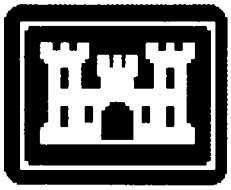

US Army Corps of Engineers
Louisville District

Five-Year Review Report

First Five-Year Review Report

for

Explosives/Munitions Manufacturing Area Operable Unit

Crab Orchard National Wildlife Refuge

Marion, Williamson County, Illinois

EPA ID: IL8143609487

PREPARED BY:
US Army Corps of Engineers
Louisville District
CELRL-ED-E

PREPARED For:
U.S. Environmental Protection Agency, Region V

August 2006

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Prepared By: Date:

Karen Rabek 2 August 2006

Karen Rabek, P.G.
Project Scientist

Approved By: Date:

Nathaniel Peters 2 August 2006

Nathaniel Peters, PhD., P.E.
Independent Technical Review Team Leader

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Five-Year Review Report

Table of Contents

Tables

Attachments

A Figures

B Photographs

Photograph 9 COP-4 – Finishing Groundwater monitoring at MW-05A.

C Forms

1 5-Year Review Site Inspection Attendees
2 Site Inspection Checklist
3 Cover Inspection Forms, COC-3 and COP-4
4 Summary of Groundwater Results BAT Associates, Inc – (May 2001 – May 2006)
5 Soil Boring Log/Monitoring Well Diagrams
6 RIMS, FUDS, Project Fact Sheet, HNC Revision: 13 April 2006
7 Risk Assessment Procedures for the Military Munitions Response Projects – 10 May 2006
8 Content Checklist for Five-Year Review Reports

List of Acronyms

ARAR	Applicable or relevant and appropriate requirement
BAT	BAT Associates, Inc.
BRA	Baseline Risk Assessment
CD	*Consent Decree*
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Crab Orchard Cemetery
CONWR	Crab Orchard National Wildlife Refuge
COP	Crab Orchard Plant
cy	Cubic yard
DA	Department of Army
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DO	Dissolved Oxygen
DOD	Department of Defense
DOI	Department of Interior
EMMA OU	Explosive/Munitions Manufacturing Area Operable Unit
ESD	Explanation of Significant Differences
ESE	Environmental Science & Engineering, Inc.
FFA	Federal Facility Agreement
FS	*Feasibility Study*
FUDS	Formerly Used Defense Sites
HI	Hazard Index
HMX	Cyclotetramethyllenetetranitramine
HNC	Huntsville Center
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
IOP	Illinois Ordnance Plant
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram

mg/L	Milligrams per Liter
MMRP	Military Munitions Response Program
MMSPP	Military Munitions Site Prioritization Protocol
msl	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MWH	Montgomery Watson Harza
NA	Not Applicable
NCP	National Contingency Plan
NPL	National Priorities List
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
OU	Operable Unit
PCB	Polychlorinated Biphenyl
ppb	Parts per Billion
ppm	Parts per Million
PRPs	Potentially Responsible Parties
PQL	Practical Quantitation Level
QL	Quantitation Levels
RA	Remedial Action
RAC	Risk Assessment Code
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosives, Hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RIMS	Restoration Information Management System
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
TAG	Technical Advisory Group
TAL	Target Analyte List
TCLP	Toxicity Characteristics Leaching Procedure
TNB	Trinitrobenzene
TNT	Trinitrotoluene

µg/L	Micrograms per Liter
USACE	U.S. Army Corps of Engineers
USDOI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

Executive Summary

The five-year review of the remedial actions implemented at the Explosives/Munitions Manufacturing Area Operable Unit (EMMA OU) of the Crab Orchard National Wildlife Refuge in Marion, Williamson County, Illinois was completed in July 2006. A majority of the PCB OU cleanup activities were completed in 1997. The Consent Decree for the PCB OU determined the First Five-Year Review for the PCB OU as September 2000. The First Five-Year Review for the Metals Area (MA) OU was completed September 2001. It was decided at the completion of the MA OU Five-Year Review that future Five-Year Reviews would include all seven operable units. This is the review for the EMMA OU to be included in that inclusive Five –Year Review Report.

The EMMA OU was divided into 15 individual sites. The sites are grouped into three discrete areas: ten sites are located in the Crab Orchard Cemetery (COC) area, named for the close proximity to the Hampton Cemetery; four sites are located in the Crab Orchard Plant (COP) area, near the Group II load line and the former Ammonium Nitrate Plant; and one site is located in the explosives compounds storage bunker area. Based on the findings of the 1994 Remedial Investigation Report for the EMMA OU, soil, sediment, surface water, and groundwater had been affected at 13 of the 15 sites (COC-1 through COC-10, COP-1 through COP-4, and Bunker1-3). The sites contained metals and nitroaromatic compounds in various media above background concentrations.

The results of the Baseline Risk Assessment (BRA) concluded conditions at Sites COC-1, COC-2, COC-5, COC-7, COC-8, COC-9, COC-10, COP-1, COP-2, COP-3, and Bunker 1-3 do not pose an unacceptable potential risk to human health and the environment. There was a potential unacceptable risk indicated at Site COC-6. However, this potential unacceptable risk at Site COC-6 is based on an exposure scenario that is extremely unlikely. Therefore, no further action was recommended for those sites by the ROD for the EMMA OU prepared by ESE and signed by the USEPA and the DA in February 1997.

The BRA indicated that Sites COC-3 and COP-4 (see Figures 1, 2, and 3) posed a potential and unacceptable risk to human health due to elevated levels of nitroaromatic compounds and metals in the soils. Additionally, potential ecological risks to white-tailed deer, small mammals, and bobwhite quail were identified with the two sites. The Record of Decision (ROD) determined the following selected remedy for Sites COC-3 and COP-4:

- Excavation and offsite treatment and disposal of soil with concentrations of nitroaromatic compounds; greater than 100,000 mg/kg and lead greater than 450 mg/kg (approximately 270 cy)
- Removal of RDX/HMX contaminated soil at Site COP-4 to a depth of 2 feet below grade within the fenced area and disposal at an offsite permitted special waste landfill;
- Further removal and offsite disposal of soil shown by TCLP analysis to match the RCRA definition of a characteristic hazardous waste (2,4-DNT greater than 0.13 mg/L and lead greater than 5 mg/L) at both sites;
- Backfill excavated areas and construction and long-term maintenance of 24-inch soil covers, land use controls, and groundwater monitoring.

In addition, the Department of Army (DA) conducted removal activities to address unexploded ordnance at the EMMA sites. The response included surveying and excavation for unexploded ordnance over 20 acres and reforestation of 83 acres to eliminate intrusive land use activities. Both the remedial and removal activities at the EMMA OU sites are complete.

The results of this five-year review indicate that the removal actions conducted and the remedy selected are expected to be protective of human health and the environment. The soil covers at both areas are in good condition with well established vegetation. Monitoring wells installed have been sampled since 2001. Some metals and explosive compounds continue to be detected at values exceeding the applicable or relevant and appropriate requirements (ARARs) at both sites. Based on Illinois Environmental Protection Agency (IEPA) concerns, three wells (two at Site COC-3 and one at Site COP-4) were installed to further assist in delineating the explosive contamination plumes at both sites. Continued groundwater monitoring at these sites is recommended to determine the extents of the plumes and whether natural attenuation is occurring.

In March 2006, a biologist with USFWS found a mine south of sites COC-3 and COC-4 (see Figure 4). The mine was a live, explosively loaded, M-21 Anti-Tank mine, unfuzed. The mine was seriously deteriorated due to rust and the explosives were exposed. It was detonated in place in April 2006. USACE has an agreement with the IEPA to resolve a DSMOA dispute at Camp Ellis. As part of this agreement, USACE pledged to follow the emergency response procedures established by previous Illinois EPA policy regarding munitions and explosives of concern (MEC). Specifically, USACE will provide timely notification to the Illinois Emergency Management Agency at (800-782-7860) of any live or potentially live MEC encounter during future Camp Ellis field efforts. In addition, USACE agreed to conduct post detonation sampling within a reasonably short period of time following any detonation in order to determine if soils are impacted by residual nitroaromatics. Follow up for any contamination identified in association with the destruction of MEC will be integrated into the planned Hazardous, Toxic, and Radioactive Waste (HTRW) investigations for the site.

In April 2006, the Hunstville Center (HNC) revised the August 1993 Restoration Information Management System Formerly Used Defense Sites (FUDS) Project Fact Sheet. The August 1993 Project Fact Sheet had given the Illinois Ordnance Plant a Risk Assessment Code (RAC) score of 2, medium priority. The RAC score was revised to a score of 1, high priority (Attachment C). Due to the discovery of the mine and the change in RAC score, USACE recommends that a new munitions management response project (MMRP), an investigation following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process be initiated.

The Crab Orchard National Wildlife Refuge consists of seven operable units. The next five year report will include all of the OUs and is due in September 2011.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Crab orchard National Wildlife Refuge		
EPA ID: IL8143609487		
Region: 05	**State: IL**	**City/County: Marion/Williamson**
SITE STATUS		
NPL status: Final		
Remediation status (choose all that apply)**: Complete**		
Multiple OUs?* yes	**Construction completion date:**	
Has site been put into reuse? yes		
REVIEW STATUS		
Lead agency: US Environmental Protection Agency		
Author name: Karen Rabek, P.G.		
Author title: Project Scientist	**Author affiliation: USACE, Louisville District**	
Five Year Review Period: 10/01/01 to 09/30/06		
Review period: January 3, 2006 to June 30, 2006		
Date(s) of site inspection: January 19, 2006		
Type of review: Policy		

Review number: 1 (first) for EMMA OU

Triggering action:
A majority of the PCB OU cleanup activities were completed in 1997. The Consent Decree for the PCB OU determined the First Five-Year Review for the PCB OU as September 2000. The First Five-Year Review for the MA OU was completed September 2001. It was decided at the completion of the MA OU Five-Year Review that future Five-Year Reviews would include all seven operable units. This is the review for the EMMA OU to be included in that Five-Year Review Report.

Triggering action date: 27 September 1995

Due date *(five years after triggering action date)*: 27 September 2000

Issues:
Groundwater contamination at Site COC-3 and Site COP-4 of metals and explosive compounds.

Recommendations and Follow-up Actions:
Recommendation is to continue the semi-annual groundwater monitoring at both Site COC-3 and COP-4 to determine extent of contamination plumes and if natural attenuation is occurring.

Protectiveness Statement:
The remedies at the Crab Orchard National Wildlife Refuge are protective of human health and the environment, because the removal actions and land use controls at both Site COC-3 and Site COP-4 are protective.

* ["OU" refers to operable unit.]

Five-Year Review Report

I. Introduction

The Purpose of the Review

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and recommendations to address them.

Authority for Conducting the Five-Year Review

The Agency is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Chapter 121 and the National Contingency Plan (NCP). CERCLA Chapter 121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

Who Conducted the Five-Year Review

The U.S. Army Corps of Engineers, Karen Rabek, of the Louisville District, has conducted a five-year review of the remedial actions implemented at the EMMA OU of the Crab Orchard National Wildlife Refuge, Marion, Williamson County, Illinois. This review was conducted from January 2006 through June 2006 for the period from September 2001 through September 2006. This report documents the results of the review. A full list of site inspection participants is provided in Attachment C.

Other Review Characteristics

This is the first Five-Year review for EMMA OU of the Crab Orchard National Wildlife Refuge. The triggering action for this review was the completion of a majority of the PCB OU cleanup activities completed in 1997. The Consent Decree for the PCB OU determined the First Five-Year Review for the PCB OU as September 2000. The First Five-Year Review for the MA OU was completed September 2001. It was decided at the completion of the MA OU Five-Year Review that future Five-Year Reviews would include all seven operable units. This is the review for the EMMA OU.

II. Site Chronology

Table 1 lists the chronology of events for the Crab Orchard site.

Table 1: Chronology of Site Events

Event	Date
Eastern portion of the refuge was transferred to the War Department. The Illinois Ordnance Plant (IOP) was constructed.	1941
IOP conducted trinitrotoluene (TNT) melt-pour operations, ammonium nitrate production, storage, shipping, and maintenance.	1941 - 1945
IOP was closed shortly after the end of World War II and was transferred to the WAR Assets Administration (WAA) for disposition.	1945
The property was transferred to U.S. Department of Interior (USDOI).	1947
Crab Orchard National Wildlife Refuge (CONWR) was proposed for inclusion on the National Priorities List (NPL).	1984
As part of the Formerly Used Defense Sites (FUDS) program. U.S. Army Corps of Engineers (USACE) Chicago District initiated an Inventory Project Report. Site surveys were limited to areas associated with the Explosives/Munitions Manufacturing Areas (EMMA) OU.	1986
U.S. EPA and USFWS entered a Federal Facility Initial Compliance Agreement for the performance of a RI/FS in February 1986.	1986
RI/FS began at CONWR in May 1986	1986
CONWR was included as final on the NPL as published in the July 22 1987 Federal Register (52 FR 27620).	1987
Based on the findings of the Inventory Project Report, the USACE – Omaha District conducted a Confirmation Study. The Confirmation Study Report was completed by Woodward Clyde Consultants, April 1988. The Confirmation Study focused on 14 sites in the Crab Orchard Cemetery (COC) and Crab Orchard Plant (COP) areas. Results of magnetometer surveys indicated buried ferrous materials. Results of some of the sampling revealed the presence of munitions related compounds.	1988
Remedial Investigation (RI) conducted at the Polychlorinated Biphenyls Area (PCB) and Metals Area (MA) OUs. RI/FS complete in May 1988.	1988
ROD signed for MA OU 3 March 1990.	1990
ROD signed for PCB OU 01 August 1990.	1990
A Preliminary Assessment of the former IOP was conducted by USACE, Chicago District with the Findings and Determination of Eligibility dated 8 June 1990.	1990

Table 1: Chronology of Site Events

Event	Date
TechLaw, Inc. prepared a Site Operations/Ownership History providing general site descriptions, brief site ownership history, and site contamination history.	1991
Consent Decree signed for PCB OU 13 May 1991.	1991
Federal Facilities Agreement signature 13 September 1991.	1991
An RI was conducted at the EMMA OU which included a Baseline Risk Assessment (BRA). Phase I field work of the RI was conducted from August to October 1991 in the EMMA OU by UXB International, Inc (UXB).	1991
Phase II of the RI was conducted in June, July, and September of 1993 and focused on 8 of the EMMA OU sites based on the data from the Phase I.	1993
The RI for the EMMA OU was completed in September 1994.	1994
A Feasibility Study (FS) was performed on the 15 EMMA OU sites based on the RI and BRA findings. The FS evaluated 7 remedial alternatives and was completed in September 1995. A proposed Plan (PP) for the EMMA OU was developed and submitted for public comment in September 1995.	1995
Record of Decision (ROD) for the EMMA OU was submitted by Environmental Science and Engineering, Inc. (ESE) in April 1996.	1996
ROD signed for EMMA OU 19 February 1997	1997
Explanation of Significant Differences (ESD) for the EMMA OU 11 January 2000.	2000
ESD for the PCB OU 23 June 2000.	2000
First Five-Year Review completed for the PCB OU on 27 September 2000.	2000
UXO/OE removal at EMMA OU sites COC-1, COC-4, COC-6, and COC-15, June to November, by Sudhakar Company, Inc. (SCI)	2000
First Five-Year Review completed for the MA OU in September 2001.	2001

III. Background

Physical Characteristics

The Crab Orchard National Wildlife Refuge (CONWR) is located approximately 5 miles west of Marion, Illinois, primarily in Williamson County, extending into Jackson and Union Counties in southern Illinois (Figure 1). It is located near the center of the southern tip of the state, with the Mississippi River approximately 25 miles to the west and the Ohio River approximately 55 miles to the east. The CONWR comprises approximately 43,500 acres of forested land, pine plantations, and cultivated lands. Since 1947, the USFWS has operated CONWR under the authority of the U.S. Department of Interior (DOI). Twelve lakes are located within the CONWR, including Crab Orchard Lake, a 7,000-acre man-made reservoir.

