trenches. The soil samples were analyzed by the Edgewood Chemical Biological Center (ECBC) for mustard (H); nitrogen mustards (HN-1 and HN-3); Lewisite (L); and their corresponding Agent Breakdown Products (ABPs).

No chemical warfare agents or breakdown products were detected in the ECBC laboratory analyses. Additionally, no CWM was found during the intrusive investigation. The only military-related items were a live practice mine fuze and ordnance-related scrap from two rifle grenades. The live practice mine fuze was found in the former Pistol Ranges, approximately 40 feet southeast of the 1986 incident location. The fuze was relocated next to the berm and **blown-in-place** by a U.S. Army Explosives Ordnance Disposal unit from Fort Leonard Wood. Soil samples were collected from the detonation location and were submitted to Severn Trent Laboratories for explosives and metals analysis. Explosives constituents were below detection limits for the soil samples submitted and there was no significant increase in the concentration of metals at the location. The remainder of the items recovered were common scrap metal items consistent with building materials and farm activities, including barbed wire, banding material, nails, rebar, tool parts, wire, nuts, bolts, and pieces of reinforced concrete.

Although no CWM was discovered during the 2003 SI, buried CAIS may remain at the site.

2.2.4.6.2.3 2004 Aerial Photographic Analysis

In May 2004, TEC completed the Special Assessment GIS-Based Historical Photographic Analysis report for the former Fort Crowder. This report included additional photographic sources from December 1942, August 1945, and November 1950, as well as the photographic sources used in the 2003 report. The 1942 aerial photographs clearly show the No. 110 Gas Chambers, and the Pistol Ranges to the east. However, ground scars to the east of the Pistol Ranges identified in the 1953 aerial photograph are not as evident in the 1942 aerial photograph.

2.2.4.7 2006 Public Involvement Plan

In 2006, a Public Involvement Plan (PIP) was prepared for the former Fort Crowder CWM site. A PIP is required for all FUDS projects that progress beyond the SI, and serves as the foundation for future public involvement activities. The Fort Crowder PIP includes an assessment of the local community and their concerns about the site and identifies appropriate community-specific public involvement initiatives. As part of the PIP process, an Educational Awareness and Training session was conducted on April 6, 2006. The purpose of the training session was to provide an opportunity for the public to learn the details of the 2005 *CWM Scoping and Security Study* at the former Fort Crowder and have questions answered and concerns addressed.

2.2.4.8 2007 Programmatic RI/FS Report for Possible CAIS Sites

In 2007, USAESCH completed a *Programmatic RI/FS* for sites where CAIS is the CWM of concern and no further information is available concerning any known or suspect burial locations. Although historical records indicate that CAIS were used and stored at the former Fort Crowder; the records do not include any information on the final disposition of the CAIS. Thus, buried CAIS may remain on site. Further investigation is considered technically unfeasible because: 1) no other burial locations were identified during records review or visual site inspection; 2) glass vials from CAIS cannot be detected in soil with currently available technology; and 3) soil sampling and analysis for chemical agents and associated breakdown products is impractical due to the lack of identifiable locations and the small quantities likely involved. The *Programmatic RI/FS* evaluates the former Fort Crowder collectively with other CAIS sites where field investigation is unfeasible, and discusses potential remedial alternatives. In conjunction with the *Programmatic RI/FS,* USAESCH developed an online educational awareness and training program available at URL: https://www.denix.osd.mil/uxosafety. This public-access website has information on CAIS, the history of chemical warfare, and the response process.

3 Site Characteristics

3.1 Site Geology and Soils

The former Fort Crowder lies on the west-central edge of the Ozark Plateau physiographic province, which is characterized by heavily eroded features and relatively deep valleys (Fenneman, 1946). The site is located on the southern flank of the Springfield Plateau, which is a localized expression of the Ozark Dome. Stream flow is controlled by regional bedrock dip and localized fracture systems. The area is notable for features typical of karst topography, such as sinkholes and losing streams (Missouri Dept. of Natural Resources, 1986).

The geology of Newton County is characterized by outcrops of primarily Mississippian limestones and dolomites that dip gently to the west. The uppermost formation commonly encountered in the Fort Crowder area is the Warsaw Formation, which consists of crystalline, fossiliferous limestone with bedded chert (MDNR, 1986).

Overburden materials found on ridges and uplands in the Fort Crowder area consist of reworked loess and cherty limestone residuum. Formation of soils from cherty limestone or dolomite produces soils of moderate to high permeability due to the insolubility of the chert (US Dept. of Agriculture , 1979). Lowland and stream valley soils characteristically contain fragipan, or hard calcite deposits, which are laterally discontinuous, but extensive enough to restrict permeability in some areas.

3.2 Nature and Extent of Contamination

The suspected CWM contamination at the former Fort Crowder is CAIS. Historical records indicate that CAIS were used and stored at the former Fort Crowder but do not include any information on the final disposal of the CAIS. Although no CWM or chemical agent-contaminated media were discovered during an intrusive investigation conducted in 2003, the results of the 2005 *CWM Scoping and Security Study* (Parsons, 2005) indicated that CWM in the form of CAIS could potentially remain at the former Fort Crowder.

The available data indicates that the two main types of CAIS used at Fort Crowder were “sniff sets” (K955 Navy or Navy X sets) and ampoule sets (K951/K952 sets). The chemical agents associated with these types of CAIS are listed in Table 2-1. All types of CAIS contained only small amounts of chemicals.

“Sniff sets” were intended for indoor use to instruct military personnel in recognizing chemical odors (Fig. 2-3). This type included the K955 and Navy X sets, which were used from the late 1930s through World War II. Sniff sets contained glass bottles filled with chemical-impregnated charcoal, chemical-impregnated plastic pellets, or agent simulants (Fig. 2-4). The sniff set bottles were stored in metal cans with paint can-type lids, which were packaged in hinged wooden boxes.

Ampoule sets were designed for outdoor use, and consisted of chemicals (pure or in solution) in sealed ampoules made of shock-resistant borosilicate glass. These CAIS were exploded with detonators during field exercises to simulate actual battlefield conditions. This type included the K951 and K952, which were used in the early 1950s during the Korean War (Fig. 2-5). The ampoules were approximately one inch in diameter and approximately 7.5 inches long (Fig. 2-6). Individual ampoules were packed in cardboard screw-cap containers with the chemical type indicated on the cap. Twelve cardboard containers were placed into a metal can with a press-fit lid. Four cans were stored in a steel shipping container (called a “pig”).

Potential sources of CAIS contamination include: 1) intact CAIS ampoules or bottles (full, partly full, or empty); 2) CAIS chemicals released to the environment during chemical warfare training and/or CAIS disposal. Data from CAIS sites indicates that the intact CAIS ampoules or bottles are the main potential source of CAIS contamination. These items, if present, are likely to be buried beneath the ground surface. However, due to the nature of the chemical warfare training activities, some items could be present on the ground surface. Release of CAIS chemicals to the environment would have occurred at outdoor demonstration and training areas where detonation sets and decontamination training were conducted and also

potentially at disposal sites where the contents of CAIS were dumped and incompletely destroyed. However, release of CAIS chemicals to the environment has not been shown to be a source of contamination to soil, groundwater, or surface water (Parsons, 2007).

4 Scope and Role of the Action

The proposed action will be the final action for remediation of CWM at Fort Crowder. This **response action** builds upon the previous restoration activities at the site, which include a site educational awareness and training session conducted in 2006 as part of the PIP, and an online educational awareness and training program available at URL: https://www.denix.osd.mil/uxosafety, which has information on CAIS, the history of chemical warfare, and the response process. The goal of the Fort Crowder Response Action is to reduce the risk of exposure to CWM in the form of CAIS, and reduce the impact in the event an exposure occurs.

Because intrusive activities during the *CWM Scoping and Security Study* (Parsons, 2005) uncovered a practice mine fuze and ordnance-related scrap from rifle grenades, the Fort Crowder INPR was amended to initiate a project for conventional munitions. A Military Munitions Response Program (MMRP) SI is expected to be complete in 2012.

5 Summary of Site Risks

As required by CERCLA, a **baseline risk assessment** (BLRA) was prepared in support of the *Programmatic RI/FS Report*. The greatest risk to human health and the environment associated with CWM in the form of CAIS is the safety risk due to acute exposure from breakage of loose ampoules and bottles remaining at the site. Due to the small amounts of chemicals in CAIS, release of the chemicals to the environment is a lesser hazard.

The potential for a CWM safety risk depends on the presence of three critical elements:

- a **source** (presence of CWM);
- a **receptor**; and
- an interaction between source and receptor.

There is no risk if any one of these three elements is missing.

5.1 Hazard Identification

The potential for CAIS to remain at the former Fort Crowder is based on site history and documentation (Parsons, 2005). The chemicals of potential concern contained in the CAIS used at Fort Crowder are listed in Table 3-1. The greatest hazard is from intact, loose bottles or ampoules. All reported injuries from accidental exposures to CAIS were from ampoules or bottles (Parsons, 2007). Chemicals in these containers may persist indefinitely until opened or accidentally broken. The ampoules and bottles from the CAIS normally detonated in outdoor demonstrations (e.g., K951, K953, K941, K942) were most likely to have been buried as a means of disposal or buried following attempted destruction via burning (Parsons, 2007). Chemicals from “sniff sets” were most likely expended prior to disposal of the bottles.

Old releases, chemicals and breakdown products remaining from the use of CAIS during chemical warfare training, may also be a potential hazard. However, there have been no reports of injuries related to exposure to old releases (Parsons, 2007). Persistent CAIS

chemicals dissolved in a solvent (e.g., mustard, Lewisite, nitrogen mustard) most likely have volatilized or degraded into breakdown products. Chloroform in the soil may persist while gradually volatilizing over time. Some compounds (e.g., Adamsite, chloroacetophenone) only present a hazard if made airborne as a dust or if direct skin contact to high concentrations is made. All nonpersistent chemicals (e.g., phosgene, triphosgene, chloropicrin) will have long since volatilized and dispersed.

5.2 Exposure Assessment

The exposure assessment estimates the extent of human contact with potential chemicals of concern by characterizing potentially exposed receptors, identifying actual or potential routes of exposure, and estimating the extent of human exposure. Undisturbed CAIS do not present significant hazard to humans or the environment. An exposure can only occur if CAIS are encountered and the glass containers are broken. The most common scenario for encountering CAIS occurs during excavation for utilities or building foundations (Parsons, 2007). If bottle or ampoule breakage occurs during excavation, workers in the immediate vicinity will be subject to the harmful effects of the chemical release. Exposure would occur via inhalation and dermal contact.

The current and future receptors are:

- a construction worker, who is assumed to be conducting some form of intrusive activities in the soil;
- a maintenance worker, who would only be servicing existing facilities and, therefore, would be less likely to encounter CAIS chemicals;
- an emergency responder to an incident involving exposure to CAIS chemicals;
- passersby and pedestrians, including casual visitors, who might be exposed due to intrusive activities.

The most likely exposure pathways for construction workers are:

- inhalation of vapors released from broken CAIS ampoules or bottles;
- direct dermal contact with CAIS chemicals;
- direct dermal contact with contaminated soil.

The most likely exposure pathways for emergency responders are:

- direct dermal contact with CAIS chemicals;
- direct dermal contact with contaminated soil;
- direct dermal contact with contaminated personnel.

Other receptors are less likely to be exposed.

5.3 Toxicity Assessment

The limited history of unintentional exposures to CAIS chemicals shows that acute symptoms predominate, including choking, watery eyes, trouble breathing, blisters, and redness of skin.

5.4 Uncertainty Analysis

Uncertainty in evaluating the hazards due to CAIS is due to inability to determine the presence of CAIS at the site or to quantify the amounts of chemicals in the CAIS, and lack of

information on the locations of outdoor chemical warfare training or demonstration areas and the locations of CAIS burials. The conservative assumption is that CAIS are present, although in many cases the quantities of chemicals used were likely very small.

5.5 Summary and Conclusions

The greatest risk from CAIS is the potential presence of intact, loose bottles or ampoules, which could produce a dangerous release of chemicals if opened or broken. A less significant risk may also remain from small amounts of chemical agents and breakdown products that persist from historical chemical warfare training exercises.

6 Remedial Action Objectives

6.1 Description of Remedial Action Objectives

Remedial action objectives (RAOs) are specific goals to protect human health and the environment. The RAOs are intended to be specific to the affected media, but sufficiently broad so as not to overly restrict the potential remedial technology available.

The greatest risk to human health and the environment associated with CAIS is due to acute exposure from breakage of loose bottles and ampoules. The most common scenario for encountering CAIS occurs during intrusive activities, such as excavation for utilities or building foundations. The glass CAIS containers can be broken when struck by a shovel, bulldozer blade, backhoe bucket, or being driven over by heavy equipment. If bottle or ampoule breakage occurs during excavation, workers in the immediate vicinity will be subject to the harmful effects of the chemical release.

The overall RAO for CWM at Fort Crowder is to reduce the risk of human exposure via dermal contact, inhalation, and/or ingestion of CAIS chemical agent or chemical agent-impacted media. Specific RAOs to reduce the hazards from an acute exposure include the following:

- To educate site workers and managers in the possible hazards of releases from CAIS, and to reduce risk by understanding that CAIS may remain at the site, avoiding items that may potentially be CAIS, and promptly reporting a possible CAIS exposure incident;
- To promote early recognition to site workers and managers of potential CAIS exposures, so that exposed persons can receive prompt, proper treatment, and so the incident location can be closed until the authorities can respond, avoiding follow-on exposure incidents.

6.2 ARARs and TBCs

Applicable or relevant and appropriate requirements (ARARs) are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance found at a CERCLA site, or address problems sufficiently similar to those encountered at the CERCLA site such that their use is well-suited to the particular site. RAOs and proposed cleanup levels for the Site are based on ARARs. State

ARARs that are promulgated, more stringent than Federal ARARs, identified by the State in a timely manner, must be satisfied in the final remedial action.

There are three types of ARARs: 1) Location-specific ARARs restrict the occurrence of chemicals in certain sensitive environments, such as wetlands (for example, the Endangered Species Act); 2) Action specific ARARs are activity-based or technology-based, and typically control remedial activities that generate hazardous wastes (for example, RCRA); 3) Chemical-specific ARARs are health-based or risk management-based numbers that provide concentration limits for the occurrence of a chemical in the environment (for example, USEPA drinking water maximum contaminant levels).

There are no location-specific, action-specific or chemical-specific ARARs identified for the CAIS chemicals at the former Fort Crowder CWM Site.

In some instances, promulgated standards or requirements do not exist for a specific situation. In those cases, to-be-considered (TBC) information may be used to help choose response actions. TBCs are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of ARARs, but that may assist the lead agency in attaining a desired remedial outcome. TBCs are listed in Table 6-1. Only three of the chemicals used in CAIS at Fort Crowder have TBCs.

7 Summary of Remedial Alternatives

Five remedial alternatives considered for the former Fort Crowder CWM Site (Table 7-1) are presented in this section based on the results of the *Programmatic RI/FS for Possible CAIS Sites* (Parsons, 2007), which evaluated remedial alternatives for Response Actions at sites where CAIS is the CWM of concern.

The range of alternatives developed to address CAIS under the *Programmatic RI/FS* is unique because identifiable CAIS disposal or burial locations are not known, and technologies for investigation or detection of CAIS are limited or not available.

7.1 Alternative 1 – No Action

*Estimated **Capital Cost**:* $0.
*Estimated Annual **Operations & Maintenance** (O&M) Cost:* $0.
*Estimated **Present Worth** Cost:* $0.

The “No Action” alternative is required to be considered in the CERCLA process, and is used to establish a baseline for comparison with the other remedial alternatives. No Action means that no remedial action will be implemented to reduce the potential safety risk posed by suspect CAIS. This alternative would involve the continued use of the site in its current condition. If the potential exposure to CAIS and hazards associated with CAIS are compatible with the current conditions and future use of the site, then the implementation of No Action would be warranted.

7.2 Alternative 2 – Access Controls

Estimated Capital Cost: $144,520.

Estimated Annual O&M Cost: $ 2,950.
Estimated Present Worth Cost: $ 335,269.

Access controls are a form of physical land use controls (LUCs) that limit future receptor usage of the site by implementing various restrictions or dedicating the property to compatible use. Access controls can take the forms of signage, fencing, and land-use restrictions or regulatory control.

Signage consists of a comprehensive sign posting system that entry to a site is prohibited, that activities within the property are restricted, that the area has a history of past CAIS-related activity. Fencing provides a physical barrier to inadvertent future receptor entry. Enforcement of trespass restrictions will be more effective if fencing is present. Signage and fencing reinforce the link between appropriate access and safety, but require periodic repair and maintenance, depend on cooperation of stakeholders for implementation, and may not coincide with current and planned land use. Because specific CAIS disposal or burial locations are not known, access controls would be applied to the entire former Chemical Exercise Area (approximately 58 acres).

7.3 Alternative 3 – Educational Awareness and Long-term Management

Estimated Capital Cost: $0.
Estimated Annual O&M Cost: $6,500.
Estimated Present Worth Cost: $131,225.

Alternative 3 involves educational awareness measures consisting of online educational tools and materials that contain information on CAIS, the history of chemical warfare, and the response process, and includes videos, presentations, and fact sheets. These materials will be made available to the stakeholders through the public-access website https://www.denix.osd.mil/uxosafety. These measures have the goal of modifying behavior to reduce the risk of exposure and reduce the impact in the event exposure occurs. The USACE District office will also issue a fact sheet to notify stakeholders about the history and location of the site, contaminants of concern, USACE points of contact, public comment information and location of the educational awareness materials.