The CONWR was included into the National Priorities List (NPL) in 1987. The U.S. Fish and Wildlife Service (USFWS), and agency of the U.S. Department of Interior (USDOI), administers the refuge. Affected areas within the refuge are divided into seven separate operable units (OUs). These OUs are the Polychlorinated Biphenyls Area (PCB) OU, the Metals Area (MA) OU, the Explosives/Munitions Manufacturing Areas (EMMA) OU, the miscellaneous Area (MISCA) OU, the Water Towers (WT) OU, Additional Uncharacterized Sites (AUS) OU, and Lake Monitoring (LM) OU.

The CONWR is situated on the Illinois Basin that is the major feature of southern Illinois. The Illinois basin is a broad, gentle, structural depression that contains more than 10,000 feet of sedimentary rock. Williamson County lies in the southwestern limit of the basin, so the regional dip of the bedrock is towards the center of the basin to the north and east. The topography of the area is relatively uniform, characterized by flat to moderately sloping areas. Elevations across the area range from 420 to 455 feet above mean sea level (msl). Numerous streams, drainage ways, and drainage courses dissect the area.

Williamson County is underlain by Pennsylvanian-age bedrock. The bedrock at the CONWR consists of shales, sandstones, and thin limestones of the Carbondale formation and interbedded shales and sandstones of the Pottsville Formation. Illinoisian glacial till overlies the bedrock and overlying the glacial till is a loess layer from the Wisconsin age.

Groundwater resources in Williamson County are relatively poor. Shallow drift wells and cisterns have been utilized by farmers in the area; however, surface water is the principal water source for industries and towns. The city of Marion's water supply comes from the Marion Reservoir with Crab Orchard Lake being a backup supply if needed during dry periods.

Land and Resource Use

The former IOP was comprised of approximately 22,481 acres of which 10,122 acres were a public domain transfer from the Department of Agriculture to the War Department and 12,359 acres were acquired by purchase and condemnation. This acreage is currently part of the CONWR. The entire CONWR comprises an area of approximately 43,500 acres. The land is used as a wildlife refuge and also for recreational, agricultural, and industrial purposes.

The western end of CONWR around Crab Orchard Lake is used for recreational purposes, while the eastern end is used for manufacturing facilities. Access to the eastern portion is closed to the public, except for limited access to workers at the industrial sites and restricted access to hunters. Crab Orchard Lake supports a large population of sport fish. Wetlands are found in some areas adjacent to the lakes. Wildlife in the area includes many game and non-game species. CONWR has habitat suitable for one endangered species, the Indiana bat.

History of Contamination

In the early 1940's, the War Department, the predecessor to the Department of Defense (DOD), used the area at the end of Crab Orchard Lake for the manufacturing of bombs, land mines, and explosives. Manufacturing stopped at the end of World War II. The War Assets Department transferred administration of the area to DOI in 1947, with the exception of the ammonia nitrate plant (which was transferred to DOI in 1951) for use as a National Wildlife Refuge. The enacting legislation, which created CONWR, required DOI to continue leasing former wartime industrial buildings to industrial tenants (as was initiated by the War Assets Department). The industrial manufacturing operations, which continue to the present, included at various times ammunition and explosives, metal fabrication, plating, and manufacturing of printing inks, fiberglass boats, and electrical components. Over the years, these tenants have disposed of their waste at several areas within CONWR.

Tests performed in the eastern portions of COWR during the late 1970's and early 1980's indicated that contaminants such as PCBs, lead, and cadmium were present. Based on these findings and the potential threat of these contaminants to human health and the environment, USEPA placed the Crab Orchard Site on the National Priorities List (NPL) in July 1987.

On February 26, 1986, the USFWS and USEPA entered into a Federal Facility Initial Compliance Agreement, which required the performance of a Remedial Investigation/Feasibility Study (RI/FS). USFWS and Sangamo Weston, Inc, which was one of the former industrial tenants at CONWR, entered into a Cooperative Agreement to conduct the RI/FS at CONWR. USFWS and Sangamo Weston began the RI/FS in 1986 and completed it in August 1988. The RI Report investigated thirty-three study sites at CONWR, including two background sites. Based on the results of the RI Report, USEPA, in consultation with DOI and Illinois EPA (IEPA), made available to the public the draft-final FS Report and two Proposed Plans for remedial action. The first Proposed Plan was for three study sites contaminated primarily with metals. These are designated as the Metals Areas Operable Units (MAOU). The second Proposed Plan addressed four study sites that were primarily contaminated with PCBs, lead, and cadmium. These are designated as the PCB Areas Operable Unit (PCB OU).

Pursuant to Section 120(e) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), USEPA, Department of Army (DA), IEPA, and DOI signed a Federal Facility Agreement (FFA) on September 13, 1991. Because the study sites differ in terms of contamination problems, types of remedies and schedules that may be appropriate, or potentially responsible parties (PRPs) etc., and because site problems are spatially distinct, FFA partners created two additional OUs. These are the Explosive/Munitions Manufacturing Areas Operable Unit (EMMA OU) and the Miscellaneous Areas Operable Unit (MISCA OU). EMMA OU included those areas physically associated with explosives/munitions manufacturing and disposal sites at the Crab Orchard Cemetery and Crab Orchard Plant areas within CONWR. MISCA OU included those sites that were proposed in the August 1998 RI Report as needing further investigation. DOI created a Water Towers Areas Operable Unit (WT OU) to remove lead contaminated soil in the vicinity of three existing water towers and two previous Water Tower areas within CONWR.

In 1997, DOI created two more OUs, the Additional and Uncharacterized Sites Operable Units (AUS OU) and the Lake Monitoring Operable Unit (LM OU). The purpose of the AUS OU is to investigate any remaining uncharacterized areas within CONWR that were previously not investigated in the 1988 RI Report. The AUS OU also included several additional sites that may be suspected of contamination due to past disposal practices by several industrial tenants. The purpose of the LM OU is to verify and take appropriate action, if Crab Orchard Lake is affected by the past waste disposal activities at CONWR.

DOI is the lead agency for the MA OU, MISCA OU, PCB OU, WT OU, AUS OU, and the LM OU. DA is the lead agency for the EMMA OU. Schlumberger, as a Settling Defendant signed a Consent Decree (CD) with the USEPA and DOI. Under the terms of the CD, Schlumberger agreed to perform the cleanup set out in the ROD for the PCB OU. USEPA is the lead agency for the implementation of the remedial action required under the PCB OU ROD and enforcement of the terms of the CD.

USEPA is responsible for conducting separate five-year reviews for all of the remaining OUs except for the EMMA OU. Under the Executive Order 12580, DA is responsible for the five-year review of the EMMA OU. The MA OU remediation was completed in 1998. The remaining six operable units are in various stages of site investigation and/or construction. USEPA completed five–year reviews of the PCB OU in September 2000 and the MA OU in September 2001. This five-year review pertains only to the EMMA OU and will be provided to USEPA to be included in a Five-Year Review Report of CONWR which will include all seven OUs.

Summary of Investigations and Remedial Actions at the EMMA OU

The EMMA OU was divided into 15 individual sites. The sites are grouped into three discrete areas: ten sites are located in the Crab Orchard Cemetery (COC) area, named for the close proximity to the Hampton Cemetery; four sites are located in the Crab Orchard Plant (COP) area, near the Group II load line and the former Ammonium Nitrate Plant; and one site is located in the explosives compounds storage bunker area.

Initial Response

Based on the findings of the 1994 RI Report for the EMMA OU prepared by Environmental Science & Engineering, Inc. (ESE), soil, sediment, surface water, and groundwater had been affected at 13 of the 15 sites (COC-1 through COC-10, COP-1 through COP-4, and Bunker1-3). The sites contained metals and nitroaromatic compounds in various media above background concentrations.

Site COC-1

Site COC-1 is approximately 100 by 200 feet in area. The site was suspected of formerly being a burial and detonation disposal area. An east-west oriented berm approximately 3 feet high appeared to be a burial mound for mine springs. By themselves the springs have no explosive capability.

Lead concentrations above background appeared to occur in the surface soils, ranging from 22.5 to 197 mg/kg. Background concentrations of lead are considered to be below 21.1mg/kg (ESE, 1994). Lead was also detected in one offsite sediment sample (21.9mg/kg). Concentrations of iron, chromium, lead, zinc, cobalt, copper, mercury, nickel, and silver were detected as well.

Chloride and sulfate were detected above the background concentrations in the groundwater during Phase I of the RI (at 31.6 mg/L and 1,600 mg/L respectively), but were not detected above background during the Phase II. Metals detected in the groundwater above background or detection limits include cadmium, aluminum, iron, manganese, vanadium, arsenic, chromium, lead, selenium, zinc, barium, copper, nickel, potassium, silver, and thallium. No nitroaromatic compounds were detected in any of the groundwater, soil, or sediment samples collected.

Site COC-2

Site COC-2 is approximately 250 by 350 feet in area and encompasses an old burn furnace and two depressions. A subsurface clay drain tile extends to the northeast from the site and discharges into a dry stream.

Lead was detected above background levels in Site COC-2 soil samples. Other metals detected in the soil above background levels include antimony, beryllium, calcium, chromium, copper, iron, and mercury primarily in the 0- to 2-foot interval samples. Monitoring well soil borings samples contained TNT at depths of 5 to 7 feet (1.05 mg/kg) and 12 to 14 feet (1.50 mg/kg). A sediment sample collected from the dry streambed northeast of the discharge point for the clay drain tile exhibited selenium concentrations above background. Metals detected above background levels in groundwater samples included barium, iron, manganese, potassium, and selenium. Chloride, fluoride, and sulfate were also present above background levels. One groundwater sample exhibited TNT concentrations above detection limits.

Site COC-3

Site COC-3 is a large area divided into two halves, the southern fenced heavily wooded area and the northern area. Various sized pieces of TNT, metal debris, and asbestos containing tile were found scattered across the northern half. The area of concentrated debris remained void of vegetation. A north-south oriented erosional gully bisected the northern half, with the debris concentrated on the west bank of the berm. Stained soil of an apparent burn layer was seen approximately 2 feet below the gully bank. A sample from the stained soil contained 223,000 mg/kg of TNT. Nitroaromatic compounds detected in the soils above detection limits included TNT; 1,3,5-trinitrobenzene(TNB); 2-amino-4,6-dinitrotoluene (2-amino-4,6-DNT); 2,4-DNT,1,3-dinitrobenzene (1,3-DNB); 2-nitrotoluene; 4-nitrotoluene; tetryl; 2,6-DNT; and 4-amino-2,6-DNT. Metal compounds present were antimony, arsenic, barium, beryllium, calcium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silver, and zinc. Nitroaromatic compounds were observed primarily in the 0- to 2-foot levels with two boring samples exhibiting nitroaromatic compounds in the 3- to 5-foot interval and one boring exhibiting nitroaromatic compounds in the 7- to 9-foot interval samples. The prevalent metals (beryllium, copper, antimony, mercury, and lead) were observed primarily in the 0- to 2-foot and 7- to 9-foot interval samples with four borings exhibiting the metal compounds in the 3- to 5-foot interval and two borings in the 4- to 6-foot interval samples.

Nitroaromatic and metal compounds above background or detection limits were also detected in Site COC-3 sediment samples.

Surface water samples collected at Site COC-3 exhibited nitroaromatic and metal compounds above background concentrations including High Melting Explosive, cyclotetramethylenetetranittranmine, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); 2,4-DNT; copper; selenium; and sulfate.

Nitroaromatic compounds above detection limits present in groundwater samples included Royal Demolition Explosive, cyclonite hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX); nitrobenzene; TNT; 1,3,5-TNB; 2,4,6-DNT; 2-nitrotoluene; 3-nitrotoluene; 4-amino-2,6-DNT; and 2-amino-4,6-DNT. Both wells exhibited thallium and iron concentrations above background or detection limits in groundwater samples. Additional compounds detected include chloride, fluoride, and sulfate.

Site COC-4

Site COC-4 is a rectangular area approximately 250 by 600 feet. Several man-made depressions were thought to be the result of detonation disposal. A deep man-made depression located at the north end of the site retained water and became a pond.

Soil samples exhibited TNT above detection limits. Metals detected in soil samples included beryllium, cadmium, calcium, cobalt, copper, iron, magnesium, nickel, silver, and zinc. Sediment samples collected from the depression exhibited detectable levels of antimony, beryllium, cadmium, copper, and TNT.

Surface water samples collected from the deeper depression exhibited detectable metal concentrations including aluminum, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, vanadium, and zinc. The groundwater samples collected from Site COC-4 exhibited detectable concentrations of chloride, sulfate, TNT, barium, iron, lead, and potassium.

Site COC-5

Site COC-5 is a fenced heavily vegetated area approximately 210 by 280 feet. A shallow man-made depression was found in the southwestern corner of the site and a steeply sloped depressed area on the eastern side formed a north-south oriented canyon-type feature.

TNT concentrations above detection limits were exhibited in a 5- to 7-foot interval soil sample as well as in a sediment sample (1.4 mg/kg) from the man-made depression. TNT was not detected in Phase II sediment samples.

Chloride, fluoride, and sulfate were detected in the groundwater samples collected from Site COC-5. Various metals including barium, cadmium, iron, manganese, potassium, selenium, and vanadium were also detected in shallow groundwater samples. Arsenic was detected in a Phase I surface water sample. No organic constituents were observed above detection limits in surface water samples.

Site COC-6

Site COC-6 is a large triangular shaped fenced area covering approximately 6 acres. Several variably sized man-made depressions assumed to be the result of detonation disposal activities were found in the central and northern areas of the site. Small metal fragments were observed scattered around these depressions. TNT was detected above background concentration limits in soil at this site. Notable iron levels (up to 102, 000 mg/kg) were also observed. Beryllium, lead, and mercury were detected in soil boring samples at depth. Additional metals detected in soil samples include antimony, barium, cadmium, cobalt, copper, iron, magnesium, nickel, potassium, silver, and zinc. Many of these metals were found in the 19- to 21-foot intervals. Two sediment samples exhibited detectable TNT concentrations. Metals noted in other sediment samples included antimony, barium, cadmium, and magnesium.

Metal compounds detected above background in the surface water included aluminum, barium, calcium, iron, magnesium, potassium, and sodium. Groundwater samples also exhibited levels of metals above background including potassium, selenium, zinc, cadmium, chromium, lead, mercury, iron, barium, and nickel. Elevated levels of chloride (366 mg/L), fluoride (0.40 mg/L), and sulfate (478 mg/L) were also detected in the groundwater. No nitroaromatic compounds were noted above detection limits in the surface water or groundwater.

Site COC-7

Site COC-7 consists of approximately 2 acres of open area within a large field. An intact land mine and land mine casing fragments were found at this site and provided evidence of detonation disposal activities in this area. The intact land mine was not fused, and therefore, did not pose an immediate detonation hazard. However, it was determined to be filled with the original explosive filler, indicating a potential for detonation. The mine was isolated, collected, and destroyed by the unexploded ordnance demolition team. The characteristic depressions observed at other disposal sites were not evident at Site COC-7. No aromatic compounds above detection limits were detected in soil samples collected from this site. Metals detected above background in the soil include calcium, (2,530 mg/kg) and cobalt (22.9 mg/kg).

Groundwater samples collected from this site exhibited levels above background or detection limits of cadmium, iron, potassium, and selenium, as well as detectable levels of chloride, fluoride, and sulfate. A low level of TNT (0.00021 mg/L0 was detected in the Phase I groundwater sample. However, no nitroaromatic compounds were detected in the Phase II sample. A probable cause of this variance is the greater influx of groundwater during the Phase II sampling as evidenced by the elevated water levels noted during Phase II.

Site COC-8

Site COC-8 is located in an open area within a farmed field. Two magnetic anomalies detected during the Confirmation Study were investigated during the RI. Magnetic anomalies investigated at this site were identified as a sickle blade and metal fence posts. No aromatic compounds were detected in samples collected from this site. Metals were detected in soil samples collected from test pits at Site COC-8. Mercury was detected at 0.088 mg/kg, calcium at 2,340 mg/kg, and copper at 20.1 mg/kg. Mercury was detected at a concentration only slightly above the average background concentration (0.046 mg/kg). The source of the mercury may be a result of use of agricultural chemicals for fungal or pest control. A probable source of the copper and calcium detected at this site is past farming activities [i.e., the metal farm implements noted above or use of agricultural insecticides and/or fungicides (copper), and lime or other additives to the soil (calcium)].

Site COC-9

Site COC-9 is approximately 4 acres of heavy vegetation. The northern portion is fenced. Several man-made depressions were found in the area, with two located near the southern area and the others located near the center and northern portions of the site. The depressions are thought to be the result of ordnance disposal activities. Samples collected from test pits revealed a subsurface ash layer roughly 15 feet in diameter, providing evidence of burning at this site.

Most of the samples collected from each medium at this site exhibited metal concentrations above background with the most prevalent being arsenic, antimony, cadmium, chromium, copper, iron, lead, nickel, and selenium. Additional metals detected in the soil in this area included aluminum, barium, beryllium, calcium, cobalt, magnesium, mercury, potassium, silver, sodium, thallium, vanadium, and zinc. The highest metal concentrations were observed in soil samples from the 0- to 2-foot and 4- to6-foot intervals. Detectable levels of TNT, and 1,3,5-TNB were present in sediment samples collected from the southern and northern depressions. The most commonly noted metals detected in the sediment include arsenic, beryllium, chromium, iron, nickel, selenium, silver, thallium, and zinc.

Several metal concentrations above background were detected in surface water samples including, aluminum, barium, calcium, cobalt, copper, iron, magnesium, manganese, nickel, selenium, and zinc. HMX was detected in a single surface water sample. Elevated sulfate levels were also detected in surface water samples. Although TNT was detected in the Phase I groundwater sample, no nitroaromatic compounds were detected in Phase II groundwater samples. A probable cause of this variance is the greater influx of groundwater during the Phase II sampling as evidenced by the elevated water levels noted during Phase II. Metal concentrations noted above background in groundwater samples include arsenic, cadmium, cobalt, iron, manganese, nickel, potassium, selenium, silver, vanadium and zinc. Chloride fluoride and sulfate were also detected in the Phase I groundwater sample.

A sediment sample collected downgradient to the north of the site exhibited no nitroaromatic compounds or metal concentrations above background.

Site COC-10

Site COC-10 is approximately 120 feet square and consists of a fenced area on the northern edge of a corn field. This COC site is closer to the COP area than to the other COC sites. A large portion of the site was taken up by an irregularly-shaped man-made depression. No ordnance were observed at this site.

One soil sample collected in Phase I exhibited levels of nitroaromatic compounds above detection limits (nitrobenzene at 0.0058 mg/kg). Two Phase I sediment samples contained TNT at 0.66 and 0.72 mg/kg. Phase II soil and sediment samples exhibited no detectable nirtroaromatic compounds. The RI determined that explosive effects on soil and sediment at this site were defined and localized. Beryllium, barium, cadmium, and copper were also detected in sediment samples above background. Sediment samples collected downgradient of the site showed no levels of site constituents above background or detection limits, indicating that surface migration from this site had not occurred.

Aluminum, barium, calcium, copper, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc were present above background levels in surface water samples. Groundwater samples from this site exhibited no detectable nitroaromatic compounds. Arsenic, barium, beryllium, chromium, potassium, thallium, chloride and sulfate were detected in groundwater above background concentrations.

Site COP-1

Site COP-1 is an area containing a man-made impoundment that received drainage from the Group II process buildings. Drainage from the impoundment went through a 12-inch pipe on the west side of the impoundment to a small stream. This stream drains north to Crab Orchard Lake. Numerous metals were detected in sediment samples collected from the impoundment and from the streambed. However, few of the metals are consistently present in the samples. The metals most commonly detected above background in sediment samples were calcium, lead, and mercury. Additional metals detected in the sediment include antimony, beryllium, chromium, cobalt, copper, manganese, silver, and zinc. One impoundment sediment sample and two streambed sediment samples exhibited detectable levels of TNT. The compound 2,6-DNT was detected in one streambed sediment sample.

Surface water samples from the impoundment exhibited detectable levels of RDX, HMX, and 1,3-DNB. Metals present in above background levels in the impoundment surface water samples include aluminum, barium, cadmium, calcium, copper, iron, magnesium, manganese, sodium, vanadium, and zinc. The groundwater sample collected in Phase I exhibited detectable levels of 1,3,5-TNB, antimony, beryllium, cadmium, and potassium. Also chloride, fluoride, nitrate, and sulfate were detected. With the exception of thallium at 0.0031mg/L, no metals were detected in Phase II groundwater sample at concentrations above background levels. No nitroaromatic compounds were detected in the Phase II groundwater samples. A probable cause of the variance I analytical results between Phase I and Phase II sample events is the greater influx of groundwater during the Phase II sampling as evidenced by the elevated water levels noted.

Site COP-2

Site COP-2 is a former underwater storage area for bulk explosives. Sodium is the most commonly detected constituent above background concentrations at this site, being present in most of the surface soil samples (0- to 2-foot interval) at concentrations ranging from 1,860 to 3, 970 mg/kg and one soil boring sample (5- to 7-foot interval) at 1, 960 collected during the installation of a monitoring well. Magnesium, calcium, and mercury were present above background in one soil samples collected during the installation of monitoring well MWS-1. Lead (24.9 mg/kg) and cobalt (22.1 mg/kg were each detected in one surface soil sample. No nitroaromatic compounds or organic constituents were detected in soil samples collected.

Groundwater samples exhibited detectable levels of metals including arsenic, selenium, and thallium. Additional metals detected in groundwater samples include barium, iron, and potassium. Chloride, fluoride, nitrate, and sulfate were also detected in groundwater samples. TNT was detected in one groundwater sample during Phase I sampling at a concentration of 0.0002mg/L. No nitroaromatic compounds were detected in the Phase II sampling.

Site COP-3

Like Site COP-2, Site COP-3 is a former underwater storage area for bulk explosives. Metals detected above background in soils include arsenic, barium, beryllium, calcium, cobalt, iron, magnesium, mercury, and silver. Iron, calcium, magnesium, and manganese were the most prevalent metals detected. The remaining metals were detected in only one or two soil borings at various intervals between 0 and 21 feet. One soil boring exhibited TNT at the 4- to6-foot interval at 0.25 mg/kg. Sediment samples collected from areas draining this site contained no nitroaromatic compounds or above background metals.

Elevated levels of aluminum (21mg/L) and iron (10.1 mg/L) were detected in Phase I groundwater samples. Additional metals above background in the Phase I groundwater samples include antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, and vanadium. Phase II groundwater samples exhibited an elevated chromium level (0.417 mg/L) in one well and 1,3-DNB (0.332 mg/L) in another. Groundwater samples also exhibited detectable levels of chloride, fluoride, and sulfate.

Site COP-4

Three types of disposal activities were identified at Site COP-4. These activities included burning operations in the northwest portion of the site, burial activities in the southwest portion, and surface dumping in the south central portion. The area is bounded by old roads and is transected in an east-west direction by an old railroad grade. Extensive magnetic anomalies (identified in the area south of the railroad tracks) and debris (found during excavation of test pits in this area) indicated that this area may have been used as a burial or disposal area. The area north of the railroad tracks was reported to have been used to burn ordnance. Land mine casings and pieces of TNT have been observed on the surface in the southeast corner of Site COP-4 in an area referred to as the former land mine disposal area.

TNT, HMX, RDX, and 1,3,5-TNB were detected in samples collected from and throughout the soil column to a depth of 6 feet in the burial area south of the railroad tracks.

Concentrations of 2-amino-4,6-DNT, 2,6-DNT, 2-nitrotoluene, and 4-nitrotoluene were also detected in soil samples. HMX and RDX were also detected in one soil boring in the 12- to 14-foot interval. Metals such as antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, silver, sodium, thallium, and zinc were also detected in soils in varying sample intervals.

Surface soil samples collected from the reported burn area north of the railroad grade contained no detectable concentrations of nitroaromatic compounds. One surface soil sample exhibited levels of barium, calcium, copper, lead, silver, and zinc above background concentrations. Soil samples collected from the former land mine disposal area revealed significant concentrations of nitroaromatic compounds. Constituent concentrations were highest in the surface soils for RDX and TNT in various sampling intervals between 0 and 10 feet. Metals detected ion soil samples were sporadic in this area. Only three metals were detected above background more than once: calcium, lead, and mercury.

Metals detected above background in groundwater samples included aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, selenium, silver, vanadium, and zinc. Arsenic, beryllium, chromium, copper, lead, and zinc were detected at levels above background in samples from Well COP4-3 during Phase II sampling. RDX was detected in Phase II groundwater samples at 0.00118 and 0.00199 mg/L. No Phase I groundwater samples exhibited detectable concentrations of nitroaromatic compounds.

Site Bunker 1-3

The Bunker 1-3 site is one of approximately 85 bunkers in Area 13 originally built for storage of 500-pound bombs. There was a report of a chemical spill occurrence at Bunker 1-3. This spill occurred in the adjacent field to the northwest side of the bunker as evidenced by an area of discolored vegetation. During the Phase I investigation, one monitoring well was installed and sampled, and three composite surface soil samples were collected. No sign of discolored vegetation or other evidence of impact was observed during the Phase I field activities. One confirmatory groundwater sample was collected during the Phase II investigation and analyzed for nitroaromatic compounds and priority pollutant metals. None of the surface soil, monitoring well boring soil, or groundwater samples exhibited any nitroaromatic compounds above detection limits or metals above

background levels.

Basis for Taking Action

The results of the Baseline Risk Assessment (BRA) concluded conditions at Sites COC-1, COC-2, COC-5, COC-7, COC-8, COC-9, COC-10, COP-1, COP-2, COP-3, and Bunker 1-3 do not pose an unacceptable potential risk to human health and the environment. There was a potential unacceptable risk indicated at Site COC-6. However, this potential unacceptable risk at Site COC-6 is based on an exposure scenario that is extremely unlikely. Therefore, no further action was recommended for those sites by the ROD for the EMMA OU prepared by ESE and signed by the USEPA and the DA in February 1997.

The BRA indicated that Sites COC-3 and COP-4 posed a potential and unacceptable risk to human health due to elevated levels of nitroaromatic compounds and metals in the soils. Additionally, potential ecological risks to white-tailed deer, small mammals, and bobwhite quail were identified with the two sites. The BRA indicated that Site COC-4 posed a potential ecological risk to bobwhite quail, while not posing any unacceptable risk to human health. Ecological risks associated with Site COC-4 are several orders of magnitude lower than the estimated potential risks at Sites COC-3 and COP-4 and therefore the ROD did not include a selected remedy for Site COC-4.

The ROD determined the following selected remedy for Sites COC-3 and COP-4:

- Excavation and offsite treatment and disposal of soil with concentrations of nitroaromatic compounds; greater than 100,000 mg/kg and lead greater than 450 mg/kg (approximately 270 cy)
- Removal of RDX/HMX contaminated soil at Site COP-4 to a depth of 2 feet below grade within the fenced area and disposal at an offsite permitted special waste landfill;
- Further removal and offsite disposal of soil shown by TCLP analysis to match the RCRA definition of a characteristic hazardous waste (2,4-DNT greater than 0.13 mg/L and lead greater than 5 mg/L) at both sites;
- Backfill excavated areas and construction and long-term maintenance of 24-inch soil covers, land use controls, and groundwater monitoring.

In addition, the DA conducted removal activities to address unexploded ordnance at the EMMA sites. The response included surveying and excavation for unexploded ordnance over 20 acres and reforestation of 83 acres to eliminate intrusive land use activities. Both the remedial and removal activities at the EMMA OU sites are complete.

Table 2 below contains the remediation Goals for EMMA OU soils.

Table 2: Remediation Goals for EMMA OU Soil (mg/kg), Crab Orchard National Wildlife Refuge, Marion, Illinois

Contaminant	Remediation Goal	Basis*
NITROAROMATICS		
TNT	2.11	PQL
1,3,5-TNB	2.25	PQL
HMX	4.19	PQL
RDX	4.13	PQL
METALS		
Lead	450	MA OU and PCB OU Remediation Goal

*The nitroaromatics remediation goals are based on the current Practical Quantitation Levels (PQLs). PQLs are generated by the laboratory based on site-specific samples/information. In the case of the EMMA OU sites, enough data are available to provide PQLs based on analytical results from the site. These PQL values are higher than the estimated method quantitation limits (QLs) due to matrix interferences and other laboratory instrumentation interferences from the soils (clays) at the EMMA OU sites. The estimation method QLs are developed under "ideal" situations (sands), where extraction and analysis are optimal.

IV. Remedial Actions

Remedy Selection

The USEPA and DA signed the ROD for the EMMA OU at the CONWR on February 19, 1997. Remedial action was determined to be necessary at Sites COC-3 and COP-4, while no further action is required at the remaining 12 EMMA OU sites. The selected remedy included:

- Excavation and offsite treatment and disposal of soil with concentrations of nitroaromatic compounds; greater than 100,000 mg/kg and lead greater than 450 mg/kg (approximately 270 cy) for treatment at an offsite incinerator;
- Removal of RDX/HMX contaminated soil at Site COP-4 to a depth of 2 feet below grade within the fenced area and disposal at an offsite permitted special waste landfill;
- Further removal and offsite disposal of soil shown by TCLP analysis to match the RCRA definition of a characteristic hazardous waste (2,4-DNT greater than 0.13 mg/L and lead greater than 5 mg/L) at both sites;
- Backfill excavated areas and construction and long-term maintenance of 24-inch soil covers, land use controls, and groundwater monitoring.

Land use controls implemented at Sites COC-3 and COP-4 include restrictions of groundwater well installation, subgrade activities, and pond creation within the perimeter of the soil covers. In addition, the DA conducted removal activities to address unexploded ordnance at the EMMA sites. The response included surveying and excavation for unexploded ordnance over 20 acres and reforestation of 83 acres to eliminate intrusive land use activities.

The studies undertaken at the EMMA OU identified potential human and ecological risks associated with nitroaromatic compounds and metals, specifically lead, in soil at Sites COC-3 and COP-4. The remedial objective for the EMMA OU is to minimize potential human health and ecological risks associated with the direct contact of affected surface soils at Sites COC-3 and COP-4. The overall response strategy consistent with CERCLA is to restrict the ability of humans and animals to contact nitroaromatic compounds and lead in soils at Sites COC-3 and COP-4, while monitoring the groundwater at Sites COC-3 and COP-4 for contaminants over time.

Both the remedial and removal activities at the EMMA OU sites are complete.

Remedy Implementation

In August 1999, a USACE contractor, SCI UXO/OE Services (SCI), located, identified, and disposed of ordnance and explosives (OE) and OE/non-OE related scrap greater than one square inch in size to a depth of one foot in sites COC-1, COC-4, COC-5, COC-6, and COC-15. In COC-1, the whole area was cleared of OE and OE/non-OE scrap with the exception of a berm measuring approximately 75' X 50' X 4'. At Site COC-4, a survey of all grid corners was completed; however no OE clearance was conducted at that time. In Site COC-5, all grids were cleared of OE and non-OE scrap. At Site COC-6, approximately 3.6 acres were cleared of OE and OE/non-OE crap. In Site COC-15, approximately 0.35 acres were cleared of OE and OE/non-OE scrap.