Long-term management (LTM) will be implemented in the form of annual interviews with stakeholders, annual site inspections of land use, annual visits to the county assessor's office to update property ownership, and annual newsletters to land owners surrounding the site. Regular, continued communication with stakeholders is an important means to remain actively informed of any new or different information regarding the site including changes in future land use. As part of the annual interviews, updated educational awareness materials will be provided to stakeholders, as necessary. Additionally, an annual inspection report will be prepared and submitted each year to the administrative record and a periodic public availability session associated with the report's submittal will also be considered as part of this Alternative.

7.4 Alternative 4 – Geophysics and Intrusive Investigation

Estimated Capital Cost: $2,269,069.

Estimated Annual O&M Cost: $ 0.
Estimated Present Worth Cost: $2,400,263.

This alternative includes geophysical surveys to identify subsurface metallic anomalies which may be associated with CAIS, and intrusive investigation of metallic anomalies until either the cause of the anomaly is identified or until the site-specific risk-based depth is reached. Metallic objects discovered during intrusive investigation will be identified as CAIS-related or as scrap metal. If CAIS are found, soil sampling and analysis would be conducted for chemical agents and breakdown products.

Because specific CAIS disposal or burial locations are not known, geophysical surveys must be conducted over the entire former Chemical Exercise Area (approximately 58 acres). A land survey to establish control points, vegetation removal, and surface clearing by unexploded ordnance (UXO)-qualified personnel would be required prior to geophysical surveying. The geophysical data must be reviewed and evaluated by a qualified geophysicist to select the anomalies that will be investigated. This alternative will only be effective in finding CAIS associated with detectable subsurface metallic anomalies.

This alternative requires development and approval of site-specific work plans, including UXO safety and Chemical Safety Submittals (CSS) that detail monitoring and response actions for UXO and chemical agents. Planning and implementation require specialized equipment and technical specialists. During intrusive investigations, special provisions for safety of workers and the public would be required, including air monitoring for chemical releases, establishment of an **exclusion zone**, use of a decontamination station, and onsite standby medical support.

After the remedial action, CAIS could potentially remain on site in areas not selected for excavation.

7.5 Alternative 5 – Excavation and Restoration

Estimated Capital Cost: $126,517,112.
Estimated Annual O&M Cost: $ 0.
Estimated Present Worth Cost: $126,648,306.

This alternative involves excavation to remove CAIS from all potential disposal or burial areas within a target excavation depth at the site, followed by restoration. Based on CAIS disposal depths observed at other sites, the excavation depth would be a minimum of six feet below ground surface (bgs), but could be deeper if there are indications that additional CAIS or potential CAIS items may be present at greater depths.

Because specific CAIS disposal or burial locations are not known, the entire former Chemical Exercise Area (approximately 58 acres) would be excavated. Under this alternative, all existing vegetation, including tree cover, will be cleared to facilitate soil excavation. Surface clearing by UXO-qualified personnel would be required prior to excavation.

Excavated soils will be sifted to identify and remove CAIS-related items for proper disposal. If CAIS are found, soil sampling and analysis would be conducted for chemical agents and breakdown products. Soils free of chemical agents will be reused at the site for backfill. Extensive site restoration activities would be required following the removal action.

This alternative also requires development and approval of site-specific work plans, including UXO safety and CSS that detail monitoring and response actions for UXO and chemical agents. Planning and implementation require specialized equipment, technical specialists, and other resources that may not be readily available. During intrusive investigations, special provisions for safety of workers and the public would be required, including air monitoring for chemical releases, establishment of an exclusion zone, use of a decontamination station, and onsite standby medical support.

After the remedial action, CAIS could potentially remain on site at depths greater than those excavated.

8 Evaluation of Alternatives

To assist in the evaluation of alternatives during a FS and make an orderly progression toward the selection of a Preferred Remedial Alternative, EPA has developed nine criteria to assist in the decision-making process (Table 8-1). The first two criteria are the **Threshold Criteria**, which each alternative must meet to receive further consideration. These are: 1) Overall Protection of Human Health and the Environment; and 2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs).

The next five criteria are the **Primary Balancing Criteria**, which are the basis for analysis of the alternatives. These are: 3) Long-Term Effectiveness and Permanence; 4) Reduction of Toxicity, Mobility, and Volume through Treatment; 5) Short-term Effectiveness; 6) Implementability; and 7) Cost.

The two final criteria are the **Modifying Criteria**, which can only be evaluated following the public comment period. These are: 8) State Acceptance; and 9) Community Acceptance.

Each of the five remedial alternatives were evaluated with respect to the individual criteria, and were compared to one another to determine their respective strengths and weaknesses and to identify the key trade-offs. The alternative(s) identified as the most practicable solution in reducing the CAIS exposure hazard at the site was selected with respect to each evaluation criteria. The following subsections provide a description of each of the criteria and the evaluation process used for performing the analysis. The “Detailed Analysis of Alternatives” can be found in the *Programmatic RI/FS Report* in the Administrative Record file.

8.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether a remedial alternative provides protection of human health and the environment and describes how risks which are posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

This criterion was evaluated based on the impact each remedial action alternative has on the factors of possible CAIS exposure hazard. CAIS exposure hazard is comprised of two components, the CAIS source characteristics and receptor interaction. Both components (i.e., source and receptor) are required in order to pose a safety threat to the public.

The “protectiveness” criterion was evaluated in terms of possible future human interaction with CAIS chemicals, whether in containers or released to the environment. An environmental protectiveness factor was based on the protection employing an alternative will have on the existing environment and ecology. Each alternative was evaluated in terms of whether it would decrease the amount of CAIS chemicals currently in the environment.

Alternative 1 is not protective of human health and the environment. Alternatives 1, 2, and 3 do no remove any CAIS chemicals and provide no source reduction. However, Alternatives 2 and 3 provide protection by decreasing the potential for exposure pathway completion, either by restricting access (Alternative 2) or improving hazard recognition (Alternative 3).

Although Alternatives 4 and 5 provide source reduction by removing CAIS, there is no way to insure that all CAIS are removed. Also, Alternatives 4 and 5 both have a potential to cause an accidental release as part of the investigative or removal process. Alternative 4 may not provide an adequate level of protection, since only CAIS associated with detectable subsurface metallic anomalies will be removed, and only if those anomalies are selected for intrusive investigation. Alternative 5 will remove CAIS within the target excavation depth, but CAIS may remain at other depths. Also, Alternative 5 causes significant associated ecological damage by excavating the entire 58-acre site.

8.2 Compliance with ARARs

Compliance with ARARs addresses whether a remedial alternative will meet all applicable or relevant and appropriate requirements of federal and state laws and regulations related to addressing hazardous substances at the site.

The criteria, Compliance with ARARs, is not applicable as there are no ARARs pertaining to the evaluated alternatives for this site.

8.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence addresses the ability of a remedial alternative to permanently reduce or eliminates the potential for CAIS exposure hazard.

Alternative 1 does not meet the criterion. Alternative 2 can be effective at decreasing possible receptor interaction, but access controls require maintenance, may not be compatible with current or future land use, and must be reviewed and updated over time. Alternative 3 can be effective at behavior modification, but requires implementation by stakeholders, may not be effective for all persons, and also must be reviewed and updated over time. Alternative 4 is not effective at decreasing CAIS risk in areas without detectable metallic anomalies. Alternative 5 provides the most long-term effectiveness and permanence based on the ability to remove the risk due to possible CAIS.

8.4 Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies which permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to decrease the principal threats at a site by destruction of toxic

contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

Alternatives 1, 2, and 3 provide no reduction in toxicity, mobility, or volume of contaminants. Alternative 4 may not provide an adequate level of reduction in toxicity, mobility, or volume of contaminants, since only CAIS associated with detectable subsurface metallic anomalies will be removed. Alternative 5 provides the greatest reduction in toxicity, mobility, or volume of potential contaminants by removing CAIS items and associated contaminated soils (if present) to a predetermined target depth.

8.5 Short-term Effectiveness

Short-term effectiveness addresses short-term risks and the potential consequences and effects of an alternative during the implementation phase. Short-term risks are potential adverse impacts to workers, the community, and the environment during the construction and implementation phases of the remedial action.

Alternatives 1 and 3 both had no associated short-term risks or adverse impacts to workers, the community, and the environment. Alternative 2 has possible short-term impacts to workers associated with heavy equipment use during fence installation. Alternatives 4 and 5 both have short-term impacts associated with vegetation removal, heavy equipment use, intrusive activities and/or excavation, and possible interaction with CAIS. However, the risks associated with Alternative 5 were determined to be greater because the activities are more extensive. Also, Alternative 5 would cause significant environmental and ecological impacts by excavating the entire site to a predetermined depth.

8.6 Implementability

This criterion addresses the technical and administrative feasibility of implementing a specific remedial action alternative. Implementability includes consideration of whether the alternative is technically possible; the availability of necessary materials, equipment, and specialists; administrative and regulatory requirements; and monitoring requirements.

Alternatives 1, 2, and 3 are all technically and administratively feasible and readily implemented. No services or materials are necessary for implementation of Alternative 1. Alternative 2 requires landowner permission and the materials and services to install fencing and signs are readily and commercially available. The online educational and training materials for Alternative 3 are readily available through the DENIX public-access website, and the materials, equipment, and specialists for long-term management are available.

Alternative 4 is not technically feasible due to the need to conduct geophysical surveys over the entire site and the limitations of available exploratory geophysical technology, which cannot locate glass CAIS bottles and ampoules, unless co-located with detectable metal. Limitations on detection of metal include survey spacing, depth, amount and condition of the metal, and background noise level. Alternative 4 requires materials, services, and technical specialists which may not be readily available.

Alternative 5 is not technically feasible. Removing all vegetation including tree cover, excavating an approximate 58-acre site to a predetermined depth, and processing and carefully examining all excavated soils to locate and remove small glass CAIS bottles and ampoules is impractical. Administrative difficulties may be encountered due to the nature

and extent of the earth-moving activities, and this alternative may not be acceptable to stakeholders. Alternative 5 requires specialized equipment, materials, services, and technical specialists which may not be readily available.

Both Alternatives 4 and 5 require the development of detailed work plans with a CSS and Department of Defense Explosives Safety Board (DDESB) approval. Field activities require special provisions for safety of workers and the public, including qualified UXO technicians with specialized equipment, and specialized air monitoring equipment and personnel with limited availability.

8.7 Cost

This criterion evaluates the cost to implement the remedial action alternative, and includes estimated initial capital cost, annual operation and maintenance or monitoring costs, and present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates for each alternative were presented in sec. 7. These costs were adapted from cost estimates prepared for the *CWM Scoping and Security Study Report* (Parsons, 2005) and the *Programmatic RI/FS for Possible CAIS Sites* (Parsons, 2007).

The actual costs will depend upon true labor rates, actual site conditions, final project scope and other variable factors. Alternative 1 requires no action, therefore, no costs are incurred. Alternative 2 has costs associated with installing signs and fencing around the entire perimeter of the site and subsequent long-term maintenance. Alternative 3 has costs associated with conducting long-term management activities. Alternatives 2 and 3 are similar in present value cost and moderate in cost relative to Alternatives 4 and 5.

Alternatives 4 and 5 both have high initial costs associated with work plan and CSS development, and high to extremely high costs associated with implementation of field activities and site safety precautions during field activities. Alternative 4 has very high costs associated with geophysical surveys and intrusive investigations, and the number of intrusive investigations is based on how the anomalies are selected. Alternative 5 has prohibitive costs associated with implementation, which could exceed $2,000,000 per acre.

8.8 State/Support Agency Acceptance

The MDNR supports the Preferred Alternative (Alternative 3). However, the MDNR encourages the public to submit comments on the alternatives presented in this Proposed Plan, and reserves the final recommendation until input from the community is evaluated.

8.9 Community Acceptance

Community acceptance of the Preferred Alternative will be evaluated after the public comment period ends and will be described in the Responsiveness Summary of the **Decision Document** (DD) for the site.

9 Preferred Alternative

The Preferred Alternative for the site is Alternative 3 – Educational Awareness and Long-term Management. This is the recommended alternative for all sites such as Ft. Crowder, which are suspect CWM sites that have CAIS as the sole remaining potential CWM hazard.

The Preferred Alternative includes the following major components:

- An online educational awareness program available at URL: https://www.denix.osd.mil/uxosafety. This public-access website has information on CAIS, the history of chemical warfare, and the response process.
- Long-term Management, consisting of annual interviews with stakeholders, annual site inspections of land use, annual visits to the county assessor's office to update property ownership, and annual newsletters to land owners surrounding the site. Regular, continued communication with stakeholders is an important means to remain actively informed of any new or different information regarding the site, including changes in future land use. As part of the annual interviews, updated educational awareness materials will be provided to stakeholders, as necessary. Additionally, an annual inspection report will be prepared and submitted each year to the administrative record and a periodic public availability session associated with the report's submittal will also be considered.

10 Community Participation

One of the purposes of this Proposed Plan is to obtain comments from members of the public. USACE encourages the public to gain a more comprehensive understanding of the site and the activities that have been conducted at the site. Detailed information about the previous studies and restoration activities can be found in the reports and documents contained in the Administrative Record file located at:

Neosho/Newton County Library
201 West Spring St.
Neosho, MO 64850
(417) 451-4231
www.neosholibrary.org

The Proposed Plan and a fact sheet can also be viewed online by visiting the MDNR Web page at: http://www.dnr.mo.gov/env/hwp/fedfac/ffs-dod.htm#ft-crowder.

Public Comment Period: USACE is initiating the 30-day public comment period required by CERCLA. The public comment period will run from June 6, 2012 through July 6, 2012, and is provided to allow the public time to review the Preferred Alternative presented in this document. USACE, in consultation with MDNR and EPA, will consider the views and input of the general public before making a final decision on remediation of the Fort Crowder CWM Site. Public concerns may cause USACE to modify the approach contained in this Proposed Plan or to select another approach. MDNR and EPA must concur with the Final Remedial Alternative.

Public Meeting: As part of the public comment period, USACE will host a Public Meeting on June 13, 2012 from 7:00 to 8:00 p.m. to provide and discuss the information in this Proposed Plan. The Public Meeting will be held at the Neosho Fish Hatchery Visitors Center.

Public Comments: The public is encouraged to provide comment on the approach in this Proposed Plan through attendance at the Public Meeting. Interested parties may also submit written comments by letter or by using the attached form. Written comments should be submitted to Josephine Newton-Lund at the address below:

United States Army Corps of Engineers
ATTN: Josephine Newton-Lund
CENWK-PM-ES
601 East 12th Street
Kansas City, MO 64106-2896
(816) 389-3912
Josephine.M.Newton-Lund@usace.army.mil

Information can also be obtained from Ruben Zamarripa with MDNR at the address below:

Missouri Department of Natural Resources
Ruben Zamarripa
1730 E. Elm
Jefferson City, MO 65102
ruben.zamarripa@dnr.mo.gov

Please refer to the end of this document for a mail-in form to submit written comments or information to USACE and MDNR.

11 References

Fenneman, N.M., 1946, Physiography of the eastern United States: New York, McGraw-Hill.

Missouri Dept. of Natural Resources, 1986, Paleozoic succession in Missouri, part 4 – Mississippian System.

Parsons, 2007, Final programmatic remedial investigation and feasibility study for possible CAIS sites, CWM scoping and security study, prepared for US Army Engineering and Support Center, Huntsville, contract DAC87-00-D-0038 delivery order 27: Norcross, GA, Parsons, var. pg.

Parsons, 2006, Public Involvement Plan for the Former Fort Crowder, Neosho, MO, CWM Scoping and Security Study, prepared for US Army Engineering and Support Center, Huntsville, contract DAC87-00-D-0038 delivery order 27: Norcross, GA, Parsons, var. pg.

Parsons, 2005, Final site-specific chemical warfare materiel scoping and security study report, formerly-used defense sites site inspection report, Fort Crowder, FUDS no. B07MO0130801, prepared for US Army Engineering and Support Center, Huntsville, contract no. DACA87-00-D-0038 delivery order 27: Norcross, GA, Parsons, var. pg.

Parsons, 2003, Final work plan annex, Camp Crowder, CWM scoping and security study, prepared for US Army Engineering and Support Center, Huntsville, contract no. DACA87-00-D-0038 delivery order 27: Norcross, GA, Parsons, var. pg.

TCT-St. Louis, 1992. Archives Search Report and Appendix A, Preliminary Assessment of Ordnance Contamination at the Former Camp Crowder, Neosho, Missouri, October 1992.

U.S. Army Corps of Engineers, St. Louis District, 1993, Archives Search Report, Camp Crowder, Newton County, Missouri, Project No. B07MO0138.

U.S. Army Corps of Engineers, Kansas City District, 1993, Inventory Project Report, Camp Crowder, Newton County, Missouri, Site No. B07MO013800.

US Dept. of Agriculture, 1979, Missouri general soil map and soil association descriptions.

Tables

Table 3-1. Hazardous Chemicals contained in CAIS

Compound	Type of CAIS		
	K951/K952	K955 Navy	Navy X
Adamsite (DM)		P	P
Chloroacetophenone (CN)		P	P
Chloroform	S		
Chloropicrin (PS)	D	C	C
Lewisite (L, M-1)	D	C	C
Mustard (sulfur) (H, HD, HS)	D	C	C
Nitrogen mustard HN-1			C
Nitrogen mustard HN-3			C
Phosgene (CG)	P		
Triphosgene		P	P

Notes:
C = absorbed in charcoal;
D = diluted;
P = in pure or undiluted form;
S = used as a solvent for other chemicals.