Removal activities and site surveys were also conducted at Sites COC-1, COC-4, COC-5, COC-6, and COC-15 from June 2000 to November 2000. The objective of this removal action was to safely locate, identify, and dispose of all OE and OE/non-OE related scrap greater than one square inch in size to a depth of one foot. The total area cleared was approximately 7.8 acres. A total of 21,000 pounds of OE scrap and 1,800 pounds of non-OE scrap were recovered, inspected, and transferred offsite. At Site COC-1, OE and OE/non-OE scrap were excavated and removed from 0.09 acres contained within the 75' X 50' X 4' berm. At Site COC-4, OE and OE/non-OE scrap were removed from 3.3 acres to a depth of one foot. At Site COC-6, OE and OE/non-OE scrap were removed from 2.9 acres to a depth of one foot. At Site COC-15, a visual surface walkover and geophysical survey were performed on 1.5 acres. Based on the result of the geophysical survey, OE and OE/non-OE scrap were removed to a depth of one foot in three grid areas. Clearance was accomplished on the entire 100' X 100' grid areas COC15-A2, COC15-D1, and COC15-F1 to a depth of one foot.

The focus for implementing land use controls is on explosive safety risk. Land use controls are needed at Sites COC-1, COC-2, COC-4, COC-5, COC-6 and COC-15 for the following reasons:

- OE may remain in areas or at depths not suspected or identified.
- Detection and removal methods are not always 100 percent effective; some ordnance may remain undetected at depths or in areas already subjected to removal actions.

Studies conducted by USACE indicate that activities such as standing, walking, running, jumping, sitting or lying prone have close to a zero risk hazard. Group activities also are very low risk. Provided adequate notice is given and reasonable care is exercised, the former IOP is considered suitable for any and all development involving intrusive activities. The best alternative to reduce the OE risk is the use of construction support, monitoring, and institutional controls. Fences and signs would be needed in areas where removal actions have not been conducted. Fence construction would require OE surface clearance in narrow lanes in which to drive in the fence posts.

V. Progress Since the Last Review

This is the first Five-Year Review for the EMMA OU.

VI. Five-Year Review Process

Administrative Components

In March 2005, Mr. Nan Gowda, USEPA Region 5 Superfund Division discussed with Mr. Walt Perro, USACE, the need to have the EMMA OU incorporated into the 2006 Five –Year Review for Crab Orchard National Wildlife Refuge. Ms. Karen Rabek of USACE Louisville District in a phone conference with Mr. Gowda agreed to have USACE Louisville District conduct the EMMA OU portion of the Five-Year Review. An agreement between Ms. Rabek and Mr. Gowda established the following schedule:

Document Review	Mid Dec - Mid Jun
Data Review	Mid Dec - Mid Jun
Site Inspection	January 19, 2006
Five-Year Draft Report	June 30, 2006
Five-Year Final Report	September 2006

Document Review

This first Five-Year Review consisted of a review of relevant documents including:

Investigation Former Illinois Ordnance Plant (UXB 1991)
Archives Search Report, Conclusions and Recommendations for the former Illinois Ordnance Plant (1993)
Record of Decision (ROD) for Crab Orchard National Wildlife Refuge, Explosives/Munitions Manufacturing Area (EMMA) Operable Unit (OU) (ESE 1996)
Final Removal Report, Ordnance and Explosives (OE) Removal Action (SCI 2001)
Five-Year Review Report, Metals Areas Operable Unit (USEPA, Region 5, 2001)
Fact Sheet, former Illinois Ordnance Plant Now Crab Orchard National Wildlife Refuge (USACE 2004)
Environmental Land Use Control Plan, Crab Orchard National Wildlife Refuge NPL Site (USFWS 2004)
Long-Term Groundwater Monitoring, Sites COC-3 and COP-4, Crab Orchard National Wildlife Refuge, Final Report - October 2005 Survey, (BAT Associates, Inc. 2006)

Data Review

The following items included in Attachment C were reviewed:

Attachment C-1 lists the attendees of the 19 January 2006 site inspection. Attendees represented the USEPA, IEPA, USFWFS and USACE.

Attachment C-2, the checklist for the 19 January 2006 site inspection was prepared by USACE.

Attachment C-3, the Summary of Groundwater results for COC-3 (May 2001 – May 2006) and the Summary of Groundwater results for COP-4 (May 2001 – May 2006)

Attachment C-4 consists of the COC-3 MW7, COC-3 MW8 and COP-4 MW9 soil boring/monitoring well logs.

Attachment C-5 is the Restoration Information Management System, Formerly Used Defense Sites (FUDS), Project Fact Sheet, HNC Revision: 13 April2006

Attachment C-6 is the Content Checklist for Five-Year Review Reports.

Groundwater Monitoring Results: The ROD required monitoring of groundwater at Sites COC-3 and COP-4. At Site COC-3, one well (MW-06) is up gradient from the soil cover and three pairs of wells (MW-03A and B, MW-04A and B, and MW-05A and B) are down gradient. See Figure 2 in Attachment A. Based on Illinois Environmental Protection Agency (IEPA) concerns, in April 2006, two more wells were installed down gradient (MW-07 and MW-08). See the soil borings/monitoring well logs in Attachment C. At Site COP-4, one monitoring well is up gradient of the cover (MW-02R) and four pairs of wells (MW-05A and B, MW-06A and B, MW-07A and B, and MW-08A and B) surround the area of excavation. One new well (MW-09) was installed cross gradient to further delineate the explosives contamination at Site COP-4. See Figure 3 in Attachment A and the well logs in Attachment C. Groundwater samples were collected from the original wells in 2001 through 2006. The newly installed wells were added to the monitoring for the May 2006 round of sampling. Results of the monitoring are summarized in Tables 1A and 1B in Attachment C.

COC- 3: The analytical results of the monitoring at COC-3 show concentrations of nitrates/nitrites are well below the ARARS in all samples from all wells. Explosive compounds, combined amino-dinitrotoluenes and 2,6-dinitrotoluene, were detected at levels above their applicable or relevant and appropriate requirements (ARARs) at two only wells, MW-04A and MW-05A. Concentrations of 13 of the 23 TAL metals in unfiltered samples exceeded at least one of their respective ARARs in the last two rounds of sampling (October 2005 and May 2006) compared with 17 in May of 2001. The most frequent exceedances were for aluminum, iron, lead, and manganese. Only aluminum, iron, lead, and selenium exceeded their ARARs at the control up gradient well (MW-06). Only aluminum, iron, lead, manganese and selenium exceeded their ARARs at the newly installed wells. Overall, the levels of detected concentrations seem to be lower over time. Continued monitoring is recommended to determine if natural attenuation is occurring.

COP-4: The analytical results of monitoring at COP-4 reveal concentrations in all groundwater samples from all wells were well below the applicable ARARs. Results for explosives reveal that except for the November 2001 round of sampling, explosives only show up in wells MW-06A and MW-07A. RDX and the combined amino-dinitrotoluenes are found in groundwater samples from MW-07A and MW-06A. Groundwater samples from MW-06A have also been found to have concentrations of 2,4-dinitrotoulene, 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, 1,3,5-trinitrobenzene, and 1,3-dinitrobenzene, but not at every sampling event. Overall, the concentrations of explosives in the groundwater are lower in the later sampling events. Concentrations of six TAL metals samples exceeded their ARARS at COP-4 in the latest sampling event in May 2006. As in Site COC-3, the most frequent exceedences are for aluminum, iron, and manganese. Only aluminum, iron, and manganese exceeded their ARARs at the newly installed well MW-09. Overall, the number of analytes detected, as well as the concentrations, seems to be diminishing over time. Continued monitoring is recommended to determine if natural attenuation is occurring.

Some metals and explosive compounds continue to be detected at values exceeding the ARARs at both sites. See Attachment C. Continued groundwater monitoring at these sites is recommended to determine the extents of the plumes and whether natural attenuation is occurring.

Site Inspection

A Site Inspection was conducted on January 19, 2006 by representatives of the Illinois Environmental Protection Agency, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers. The purpose of the inspection was to assess the protectiveness of the remedy. A complete list of inspection attendees is provided in Attachment C. The team started at COC-3 then continued to COC-4, COC-1 and COP-4. Reforested areas between COC-5, COC-6 and COC-1 were viewed from the edge of COC-3. The temperature was mid 40's, cloudy, and very windy.

Erosion damage at COC-3 had been repaired. At COC-3 and COP-4 here were no signs of erosion and the grass was thick and healthy. The catch basin at COC-3 appeared to be in good condition. The oak, hickory, and walnut trees that were planted in the reforested areas appear to be growing well. The trees varied in height from 3 to 6 feet.

At the May 2006 round of groundwater sampling, the soil covers were inspected at Site COC-3 and COP-4. Both covers look healthy and in very good shape. The cover inspection forms can be seen in Attachment C.

Site Inspection Summary

The removal actions have all been successful. The sites are within fenced areas which limits any exposures. Land use controls will continue to protect human health and the environment.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents ?

Yes, the removal actions have all been successful. The quarterly and annual groundwater monitoring has been maintained. The soil covers are in good shape and the sites are in fenced areas and are inaccessible to the public.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid ?

Yes, the remedial action objectives are still valid.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy ?

The remedies are working as intended. However, in March 2006, a biologist with USFWS found a mine south of sites COC-3 and COC-4 (see Figure 4). The mine was a live, explosively loaded, M-21 Anti-Tank mine, unfuzed. The mine was seriously deteriorated due to rust and the explosives were exposed. It was detonated in place in April 2006. USACE has an agreement with the IEPA to resolve a DSMOA dispute at Camp Ellis. As part of this agreement, USACE pledged to follow the emergency response procedures established by previous IEPA policy regarding munitions and explosives of concern (MEC). Specifically, USACE will provide timely notification to the Illinois Emergency Management Agency at (800-782-7860) of any live or potentially live MEC encounter during future Camp Ellis field efforts. In addition, USACE agreed to conduct post detonation sampling within a reasonably short period of time following any detonation in order to determine if soils are impacted by residual nitroaromatics. Follow up for any contamination identified in association with the destruction of MEC will be integrated into the planned HTRW investigations for the site. This agreement between USACE and the IEPA would apply to Crab Orchard as well.

In April 2006, the Hunstville Center (HNC) revised the August 1993 Restoration Information Management System Formerly Used Defense Sites (FUDS) Project Fact Sheet. The August 1993 Project Fact Sheet had given the Illinois Ordnance Plant a Risk Assessment Code (RAC) score of 2, medium priority, to a score of 1, high priority (Attachment C). Due to the discovery of the mine and the change in RAC score, USACE recommends that a new MMRP investigation, following the CERCLA process, be initiated.

Technical Assessment Summary

The long-term monitoring appears to show some natural attenuation. The Sites COC-3 and COP-4 are located within fenced areas, limiting access to the public. Access to these sites remains closed to the public. The soil covers are in good shape with thick vegetation. Long-term groundwater monitoring at both sites appears to show some natural attenuation.

VIII. Issues

The removal actions along with the land use controls are protective of human heath and the environment, however the groundwater sampling results show that there is a need for continued groundwater monitoring to delineate the plumes and determine if natural attenuation is occurring. The discovery of the mine so close to COC-3 and COP-4 is a reason for concern and investigation.

IX. Recommendations and Follow-up Actions

The recommendation is to maintain groundwater monitoring activities at Sites COC-3 and COP-4. Continued groundwater monitoring at these sites is recommended to determine the extents of the plumes and whether natural attenuation is occurring.

Due to the discovery of the mine and the change in RAC score, USACE recommends that a new MMRP investigation, following the CERCLA process, be initiated.

X. Protectiveness Statement

The remedies at the Crab Orchard National Wildlife Refuge EMMA OU are protective of human health and the environment, because the remedial actions and land use controls at both Site COC-3 and Site COP-4 are protective.

XI. Next Review

The next review (expected to be in 2011) will be conducted within five years of the completion of the Five –Year Review report which addresses all seven OUs at CONWR. The completion date will be the date of the signature shown on the signature page attached to the front cover of that report.

XII. References

BAT (BAT Associates, Inc.). 2006. Crab Orchard National Wildlife Refuge, Marion, Illinois, Long-term Groundwater Monitoring, Sites COC-3 and COP-4, Final Report – May 2005 Survey. March 22.

Defense Environmental Restoration Program for Formerly Used Defense Sites, Ordnance and Explosive Waste, 1993. Archive Search Report, Conclusions and Recommendations for the former Illinois Ordnance Plant, Carbondale, Illinois. August.

ESE (Environmental Science & Engineering, Inc.). 1994. Remedial Investigation/Baseline Risk Assessment Report, Explosive/Munitions Manufacturing Area (EMMA) Operable Unit (OU), for Crab Orchard National Wildlife Refuge. September 15.

ESE (Environmental Science & Engineering, Inc.). 1996. Record of Decision (ROD) for Crab Orchard National Wildlife Refuge, Explosive/Munitions Manufacturing Area (EMMA) Operable Unit (OU). August 22.

SCI UXO/OE Services 2001. Final Removal Report, Ordnance and Explosives (OE) Removal Action, Former Illinois Ordnance Plant, Marion, Illinois. July 2.

USACE. 1994. Defense Environmental Restoration Program for Formerly Used Defense Site Findings, Ordnance and Explosive Waste Archives Search Report For Former Illinois Ordnance Plant, Marion, Illinois. March.

USACE 2004. Fact Sheet, Former Illinois Ordnance Plant Now Crab Orchard National Wildlife Refuge (NWR), Illinois. July15.

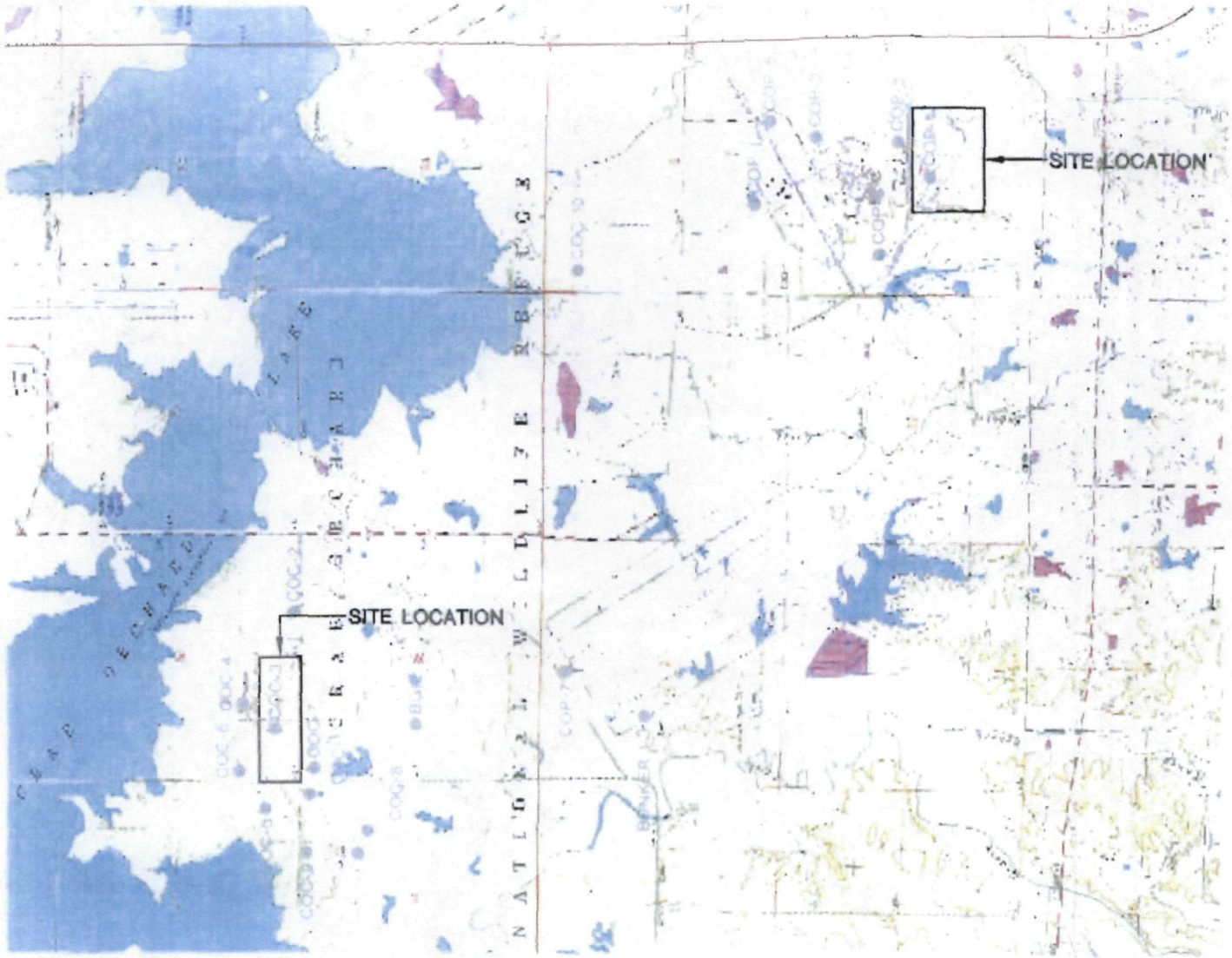
USFWS 2004. Environmental Land Use Control Plan, Crab Orchard National Wildlife Refuge NPL Site, Marion, Illinois. January.