Table 6-1. TBCs for CAIS chemicals

Contaminant		Screening Levels											Protection of Groundwater Soil Screening Levels	
Analyte	CAS no.	residential soil	code	industrial soil	code	residential air	code	industrial air	code	tap water	code	MCL	risk-based SSL	MCL-based SSL
		mg/kg		mg/kg		µg/m3		µg/m3		µg/L		µg/L	mg/kg	mg/kg
Adamsite		-		-		-		-		-		-	-	-
chloroacetophenone	532-27-4	43,000	n	180,000	nm	0.031	n	0.13	n	-		-	-	-
chloroform	67-66-3	0.3	c	1.5	c	0.11	c	0.53	c	0.19	c	-	0.000055	-
chloropicrin		-		-		-		-		-		-	-	-
Lewisite		-		-		-		-		-		-	-	-
mustard (sulfur)		-		-		-		-		-		-	-	-
nitrogen mustard HN-1		-		-		-		-		-		-	-	-
nitrogen mustard HN-3		-		-		-		-		-		-	-	-
phosgene	75-44-5	0.4	n	1.7	n	0.31	n	1.3	n	-		-	-	-
triphosgene		-		-		-		-		-		-	-	-

from the Sept. 2008 "Regional Screening Levels for Chemical Contaminants at Superfund Sites" table at URL http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

codes:
c = cancer;
n = noncancer;
m = concentration may exceed ceiling limit (See User's Guide);
SSL values are based on DAF=1

- no standard established

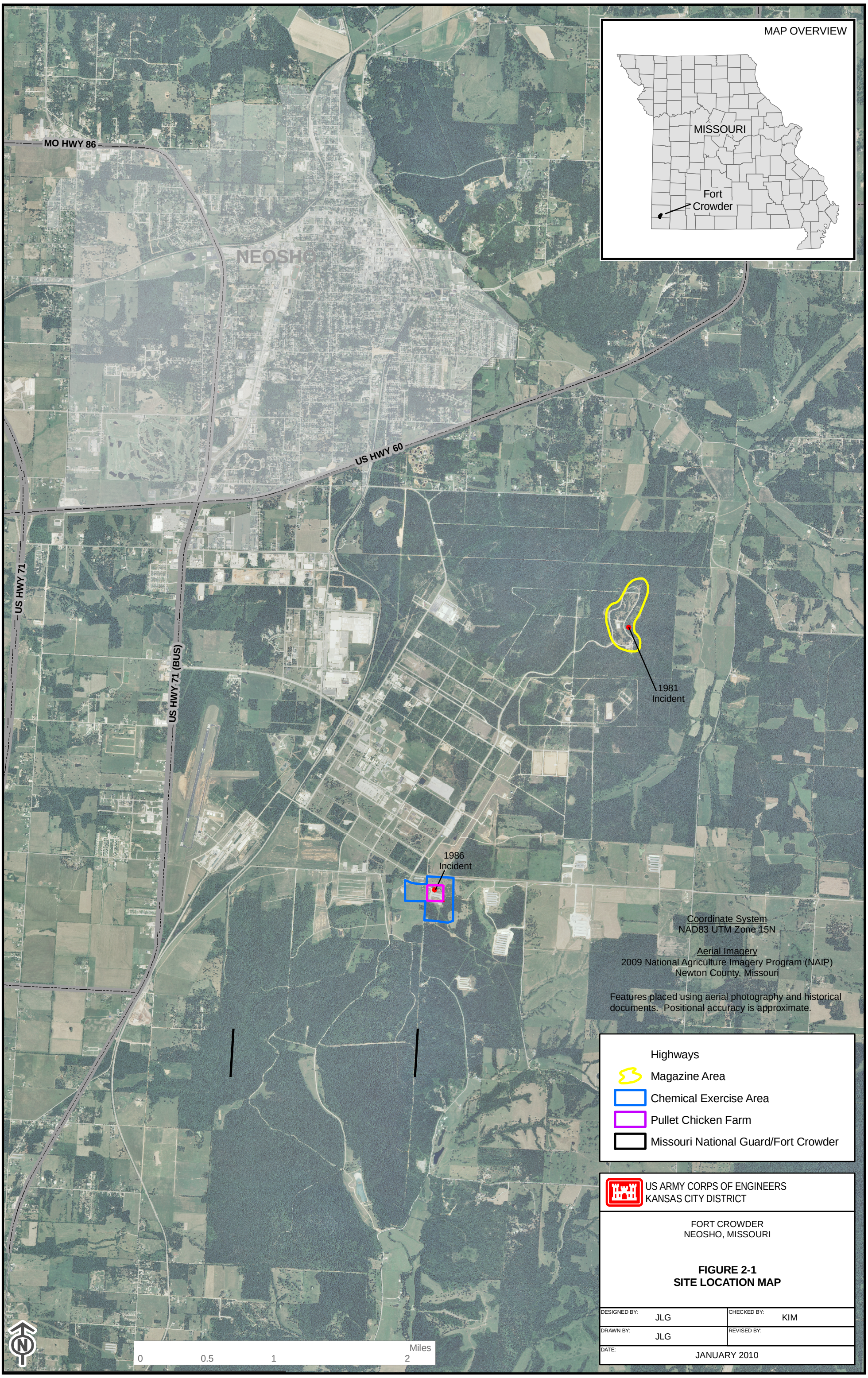
Table 7-1. Summary of Remedial Alternatives

Former Fort Crowder CWM Site	
RI/FS Designation	Description
Alternative 1	No Action: CERCLA requires that the “No Action” alternative be considered as a baseline for comparison with other alternatives.
Alternative 2	Access Controls: utilizes physical means such as warning signs and fencing to limit receptor access to the site.
Alternative 3	Educational Awareness and Long-term Management: utilizes preventive measures that have the goal of modifying behavior to reduce the risk of exposure and reduce the impact in the event exposure occurs
Alternative 4	Geophysics and Intrusive Investigation: utilizes geophysical surveys to locate subsurface metallic anomalies which may be associated with CAIS, and intrusive investigation of metallic anomalies.
Alternative 5	Excavation and Restoration: utilizes excavation to a predetermined depth and processing of excavated soils to locate and remove CAIS. Requires extensive restoration.

Table 8-1. Nine evaluation criteria for remedial alternatives under CERCLA

NINE EVALUATION CRITERIA FOR REMEDIAL ALTERNATIVES UNDER CERCLA
Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets Federal and State environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified. No waivers have been identified for the site.
Long-term Effectiveness and Performance considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the State/Support Agency agree with the Lead Agency's analyses and recommendations, as described in the Site Inspection (SI), Programmatic Remedial Investigation and Feasibility Study (RI/FS), and Proposed Plan.
Community Acceptance considers whether the local community agrees with the Lead Agency's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Figures


MAP OVERVIEW
MISSOURI
Fort Crowder
MO HWY 86
NEOSHO
US HWY 60
US HWY 71
US HWY 71 (BUS)
1981 Incident
1986 Incident
Coordinate System
NAD83 UTM Zone 15N
Aerial Imagery
2009 National Agriculture Imagery Program (NAIP)
Newton County, Missouri
Features placed using aerial photography and historical documents. Positional accuracy is approximate.
Highways
Magazine Area
Chemical Exercise Area
Pullet Chicken Farm
Missouri National Guard/Fort Crowder
US ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
FORT CROWDER
NEOSHO, MISSOURI
FIGURE 2-1
SITE LOCATION MAP
DESIGNED BY: JLG
CHECKED BY: KIM
DRAWN BY: JLG
REVISED BY:
DATE: JANUARY 2010
Miles
0
0.5
1
2
N
K:\MissionProjects\htw\Ft_Crowder_CWM\GIS\arcgismaps\Fig2-1_SiteLocation_22JAN09.mxd