UXB 1991. Investigation Former Illinois Ordnance Plant , Marion, Illinois.

A Figures

Five Year Review
For
Explosives/Munitions Manufacturing Area Operable Unit
Crab Orchard National Wildlife Refuge

Figure 1	Site Location Map
Figure 2	Site Map – Area COC-3
Figure 3	Site Map – Area COP-4
Figure 4	Mine Location March 13, 2006



0 1000 2000
SCALE IN FEET

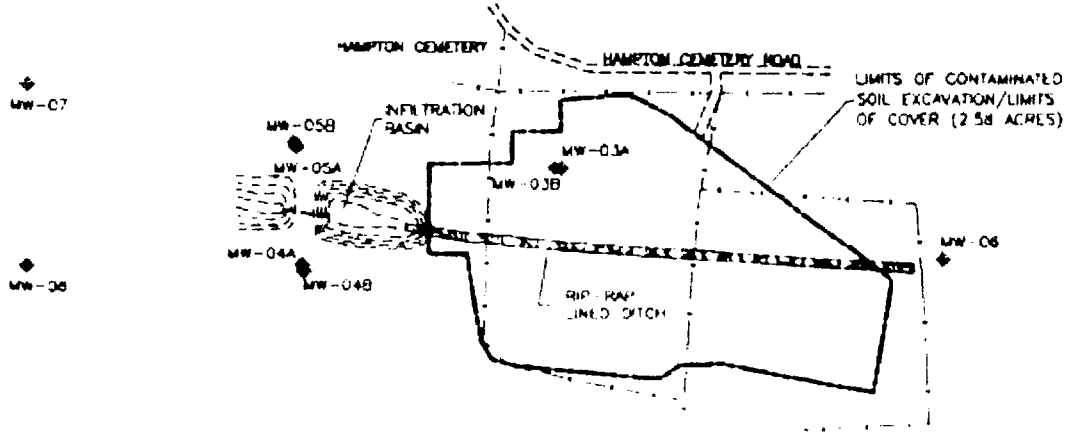
Base map obtained from USGS 7.5 minute Quadrangle Map of Crab Orchard Lake, Illinois, 1968 (Revised 1990)

BAT
BAT Associates, Inc.
ENVIRONMENTAL, HEALTH, SAFETY SERVICES
5151 Brookhollow Parkway
Suite 256, Norcross, GA 30071

DATE 5/7/03
DWN. GHA
APPR. JKK
REVIS. / 2004
PROJECT NO.
983007
TASK 24

LONG-TERM GROUNDWATER MONITORING
CRAB ORCHARD NATIONAL WILDLIFE REFUGE
MARION, ILLINOIS

FIGURE 1
SITE LOCATION MAP



BAT

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ENVIRONMENTAL, HEALTH, SAFETY SERVICES
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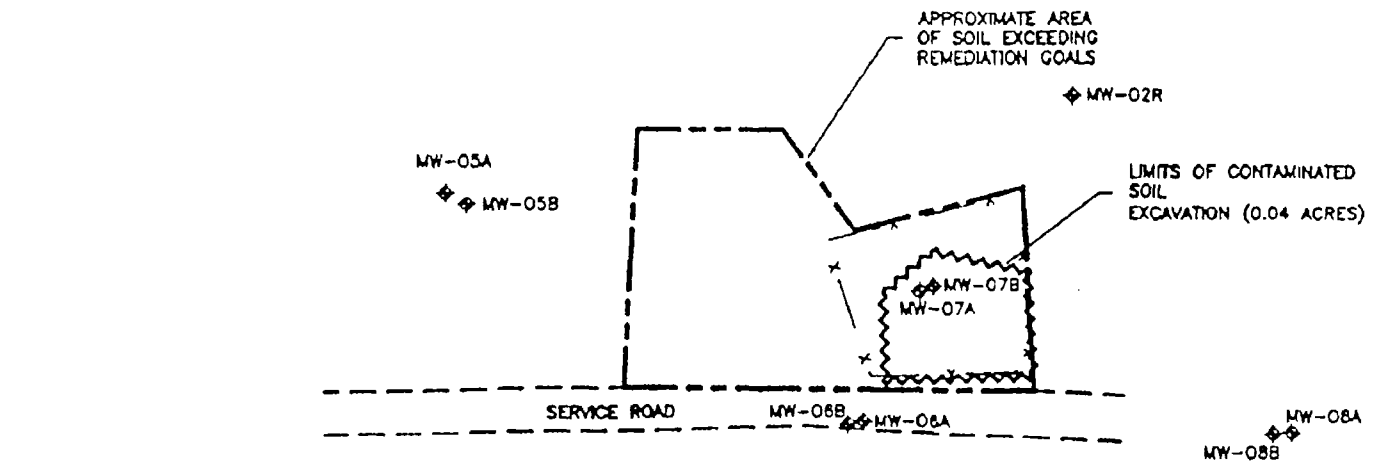
DATE ISSUED
DRWN
APVD
REVIS
PROJ NO.
06-0

CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS
JANUARY, 2006

FIGURE 2
SITE MAP
AREA COC-3



MW-09

LEGEND

MW-08A MONITORING WELL

0 30 60

SCALE IN FEET

BAT

BAT Associates, Inc.

ENVIRONMENTAL, HEALTH, SAFETY SERVICES

5151 Brookhollow Parkway
Suite 260, Norcross, GA 30071

DATE 1/18/06
DWN. GHA
APPR. JKK
REVS.
PROPOSAL NO.
06-005

CRAB ORCHARD NATIONAL WILDLIFE REFUGE – MARION, ILLINOIS
JANUARY, 2006

FIGURE 3
SITE MAP
AREA COP-4

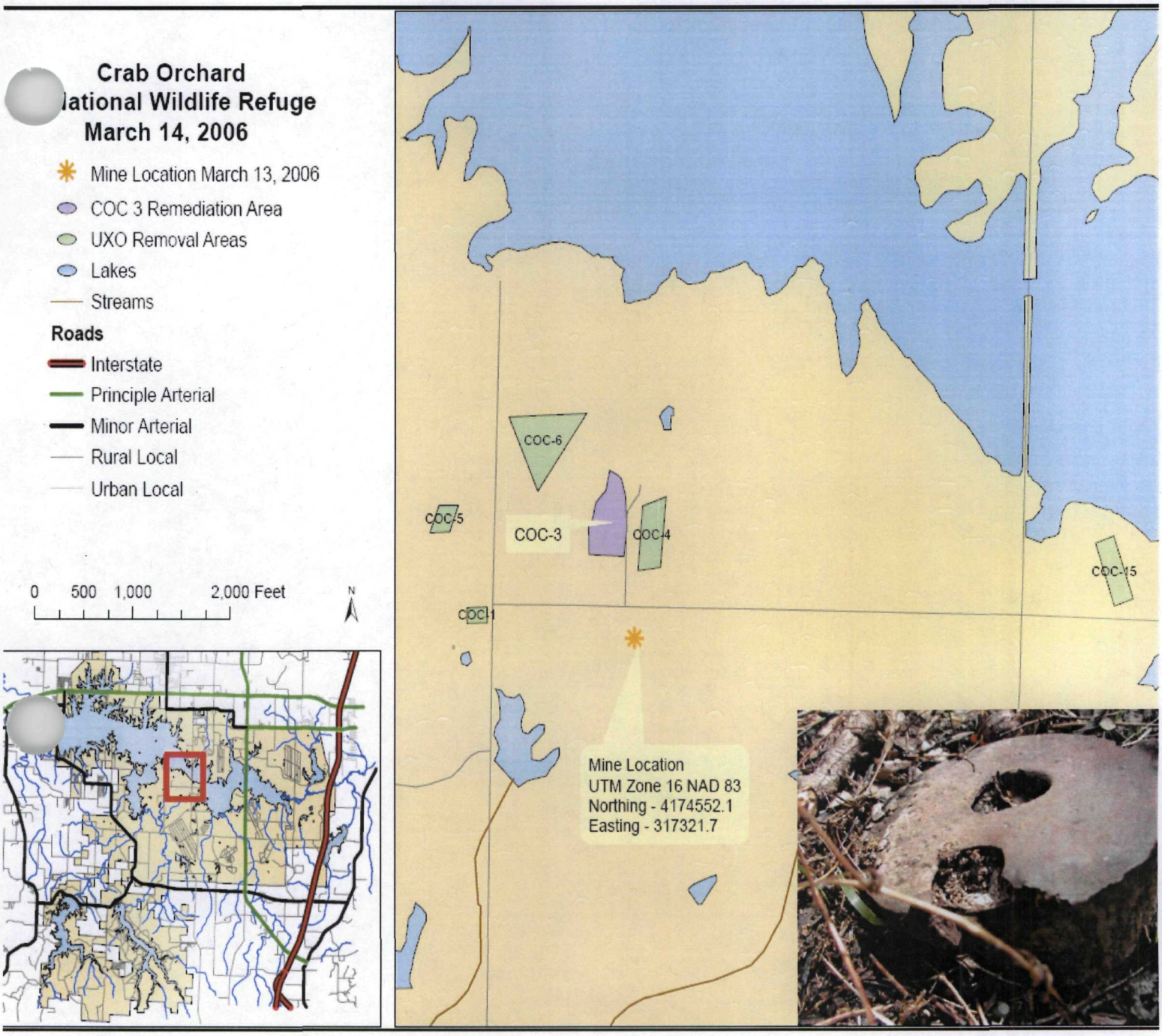


Figure 4: Mine Location March 13, 2006

B Photographs

Five Year Review
For
Explosives/Munitions Manufacturing Area Operable Unit
Crab Orchard National Wildlife Refuge

Photograph 1	COC-3 - Long-term monitoring at the COC-3, looking across the landfill towards MW-06.
Photograph 2	COC-3 - Long-term groundwater monitoring at MW-06.
Photograph 3	COC-3 – Looking across landfill cap from MW-03.
Photograph 4	COC-3 – Setting up for monitoring at MW-07.
Photograph 5	COC-3 – Setting up for monitoring at MW-08.
Photograph 6	COP-4 – Jeff Keenum of BAT Associates, Inc. taking a depth measurement at MW-09, newly installed well.
Photograph 7	COP-4 – Getting set up at MW-08A and MW-08B.
Photograph 8	COP-4 –From MW-08A looking across cap at BAT Associates, Inc personnel taking depth measurements at MW-07A and MW-07B.
Photograph 9	COP-4 – Finishing Groundwater monitoring at MW-05A.

Photograph 1 COC-3 - Long-term monitoring at the COC-3, looking across the landfill towards MW-06.

Photograph 2 COC-3 - Long-term groundwater monitoring at MW-06.

Photograph 3 COC-3 – Looking across landfill cap from MW-03.

Photograph 4 COC-3 – Setting up for monitoring at MW-07.

Photograph 5 COC-3 – Setting up for monitoring at MW-08.

Photograph 6 COP-4 – Jeff Keenum of BAT Associates, Inc. taking a depth measurement at MW-09, newly installed well.

Photograph 7 COP-4 – Getting set up at MW-08A and MW-08B.

Photograph 8 COP-4 –From MW-08A looking across cap at BAT Associates, Inc personnel taking depth measurements at MW-07A and MW-07B.

Photograph 9 COP-4 – Finishing Groundwater monitoring at MW-05A.

C FORMS

Five Year Review
For
Explosives/Munitions Manufacturing Area Operable Unit
Crab Orchard National Wildlife Refuge

1	Five-Year Review Site Inspection Attendees
2	Site Inspection Checklist
3	Cover Inspection Forms, COC-3 and COP-4
4	Summary of Groundwater Results BAT Associates, Inc – (May 2001 – May 2006)
5	Soil Boring Log/Monitoring Well Diagrams
6	RIMS, FUDS, Project Fact Sheet, HNC Revision: 13 April 2006
7	Risk Assessment Procedures for the Military Munitions Response Projects – 10 May 2006
8	Content Checklist for Five-Year Review Reports

Crab Orchard National Wildlife Refuge
Five Year Review - Site Inspection
EMMA Operable Unit
January 19, 2006

Name	Affiliation	Signature
Nan Gowda	U.S. EPA	
Paul Lake	IL EPA	
Dennis Pinigis	U.S. FWS	
Leanne Moore	U.S. FWS	
Frank Horvath	U.S. FWS	
Chuck Beasley	U.S. FWS	
Karen Rabek	U.S. ACOE	

Five-Year Review Site Inspection Attendees

Site Inspection Checklist

I. SITE INFORMATION	
Site name: *Crab Orchard National Wildlife Refuge*	**Date of inspection:** *19 January 2006*
Location and Region: *Marion, IL*	**EPA ID:** ***IL8143609487***
Agency, office, or company leading the five-year review: *USACE, Louisville District*	**Weather/temperature:** *Clear, Sunny, Cool temperatures, 40's*

Remedy Includes: (Check all that apply)

_ Landfill cover/containment
_ Access controls
X_ Institutional controls
_ Groundwater pump and treatment
_ Surface water collection and treatment
_ Other
X_ Monitored natural attenuation
_ Groundwater containment
_ Vertical barrier walls

Attachments: _ Inspection team roster attached _ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** *Dennis Pinigis* (Name) *CERCLA Program Manager* (Title) *19 January 2006* (Date)
   Interviewed X_ at site _ at office _ by phone Phone no. *(618 998-5912*
   Problems, suggestions; _ Report attached _____

2. **O&M staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed _ at site _ at office _ by phone Phone no. _____
   Problems, suggestions; _ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency *IEPA*
Contact *Paul Lake* *Remediation Project Manager* *01/19/06* *(217) 785-7728*
Name Title Date Phone no.
Problems; suggestions; _ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; _ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; _ Report attached _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; _ Report attached _____

4. **Other interviews** (optional) _ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   _ O&M manual _ Readily available _ Up to date _ N/A
   _ As-built drawings _ Readily available _ Up to date _ N/A
   _ Maintenance logs _ Readily available _ Up to date _ N/A
   Remarks_____

2. **Site-Specific Health and Safety Plan** X_ Readily available _ Up to date _ N/A
   _ Contingency plan/emergency response plan _ Readily available _ Up to date _ N/A
   Remarks_____

3. **O&M and OSHA Training Records** _ Readily available _ Up to date _ N/A
   Remarks_____

4. **Permits and Service Agreements**
   _ Air discharge permit _ Readily available _ Up to date _ N/A
   _ Effluent discharge _ Readily available _ Up to date _ N/A
   _ Waste disposal, POTW _ Readily available _ Up to date _ N/A
   _ Other permits_____ _ Readily available _ Up to date _ N/A
   Remarks_____

5. **Gas Generation Records** _ Readily available _ Up to date _ N/A
   Remarks_____

6. **Settlement Monument Records** _ Readily available _ Up to date _ N/A
   Remarks_____

7. **Groundwater Monitoring Records** *X*_ Readily available _ Up to date _ N/A
   Remarks__*Groundwater Monitoring Reports available upon request.*_____

8. **Leachate Extraction Records** _ Readily available _ Up to date _ N/A
   Remarks_____

9. **Discharge Compliance Records**
   _ Air _ Readily available _ Up to date _ N/A
   _ Water (effluent) _ Readily available _ Up to date _ N/A
   Remarks_____

10. **Daily Access/Security Logs** _ Readily available _ Up to date _ N/A
    Remarks_____

IV. O&M COSTS

1. **O&M Organization**

_ State in-house _ Contractor for State
_ PRP in-house _ Contractor for PRP
_ Federal Facility in-house _ Contractor for Federal Facility
_ Other_____

2. **O&M Cost Records**

_ Readily available _ Up to date
_ Funding mechanism/agreement in place
Original O&M cost estimate_____ _ Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ _ Breakdown attached
Date Date Total cost
From_____ To_____ _____ _ Breakdown attached
Date Date Total cost
From_____ To_____ _____ _ Breakdown attached
Date Date Total cost
From_____ To_____ _____ _ Breakdown attached
Date Date Total cost
From_____ To_____ _____ _ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS *X*_ Applicable _ N/A

A. Fencing

1. **Fencing damaged** _ Location shown on site map _ Gates secured *X*_ N/A

Remarks_____

B. Other Access Restrictions

1. **Signs and other security measures** _ Location shown on site map _ N/A

Remarks *Deed Restrictions –No Digging. No use of groundwater.*

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented _ Yes X_ No _ N/A
Site conditions imply ICs not being fully enforced _ Yes X_ No _ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _____
Frequency _____
Responsible party/agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up-to-date _ Yes _ No _ N/A
Reports are verified by the lead agency _ Yes _ No _ N/A

Specific requirements in deed or decision documents have been met _ Yes _ No _ N/A
Violations have been reported _ Yes _ No _ N/A
Other problems or suggestions: _ Report attached

_____
_____
_____
_____

2. **Adequacy** X_ ICs are adequate _ ICs are inadequate _ N/A
Remarks_____
_____
_____

D. General

1. **Vandalism/trespassing** _ Location shown on site map X_ No vandalism evident
Remarks_____
_____

2. **Land use changes on site** X_ N/A
Remarks_____
_____

3. **Land use changes off site** X_ N/A
Remarks_____
_____

VI. GENERAL SITE CONDITIONS

A. Roads X_ Applicable _ N/A

1. **Roads damaged** _ Location shown on site map X_ Roads adequate _ N/A
Remarks_____
_____

B. Other Site Conditions

Remarks _____

_____

_____

_____

_____

_____

VII. LANDFILL COVERS X_ Applicable _ N/A

A. *Landfill Surface*

1. **Settlement** (Low spots) _ Location shown on site map X_ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Cracks** _ Location shown on site map X_ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____
   _____

3. **Erosion** _ Location shown on site map X_ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** _ Location shown on site map X_ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

5. **Vegetative Cover** X_ Grass X_ Cover properly established X_ No signs of stress
   _ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____
   _____

6. **Alternative Cover (armored rock, concrete, etc.)** **X**_ N/A
   Remarks_____
   _____

7. **Bulges** _ Location shown on site map X_ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

8. **Wet Areas/Water Damage** X_ Wet areas/water damage not evident
_ Wet areas _ Location shown on site map Areal extent_____
_ Ponding _ Location shown on site map Areal extent_____
_ Seeps _ Location shown on site map Areal extent_____
_ Soft subgrade _ Location shown on site map Areal extent_____
Remarks_____

9. **Slope Instability** _ Slides _ Location shown on site map X _ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches _ Applicable X_ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** _ Location shown on site map _ N/A or okay
Remarks_____

2. **Bench Breached** _ Location shown on site map _ N/A or okay
Remarks_____

3. **Bench Overtopped** _ Location shown on site map _ N/A or okay
Remarks_____

C. Letdown Channels _ Applicable X_ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** _ Location shown on site map _ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** _ Location shown on site map _ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** _ Location shown on site map _ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** _ Location shown on site map _ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ _ No obstructions
_ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
_ No evidence of excessive growth
_ Vegetation in channels does not obstruct flow
_ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations _ Applicable X_ N/A

1. **Gas Vents** _ Active _ Passive
_ Properly secured/locked _ Functioning _ Routinely sampled _ Good condition
_ Evidence of leakage at penetration _ Needs Maintenance
_ N/A
Remarks_____

2. **Gas Monitoring Probes**
_ Properly secured/locked _ Functioning _ Routinely sampled _ Good condition
_ Evidence of leakage at penetration _ Needs Maintenance _ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
_ Properly secured/locked _ Functioning _ Routinely sampled _ Good condition
_ Evidence of leakage at penetration _ Needs Maintenance _ N/A
Remarks_____

4. **Leachate Extraction Wells**
_ Properly secured/locked _ Functioning _ Routinely sampled _ Good condition
_ Evidence of leakage at penetration _ Needs Maintenance _ N/A
Remarks_____

5. **Settlement Monuments** _ Located _ Routinely surveyed _ N/A
Remarks_____

E. Gas Collection and Treatment _ Applicable X_ N/A

1. **Gas Treatment Facilities**
   _ Flaring _ Thermal destruction _ Collection for reuse
   _ Good condition _ Needs Maintenance
   Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
   _ Good condition _ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   _ Good condition _ Needs Maintenance _ N/A
   Remarks_____

F. Cover Drainage Layer X_ Applicable _ N/A

1. **Outlet Pipes Inspected** X_ Functioning _ N/A
   Remarks_____

2. **Outlet Rock Inspected** X_ Functioning _ N/A
   Remarks_____

G. Detention/Sedimentation Ponds X_ Applicable _ N/A

1. **Siltation** Areal extent_____ Depth_____ _ N/A
   X_ Siltation not evident
   Remarks_____

2. **Erosion** Areal extent_____ Depth_____
   X_ Erosion not evident
   Remarks_____

3. **Outlet Works** X_ Functioning _ N/A
   Remarks_____

4. **Dam** _ Functioning X_ N/A
   Remarks_____

H. Retaining Walls _ Applicable X_ N/A

1. **Deformations** _ Location shown on site map _ Deformation not evident
   Horizontal displacement_____ Vertical displacement_____
   Rotational displacement_____
   Remarks_____

2. **Degradation** _ Location shown on site map _ Degradation not evident
   Remarks_____

I. Perimeter Ditches/Off-Site Discharge _ Applicable X_ N/A

1. **Siltation** _ Location shown on site map _ Siltation not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Vegetative Growth** _ Location shown on site map _ N/A
   _ Vegetation does not impede flow
   Areal extent_____ Type_____
   Remarks_____

3. **Erosion** _ Location shown on site map _ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Discharge Structure** _ Functioning _ N/A
   Remarks_____

VIII. VERTICAL BARRIER WALLS _ Applicable *X*_ N/A

1. **Settlement** _ Location shown on site map _ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Performance Monitoring** Type of monitoring_____
   _ Performance not monitored
   Frequency_____ _ Evidence of breaching
   Head differential_____
   Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES X_Applicable _N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines X_Applicable _N/A

1. **Pumps, Wellhead Plumbing, and Electrical**

X_Good condition _All required wells located _Needs O&M _N/A

Remarks_____

_____

_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

X_Good condition _ Needs O&M

Remarks_____

3. **Spare Parts and Equipment**

X_Readily available _Good condition _Requires upgrade _Needs to be provided

B. Surface Water Collection Structures, Pumps, and Pipelines _Applicable X_N/A

1. **Collection Structures, Pumps and Electrical**

_Good condition _Needs O&M

Remarks _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

_Good condition _Needs O&M

Remarks_____

3. **Spare Parts and Equipment**

_Readily available _Good condition _Requires upgrade _Needs to be provided

Remarks_____

C. Treatment System _ Applicable X_ N/A

1. **Treatment Train** (Check components that apply)

_ Metals removal _ Oil/water separation _ Bioremediation
_ Air stripping _ Carbon adsorbers
_ Filters_____
_ Additive (*e.g.*, chelation agent, flocculent)_____
_ Others_____
_ Good condition _ Needs Maintenance
_ Sampling ports properly marked and functional
_ Sampling/maintenance log displayed and up to date
_ Equipment properly identified
_ Quantity of groundwater treated annually_____
_ Quantity of surface water treated annually_____
Remarks_____

_____

2. **Electrical Enclosures and Panels** (properly rated and functional)

_ N/A _ Good condition _ Needs Maintenance
Remarks_____

_____

3. **Tanks, Vaults, Storage Vessels**
_ N/A _ Good condition _ Proper secondary containment _ Needs Maintenance
Remarks_____

4. **Discharge Structure and Appurtenances**
_ N/A _ Good condition _ Needs Maintenance
Remarks_____

5. **Treatment Building(s)**
_ N/A _ Good condition (esp. roof and doorways) _ Needs repair
_ Chemicals and equipment properly stored
Remarks_____

6. **Monitoring Wells** (pump and treatment remedy)
_ Properly secured/locked _ Functioning _ Routinely sampled _ Good condition
_ All required wells located _ Needs Maintenance _ N/A
Remarks_____

D. Monitoring Data

1. Monitoring Data
X_ Is routinely submitted on time X_ Is of acceptable quality

2. Monitoring data suggests: *Three new wells added to define plume; further monitoring needed*
_ Groundwater plume is effectively contained _ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
X_ Properly secured/locked X_ Functioning X_ Routinely sampled X_ Good condition
X_ All required wells located _ Needs Maintenance _ N/A
Remarks_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and as emission, etc.).

Groundwater has been monitored quarterly from May 2001 through February 2002. Annual monitoring began in February 2003. Semi-nnual monitoring began in October 2003. The last monitoring occurred in May 2006..

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Current remedies protective of both human health and the environment.

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

N/A

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Three new wells were installed in April 2006; 2 at

Cover Inspection Form
EMMA-OU
Crab Orchard National Wildlife Refuge
Marion, IL

Date of Inspection: *16 May 2006*
Inspector: *Karen Rabek, USACE*
Site Inspected: COC-3

Check Cover	Observation Made:
Major storm event occurred (1 inch in 2 hours)?	*Walked circumference and through the center of*
Not aware of any	*the cover. No signs of erosion. Thick grass.*
Erosion observed on cover? *No*	
Rills greater than 6 inches? *No*	
Condition of vegetation? *Thick and Healthy*	
Reseeding necessary? *No*	
Any repairs required? *No*	
Other?	
Inspect Storm Water System:	Observations Made:
Photos attached.	*Appears to be in good shape; No obvious problems.*

Site COC-3 - Looking across cover towards MW-06.

Site COC-3 - Looking across cover from MW-03.

Cover Inspection Form
EMMA-OU
Crab Orchard National Wildlife Refuge
Marion, IL

Date of Inspection: *17 May 2006*
Inspector: *Karen Rabek, USACE*
Site Inspected: COP-4

Check Cover	Observation Made:
Major storm event occurred (1 inch in 2 hours)?	*Walked circumference and through center.*
Not aware of any.	*No signs of cracks, erosion, or settlement.*
	Thick healthy grass.
Erosion observed on cover? *No*	
Rills greater than 6 inches? *No*	
Condition of vegetation? *Thick and healthy.*	
Reseeding necessary? *No*	
Any repairs required? *No*	
Other?	
Inspect Storm Water System:	Observation Made:
	No apparent problems.
	See attached photo.

Site COP-4 –From MW-08A looking across cover at BAT Associates, Inc personnel taking depth measurements at MW-07A and MW-07B.

RESTORATION INFORMATION MANAGEMENT SYSTEM
FORMERLY USED DEFENSE SITES (FUDS)
PROJECT FACT SHEET
AUGUST 1993
HNC Revision: 13 April 2006

1. **SITE NAME:** Illinois Ordnance Plant

SITE NUMBER: E05IL000200

LOCATION: City: Carbondale
Counties: Williamson
State: Illinois

PROJECT NUMBER: E05IL000203

CATEGORY: MMRP

INPR RAC: 2

ASR RAC: 2

TAG RAC:

2. **POC'S:**

GEOGRAPHIC DISTRICT:
Name: Gary Chisholm
Office: CELRL-PM-P
Phone: 502-315-6793

GEOGRAPHIC DIVISION:
Name: Patty Bertsch
Office: CELRD-MT-M
Phone: 513-684-6248

HEADQUARTERS:
Name: Dale Moeller
Office: CEMP-RF
Phone: 202-761-4649

ASR/INPR TEAM:
Name: Bradford McCowan
Office: CEHNC-OE-CX
Phone: 256-895-1174

ASR SUPPORT DISTRICT:
Name: Jodi Bausman
Office: CEMVR-ED-DO
Phone: 309-794-5504

ASR TECHNICAL REVIEWER:
Name: Ron Thornhill
Office: SJMAC-ESM
Phone: 918-420-8395

3. **SITE DESCRIPTION:**

a. The Illinois Ordnance Plant property consisted 22,481.9 acres, located in Williamson County, IL, approximately 5 miles west of the town of Marion.

b. The Army used the property as an ordnance plant to load, assemble, pack and store explosive munitions during the World War II period, which consisted of loading lines, burning and demolition grounds, ordnance storage, and other buildings and land.

c. The site visit team found landmines and landmine fuze debris during the site visit.

4. **SITE HISTORY:**

a. The Army acquired the property on 01 August 1941.

b. There is documented and physical evidence of MEC associated with the property.

c. A Certificate of Clearance was issued for this property on 06 August 1948. There was one instance where EOD came and blew a landmine that high ordered in place (interview, EOD report not provided). During a fire, there was a detonation in Area 8 on 13 April 1975.

d. There is no evidence of chemical warfare training, storage or disposal activities associated with the FUDS property.

e. The Army disposed of the property on 05 August 1947.

5. **PROJECT DESCRIPTION:**

Area A

Size:	3,087.1 acres (approximately)
Former Use:	Production/Load Line (Area 2, 8, 9, 11 & 12)
Present Use:	National Wildlife Refuge
Possible End Use:	Same
MEC Presence:	
Confirmed:	HE Landmines, Propellant, Detonators, Boosters, Bursters, Bulk Secondary Explosives (TNT)
Potential:	HE Bombs and HE Projectiles
ASR Recommends:	RAC 2
HNC Safety:	RAC NA (1)

Area B

Size:	2,638.7 acres (approximately)
Former Use:	Ammunition Storage (Area 3, 6, 10, & 13)
Present Use:	National Wildlife Refuge
Possible End Use:	Same
MEC Presence:	
Confirmed:	HE Landmines, Propellant, Detonators, Boosters, Bursters, Bulk Secondary Explosives (TNT)
Potential:	HE Bombs and HE Projectiles
ASR Recommends:	RAC 2
HNC Safety:	RAC NA (1)

Area C

Size:	421 acres (approximately)
Former Use:	Classification Yard
Present Use:	Agricultural
Possible End Use:	Same
MEC Presence:	
Confirmed:	None
Potential:	Detonators, Boosters, Bursters, Bulk Secondary Explosives (TNT)
ASR Recommends:	RAC 2
HNC Safety:	RAC NA (5)

Area D

Size:	421.7 acres (approximately)
Former Use:	Burning/Demolition Area
Present Use:	National Wildlife Refuge
Possible End Use:	Same
MEC Presence:	
Confirmed:	HE Landmines, Propellant, Detonators, Boosters, Bursters
Potential:	HE Bombs and HE Projectiles, Bulk Secondary Explosives (TNT)
ASR Recommends:	RAC 2
HNC Safety:	RAC NA (1)

Area E

Size:	244 acres (approximately)
Former Use:	Burial Site
Present Use:	National Wildlife Refuge
Possible End Use:	Same
MEC Presence:	
Confirmed:	None
Potential:	HE Landmines, Propellant, Detonators, Boosters, Bursters, Bulk Secondary Explosives (TNT), HE Bombs and HE Projectiles
ASR Recommends:	RAC 2
HNC Safety:	RAC NA (1)

Area F

Size:	15,669.4 acres (approximately)
Former Use:	All Remaining Lands
Present Use:	National Wildlife Refuge/Prison/ Agriculture
Possible End Use:	Same
MEC Presence:	
Confirmed:	None
Potential:	Same
ASR Recommends:	RAC 5
HNC Safety:	RAC NA (5)

6. **CURRENT STATUS:**

The U.S. Army Corps of Engineers, Rock Island District, completed the Archives Search Report for Illinois Ordnance Plant in August 1993.

7. **STRATEGY:**

RI/FS	Areas A, B, D and E
NDAI	Areas C & F

8. **ISSUES AND CONCERNS:**

a. There is a difference between ASR and FDE acreage. ASR determined the Army acquired 262.1 acres more than was addressed in the FDE.

b. There was a fire on 13 April 1975, which included an explosion that injured two personnel. Investigations by the U.S. Army Armament Command (ARMCOM) indicated that various locations within the area contained explosives and propellant. Documentation indicates there was

decontamination conducted. The question arises whether the explosives were a result of the War Department or Industrial Tenants (page 10).

c. Document E-4 indicates there were concerns of MEC presence at 10 suspect burial and/or burning sites (located in the Hampton Cemetery area) and four holding ponds (located near production areas 11 and 12).

d. In Appendix F-14, it indicates a company wanting to lease buildings III-1-13, F-2-1 and F-2-2 requested the buildings be decontaminated (January 1950). Further, after leasing building III-1-1, III-1-2 and III-1-3 a ramp was blocked between buildings due to contamination. These building were building included in the 1949 clearance report.

e. Numerous rejected HE loaded bombs, projectiles and anti-tank land mines accumulated. No disposition was indicated for these waste items. In June 1943, 69,055 pounds of TNT scrap had accumulated with no disposition identified (Appendix F-14)

f. According to the DERP Site Survey report prepared in 1984, the Army also fenced off several ½ to 2 acre areas near the Hampton Cemetery in 1946 for the disposal of landmine parts.

g. There are known Federally-and State-listed species occurring in the site area. An on-site inspection by the appropriate federal and state personnel may be necessary to verify the presence, absence or location of listed species, or natural communities.

9. **SCHEDULE SUMMARY:**

Phase	Orig. Start	Sch. Start	Actual Start	Orig. Comp.	Sch. Comp.	Actual Comp.

10. **FUNDING/BUDGET SUMMARY:**

Year	Phase	EXEC FOA	IN House Required	Contract Required	Funds Obligated

U. S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS — PROJECT DERP FUDS **Illinois Ordnance Plant** **E05IL000203**

☐ ASR/INPR TEAM

REVIEW PA TAG MMRP
DATE 13 April 2006
NAME Ron Thornhill (918)420-8395

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
1.	General	Draft PA for Illinois Ordnance Plant, Williamson County, IL was reviewed for accuracy and completeness. Based on this review the following comments are provided:	
2.	General	There is a difference between ASR and FDE acreage. ASR determined the Army acquired 262.1 acres more than was addressed in the FDE.	
3.	General	There was a fire on 13 April 1975, which included an explosion that injured two personnel. Investigations by the U.S. Army Armament Command (ARMCOM) indicated that various locations within the area contained explosives and propellant. Documentation indicates there was decontamination conducted. The question arises whether the explosives were a result of the War Department or Industrial Tenants (page 10).	
4.	General	Document E-4 indicates there were concerns of MEC presence at 10 suspect burial and/or burning sites (located in the Hampton Cemetery area) and four holding ponds (located near production areas 11 and 12).	

U. S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE — CORPS OF ENGINEERS

DESIGN REVIEW COMMENTS — PROJECT DERP FUDS **Illinois Ordnance Plant E05IL000203**

☐ ASR/INPR TEAM — REVIEW PA TAG MMRP; DATE 13 April 2006; NAME Ron Thornhill (918)420-8395

ITEM	DRAWING NO. OR REFERENCE	COMMENT	ACTION
5.	General	In Appendix P-14, it indicates a company wanting to lease buildings III-1-13, F-2-1 and F-2-2 requested the buildings be decontaminated (January 1950). Further, after leasing building III-1-1, III-1-2 and III-1-3 a ramp was blocked between buildings due to contamination. These building were building included in the 1949 clearance report.	
6.	General	Numerous rejected HE loaded bombs, projectiles and anti-tank land mines accumulated. No disposition was indicated for these waste items. In June 1943, 69,055 pounds of TNT scrap had accumulated with no disposition identified (Appendix P-14)	
7.	General	According to the DERP Site Survey report prepared in 1984, the Army also fenced off several ½ to 2 acre areas near the Hampton Cemetery in 1946 for the disposal of landmine parts.	
8.	General	The reviewer disagrees with the previous ASR overall RAC score of 2. Recommend Areas A, B, D and E receive a RAC score of 1. Areas C and F receive a RAC score of 5. Overall RAC score of 1. Updated RAC Forms are included.	

RISK ASSESSMENT PROCEDURES FOR
MILITARY MUNITIONS RESPONSE PROJECTS

Property Name:	Illinois Ordnance Plant	Rater's Name:	Ron Thornhill
Property Location:	Williamson County, IL	Phone Number:	(918)420-8395
FUDS Property/Project #:	E05IL000203	District:	DAC
Property Type:	Ordnance Plant Areas A, B, D & E	Office Symbol:	SJMAC-ESM
Score:	1	Date Completed:	13 April 2006

RISK ASSESSMENT:

This risk assessment (RAC) procedure was developed to address explosives safety hazards related to munitions. This procedure does not address environmental hazards associated with munitions constituents. The U.S. Army Engineering and Support Center, Huntsville (USAESCH), Ordnance and Explosives Directorate (CEHNC-OE) developed this procedure in accordance with MIL-STD 882C and AR 385-10. The Risk Assessment Code (RAC) score will be used by the U.S. Army Corps of Engineers to prioritize the response action(s) at Formerly Used Defense Sites (FUDS). The risk assessment should be based on the best available information resulting from record searches, reports of Explosive Ordnance Disposal (EOD) actions, field observations (site visits), and interviews. This information is used to assess the risk involved based on the potential MMRP hazards identified for the project. The risk assessment evaluates two factors, hazard severity and hazard probability.

Part I - Hazard Severity. Hazard severity categories are defined to provide a qualitative measure of the worst credible event resulting from personnel exposure to various types and quantities of unexploded ordnance.

TYPE OF ORDNANCE: (Check all that apply)

A. Conventional ordnance and ammunition:	VALUE
Projectiles, explosive (20 millimeter and larger)	10☒
Bombs, explosive	10☒
Grenades, hand or rifle, explosive	10☐
Landmine, explosive	10☒
Rockets, guided missile, explosive	10☐
Other Explosive item not previously stated	10☐
Bomb, practice (w/spotting charge)	6☐
Detonators, blasting caps, fuses, boosters, bursters	6☒
Practice ordnance (w/ spotting charges, other than bombs)	4☐
Small arms, complete round (.50 cal or less)	1☐
Small arms, expended (.50 cal or less)	0☐
Practice ordnance (w/o spotting charges)	0☐
Conventional ordnance and ammunition (enter largest single value checked)	10

What evidence do you have regarding conventional unexploded ordnance? The site visit team found landmines and landmine fuze debris during the site visit. There are numerous other documentation that indicate a possible disposal of MEC by burial and/or burning throughout this area. These areas are considered to have a potential for MEC to remain on the property.

B. Pyrotechnics (for munitions not described above):

	VALUE
Munitions containing White Phosphorus (WP) or other pyrophoric material (i.e., spontaneously flammable)	10☐
Munitions containing a flame or incendiary material (i.e., Napalm, Triethylaluminum metal incendiaries)	10☐
Containers containing WP or other pyrophoric material or flame or incendiary material	6☐
Flares, signals, simulators, screening/burning smokes (other than WP)	4☐
Pyrotechnics (enter the single largest value checked)	0

What evidence do you have regarding pyrotechnics? None.

C. Bulk Explosives (HE) (not an integral part of conventional ordnance; un-containerized):

	VALUE
Primary or initiating explosives (Lead Styphnate, Lead Azide, Nitroglycerin, Mercury Azide, Mercury Fulminate, Tetracene, etc.)	10☒
Secondary explosives (Demolition charges, PETN, Compositions A, B, C, Tetryl, TNT, RDX, HMX, HBX, Black Powder, etc.)	8☒
Insensitive explosive substances (explosive contaminated soils, ammonium nitrate)	3☐
Bulk Explosives (HE) (enter the single largest value checked)	10

What evidence do you have regarding bulk explosives? There are numerous documents that indicate possible disposal of MEC by burial and/or burning throughout this area including primary and secondary explosives.

D. Bulk propellants (not an integral part of rockets, guided missiles, or other conventional ordnance; uncontainerized)

	VALUE
Solid or liquid propellants	6☒
Bulk Propellants (select 6 or 0)	6

What evidence do you have regarding bulk propellants? A fire caused an explosion injuring two people in 1975, which was later determined to contain propellant that was used in 8-inch, 120mm and 155mm projectile cartridges.

E. Recovered Chemical Warfare Materiel (RCWM), Weaponized Industrial Chemicals and Radiological Materiel:

	VALUE
Toxic chemical agents (H-Mustard, G-Nerve, V-Nerve and L-Lewisite)	25☐
Chemical Agent Identification Sets	20☐
Radiological Materiel (If rad waste is identified please call the HTRW–CX at 402-697-2555)	15☐
Weaponized Industrial Chemicals (Hydrogen Cyanide AC; Cyanogen Chloride, CK; Phosgene, CG)	10☐
Riot Control Agents (vomiting, tear)	5☐
Chemical and Radiological (enter the single largest value checked)	0

What evidence do you have regarding chemical or radiological? None.

TOTAL HAZARD SEVERITY VALUE (Sum of value A through E, maximum of 61) 26
Apply this value to Table 1 to determine Hazard Severity Category

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Property Name:
Project Number
Property Type

TABLE 1
HAZARD SEVERITY*

DESCRIPTION	CATEGORY	HAZARD SEVERITY VALUE
CATASTROPHIC	I ☒	21 and/or greater
CRITICAL	II ☐	10 to 20
MARGINAL	III ☐	5 to 9
NEGLIGIBLE	IV ☐	1 to 4
**NONE	V ☐	0

*Apply Hazard Severity Category to Table 3 and complete Part II of this form.
**If hazard severity value is 0, complete Part II of this form. Then proceed to Part III and use a RAC score of 5 to determine your appropriate action.

PART II - Hazard Probability. The probability that a hazard has been, or will be, created due to the presence and other rated factors of unexploded ordnance, explosives, incendiary, pyrotechnic, radiological, or RCWM materials on a formerly used Department of Defense (DOD) site.

AREA, EXTENT, ACCESSIBILITY OF MMRP HAZARD (Check all that apply)

A. Locations of MMRP hazards:

	VALUE
On the surface	5☒
Within tanks, pipes, vessels, or other confined areas	4☒
Inside walls, ceilings, or other building/structure	3☐
Subsurface	2☒
Location (enter the single largest value checked)	5

What evidence do you have regarding the location of MMRP? Debris from landmines were found on the surface during the site visit. Documentation also indicated buildings did not appear to be fully decontaminated.

Property Name:
Project Number:
Property Type:

B. Distance to nearest inhabited location/structure likely to be at risk from MMRP hazard (road, park, playground, building, etc.).

	VALUE
Less than 1,250 feet	5☐
1,250 feet to 0.5 mile	4☐
0.5 mile to 1.0 mile	3☒
1.0 mile to 2.0 Miles	2☐
Over 2 miles	1☐
Distance (enter the single largest value checked)	3

What are the nearest inhabited structures/buildings? There are industrial warehouses and agricultural buildings located within a mile of the plant.

C. Number(s) of building(s) within a 2-mile radius measured from the MMRP hazard area, not the installation boundary.

	VALUE
26 and over	5☒
16 to 25	4☐
11 to 16	3☐
6 to 10	2☐
1 to 5	1☐
0	0☐
Number of buildings (enter the single largest value checked)	5

Narrative: There are approximately 30 industrial warehouses and agricultural buildings located within a 2-mile radius of the plant.

D. Types of Buildings (within 2-mile radius)

	VALUE
Educational, childcare, residential, hospitals, hotels, commercial, shopping centers	5☐
Industrial, warehouse, etc.	4☒
Agricultural, forestry, etc.	3☐
Detention, correctional	2☐
No buildings	0☐
Types of buildings (enter the single largest value checked)	4

Describe the types of buildings: There are approximately 30 industrial warehouses and agricultural buildings.

E. Accessibility to site refers to access by humans to military munitions. Use the following guidance:

	VALUE
No barrier nor security system	5☐
Barrier is incomplete (e.g., in disrepair or does not completely surround the site). Barrier is intended to deny egress from the site, as for a barbed wire fence for grazing	4☒
A barrier (any kind of fence in good repair) but no separate means to control entry. Barrier is intended to deny access to the site.	3☐
Security Guard, but no barrier	2☐
A 24-hour surveillance system (e.g., television monitoring or surveillance by guards or facility personnel continuously monitors and controls entry; or, an artificial or natural barrier (e.g., fence combined with a cliff) which completely surrounds the area; and, a means to control entry at all times through the gates or other entrances (e.g., an attendant, television monitors, locked entrances, or controlled roadway access to the area).	0☐
Accessibility (enter the single largest value checked)	4

Describe the site accessibility: The site has fencing and some locked gates but no guard.

F. Site Dynamics. This deals with site conditions that are subject to change in the future, but may be stable at the present. Examples would be excessive soil erosion on beaches or streams, increasing land development that could reduce distances from the site to inhabited areas or otherwise increase accessibility.

	VALUE
Expected	5☒
Not anticipated	0☐
Site Dynamics (enter the single largest value checked)	5

Describe the site dynamics: Site dynamics expected to change.

TOTAL HAZARD PROBABILITY VALUE 26

(Sum of largest values for A through F (maximum of 30). Apply this value to Hazard Probability Table 2 to determine the Hazard Probability Level.

TABLE 2
HAZARD PROBABILITY*

DESCRIPTION VALUE	LEVEL	HAZARD PROBABILITY
FREQUENT	A☐	27 or greater
PROBABLE	B☒	21 to 26
OCCASIONAL	C☐	15 to 20
REMOTE	D☐	8 to 14
IMPROBABLE	E☐	less than 8

*Apply Hazard Probability Level to Table 3.

Part III - Risk Assessment. The risk assessment value for this site is determined using the following Table. Enter the results of the Hazard Probability and Hazard Severity values.

TABLE 3

PROBABILITY LEVEL		FREQUENT A	PROBABLE B	OCCASIONAL C	REMOTE D	IMPROBABLE E
SEVERITY CATEGORY:						
CATASTROPHIC	I	1 ☐	1 ☒	2 ☐	3 ☐	4 ☐
CRITICAL	II	1 ☐	2 ☐	3 ☐	4 ☐	4 ☐
MARGINAL	III	2 ☐	3 ☐	4 ☐	4 ☐	4 ☐
NEGLIGIBLE	IV	3 ☐	4 ☐	4 ☐	4 ☐	4 ☐

None (V) = RAC 5 ☐

RISK ASSESSMENT CODE (RAC)

RAC 1-4	Recommend and approve further action as appropriate. Refer to EP 1110-1-18 for discussion of MMRP projects and the process to be followed for execution of project response actions.
RAC 5	Usually indicates that No DOD Action Indicated (NDAI) is necessary. Recommend and approve NDAI and follow instructions for project closeout in accordance with current program guidance.

PART IV - Narrative. Summarize the documented evidence that supports this risk assessment. If no documented evidence was available, explain all the assumptions that you made.

The site visit team found landmines and landmine fuze debris during the site visit. There are numerous other documentation that indicate a possible disposal of MEC by burial and/or burning throughout this area. These areas are considered to have a potential for MEC to remain on the property. Additionally, a fire caused an explosion injuring two people in 1975, which was later determined to contain propellant that was used in 8-inch, 120mm and 155mm projectile cartridges. There is no evidence CWM training, storage or disposal on this property. Recommend a RAC score of 1.

Property Name:
Project Number:
Property Type:

RISK ASSESSMENT PROCEDURES FOR MILITARY MUNITIONS RESPONSE PROJECTS

Property Name:	Illinois Ordnance Plant	Rater's Name:	Ron Thornhill
Property Location:	Williamson County, IL	Phone Number:	(918)420-8395
FUDS Property/Project #:	E05IL000203	District:	DAC
Property Type:	Ordnance Plant Areas C & F	Office Symbol:	SJMAC-ESM
Score:	5	Date Completed:	13 April 2006

RISK ASSESSMENT:

This risk assessment (RAC) procedure was developed to address explosives safety hazards related to munitions. This procedure does not address environmental hazards associated with munitions constituents. The U.S. Army Engineering and Support Center, Huntsville (USAESCH), Ordnance and Explosives Directorate (CEHNC-OE) developed this procedure in accordance with MIL-STD 882C and AR 385-10. The Risk Assessment Code (RAC) score will be used by the U.S. Army Corps of Engineers to prioritize the response action(s) at Formerly Used Defense Sites (FUDS). The risk assessment should be based on the best available information resulting from record searches, reports of Explosive Ordnance Disposal (EOD) actions, field observations (site visits), and interviews. This information is used to assess the risk involved based on the potential MMRP hazards identified for the project. The risk assessment evaluates two factors, hazard severity and hazard probability.

Part I - Hazard Severity. Hazard severity categories are defined to provide a qualitative measure of the worst credible event resulting from personnel exposure to various types and quantities of unexploded ordnance.

TYPE OF ORDNANCE: (Check all that apply)

A. Conventional ordnance and ammunition:	VALUE
Projectiles, explosive (20 millimeter and larger)	10☐
Bombs, explosive	10☐
Grenades, hand or rifle, explosive	10☐
Landmine, explosive	10☐
Rockets, guided missile, explosive	10☐
Other Explosive item not previously stated	10☐
Bomb, practice (w/spotting charge)	6☐
Detonators, blasting caps, fuses, boosters, bursters	6☐
Practice ordnance (w/ spotting charges, other than bombs)	4☐
Small arms, complete round (.50 cal or less)	1☐
Small arms, expended (.50 cal or less)	0☐
Practice ordnance (w/o spotting charges)	0☐
Conventional ordnance and ammunition (enter largest single value checked)	0

What evidence do you have regarding conventional unexploded ordnance? None.

B. Pyrotechnics (for munitions not described above):

	VALUE
Munitions containing White Phosphorus (WP) or other pyrophoric material (i.e., spontaneously flammable)	10☐
Munitions containing a flame or incendiary material (i.e., Napalm, Triethylaluminum metal incendiaries)	10☐
Containers containing WP or other pyrophoric material or flame or incendiary material	6☐
Flares, signals, simulators, screening/burning smokes (other than WP)	4☐
Pyrotechnics (enter the single largest value checked)	0

What evidence do you have regarding pyrotechnics? None.

C. Bulk Explosives (HE) (not an integral part of conventional ordnance; un-containerized):

	VALUE
Primary or initiating explosives (Lead Styphnate, Lead Azide, Nitroglycerin, Mercury Azide, Mercury Fulminate, Tetracene, etc.)	10☐
Secondary explosives (Demolition charges, PETN, Compositions A, B, C, Tetryl, TNT, RDX, HMX, HBX, Black Powder, etc.)	8☐
Insensitive explosive substances (explosive contaminated soils, ammonium nitrate)	3☐
Bulk Explosives (HE) (enter the single largest value checked)	0

What evidence do you have regarding bulk explosives? None.

D. Bulk propellants (not an integral part of rockets, guided missiles, or other conventional ordnance; uncontainerized)

	VALUE
Solid or liquid propellants	6☐
Bulk Propellants (select 6 or 0)	0

What evidence do you have regarding bulk propellants? None.

E. Recovered Chemical Warfare Materiel (RCWM), Weaponized Industrial Chemicals and Radiological Materiel:

	VALUE
Toxic chemical agents (H-Mustard, G-Nerve, V-Nerve and L-Lewisite)	25☐
Chemical Agent Identification Sets	20☐
Radiological Materiel (If rad waste is identified please call the HTRW–CX at 402-697-2555)	15☐
Weaponized Industrial Chemicals (Hydrogen Cyanide AC; Cyanogen Chloride, CK; Phosgene, CG)	10☐
Riot Control Agents (vomiting, tear)	5☐
Chemical and Radiological (enter the single largest value checked)	0

What evidence do you have regarding chemical or radiological? None.

TOTAL HAZARD SEVERITY VALUE (Sum of value A through E, maximum of 61) 0
Apply this value to Table 1 to determine Hazard Severity Category

---

Property Name:
Project Number:
Property Type:

TABLE 1
HAZARD SEVERITY*

DESCRIPTION	CATEGORY	HAZARD SEVERITY VALUE
CATASTROPHIC	I ☐	21 and/or greater
CRITICAL	II ☐	10 to 20
MARGINAL	III ☐	5 to 9
NEGLIGIBLE	IV ☐	1 to 4
**NONE	V ☒	0

*Apply Hazard Severity Category to Table 3 and complete Part II of this form.
**If hazard severity value is 0, complete Part II of this form. Then proceed to Part III and use a RAC score of 5 to determine your appropriate action.

PART II - Hazard Probability. The probability that a hazard has been, or will be, created due to the presence and other rated factors of unexploded ordnance, explosives, incendiary, pyrotechnic, radiological, or RCWM materials on a formerly used Department of Defense (DOD) site.

AREA, EXTENT, ACCESSIBILITY OF MMRP HAZARD (Check all that apply)

A. Locations of MMRP hazards:

	VALUE
On the surface	5☐
Within tanks, pipes, vessels, or other confined areas	4☐
Inside walls, ceilings, or other building/structure	3☐
Subsurface	2☐
Location (enter the single largest value checked)	0

What evidence do you have regarding the location of MMRP? None.

Property Name:
Project Number:
Property Type:

B. Distance to nearest inhabited location/structure likely to be at risk from MMRP hazard (road, park, playground, building, etc.).

	VALUE
Less than 1,250 feet	5☐
1,250 feet to 0.5 mile	4☐
0.5 mile to 1.0 mile	3☒
1.0 mile to 2.0 Miles	2☐
Over 2 miles	1☐
Distance (enter the single largest value checked)	3

What are the nearest inhabited structures/buildings? There are industrial warehouses and agricultural buildings located within a mile of the plant.

C. Number(s) of building(s) within a 2-mile radius measured from the MMRP hazard area, not the installation boundary.

	VALUE
26 and over	5☒
16 to 25	4☐
11 to 16	3☐
6 to 10	2☐
1 to 5	1☐
0	0☐
Number of buildings (enter the single largest value checked)	5

Narrative: There are approximately 30 industrial warehouses and agricultural buildings located within a 2-mile radius of the plant.

D. Types of Buildings (within 2-mile radius)

	VALUE
Educational, childcare, residential, hospitals, hotels, commercial, shopping centers	5☐
Industrial, warehouse, etc.	4☒
Agricultural, forestry, etc.	3☐
Detention, correctional	2☐
No buildings	0☐
Types of buildings (enter the single largest value checked)	4

Describe the types of buildings: There are approximately 30 industrial warehouses and agricultural buildings.

E. Accessibility to site refers to access by humans to military munitions. Use the following guidance:

	VALUE
No barrier nor security system	5☐
Barrier is incomplete (e.g., in disrepair or does not completely surround the site). Barrier is intended to deny egress from the site, as for a barbed wire fence for grazing	4☒
A barrier (any kind of fence in good repair) but no separate means to control entry. Barrier is intended to deny access to the site.	3☐
Security Guard, but no barrier	2☐
A 24-hour surveillance system (e.g., television monitoring or surveillance by guards or facility personnel continuously monitors and controls entry; or, an artificial or natural barrier (e.g., fence combined with a cliff) which completely surrounds the area; and, a means to control entry at all times through the gates or other entrances (e.g., an attendant, television monitors, locked entrances, or controlled roadway access to the area).	0☐
Accessibility (enter the single largest value checked)	4

Describe the site accessibility: The site has fencing and some locked gates but no guard.

F. Site Dynamics. This deals with site conditions that are subject to change in the future, but may be stable at the present. Examples would be excessive soil erosion on beaches or streams, increasing land development that could reduce distances from the site to inhabited areas or otherwise increase accessibility.

	VALUE
Expected	5☒
Not anticipated	0☐
Site Dynamics (enter the single largest value checked)	5

Describe the site dynamics: Site dynamics expected to change.

TOTAL HAZARD PROBABILITY VALUE 21
(Sum of largest values for A through F (maximum of 30). Apply this value to Hazard Probability Table 2 to determine the Hazard Probability Level.

TABLE 2
HAZARD PROBABILITY*

DESCRIPTION VALUE	LEVEL	HAZARD PROBABILITY
FREQUENT	A☐	27 or greater
PROBABLE	B☒	21 to 26
OCCASIONAL	C☐	15 to 20
REMOTE	D☐	8 to 14
IMPROBABLE	E☐	less than 8

*Apply Hazard Probability Level to Table 3.

Part III - Risk Assessment. The risk assessment value for this site is determined using the following Table. Enter the results of the Hazard Probability and Hazard Severity values.

TABLE 3

PROBABILITY LEVEL		FREQUENT A	PROBABLE B	OCCASIONAL C	REMOTE D	IMPROBABLE E
SEVERITY CATEGORY:						
CATASTROPHIC	I	1 ☐	1 ☐	2 ☐	3 ☐	4 ☐
CRITICAL	II	1 ☐	2 ☐	3 ☐	4 ☐	4 ☐
MARGINAL	III	2 ☐	3 ☐	4 ☐	4 ☐	4 ☐
NEGLIGIBLE	IV	3 ☐	4 ☐	4 ☐	4 ☐	4 ☐

None (V) = RAC 5 ☒

RISK ASSESSMENT CODE (RAC)

RAC 1-4	Recommend and approve further action as appropriate. Refer to EP 1110-1-18 for discussion of MMRP projects and the process to be followed for execution of project response actions.
RAC 5	Usually indicates that No DOD Action Indicated (NDAI) is necessary. Recommend and approve NDAI and follow instructions for project closeout in accordance with current program guidance.

PART IV - Narrative. Summarize the documented evidence that supports this risk assessment. If no documented evidence was available, explain all the assumptions that you made.
The site visit team did not find MEC or MPPEH Debris in these areas. There is no evidence CWM training, storage or disposal on this property. Recommend a RAC score of 5.

Property Name:
Project Number:
Property Type:

Content Checklist For Five-Year Review Reports

This checklist may be used by you, your managers, etc., to verify that you have included all of the appropriate information in your Five-Year Review report. Depending on site-specific circumstances, some items may not be applicable. For example, a report for a site just beginning construction will generally contain less data than for a site that has reached construction completion.

General Report Format

- Signed concurrence memorandum (as appropriate)
- Title page with signature and date
- Completed five-year review summary form (page E-15)
- List of documents reviewed
- Site maps (as appropriate)
- List of tables and figures
- Interview report (as appropriate)
- Site inspection checklist
- Photos documenting site conditions (as appropriate)

Introduction

- The purpose of the five-year review
- Authority for conducting the five-year review
- Who conducted the five-year review (lead agency) and when
  - Organizations providing analyses in support of the review (*e.g.*, the contractor supporting the lead agency)
  - Other review participants or support agencies
- Review number (*e.g.*, first, second)
- Trigger action and date
- Number, description, and status of all operable units at the site
- If review covers only part of a site, explain approach
  - Define which areas are covered in the five-year review
  - Summarize the status of other areas of the site that are not covered in the present five-year

Site Chronology

List all important site events and relevant dates (*e.g.*, date of initial discovery of problem, dates of pre-NPL responses, date of NPL listing, etc.)

Background

- General site description (*e.g.*, size, topography, and geology)
- Former, current, and future land use(s) of the site and surrounding areas
- History of contamination
- Initial response (*e.g.*, removals)
- Basis for taking remedial action (*e.g.*, contaminants)

Remedial Actions

- Regulatory actions (*e.g.*, date and description of Records of Decision, Explanations of Significant Difference, Administrative Orders on Consent, Consent Decrees and Action Memorandum)
- Remedial action objectives
- Remedy description
- Remedy implementation (*e.g.*, status, history, enforcement actions, performance)
- Systems operations/Operations & Maintenance
  - Systems operations/O&M requirements
  - Systems operations/O&M operational summary (*e.g.*, history, modifications, problems, and successes)
  - Summary of costs of system operations/O&M effectiveness (*i.e.*, are requirements being met and are activities effective in maintaining the remedy?)

Progress Since Last Five-Year Review (if applicable)

- Protectiveness statements from last review
- Status of recommendations and follow-up actions from last review
- Results of implemented actions, including whether they achieved the intended effect
- Status of any other prior issues

Five-Year Review Process

1. Administrative Components
   - Notification of potentially interested parties of initiation of review process
   - Identification of five-year review team members (as appropriate)
   - Outline of components and schedule of your five-year review
2. Community Involvement
   - Community notification (prior and post review)
   - Other community involvement activities (*e.g.*, notices, fact sheets, etc., as appropriate)
3. Document review
4. Data review
5. Site inspection
   - Inspection date
   - Inspection participants

Five-Year Review Process, cont'd.

- Site inspection scope and procedures
- Site inspection results, conclusions
- Inspection checklist

6. Interviews
   - Interview date(s) and location(s)
   - Interview participants (name, title, etc.)
   - Interview documentation
   - Interview summary

Technical Assessment

Answer Question A: Is the remedy functioning as intended by the decision documents?

- remedial action performance (*i.e.*, is the remedy operating as designed?)
- system operations/O&M
- cost of system operations/O&M
- opportunities for optimization
- early indicators of potential issues
- implementation of institutional controls and other measures

Answer Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

- changes in standards, newly promulgated standards, TBCs
- expected progress towards meeting RAOs
- changes in exposure pathways
- changes in land use
- new contaminants and/or contaminant sources
- remedy byproducts
- changes in toxicity and other contaminant characteristics
- risk recalculation/assessment (as applicable)

Answer Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

- new or previously unidentified ecological risks
- natural disaster impacts
- any other information that could call into question the protectiveness of the remedy

Technical Assessment Summary

Issues

Issues identified during the technical assessment and other five-year review activities

- Determination of whether issues affect current or future protectiveness

Issues, cont'd.

- A discussion of unresolved issues raised by support agencies and the community (States, Tribes, other Federal agencies, local governments, citizens, PRPs, other interested parties), if applicable

Recommendations and Follow-up Actions

- Required/suggested improvements to identified issues or to current site operations
- Note parties responsible for actions
- Note agency with oversight authority
- Schedule for completion of actions related to resolution of issues

Protectiveness Statements

- Protective statement(s) for each OU (If the remedy is not protective of human health and/or the environment, have you provided supporting discussion and information in the report to make this determination, such as current threats or level of risk?)
- Comprehensive protectiveness statement covering all of the remedies at the site (if applicable)

Next Review

Expected date of next review

If five-year reviews will no longer be done, provide a summary of that portion of the technical analysis presented in the report that provides the rationale for discontinuation of five-year reviews.