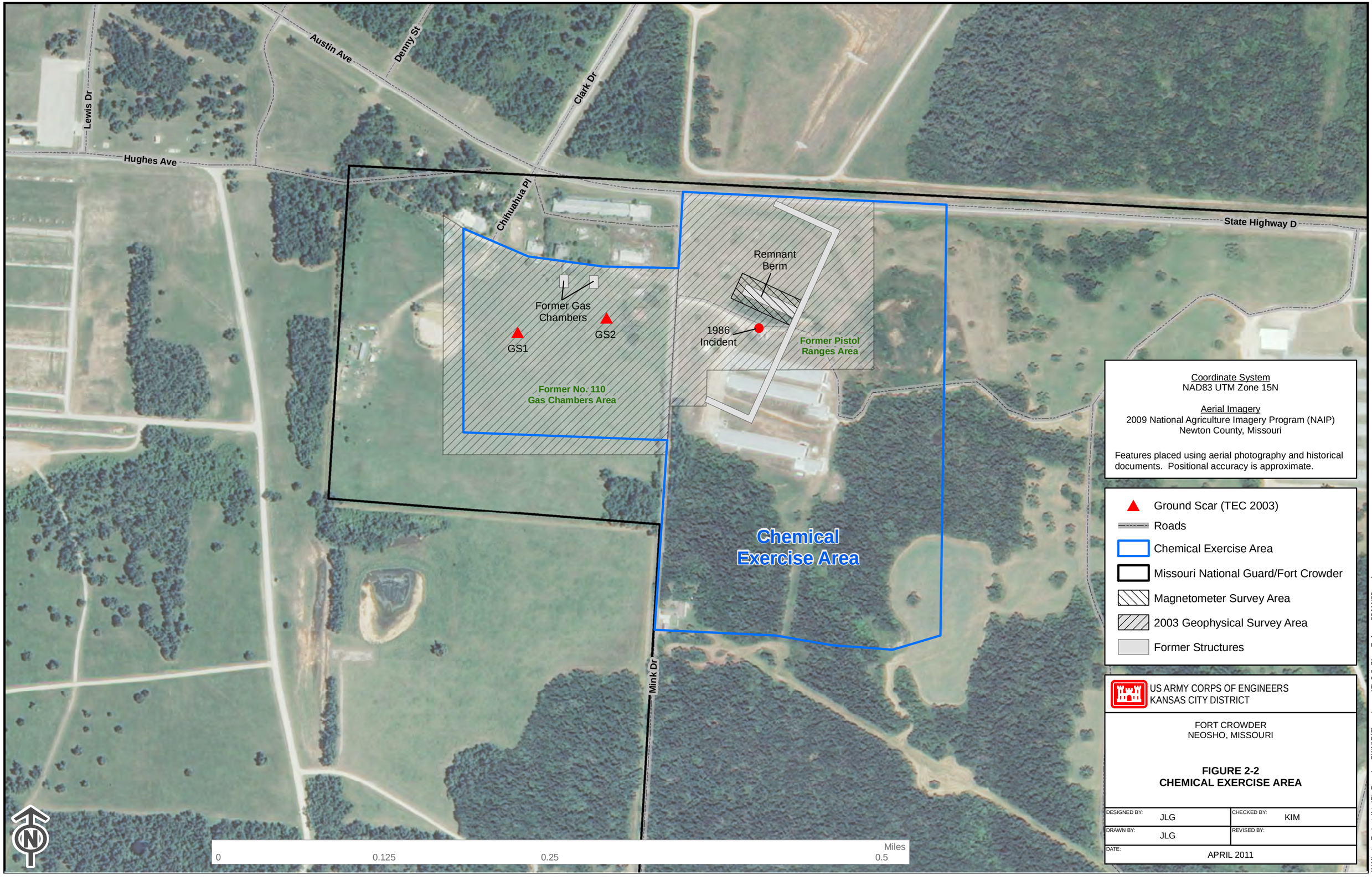

Lewis Dr
Austin Ave
Denny St
Clark Dr
Hughes Ave
Chihuahua Pl
State Highway D
Mink Dr
Remnant Berm
Former Gas Chambers
GS1
GS2
1986 Incident
Former Pistol Ranges Area
Former No. 110 Gas Chambers Area
Chemical Exercise Area
0
0.125
0.25
0.5
Miles
Coordinate System
NAD83 UTM Zone 15N
Aerial Imagery
2009 National Agriculture Imagery Program (NAIP)
Newton County, Missouri
Features placed using aerial photography and historical documents. Positional accuracy is approximate.
Ground Scar (TEC 2003)
Roads
Chemical Exercise Area
Missouri National Guard/Fort Crowder
Magnetometer Survey Area
2003 Geophysical Survey Area
Former Structures
US ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
FORT CROWDER
NEOSHO, MISSOURI
FIGURE 2-2
CHEMICAL EXERCISE AREA
DESIGNED BY: JLG
CHECKED BY: KIM
DRAWN BY: JLG
REVISED BY:
DATE: APRIL 2011
K:\MissionProjects\htw\Ft_Crowder_CWM\GIS\arcgismaps\Fig2-2_ChemExArea_22JAN09.mxd

Figure 3-1. Use of “Sniff Set” being demonstrated

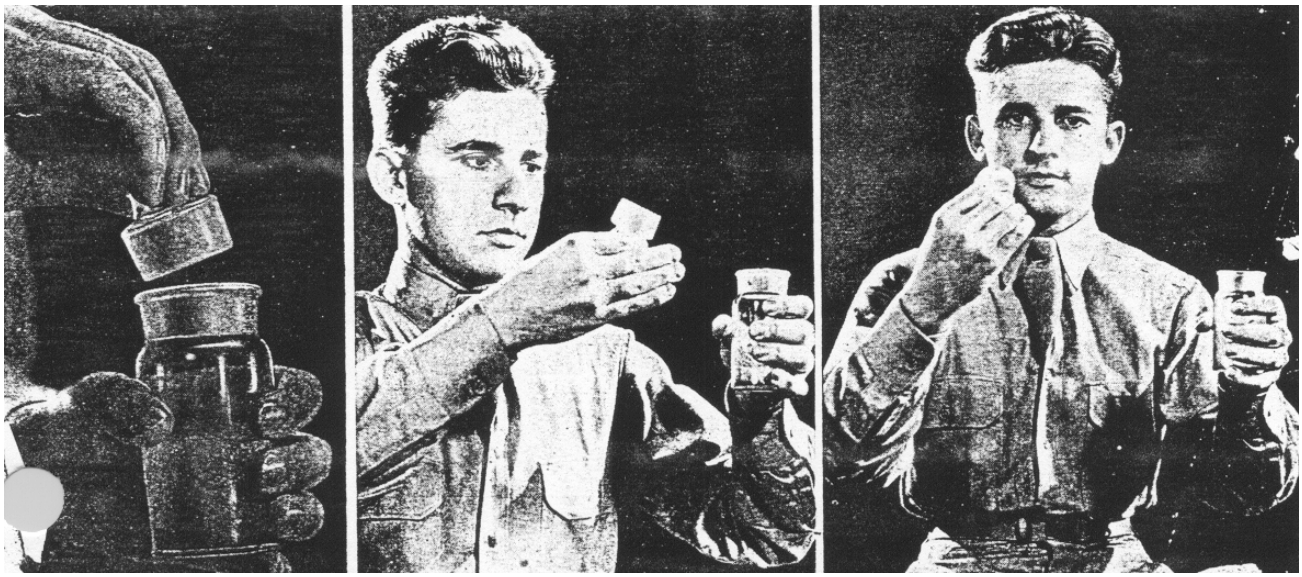


Figure 3-2: K955 or Navy X set bottle with Lewisite markings (M-1)

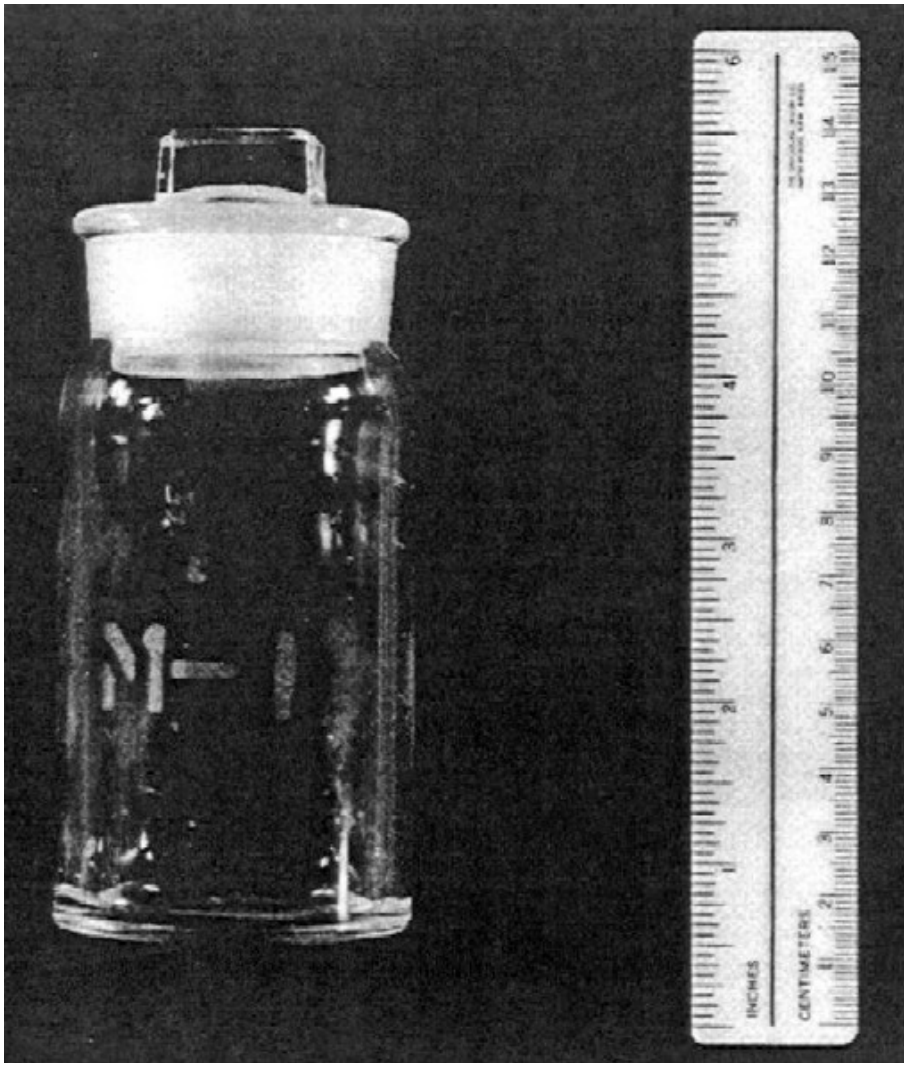


Figure 3-3. K951/K952 CAIS with storage and shipping containers

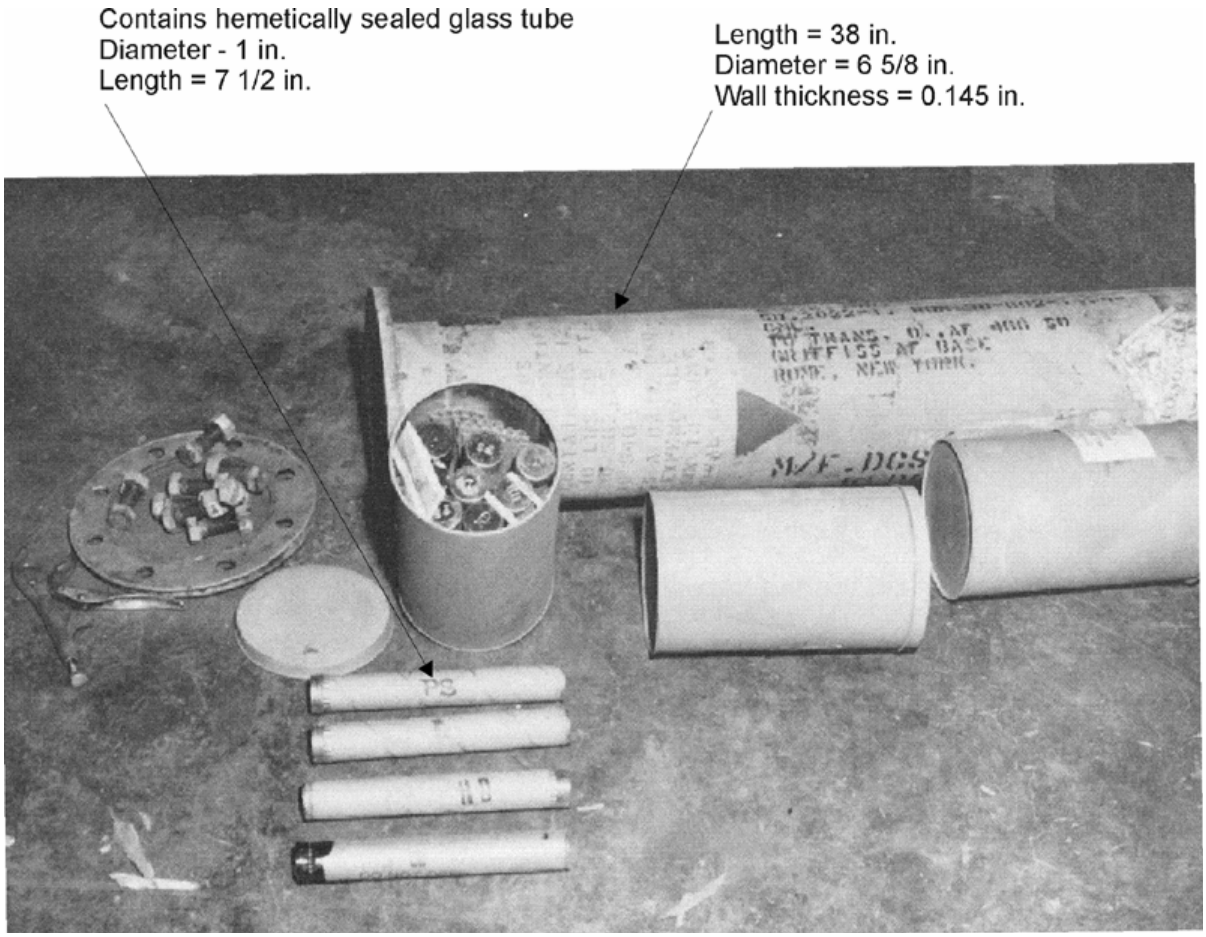
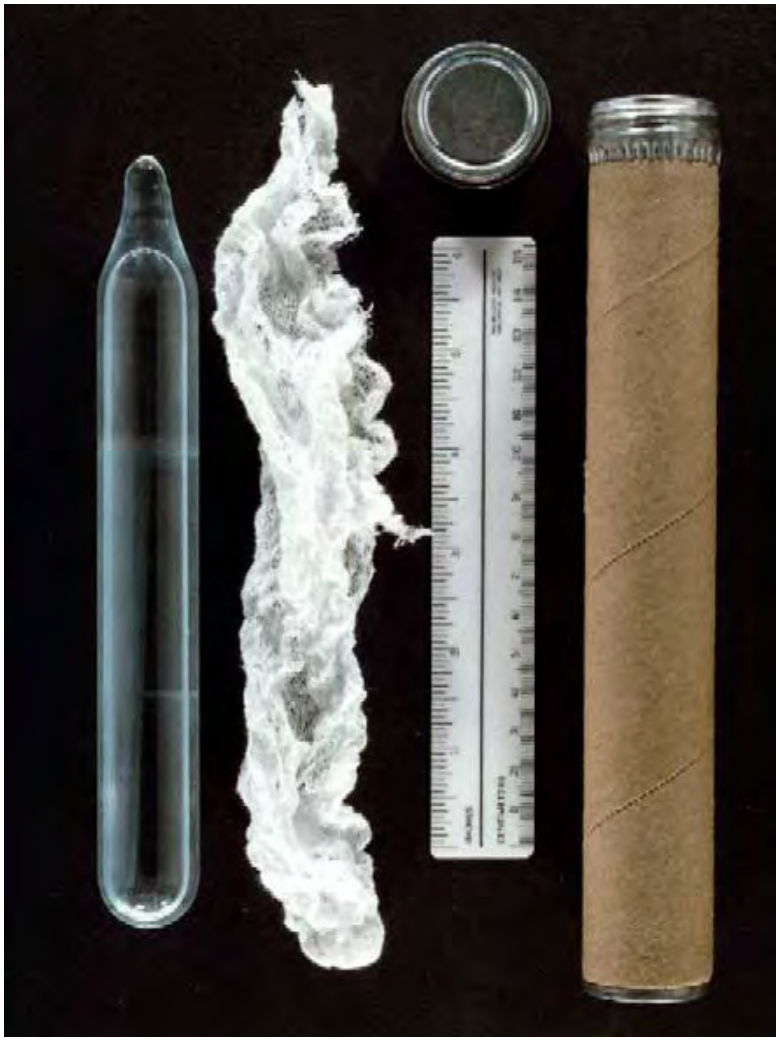


Figure 3-4. K951/K952 glass ampoule, packing, and cardboard tube



Glossary of Terms

This glossary defines specialized, technical terms used in this Proposed Plan. The terms are defined in the context of hazardous waste management and apply specifically to work performed under the CERCLA program. These terms may have other meanings when used in a different context.

Adamsite (DM): Adamsite (also known as diphenylaminochloroarsine or DM) is a vomiting agent, in the form of light green to yellow crystals with no odor. Adamsite was first produced during World War I, when it was disseminated as an aerosol. In CAIS, DM is found only in the "sniff sets" (K955 and Navy X sets).

Administrative Record: The body of documents that forms the basis for the selection of a particular response at a site.

Anomaly: A subsurface irregularity observed by geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and non-ferrous material at a site (i.e., pipes, power lines, etc.).

Applicable or Relevant and Appropriate Requirements (ARARs): The Federal and State environmental laws and regulations that apply to a selected remedy. These requirements vary among sites and alternatives.

Archives Search Report (ASR): A detailed report on past ordnance and explosives activities conducted on an installation prepared by assembling historical records and available field data, assessing potential ordnance presence, and recommending follow-up actions.

Baseline Risk Assessment (BLRA): A study of the actual or potential danger to human health and welfare from hazardous substances at a specific site. The BLRA estimates risks at the site as it exists today, with no remedial action taken.

Blown-in-Place (BIP): Term used to describe detonating an ordnance item that is deemed unsafe to move from the location where it is discovered.

Capital Costs: Direct cost of project installation which includes the construction costs.

Chemical Agent: Chemicals that have been used in military applications to produce a harmful physiological or psychological reaction when applied externally to the human body, when inhaled, or when taken internally. Chemical agents include V- and G- series nerve agents, H- and HN- series blister agents, and lewisite. Although often referred to as "poison gases" or "war gases", not all chemical agents are gases.

Chemical Warfare Materiel (CWM): An item configured as munitions and containing a chemical that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. The term also includes V- and G- series nerve agent, H- and HN-series blister agent, and lewisite in non-munitions configurations, such as chemical agent identification sets (CAIS). Due to their hazards, prevalence, and military-unique application, CAIS are also considered CWM.

Chloroacetophenone (CN): Chloroacetophenone (CN) is a tearing agent (used in "tear gas") in the form of a gray, crystalline solid with a sharp, irritating odor somewhat like apple blossoms. The commercial product, Mace, is CN dissolved in a solvent for spraying assailants. In CAIS, CN is found only as a powder in the "sniff sets" (K955 and Navy X sets).

Chloroform: Chloroform is a common solvent used to dilute certain chemical agents and industrial chemicals in the K951/K952 and K953/K954 sets. It occurs naturally and also enters the environment as a manmade pollutant as a result of chlorination of drinking water, municipal sewage, cooling water in electric power generating plants, atmospheric photodegradation of trichloroethenes, and auto exhaust.

Chloropicrin (PS): Chloropicrin (PS) is a nonpersistent tearing or choking agent in the form of a colorless to faint yellow liquid with a stinging, pungent odor. In CAIS, PS was packaged as a 50 percent dilute solution with chloroform (K951/K952) or absorbed in charcoal (K955 and Navy X sets).

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): Also referred to as "Superfund", CERCLA (as amended by the Superfund Amendments and Reauthorization Act (SARA), and other amendments, 42 U.S.C. 9601 et seq.), authorizes federal action to respond to the release or threatened release of hazardous substances into the environment or a release or threat of release of a pollutant or contaminant into the environment that may present an imminent or substantial danger to public health or welfare.

Conventional Ordnance and Explosives: Ordnance and explosives (see definition) other than CWM, biological warfare material, and nuclear ordnance (ER 1110-1-8153).

Decision Document (DD): A legal document issued after a Remedial Investigation and Feasibility Study that sets forth the selected remedy for cleanup of a site as decided by the authorized decision maker for the lead federal agency.

Defense Environmental Restoration Program (DERP): Established in 1984, DERP promotes and coordinates efforts for the evaluation and cleanup of contamination at Department of Defense installations (10 U.S.C. 2701).

Exclusion Zone (EZ): A safety zone established around a work area. Only authorized project personnel are allowed within the exclusion zone.

Feasibility Study (FS): The second part of a two-part study under CERCLA, which identifies general response actions, screens potentially applicable technologies and process options, assembles alternatives, and evaluates alternatives in detail. The first part is the Remedial Investigation.

Five-Year Reviews: Five-Year Reviews are required by CERCLA or program policy when hazardous substances remain on site above levels which permit unrestricted use and unlimited exposure. Five-Year Reviews provide an opportunity to evaluate the implementation an performance of a remedy to determine whether it remains protective of human health and the environment. Generally, reviews are performed five years following the initiation of a CERCLA response action, and are repeated every succeeding five years so long as future uses remain restricted.

Formerly-Used Defense Sites (FUDS): Properties previously owned, leased, or otherwise possessed by the U.S. and under the jurisdiction of the Secretary of Defense; or manufacturing facilities for which real property accountability rested with DOD but were operated by contractors (Government owned - contractor operated) and which were later legally disposed. FUDS is a subprogram of the DERP. Restoration of military land was extended to formerly used sites in 1983 under Public Law 98-212 (DOD Appropriations Act of FY84). USACE is the lead agency on all FUDS sites.

Intrusive Investigation: An investigation involving penetration of the ground surface.

Land Use Controls (LUCs): LUCs is a DoD term that includes any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property to prevent or reduce risks to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and/or physical barriers to limit access to property, such as fences or signs. Legal mechanisms used for LUCs are generally the same as those used for institutional controls (ICs) as discussed in the NCP. ICs are a subset of LUCs and are primarily legal mechanisms imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting or other existing land use management systems that may be used to ensure compliance with use restrictions.

Lewisite (L or M-1): Lewisite (L or M-1) is an organic arsenical blister agent in the form of an amber to dark brown (colorless when pure), oily liquid with a geranium-like odor. In CAIS, Lewisite was only found absorbed in charcoal (K955 and Navy X sets) or as a 5% solution in chloroform in the K951/K952 sets.

Military **Munitions**: All ammunition products and components produced or used by or for the U.S. DOD or the U.S. Armed Services for national defense and security.

Modifying Criteria: The last two of the nine CERCLA criteria used to evaluate remedial alternatives, namely state and community acceptance.

National Oil and Hazardous Substance Pollution Contingency Plan (NCP): Revised in 1990, the NCP provides the regulatory framework for responses under CERCLA. The NCP designates the Department of Defense as the removal response authority for ordnance and explosives hazards.

National Priorities List (NPL): The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

Nitrogen Mustards (HN-1 and HN-3): Nitrogen mustard (HN-1 and HN-3) are blister agents consisting of colorless to yellow or brown oily liquids with a faint fishy or musty odor. Both types are colorless and odorless oily liquids when freshly distilled. In CAIS, HN-1 is only found as a 10% solution diluted with chloroform (K953/K954) or absorbed in charcoal (Navy X Sets). HN-3 is only found absorbed in charcoal in the Navy X Sets.

Ordnance and Explosives (OE): Ammunition, ammunition components, chemical or biological warfare materiel or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DOD organization or activity (HQDA Policy Memorandum "Explosives Safety Policy for Real Property Containing Conventional OE").

Operation and Maintenance (O&M): Annual post-construction cost necessary to ensure the continued effectiveness of a remedial action.

Phosgene (CG): Phosgene, or carbonyl chloride (CG), is a highly toxic gas used as a choking agent. It is a severe eye and skin irritant and is highly toxic by inhalation. CG has an odor of new-mown hay or rotting fruit; although even at lethal concentrations, it may be difficult to detect. In CAIS, CG is found in the K951/K952 and K953/K954 sets.

Preferred Alternative (preferred remedy): The cleanup approach proposed by the lead agency based on the information contained in the Feasibility Study. The preferred remedial alternative is presented in this Proposed Plan and subject to change and/or revision based on public comment.

Present Worth: The amount of money that would need to be invested today to fund a stream of expenditures at given points in time.

Primary Balancing Criteria: Five of the nine CERCLA criteria used to further evaluate remedial alternatives. They are long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost.

Proposed Plan: The preferred alternative for a site as selected by the lead agency (USACE), and agreed to by the EPA and MDNR, is presented to the public for review and comment in the Proposed Plan. The Proposed Plan summarizes all relevant project information documenting the decision making process.

Receptor: A species, population, community, or habitat that may be exposed to contaminants. The potential for receptor exposure to contaminants and associated risks are evaluated during the baseline risk assessment.

Remedial Action Objectives (RAOs): Statements describing the goals to be achieved in protecting human health and the environment.

Remedial Action: The course of action taken at a CERCLA site to eliminate or reduce site contamination and protect human health and the environment.

Remedial Investigation (RI): The first part of a two-part study under CERCLA that determines how much and what kind of contamination exists at a site. A Remedial Investigation generally involves collecting and analyzing samples of groundwater, surface water, soil, sediment, and air. The second part of the study is a Feasibility Study.

Response Action: An action taken to mitigate a threat to human health or the environment. The action may be temporary in nature while a final action is developed.

Restoration: Depending on context, the return of the site as closely as possible to pre-contamination conditions (removal of the contamination).

Risk Assessment: In the context of public health, risk assessment is the process of quantifying the probability of a harmful effect to individuals or populations from exposure to chemicals found in the environment.

Superfund Amendments and Reauthorization Act (SARA): A congressional act that modified CERCLA. SARA was enacted in 1986 and again in 1990 to authorize additional funding for the Superfund Program.

Simulant: A compound that is chemically similar to a chemical agent, but which is not as toxic. Used in training exercises to minimize exposure risks to trainees.

Source: An area or source of pollution which emits a substance(s).

Mustard (H, HS, HD): Mustard or sulfur mustard (H, HS, or HD) is a strong blister agent, or vesicant commonly referred to as “mustard gas.” Mustard is usually a yellow to brown oily liquid (colorless when pure) with a slight garlic or mustard odor. The mustards H, HS, and HD in CAIS were packaged in undiluted form, as a 5 percent solution, or absorbed in charcoal. Mustard is the most prevalent chemical agent found in CAIS being found in all types of sets.

Threshold Criteria: The first two of the nine CERCLA criteria: (1) overall protection of human health and the environment and (2) compliance with ARARs.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause (40 CFR 266.201).

Triphosgene: Triphosgene is phosgene substitute in the form of a white to off-white crystalline solid. When exposed to moisture in the air triphosgene decomposes to form phosgene. Less hazardous than using phosgene, it was used as a simulant for training. Triphosgene is found only in the K955 and Navy X sets (“sniff sets”) in bottles containing 6 grams of the compound.

REQUEST FOR COMMENTS

Your input on the Proposed Plan for the former Fort Crowder site is important to the USACE. Comments provided by the public are valuable in selecting a final cleanup remedy for the site.

You may use the space below to write your comments, then fold and mail. Comments must be postmarked by July 6, 2012. If you have any questions about the comment period, please contact Josephine Newton-Lund at (816) 389-3912.

COMMENT PROVIDED BY:

Name: _____
Address: _____
City: _____**State:** _____ **Zip:** _____

SUBMIT COMMENTS AND FURTHER INFORMATION TO:

United States Army Corps of Engineers
ATTN: Josephine Newton-Lund
CENWK-PM-ES
601 East 12th Street
Kansas City, MO 64106-2896
(816) 389-3912
Josephine.M.Newton-Lund@usace.army.mil

USE THIS SPACE TO WRITE YOUR COMMENTS

Comments: