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NSWC CRANE
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FINAL

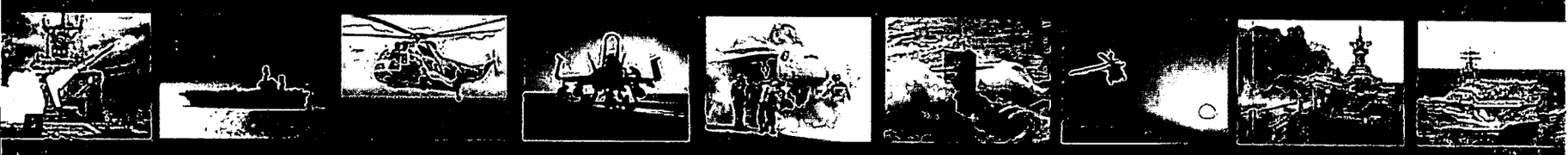
Water Area Munitions Study

Conservation Dam No. 2845

Naval Surface Warfare Center Crane Division, Indiana

April 2005

MALCOLM PIRNIE



DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE, INDIANA 47522-5001

IN REPLY REFER TO:
5090/S4.7
Ser PRCR4/7210
21 JUN 2007

Indiana Department Of Environmental Management
Office Of Land Quality
Hazardous Waste Permits
Attn: Mr. Doug Griffin
Mail Code 64-45 IGCN 1101
100 North Senate Ave.
Indianapolis, IN 46204-2251

Dear Mr. Griffin:

Crane Division, Naval Surface Warfare Center submits the Water Area Munitions Studies (WAMS) dated April 2005. The WAMS sites are to be investigated under the Military Munitions Response Program (MMRP). The following sites are addressed in separate binders as enclosure (1):

- Conservation Dam Number 2845
- Dugger Lake Facility
- Lake Greenwood Pyrotechnic Test Area Near Dam
- Lake Oberlin

Enclosure (2) contains the February 2007 Site Recommendations for the WAMS. The permit required Certification Statement is provided as enclosure (3).

If you require any further information, my point of contact is Mr. Thomas J. Brent, Code PRCR4-TB, at 812-854-6160, email thomas.brent@navy.mil.

Sincerely,

Thomas J. Brent, for
J. M. HUNSICKER
Environmental Site Mgr
By direction of the Commanding Officer

Enclosures: 1. WAMS Reports
2. Site Recommendations
3. Certification Statement

Copy to:
ADMINISTRATIVE RECORD
NAVFAC MW (Howard Hickey)
USEPA (Pete Ramanauskas)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Thomas J. Brent, acting
SIGNATURE

Environmental Site Mgr
TITLE

21 JUN 2007
DATE

ENCLOSURE (1)

WATER AREA MUNITIONS STUDIES

- CONSERVATION DAM NUMBER 2845
- DUGGER LAKE FACILITY
- LAKE GREENWOOD PYRO TEST AREA NEAR DAM
- LAKE OBERLIN

FINAL
WATER AREA MUNITIONS STUDY
CONSERVATION DAM NO. 2845
NAVAL SURFACE WARFARE CENTER
CRANE DIVISION, INDIANA

April 2005

Prepared for:

Naval Surface Warfare Center
Crane Division
Naval Facilities Engineering Command
300 Highway 361
Building 3260
Code 095
Crane, Indiana 47522-5001

Prepared by:

MALCOLM PIRNIE, INC.
300 East Lombard Street, Suite 610
Baltimore, Maryland 21202

FINAL
WATER AREA MUNITIONS STUDY
CONSERVATION DAM NO. 2845
NAVAL SURFACE WARFARE CENTER
CRANE DIVISION, INDIANA

DoD Contract Number: N62472-02-D-1300

Reviewed and Approved by:

Jeffrey R. Bennett, P.E., DEE
Program Officer
Malcolm Pirnie, Inc.

Hien Dinh
Team Leader
Malcolm Pirnie, Inc.

Malcolm Pirnie, Inc. prepared this report at the direction of Engineering Field Activity Northeast. This document should be used only with the approval of the Engineering Field Activity Northeast. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

April 2005

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ACRONYMS

°F	Degrees Fahrenheit
BRAC	Base Realignment and Closure
Bgs	Below Ground Surface
CAAA	Crane Army Ammunition Activity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EFANE	Engineering Field Activity Northeast
EOD	Explosive Ordnance Disposal
FUDS	Formerly Used Defense Site
GIS	Geographic Information System
KY	Kentucky
LANTDIV	Atlantic Division
MEC	Munitions and Explosives of Concern
MC	Munitions Constituents
MRP	Military Munitions Response Program
NAVFAC	Naval Facilities Engineering Command
No.	Number
NSWC	Naval Surface Warfare Center
NWSC	Naval Weapons Support Center
OE	Ordnance and Explosives
OESO	Ordnance Explosives Support Office
PAO	Public Affairs Office
POC	Point of Contact
RG	Record Groups
RPM	Remedial Project Manager
SWMU	Solid Waste Management Unit
U.S.	United States
USACE	United States Army Corps of Engineers

USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
Wa	Wakeland Silt Loam
WAMS	Water Area Munitions Study
WeD3	Wellston Silt Loam

GLOSSARY OF TERMS

Base Realignment and Closure (BRAC) – A Department of Defense (DoD) program that focuses on compliance and cleanup efforts at military installations undergoing closure or re-alignment, as authorized by Congress in four rounds of base closures for 1988, 1991, 1993, and 1995. (DERP Management Guidance, September, 2001)

Closed Range – A range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a DoD component. (DERP Management Guidance, September, 2001)

Defense Site – All locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used or was permitted for the treatment or disposal of military munitions. (10 U.S.C. 2710(e)(1))

Discarded Military Munitions – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))

Explosive Ordnance Disposal (EOD) – The detection, identification, field evaluation, rendering-safe, recovery, and final disposal of unexploded explosive ordnance (UXO). It may also include the rendering-safe and/or disposal of EO (explosive ordnance) which has become hazardous by damage or deterioration, when disposal of such EO requires techniques, procedures, or equipment which exceed the normal requirements for routine disposal. (OPNAVINST 8027.1G, 14 Feb 92)

Explosives Safety – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects of an ammunition or explosives mishap. (DoD Directive 6055.9 July 1996)

Formerly Used Defense Site (FUDS) – Real property that was formerly owned by, leased by, possessed by, or otherwise under the jurisdiction of the Secretary of Defense or the Components (including governmental entities that are the legal predecessors of DoD or the Components) and those real properties where accountability rested with DoD but where activities at the property were conducted by contractors (i.e., government-owned, contractor-operated (GOCO) properties) that were transferred from DoD control prior to October 17, 1986. The status of a site as a FUDS is irrespective of current ownership or current responsibility within the federal government. (DERP Management Guidance, September, 2001)

Munitions Constituents (MC) – Any materials originating from unexploded ordnance, discarded military munitions or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710 (e)(4))

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means: unexploded ordnance, discarded military munitions or munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard. (OUSD(AT&L) 18 December 2003)

Operational Range – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities, or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101 (e)(3))

Other than Operational Range – Encompasses closed, transferred and transferring ranges.

Range – A designated land or water area set aside, managed, and used for range activities of the DoD. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas, and airspace areas designated for military use in accordance with regulations and

procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101 (e)(3))

Transferred Range – A property formerly used as a military range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a range that is no longer under military control but was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. (DERP Management Guidance, September, 2001)

Transferring Range – A range that is proposed to be transferred or returned from the DoD to another entity, including federal entities. This includes a range that is used under the terms of a withdrawal, executive order, act of Congress, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An operational or closed range will not be considered a "transferring range" until the transfer is imminent. (DERP Management Guidance, September, 2001)

Unexploded Ordnance – Military munitions that have been primed, fused, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5))

MALCOLM PIRNIE

Executive Summary ES

EXECUTIVE SUMMARY

The Department of Defense (DoD) has established the Military Munitions Response Program under the Defense Environmental Restoration Program (DERP) to address munitions and explosives of concern (MEC) (including unexploded ordnance and discarded military munitions) and munitions constituents (MC) at other than operational military ranges and other sites. Closed, transferred, and transferring military ranges and sites not located on an operational range are considered other than operational. This report addresses other than operational ranges and sites at an active installation. It may include transferred and/or transferring ranges and munitions disposal sites associated with an active installation if they are not included in the Formerly Used Defense Sites (FUDS) and Base Realignment and Closure (BRAC) Programs.

However, by definition, munitions related sites located in water are not addressed under the Navy Military Munitions Response Program (MRP). For example, deep-sea sites including former munitions disposal areas and ranges are not addressed under the MRP. In order to document the history of these areas in a standard format, a Water Area Munitions Study (WAMS) report is completed. This report represents the WAMS for Conservation Dam No. 2845 associated with the Naval Surface Warfare Center, Crane Division (NSWC Crane), Indiana.

NSWC Crane is located in Martin County in south-central Indiana. NSWC Crane is the third largest naval installation in the world encompassing 100 square miles and employing approximately 3,400 Naval employees and 550 Army employees. The installation was originally built to prepare, load, renovate, receive, store, and issue all ammunition, including pyrotechnics and illuminating projectiles, and to act as a principal source of supply at a most critical time - the early days of World War II; however, due to its expertise in engineering and electronics, NSWC Crane today is a multi-mission, multi-service product center with both fleet support and industrial base missions.

Conservation Dam No. 2845 was used in the late 1970s for testing floating type pyrotechnics. According to installation personnel, testing of marking dye (greens and orange) on life vests was conducted. There is a probability that MC are present at the site because of MC associated with the munitions themselves. In addition, since the dye markers were fired over the water, evidence

of MEC or MC in the surface water would have dissipated over the years. However, there is a potential for MEC and MC to remain in the sediment.

MALCOLM PIRNIE

Introduction 1

1. INTRODUCTION

The Department of Defense (DoD) has established the Military Munitions Response Program under the Defense Environmental Restoration Program (DERP) to address munitions and explosives of concern (MEC) (including unexploded ordnance and discarded military munitions) and munitions constituents (MC) at other than operational ranges. The term "other than operational ranges" includes closed, transferred and transferring military ranges, as well as any other past-use site known or suspected to contain MEC or MC that is not located on an operational range. This report addresses other than operational ranges and sites at an active installation. It may include transferred and/or transferring ranges and munitions disposal sites associated with an active installation if they are not included in the Formerly Used Defense Sites (FUDS) and Base Realignment and Closure (BRAC) Programs.

However, by definition, munitions related sites located in water are not addressed under the Navy Munitions Response Program (MRP). For example, deep-sea sites including former munitions disposal areas and ranges are not addressed under the MRP. In order to document the history of these areas in a standard format, a Water Area Munitions Study (WAMS) report is compiled. This report represents the WAMS for Conservation Dam No. 2845 associated with the Naval Surface Warfare Center, Crane Division (NSWC Crane), Indiana.

This WAMS is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Installation Background
- Section 3 – Physical and Environmental Characteristics
- Section 4 – Summary of Data Collection Effort
- Section 5 – Site Characteristics

The following supporting information is appended to this WAMS:

- References (Appendix A)
- Project Source Data – General (Appendix B)
- Project Source Data – Site Specific (Appendix C)
- Ordnance Technical Data Sheets (Appendix D)

1.1. Purpose

This WAMS summarizes the history of munitions use at Conservation Dam No. 2845 at NSWC Crane and provides an assessment of the current conditions with respect to MEC and MC. The WAMS provides the necessary information for the United State (U.S.) Navy (Navy) and regulatory decision-makers to develop a Conceptual Site Model (CSM) for the site. The CSM presents information regarding: 1) MEC and/or MC known or suspected to be at the site; 2) current and future reasonably anticipated or proposed uses of the real property; and 3) actual, potentially complete, or incomplete exposure pathways that link them. The CSM is the basis for the risk evaluation, prioritization, and remediation cost estimate.

1.2. Project Management

This WAMS is being coordinated and managed by the Navy Engineering Field Activity Northeast (EFANE), a component of the Atlantic Division (LANTDIV) of the Naval Facilities Engineering Command (NAVFAC). The EFANE performs engineering functions for Navy installations throughout the northeast U.S. and is the Program Manager for this WAMS. Malcolm Pirnie, Inc. has been contracted to prepare this WAMS. The Navy Remedial Project Manager (RPM) and the installation points of contact (POC) for NSWC Crane provided valuable information and assistance throughout the WAMS data collection process. The Navy RPM is the responsible party for this WAMS.

1.3. Water Area Munitions Study Approach

The WAMS process for Conservation Dam No. 2845 involved collecting and reviewing existing and available information about the site; data collection activities included off-site and on-site research and interviews. The Malcolm Pirnie data collection team conducted the on-site portion of the data collection and visual survey on March 18-20, 2003. A summary of the data collection process for Conservation Dam No. 2845 is presented in Section 4.

This WAMS is inclusive and makes use of all available data relating to munitions use at Conservation Dam No. 2845, including historical records, field data, anecdotal evidence, interviews with site personnel, and professional knowledge and experience. It is based, in part, on information provided in documents referenced in Appendix A and is subject to the limitations and qualifications presented in the referenced documents.

MALCOLM PIRNIE

Installation Background 2

2. INSTALLATION BACKGROUND

The following sections provide general information about NSWC Crane, including its location and setting; a brief history of the installation; its missions over time; and a history of munitions related training, storage, and usage.

2.1. Location and Setting

NSWC Crane covers roughly the northern third of Martin County with a small overlap into Greene County to the north and an even smaller overlap into Lawrence County on the east. The approximately 63,000-acre base is approximately 37 miles southwest of Bloomington, Indiana, and approximately 70 miles southwest of Indianapolis, Indiana, as shown in Map 2-1. NSWC Crane is situated in a rural setting in southwest Indiana. Surrounding towns include Crane Village to the northwest, Burns City to the west and Bedford to the east. Map 2-1 depicts the location the Conservation Dam No. 2845 within the installation.

2.2. Installation History

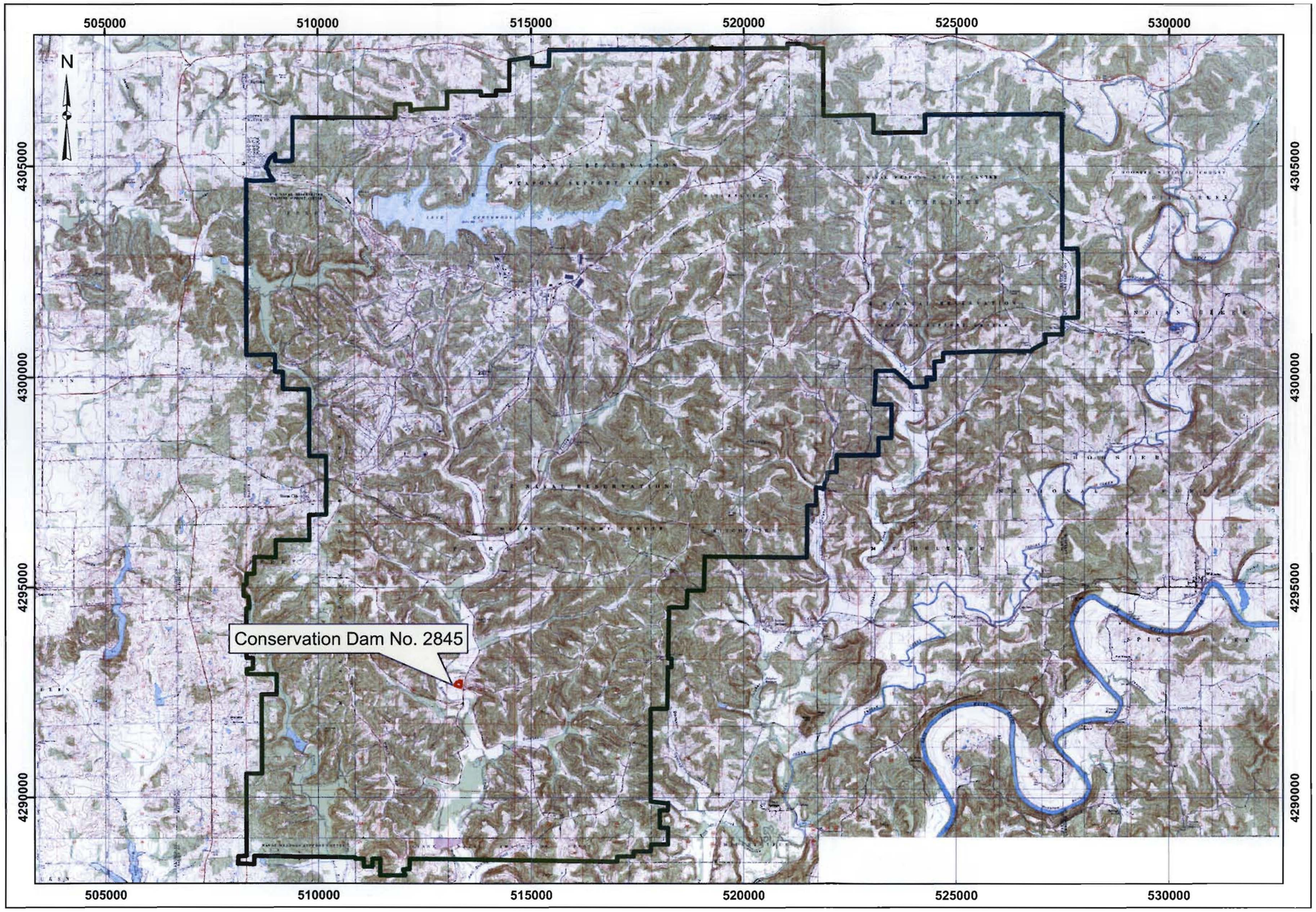
NSWC Crane began in 1941 as the Naval Ammunition Depot. Since its inception, NSWC Crane has been under four different commands. The Ammunition Quality Evaluation Unit was added in 1947, which led NSWC Crane into expanded activities, capabilities, and expertise. In 1975, the installation name changed to Naval Weapons Support Center, Crane (NWSC Crane) to reflect its true function of weapons support. The Crane Army Ammunition Activity (CAAA) was established in 1977 to assume the loading, assembly and storage of ammunition at the installation. After merging with the Naval Ordnance Station at Louisville, Kentucky (KY), in 1992, the installation received its current name: Crane Division, Naval Surface Warfare Center, and continues to be a recognized leader in highly technical product lines servicing the Navy. Table 2.2-1 contains a summary of NSWC Crane's history.

Table 2.2-1: History of NSWC Crane

Time Period	Significant Events
Prior to 1795	Indian Territory
1795 – 1940	Greenville Treaty signed and settlers arrived. The White River Project was dedicated in 1939, which provided a state park and restored forest productivity.
1941	Established in 1941 as the *Naval Ammunition Depot* for the production, testing, and storage of ordnance, including pyrotechnics and illuminating projectiles, under the command of the Bureau of Ordnance.
1947	Ammunition Quality Evaluation Unit was added by the Bureau of Ordnance to expand the quality control system and establish a laboratory at Crane.
1950s	Crane came under command of the Bureau of Weapons and expanded activities, capabilities, and expertise to include small arms, sonobouy surveillance, microwave tubes, POLARIS missiles, and other engineering support.
1960s	Crane came under command of the Naval Ordnance Systems Command and began providing technical support for weapons systems.
1974	Crane came under the Naval Sea Systems Command and Naval Ship Systems Command.
1975	The installation name changed to *NWSC Crane* to reflect its true function.
1977	Establishment of the tenant command CAAA. The CAAA assumed the loading, assembly and storage of ammunition at the installation.
1992	Crane was merged with the Naval Ordnance Station at Louisville, KY to form the *NSWC Crane.*
Present	NSWC Crane serves a modern and sophisticated Navy as a recognized leader in highly technical product lines.

2.3. Munitions Related Training / Storage / Usage

During World War II, the Korean Conflict and the Vietnam Conflict, NSWC Crane developed, tested, stored, trained with and used all types of Naval munitions including small arms, detonators, cartridge actuated devices, propellant actuated devices and various pyrotechnics.



Water Area Munitions Study
NSWC Crane, Indiana

MALCOLM PIRNIE

Map 2-1
Area Location Map
Conservation Dam No. 2845

Legend

Installation Boundary

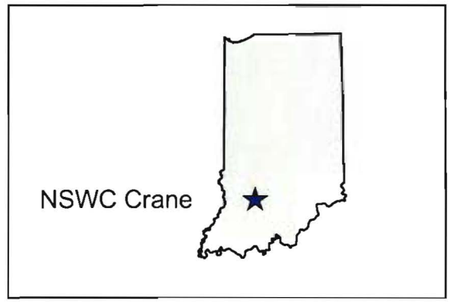
Conservation Dam No. 2845

1,500 0 1,500 3,000 4,500 Meters

Data Source: USGS. 7.5 Minute Series
Topographic Survey Map
Owensburg, IN, 1976
Indian Springs, IN, 1979
Scotland, IN, 1979
Williams, IN, 1979
Koleen, IN, 1979
Loogootee, IN, 1976
Odon, IN, 1976
Schoals, IN, 1960

Coordinate System: UTM Zone 16N
Datum: NAD83
Units: Meters

Contract: N62472-02-D-1300
Edition: Final Water Area Munitions Study
Date: April 2005



MALCOLM PIRNIE

Physical and Environmental Characteristics 3

3. PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

The following sections provide general information for NSWC Crane, including its climate; topography; geology; soil and vegetation types; hydrology; hydrogeology; cultural and natural resources; and endangered species.

3.1. Climate

NSWC Crane is located in a temperate climate zone, which has a wide temperature range between summer and winter. According to the National Climatic Data Center, the summers are warm and humid, and the winters, though generally mild, often have very cold periods of short duration. The average minimum temperature in January is 21 degrees Fahrenheit (°F), and the average maximum temperature is 38°F. The average minimum temperature in July is 66°F, and the average maximum temperature is 88°F. Precipitation totals almost 44.3 inches annually, with an average rainfall of 3.7 inches per month. Average humidity ranges from 40 to 90 percent in summer and 60 to 90 percent in winter. Winds in southwestern Indiana are generally from the south-southwest at an average speed of 8.2 miles per hour. The frost line in southern Indiana is approximately 2.5 feet below ground surface (bgs).

3.2. Topography

The topography of NSWC Crane is composed of flat to gently undulating terrain dissected by numerous well-defined drainage ways. Elevation at NSWC Crane ranges from a maximum of 860 feet in the eastern part to a minimum of 425 feet in the western part of the installation. The V-shaped drainages in the north progress to 2,000-foot wide floodplains in the south and rise approximately 150 to 200 feet to the ridgelines on slopes of 20 to 30 degrees. Soil erosion could occur along the slopes of the drainage paths at NSWC Crane.

3.3. Geology

Indiana is a large anticline that plunges to the northwest. Consequently, this large structural feature governs the age and type of rocks in Indiana. Some of the youngest rocks are in the southwestern corner of the state. The youngest rocks are mostly sandstones and shales with minor amounts of limestone and coal. The distribution of rock types is the major control on the physiographic provinces in the south-central part of the state. In the southwestern part of the

state, the rocks of the Raccoon Creek Group overlie the Mississippian-Pennsylvanian Unconformity. This group consists of mostly sandstone and shale with minor amounts of coal, limestone, and clay.

The sedimentary bedrock beneath NSWC Crane dips gently to the west-southwest. The inclination of the strata reflects NSWC Crane's location on the eastern flank of the Illinois Basin. This section of the basin is comprised of Pennsylvanian and Mississippian strata consisting of shale, sandstone, limestone, and coal (Pennsylvanian) beds. The Pennsylvanian Mansfield Formation (Raccoon Creek Group) unconformably overlies the Mississippian Stephensport and West Baden Groups at the site.

Rocks of lower Pennsylvania and upper Mississippian Ages underlie the region of Indiana in which NSWC Crane is located. With the exception of minor outwash and lacustral deposits in the northwest corner of the facility, there are no Pleistocene glacial deposits covering the installation. Surface deposits at NSWC Crane consist of recent (Holocene) and Pleistocene unconsolidated alluvial silt, sand, and gravel, and residual soils developed from the underlying rock.

3.4. Soil and Vegetation Types

According to the Soil Survey of Martin County, Indiana, conducted by the U.S. Department of Agriculture (USDA), Forest Service, in cooperation with the Indiana Department of Natural Resources, Soil and Water Conservation Committee, the primary soil types located in the area of the NSWC Crane, Martin County, are various silt loams with a variety of slopes.

The following silt loams identified within the area are nearly level and/or gently sloping, deep, poorly drained, moderately permeable soils that are prone to flooding for varying lengths of time: Birds silt loam, Bonnie silt loam, Burnside loam, Haymond silt loam, Johnsburg silt loam, Wakeland silt loam (Wa), and Wilbur silt loam. Most of these soil types are used for cultivated crops, grasslands, or woodlands. Frost heave may be associated with these types of soils due to the silty fine grain and poorly drained soils.

Some silt loams located in the area are nearly level and gently sloping, deep, well drained, moderately permeable soils: Camden silt loam, Hosmer silt loam, Pike silt loam, Pekin silt loam,

Wellston silt loam (WeD3), and Zanesville silt loam. These soil types are well suited to trees, grasses, crops, and sites for dwellings. Some are also good for septic tank absorption fields. Even though these soils contain fine grains, frost heave may not be a concern since the soils are very well drained.

Soil erosion could occur within all types of soils located at NSWC Crane if located on the higher slopes that are along the drainage paths.

3.5. Hydrology

NSWC Crane is located within the Lower East Fork White watershed. The East Fork White River flows approximately 40 miles southwest before joining the Muscatatuck River, which eventually joins the Ohio River. NSWC Crane is located approximately 10 miles northwest of the East Fork White River. The surface drainage from Crane has formed a dense, dendritic pattern throughout the installation. Six creeks in four drainage basins carry surface water off the installation. Drainage from the basin in the extreme eastern part of Crane consists of several small drainage ways. The north and northwest drainage basin eventually empties into Furst Creek, which flows in a westerly direction and crosses the installation boundary. Rainey Hollow, Sulphur Creek, and Little Sulphur Creek drain the eastern basin. The drainage basin occupying the central portion of the installation is where Boggs Creek and Turkey Creek receive drainage from the industrial area and that portion of the containment area south of Roads H43 and H5.

3.6. Hydrogeology

An 800-acre lake, Lake Greenwood, is located along the north-central portion of the base and serves as the primary water supply for the base. Groundwater resources at NSWC Crane have not been studied extensively because the facility utilizes surface waters from Lake Greenwood for human consumption, process operations, recreation, and several soil and water conservation ponds. However, the existing lithologies, occurrences of springs and seeps, and the well-developed surface drainage indicate the existence of groundwater that is hydraulically connected to the surface environment. Available groundwater data from the 1940s indicates that limited water is located at 141 and 313 feet bgs, with the shallowest water level observed at 85 feet bgs. The groundwater at NSWC Crane appears to be divided into two distinct regimes--one associated with the soil cover and one associated with bedrock. The shallow groundwater is probably transient; during periods of excessive, prolonged rainfall and during the early spring months,

there is probably saturated soil and free water above the soil-rock contact. This condition dissipates by percolation into the bedrock and into intermittent or perennial streams. The groundwater associated with the bedrock is stable and probably fluctuates only a minor amount (less than ten feet) per year. Possibly more than one zone of saturation exists in the bedrock due to the successive beds of sandstone, shale, and limestone. The shale beds should be the least permeable of the series and, where underlying a permeable sandstone or limestone, would support a saturated or free water zone. These shale zones grade laterally to zones of sandstone, so the downward percolating water would be free to move continually downward.

3.7. Cultural and Natural Resources

On a national level, NSWC Crane is considered historically significant as the primary ammunition depot for the east coast requirements of the Navy; however, according to the Cultural Resources Survey completed in June of 1992, there were no previously identified historic resources on the installation, and no buildings or structures were listed in local or state inventories or the National Register of Historic Place. The survey did identify a total of nineteen historic or prehistoric locations or possible locations, which were recorded on state survey forms. In addition, six building locations may have been eligible for listing on the National Register of Historic Places. However, according to the Indiana Department of Natural Resources Historic Preservation & Archaeology Department, no historical or archaeological sites located at NSWC Crane are listed on the National Register of Historic Places or the state inventory.

There are at least 14 caves on NSWC Crane, which range in size from small crevices or pits to the 1,500 feet that have been mapped as the Aunt Liz Cave. Cave exploration is not permitted for safety reasons and to prevent disturbance of bats that inhabit some of the caves.

Twenty-eight cemeteries are located within NSWC Crane's boundaries. The cemeteries range in size from single graves to the nearly 700 graves in Salem Cemetery. Many of the early settlers of the area are buried in these cemeteries.

NSWC Crane is vitally concerned with the conservation of the natural environment, both on and off the installation. The Navy and the DoD have recognized these efforts with awards for excellence in natural resources management. In 1995 and 1996, NSWC Crane won the Chief of Naval Operations Award for the best natural resources program. To share its abundant natural

beauty with its neighbors, NSWC Crane has opened its 800-acre Lake Greenwood to the public for fishing and boating.

NSWC Crane provides stewardship to over 63,000 acres of land, of which about 49,000 acres are forested. This is the largest forested tract of land in Indiana under a single ownership. It has been and, hopefully, will continue to be an important part of the Indiana ecosystem.

The NSWC Crane forest has been important to the re-establishment of deer, turkey, ruffed grouse and eagles in Indiana. Wildlife research is conducted at NSWC Crane by both Purdue University and Indiana University to observe species, number, and overall condition of the wildlife located at NSWC Crane. The timber is managed and harvested at NSWC Crane to provide financial means for the installation and associated counties.

3.8. Endangered and Special Status Species

According to NSWC Crane's Natural Resources Guide, protected species that are known or have the potential to inhabit NSWC Crane are listed in Table 3.8-1:

Table 3.8-1: Summary of Known or Potential Protected Species

Ecological Receptors	Species
Federal Endangered	Indiana Bat (Myotis sodalis)
Federal Threatened	Bald eagle (Haliaeetus leucocephalus)
State Endangered	Bobcat, osprey, yellow-crowned night heron, timber rattlesnake
State Threatened	Bald eagle (Haliaeetus leucocephalus)
Other Ecological Receptors	• Approximately 20 species of amphibians including the bullfrog, spotted salamander and gray treefrog • Over 100 species of birds including the wood duck, barn swallow and marsh hawk • Approximately 30 species of mammals including the white-tailed deer, coyote, raccoon, cottontail rabbit and wild turkey • Over 45 species of fish including bluegill,

	crappie, largemouth bass and channel catfish • Approximately 20 species of reptiles including the snapping turtle, northern copperhead, and eastern spiny softshell turtle • Giant Canadian Geese • Ginseng • Grouse • Several types of edible mushrooms

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Summary of Data Collection Effort 4

4. SUMMARY OF DATA COLLECTION EFFORT

Five primary sources of information were researched as part of the data collection effort for the WAMS. The sources of data included:

1) Historical archives;
2) Personal interviews;
3) Installation data repositories;
4) Visual survey; and
5) Off-site data sources and repositories, such as local libraries and museums.

These five sources of data are discussed below, along with their relative application to this WAMS.

4.1. Historical Archive Repositories (off-site)

The data collection team reviewed archival records located at the National Archives in College Park, Maryland, and in Washington, D.C., as well as the regional branches located in Philadelphia and New York City. The data collection team researched the following records and record groups (RG) for documents relating to munitions usage at NSWC Crane. Records marked with an asterisk (*) indicate boxes where pertinent information was identified and photocopied for use in the WAMS.

Textual Records:

RG 71, Bureau of Yards and Docks

Entry 12, General Correspondence, 1917-1925

Entry 13, General Correspondence re: Shore Establishments, 1916-1925

Entry 17, Index to General Correspondence, 1917-1925

Entry 21, Index to General Correspondence, 1925-1942

Entry 74, Blueprints of Naval Bases, 1940-1942

Entry 75, Drawings, 1898-1939, Vol.1, Vol.2, Box 1*

RG 72, Bureau of Aeronautics

Entry 62, General Correspondence, 1925-1942, Boxes 2797, 3842, 3843, 3844, 3845, 3920, 4014, 4019, 4020, 4036

Confidential Correspondence, 1922-1944, Box 1209

Entry 62-B, General Correspondence

1943-45, Boxes 2933, 2978, 2996, 3000, 3010, 3050, 3066*, 3078, 3385*, 3475

1946, Boxes 333, 416, 417, 418*, 419-426, 427*, 433, 436*, 437-438, 488*, 495, 503, 506, 509, 512, 513,

1947, Boxes 318, 363, 364, 365, 366*, 379*, 380, 405, 421, 426*, 430, 431, 434,

1948-1949, Boxes 371, 377*, 378*, 379, 430

1950, Box 199

1951, Boxes 163-164

1953, Boxes 242-243

1955, Boxes 193-194

1956, Boxes 184-185

1957, Boxes 192-193

1958, Box 147

RG 74, Bureau of Ordnance

Entry 25, General Correspondence, 1912-1926, Box 277*, 2317, 2318, 3087, 3093, 3112*, 3113*, 3142

Entry 25, General Correspondence, 1926-1944, Boxes 751, 754, 758*, 771, 777, 786, 787, 788*, 789*, 1060, 1078*, 1652

Entry 25-C, General Correspondence, Confidential, 1926-1939, Boxes 76, 638, 103

Entry 25-E, General Correspondence, Confidential, 1940-1942, Boxes 183, 192*

Entry 33, Index to General Correspondence, 1914-1926, Boxes 24, 33

General Correspondence, 1912-1926, Box 277*, 3112*, 3113*

Entry 33, Index to General Correspondence, 1926-1943, Boxes 21, 27

Entry1001, General Correspondence, 1907-1949, Boxes 8, 10, 11, 13, 14, 25, 26, 35-37, 51, 61, 62, 70*, 88, 101, 105, 106

Entry 1003 A-B, General Correspondence, 1948-1959, Boxes 584, 587

Construction and Procurement Files

1945, Boxes 1077*, 1190*, 1209*, 1220*, 1222, 1256*, 1257*, 1264, 1265, 1284*, 1285, 1390-1393, 1443*, 1444*, 1445*, 1446*, 1488*, 1489*, 1519-1539, 1600, 1643-1645, 1695-1696

1946, Boxes 193, 253*, 258, 265, 266, 280, 282, 289, 349*, 350*, 366*, 379*, 380*, 381*, 382*, 383*, 384*, 385*, 386*, 434*, 435

1947, Boxes 129, 188*, 199, 210*, 211, 263-265, 279*, 280, 288, 289*, 290*, 291*, 292, 330-331

RG 80, Secretary of the Navy

Entry 13, Spindle File, Letters Sent, 1918-1942, Boxes 115-118, 309, 352-353, 371-372

Entry 19, General Correspondence, 1897-1915, Boxes 1239-1241

Entry 19, General File, 1897-1926, #26395, 27280, 27812, 28332

Entry 22, General Correspondence, 1916-1926, Boxes 379, 680*, 681*, 682*, 1605, 1800, 1808, 1878*, 1879-1882, 2022, 2159, 2255*

Entry 22, General Correspondence, 1926-1940, Boxes 90,

Entry 22, General Correspondence, 1926-1944, Boxes 3071-3072, 3260

General Correspondence, 1940-1942, Box 833

Entry 130, Alphabetical File of the Assistant Secretary, 1921-1940, Box 4

Microfilm 1067, Index to General Correspondence of Secretary of Navy, 1930-1942, Rolls 29, 38, 63, 66, 90, 157

Microfilm 1052, General and Special Indexes to General Correspondence of Secretary of Navy, 1897-1926, Rolls 12, 13, 15, 24, 35, 36, 49, 62, 83, 100, 116, 119

RG 71, Bureau of Yards and Docks

Naval Property Case Files, Boxes 442, 443*, 444-450, 451*, 452

Unprocessed Naval Property Case Files, Boxes 31, 40

RG 72, Bureau of Aeronautics: [NT1-18]

Entry 62-B, General Correspondence, 1943-45, Boxes 2933, 2978, 2996, 3010, 3050, 3078, 3475

Entry 67, Confidential General Correspondence, 1922-1944, Box 1209

RG 74, Bureau of Ordnance

Entry 1001, General Correspondence, 1907-1949, Boxes 8, 10, 11, 13, 14, 25, 26, 35-37, 51, 61, 62, 70*, 88, 101, 105, 106

Entry 1003 A-B, General Correspondence, 1948-1959, boxes 584, 587

Entry 1529, Construction and Procurement Subject Files, 1945, Boxes 1519-1524, 1525*, 1526-1528, 1529*, 1530-1532, 1533*, 1534-1539

Entry 4444, Construction and Procurement Subject Files, 1946, Box 379*, 380*, 381*, 382*

Entry 1529, Construction and Procurement Subject Files, 1947, Boxes 289-291

Cartographic Records:

RG 71, Bureau of Yards and Docks

Maps for facility 903, codes 1, 2, 3, 15, 16, 32, 34, 42, 44-48

Series I microfilm, Roll 649.4*

RG 385, Naval Facilities Engineering Command, 1917-1989

Architectural and Engineering Plans, Boxes 223*, 224, 225*, 226*, 227, 228, 229, 230*

4.2. Personal Interviews

The data collection team visited the following offices located at NSWC Crane to interview representatives and research records related to the munitions/ordnance usage at the installation:

- Environmental Department
- Public Works Department
- Geographic Information Systems (GIS) Department
- Explosive Ordnance Disposal (EOD)
- Ordnance Test Group
- Explosive Safety Office
- Base Historian Office
- Public Affairs Office (PAO)
- Pyrotechnics Development Department

According to the personnel located at the installation, most people having specific knowledge regarding munitions activities at the site identified within this report are either deceased or retired and un-locatable. The data collection team attempted to locate these individuals; however, none were found. A summary of the personnel interviewed and general information obtained from each office is presented below.

Environmental Department – The data collection team interviewed the Environmental Protection Specialist, Mr. Phil Keith. Mr. Keith has been employed at NSWC Crane for 19 years. He provided the team access to current installation maps along with various other environmental information pertaining to areas within the installation. Mr. Keith did not have any information pertaining directly to Conservation Dam No. 2845. Mr. Keith was the POC for the Navy range inventory and the data collection portion of the WAMS.

Public Works and GIS Department – The data collection team interviewed the Environmental Protection Specialist, Mr. Thomas Brent. Mr. Brent has been employed at NSWC Crane for approximately 15 years. He provided the team access to various environmental documents and studies conducted throughout various areas of installation. He also stated that Conservation Dam No. 2845 is adjacent to Solid Waste Management Unit (SWMU) 19/00. Mr. Brent provided the team with electronic map files for the installation.

EOD – The data collection team interviewed Lieutenant Ron Zitzman. Lt. Zitzman, EOD Officer-in-Charge, has been stationed at NSWC Crane for 18 months. He provided the investigating team with several binders of EOD response records from fiscal years 2000 through 2003. However, these EOD response records did not provide any specific information related to Conservation Dam No. 2845 or any records of munitions/ordnance usage at the site.

Ordnance Test Group – The data collection team interviewed Mr. Steve Schantz who had some knowledge of munitions/ordnance usage at the site. Mr. Schantz is the Range Safety Officer at NSWC Crane and has been employed for numerous years. Mr. Schantz stated that it is suspected that pyrotechnics training, as well as dye testing, occurred at Conservation Dam No. 2845.

Explosive Safety Office – The data collection team interviewed the Explosive Safety Officer, Ms. Linda Stoll. She did not have any specific information related to Conservation Dam No. 2845 or any records of munitions/ordnance usage at the site.

Base Historian Office – The data collection team interviewed the Base Historian, Mr. John Allen. Mr. Allen was born and raised in the area surrounding NSWC Crane and has been employed in a variety of positions at NSWC Crane for approximately the past 60 years. He provided the team with historical summaries and other useful information regarding the history of

NSWC Crane. Mr. Allen indicated that Conservation Dam No. 2845 was built in 1962. He also provided additional information about previous activities at the pond.

PAO - The data collection team spoke with Ms. Sue Webster who oversees the PAO at NSWC Crane. She did not have any specific information related to Conservation Dam No. 2845 or any records of munitions/ordnance usage at the site.

Pyrotechnics Development Department – The data collection team spoke with Dr. Bernie Douda, an engineer employed at NSWC Crane for over 50 years, regarding munitions/ordnance usage at the site. Dr. Douda stated that Conservation Dam No. 2845 was used for testing fluorescene dye, which was fired from a signaling pistol. The dye was used for "man-overboard" training in the mid-1950s.

4.3. On-Site Data Repositories

There is no central data repository, such as a library or museum, located at the NSWC Crane except for continuing EOD response records; however, these records did not contain any information on explosive/munitions usage occurring at the site.

The base historian provided the data collection team with a copy of the book written by Mr. Robert L. Reid and Mr. Thomas E. Rodgers, entitled A Good Neighbor: The First Fifty Years at Crane 1941-1991. This book provided historical information pertaining to the installation.

A copy of the Preliminary Review/Visual Site Inspection Report, March 1987, was received from the Environmental Department to provide information pertaining to the environmental setting at the installation.

Various email correspondence relating to information regarding the installation was also received from the Environmental Department.

4.4. Visual Survey

The data collection team conducted a visual survey of the site as part of the data collection effort for the WAMS. The purpose of the visual survey was to identify any MEC ordnance related materials (e.g., expended rounds, fragmentation, range debris, old targets), any evidence of MC

(such as ground scarring, stressed vegetation, or chemical residue) and/or surface features that could provide additional information to aid in the characterization of the site. The visual survey was also used to enhance, augment, or confirm the archival data and, in some cases, provide new data to the team. A description of the area surveyed and the results of the survey are provided in Section 5.

4.5. Off-Site Data Sources

The data collection team contacted the following libraries and historical societies to obtain additional historical information regarding the site; however, no information was obtained pertaining to the identified site.

- Indiana Historical Society
- Indiana State Library
- Bedford Public Library
- Bloomfield Library
- Shoals Public Library
- Martin County Historical Society

In addition, the data collection team reviewed archival records located at the Ordnance Explosives Support Office (OESO) Library at NSWC Indian Head, Maryland. OESO provides Navy-wide environmental program support for ordnance and munitions. The data collection team researched the files available for NSWC Crane, and the following sources were of value to this WAMS:

Textual Records:

Proposed Development Plan for Station, December 21, 1940.

Chief of Bureau of Yards & Docks, July 14, 1941 indicating revisions of boundary lines.

Installation Assessment of NWSC Crane, Indiana, March 1978.

Cultural Resources Survey, Crane Division NSWC, Crane, Indiana, June 1992.

Environmental Impact Assessment for Open Burning/Detonation of Waste Munitions/Propellant, August 1975.

Records Research On-Site Survey by OESO and the Army Records Research, Pollution Control Program, 1971.

Geology and Hydrology Study for the Ammunition Burning Grounds, October 1987.

Preliminary Review/Visual Site Inspection Report of Naval Weapons Support Center, Crane, Indiana, March 1987.

Maps:

NWSC Crane, Indiana, General Development Map, updated April 1974.

U.S. Naval Ammunition Depot Crane, Indiana, Production Areas Map.

The data collection team researched environmental information such as soil and endangered species information pertaining to the installation from the U.S. Department of Fish & Wildlife and the USDA. Historical and other environmental information was researched using the Internet. A complete list of Internet sources can be found in Appendix A.

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Site Characteristics 5

5. SITE CHARACTERISTICS

The following sections provide site-specific information about Conservation Dam No. 2845 at NSWC Crane, including history and site description; visual survey observation and results; munitions characterization; contaminant migration routes; receptors; land use; access controls and restrictions; and the CSM.

5.1. History and Site Description

Conservation Dam No. 2845 is located in the center of the southern portion of NSWC Crane. It is located directly west of the intersection of Highway 30 and Highway 142.

Historical information on Conservation Dam No. 2845 is limited. The exact dates the range was active are unknown; however, based upon interviews with site personnel, it is estimated that the site was used in the late 1970s. It is reported in the Installation Assessment that Conservation Dam No. 2845 was reportedly used for testing floating type pyrotechnics. No additional documentation could be found, and as nearly as could be determined, only limited testing was performed. Mr. Allen, Base Historian, stated that dye testing of marking dye (greens and orange) on life vests was conducted in the 1970s. It is speculated that the dye testing was conducted from boats in the pond. It is assumed that the dye was observed from the edge of the lake or from the boats because the area is too heavily wooded to be observed from the air.

According to installation personnel, it was Navy policy at the time to recover all retrievable fragments or residue associated with testing. A record of this policy was not found during the data collection effort, but NSWC Crane personnel corroborated the policy. The Navy Range Inventory Questionnaire states that personnel interviewed indicated that there was limited use of the site and that hardware and misfires/malfunctions were recovered. It is assumed that all retrievable fragments were recovered; however, it is possible that small fragments were unrecoverable. However, there are no records of EOD responses for testing at Conservation Dam No. 2845.

The 150-meter long earthen dam, as shown in Figure 5.1-1, is located along the southern edge of the 4.1-acre Conservation Dam No. 2845. It is estimated that at its deepest point, the lake is approximately ten feet deep. The Conservation Dam No. 2845 is owned by the installation. No

structures are present at the site. The lake is primarily surrounded by woodland. Figure 5.1-2 is a photograph of Conservation Dam No. 2845 and its surroundings. The un-named tributary that drains Conservation Dam No. 2845 empties into Boggs Creek approximately 1,000 feet south of the pond. According to Mr. Allen and Dr. Douda, the pond has never been dredged.

Mr. Brent indicated that Conservation Dam No. 2845 is adjacent to SWMU 19/00. SWMU 19/00 is the Pyrotechnic Test Area/Annex/Rocket Range Impact Area. The SWMU is also known as the Ordnance Test Area. These areas are still considered active by NSWC Crane. No additional information was available from the Environmental Department regarding SWMU 19/00.

Conservation Dam No. 2845 was identified as a range in the Navy Range Inventory. The footprint of the lake was mapped and used to establish the 4.1-acre area indicated on Map 5-1. This area differs from the 0.0005-acres identified in the Navy Range Inventory. The 4.1-acre size of Conservation Dam No. 2845 is used in this report because it was field verified.

Conservation Dam No. 2845 is identified on numerous historic maps, but its use as a range is not indicated on any maps. Installation personnel also refer to the site as Captain's Pond.

Figure 5.1-1: Current view of dam and eastern shore of Conservation Dam No. 2845.

Figure 5.1-2: Current view of Conservation Dam No. 2845 and its surroundings from the dam.

5.1.1. Topography

The elevation of Conservation Dam No. 2845 is approximately 500 feet. The area to the east of the lake gently slopes upward to approximately 600 feet within 250 feet of the lake. The areas west and north of the site also slope upward to an elevation of approximately 550 feet within 200 feet of the site. The area immediately south of the site is relatively flat and swampy. The depth of the lake is unknown; however, based on personnel interviews, the maximum depth is estimated at approximately ten feet.

5.1.2. Geology

There are no wells located at Conservation Dam No. 2845; therefore, the specific geology of the site is unknown. A description of the regional geology can be found in Section 3.3.

5.1.3. Soil and Vegetation Types

The soil types listed in Section 3.4 would be applicable to the land surrounding Conservation Dam No. 2845. No records were available detailing the sediments of Conservation Dam No. 2845; however, the Final Lake Greenwood Diagnostic Study describes the sediments of Lake

Greenwood. It is assumed that the sediments of Conservation Dam No. 2845 are similar to the sediments of Lake Greenwood because of their close proximity (approximately 1,000 feet). The Final Lake Greenwood Diagnostic Study states:

> Lake Greenwood's sediments have a relatively large percentage of sand-sized particles. This is likely due to the primarily parent material of local soils – sandstone and shale. Since clay is only a minor component of the local soils, there is less clay in the sediments compared to sand or silt. Nevertheless, clay still ranges between 17 and 24 percent in the sediments of the lake... The various small side channels along the lake deliver enough sand- and silt-sized particles to maintain a relative homogeneity in particle size along the lake.

NSWC Crane constructed the earthen dam at Conservation Dam No. 2845. The soil composition of the dam is unknown. The primary soil types located in the area of NSWC Crane, Martin County, are various silt loams with a variety of slopes (Section 3.4). According to the Martin County Soil Survey, Conservation Dam No. 2845 is surrounded by Wa to the south and WeD3 to the north, east, and west. Wa is a nearly level, deep, somewhat poorly drained soil on flood plains, and it is frequently flooded for brief periods. Wa has a high water capacity, moderate permeability, and slow surface runoff. WeD3 has 12 to 18 percent slopes. This strong slope is present along drainageways with deep, well-drained soils. WeD3 has a high water capacity, moderate permeability, and very rapid surface runoff. Both soil types are well suited for trees.

Vegetation surrounding the lake is primarily woodland, and the earthen dam is covered in grass.

5.1.4. Hydrology

Conservation Dam No. 2845 is in the central drainage basin. Surface water drains from Conservation Dam No. 2845 into an un-named tributary. Approximately 1,000 feet south of the pond, the un-named tributary empties into Boggs Creek. Boggs Creek eventually empties into the East Fork of the White River south of NSWC Crane.

Conservation Dam No. 2845 is not a naturally occurring lake. An earthen dam (Structure No. 2845) was constructed to create the Conservation Dam by damming the un-named tributary that empties into Boggs Creek.

5.1.5. Hydrogeology

Groundwater resources at NSWC Crane have not been studied extensively because the facility utilizes surface waters from Lake Greenwood for human consumption, process operations, recreation, and several soil and water conservation ponds. There are no wells directly at Conservation Dam No. 2845; therefore, the specific hydrogeology of the site is unknown. A description of the regional hydrogeology can be found in Section 3.6.

5.1.6. Cultural and Natural Resources

Although the potential for cultural resources exists for the area in which the site is located, there have not been any archeological or cultural sites identified near the site. No records were found identifying specific cultural resources at Conservation Dam No. 2845 in the Cultural Resources Survey from June 1992, nor were any sites identified on the Indiana Register of Historic Sites and Structures (State Register) or the National Register of Historic Places.

The NSWC Crane forest that surrounds Conservation Dam No. 2845 has been important to the re-establishment of deer, turkey, ruffed grouse and eagles in Indiana. Beavers were observed during the site visit, as well as beaver dams as shown in Figure 5.1-3.

Figure 5.1-3: Eastern edge of lake with beaver dams.

The Initial Assessment Study lists the following aquatic animals for NSWC Crane:

Crayfish	Carp	Bluegill sunfish
Freshwater mussels	Yellow perch	Walleye pike
Golden shiner	Warmouth	White crappie
Redear sunfish	Largemouth bass	Yellow bullhead
Channel catfish	White bass	Longear sunfish
Spotted sucker	Brown bullhead	

Although no records were found to confirm the presence of these specific aquatic animals for Conservation Dam No. 2845, it is assumed that a variety of the aquatic animals may be present there because it is used for recreational fishing.

The Final Lake Greenwood Diagnostic Study lists the following littoral vegetation associated with Lake Greenwood:

American waterwillow	Spadderdock
Eurasian watermilfoil	Fragrant water lily
Brittle Nalad	Vallisneria
Rushes	Chara
Sedges	Broad-leaf cattail
Water-thread pondweed	American Pondweed
E. Watermilfoil/Slender naiad	

Although no records were found to confirm the presence of these varieties of littoral vegetation for Conservation Dam No. 2845, it is assumed that they may be present due to Conservation Dam No. 2845's proximity to Lake Greenwood.

5.1.7. Endangered and Special Status Species

Currently, the only species on the federal endangered species list that has been identified at NSWC Crane is the Indiana bat. Any area having trees with exfoliating bark has the potential to harbor the Indiana Bat from April to September. State listed endangered species include the

bobcat, osprey, yellow-crowned night heron and the timber rattlesnake. Other species, such as the state and federally listed (threatened) bald eagle (Haliaeetus leucocephalus), occur in the area, and the bald eagle could be located at the site based on the large hunting range of the bald eagle. Conservation Dam No. 2845 and the surrounding area do not contain any additional endangered or special status species.

5.2. Visual Survey Observations and Results

The Malcolm Pirnie survey team included Ms. Denise Tegtmeyer, Mr. Svend Egholm, and Mr. Bill Walinus. Mr. Schantz of NSWC Crane accompanied the survey team. The survey team was able to walk 100% of the area along the dam on March 18, 2003. The total area surveyed by the team was approximately 150 meters along the dam. The survey team did not observe any munitions related debris along the dam or in the surrounding land. A sign marking the entrance to Conservation Dam No. 2845 is shown in Figure 5.2-1. The outfall from Conservation Dam was observed during the site visit, as shown in Figure 5.2-2. The outfall is located immediately south of the earthen dam and drains into a wooded area. The team also observed beavers and beaver dams along the eastern side of the lake as shown in Figure 5.1-3. The team did not go into the water of the lake to investigate.

A visual depiction of the site reconnaissance is provided on Map 5-1 located at the end of Section 5. Additional range/site details are illustrated on Map 5-2 also located at the end of Section 5.

Figure 5.2-1: View of sign at the entrance to Conservation Dam No. 2845.

Figure 5.2-2: Current view of outfall from Conservation Dam No. 2845 looking south.

5.3. Munitions and Munitions Related Materials Associated with the Site

This section describes the munitions or munitions related materials known or suspected to be at the site. This includes both MEC and non-hazardous munitions related scrap (e.g., fragmentation, base plates, inert mortar fins).

The data collection team was unable to locate specific records of the types and quantities of pyrotechnics tested at Conservation Dam No. 2845. Interviews with installation personnel indicated the testing of dye markers from a signaling pistol, and an historic report indicates that submarine flotation flares were tested at Conservation Dam No. 2845. Based on this information, it is expected that the following munitions may be found on-site:

- Floating type pyrotechnics
- Dye markers (green and orange)

No records were located to indicate specific types of floating type pyrotechnics tested at Conservation Dam No. 2845. An example of a floating type pyrotechnic would be a Submarine Float Signal, Mark 2 Mod. 2. It is a signaling device designed to be launched to a maximum depth of 285 feet to produce a red, black, green, or yellow smoke display on the surface.
Pyrotechnic and screening devices contain combustible chemicals which, when ignited, rapidly generate a flame of intense heat, flash, infrared radiation, smoke or sound display (or combinations of these effects) for a variety of purposes. Compared to other explosive substances, pyrotechnics are more adversely affected by moisture, temperature, and rough handling. Some compositions may become more sensitive, and even ignite, when exposed to moisture or air. Mixtures which contain chlorates and sulfur are susceptible to spontaneous combustion. Most pyrotechnics produce a very hot fire that is difficult to extinguish and most burn without serious explosions. Many chemicals used in pyrotechnics produce toxic effects when ignited. Other pyrotechnics, which contain propelling charges, create an extremely hazardous missile hazard if accidentally ignited. The following are the different types of devices that pyrotechnic material may be found at the Conservation Dam No. 2845. Table 5.3-1 is a summary of the hazards associated with these types of pyrotechnic devices.

- SIGNALING. Pyrotechnics for signaling can be projected or released from small pistol-like devices, hand held devices, hand manipulated devices, rifle launched devices and colors delivered by .38 caliber or 9 mm ammunition. Other signaling devices are used to indicate the impact points of bombs or large rounds. Such devices produce a variety of colors (red, green yellow white, orange, red/orange, blue and others).

- DYE MARKER DEVICES. Items previously in this class of devices, used to produce a color mark on water, are now obsolete or unserviceable.

Table 5.3-1: Pyrotechnics and Associated Hazards

Class of Pyrotechnic	Type of Potential Hazard/Safety Precautions
Signaling	• Cocked firing mechanisms • Lack of safety devices on many projectors • Ballistic damage upon firing from the projector • Possible injury of user or nearby personnel • Very intense fire produced by pyrotechnic • Potential toxic hazard
Dye Marker Devices	• Declared obsolete or unserviceable • Contain explosive burster charge

Additional technical information and specifics about the types of ordnance used at the Conservation Dam No. 2845 are included in Appendix D.

Based on the information obtained during the data collection process, no special consideration munitions (chemical warfare materiel filled munitions, electrically fuzed munitions, depleted uranium associated munitions) are known or suspected to have been used at the site; therefore, Conservation Dam No. 2845 is not suspected to contain special consideration MEC.

5.4. MEC Presence

The entire site has been subdivided and categorized into one of three levels of MEC presence including: Known MEC Areas, Suspect MEC Areas, and Areas Not Suspected to Contain MEC. The MEC presence is discussed below.

Map 5-3 illustrates the munitions characterization of Conservation Dam No. 2845 and is provided at the end of Section 5.

5.4.1. Known MEC Areas

There are no known MEC areas associated with the site.

5.4.2. Suspected MEC Areas

Conservation Dam No. 2845 is identified as a site where evidence of MEC is suspected. MEC have the potential to be present in the sediment of the 4.1-acre lake as a result of the submarine flotation flare and dye marker testing. It is possible that partially consumed flares and dye markers and their associated components may have settled to the bottom of the lake and are present in the lake sediments. The suspect MEC area is depicted in Map 5-3.

5.4.3. Areas Not Suspected to Contain MEC

Based on the site history, the areas surrounding the Conservation Dam No. 2845 are not suspected to contain MEC.

5.5. Ordnance Penetration Estimates

The depth to which munitions penetrate below the ground surface depends on many factors, including the type of soil, the angle of impact, the size of the munitions, the velocity at impact, and site-specific environmental conditions. Over the years, the DoD has studied and modeled munitions penetration depths and has issued various guidance and technical documents on the subject. For the purposes of the WAMS, maximum probable penetration depths are estimated following guidance listed in the latest draft (July 2002) of the DoD Directive on Explosives Safety issued by the DoD Explosives Safety Board [*DoD Directive 6055.9* (*DoD Ammunition and Explosives Safety Standards*)]. The Directive refers to *TM 5.855.1* and *NAVFAC P-1080.*

All of the ordnance listed in Section 5.3 is only anticipated to have been present in the lake waters during testing. While it is possible that partially consumed flares and dye markers and their associated components may be present in the lake sediments, it is not anticipated that the ordnance would have penetrated the sediments or subsurface soils during testing.

5.6. Munitions Constituents

There is the potential for MC to be associated with the types of munitions suspected to have been used at Conservation Dam No. 2845. The Submarine Float Signal described in Section 5.3 contains smoke composition as the filler. Potential MC associated with the smoke filler may

include a combination of various chemicals that are contained in burning-type colored smoke munitions and explosive-type colored smoke munitions. Some chemicals used in typical smoke compositions include zinc oxide, sulfur, sodium hydrogen carbonate, sodium chloride, and potassium chlorate. The following is a partial list of chemicals that could be contained in combination in burning-type smokes:

- Red Smoke - 9-diethylamino-phenyl-5-benzo (a) phenazinone, 1-(tolylazoxylylazo)-2-naphthol
- Green Smoke - 1, 8-di-p-toluidinoanthraquinone
- Orange Smoke (burn-type) - could contain 1-aminoanthraquinone
- Orange-Red Smoke - 1-(4-nitophenylazo)-2-naphthol
- Yellow Smoke - Auramine hydrochloride, 1-(4-dimethylaminophenylazo)-2-naphthol
- Blue Smoke - 1, hydroxy-4-p-toluidinoanthraquinone, Indigo, 1,4-dimethylaminoanthraquinone
- Violet Smoke - 1,4-diamino-2, 3-dihydroanthraquinone, 1,5-di-p-toluidinoanthraquinone

The following is a list of chemicals contained in explosive-type colored smoke munitions:

- Red Smoke - 1-(2-methoxyphenylazo)-2-naphthol and a-methylaminoanthraquinone (Celanthrene Red)
- Yellow Smoke - 2,4-diaminoazobenzene (Chrysoidine G, base), Auramine Hydrochloride
- Green Smoke - 1,4-di-p-toluidinoanthraquinone (Quinizarin Green) plus quinophthalone (Quinoline Yellow, base), and 1,4-di-p-toluidinoanthraquinone plus auramine hydrochloride.

A complete list of dyes that have been used in burning-type colored smoke munitions, typical smoke compositions, and some dyes which have been used in explosive-type colored smoke munitions at NSWC Crane can be found in Appendix B.

According to Dr. Douda, the flares consisted of a cartridge with an aluminum sleeve. Therefore, MC at the site could also include aluminum, as well as additional metals.

5.7. Contaminant Migration Routes

Studies have shown that ordnance can migrate due to environmental factors such as frost heave or erosion. However, contaminants (if present) at Conservation Dam No. 2845 would potentially migrate in the surface water and sediment.

Since MEC are suspected in the sediments, there is a potential for the MEC to migrate with the sediments. MC present in the surface water during testing either would have settled to the sediment or migrated off-site via the un-named tributary. Since testing occurred in the 1970s, it is assumed that MC are no longer present in the surface water, and any MC remaining at the site would be present in the sediment. The sediment has the potential to migrate downstream if it is suspended in the surface water flow. Surface water from Conservation Dam No. 2845 drains to an un-named tributary. Approximately 1,000 feet south of the pond, the un-named tributary empties into Boggs Creek, which eventually discharges to the East Fork of the White River. Since the depth to groundwater and groundwater flow paths at the site are unknown, the specific contaminant migration route for MC in the groundwater is unknown.

5.8. Receptors

The potential contaminant receptors at Conservation Dam No. 2845 are receptors of MC in surface water and sediment and receptors of MEC in the sediment. Only surface water and sediment are expected to have the potential for receptor interaction since the lake was the impact area of the testing. Users of surface water at Conservation Dam No. 2845 include several species of vegetation and indigenous animals, as well as humans. Conservation Dam No. 2845 is used for recreational activities such as fishing. Surface water from Conservation Dam No. 2845 eventually discharges to the East Fork of the White River, and the White River is also used for fishing and recreation. Fish from Conservation Dam No. 2845 and the White River may be consumed by humans and used as a food source by waterfowl. Potential receptors of surface water include current and future Navy personnel, contractors, trespassers, visitors, fauna and flora. Potential receptors of the sediment include aquatic fauna and flora that may burrow, forage, or grow in the sediment.

5.8.1. Nearby Populations

NSWC Crane makes up the majority of Martin County. The rest of Martin County is essentially rural with some residential areas surrounding NSWC Crane. Martin County has a population of

10,383, which comprises 0.16 percent of the state's population. The population per square mile in Martin County is 30.9. NSWC Crane is the second largest employer in southwest Indiana with over 3,400 Navy employees and over 550 Army employees. A Combined Bachelors Quarters (approximately 36 rooms) and family housing (approximately 30 units) are located at NSWC Crane. Conservation Dam No. 2845 is used for recreational fishing.

5.8.2. Buildings Near/Within Site

There are no structures at Conservation Dam No. 2845. The hazard zone for the active Ordnance Test Area and its associated support buildings (Buildings 3253, 3254, 3255, 3256, 3258, 3300, 4044) are located immediately north of the site. In addition, numerous storage magazines are located within a one-mile radius of Conservation Dam No. 2845.

5.8.3. Utilities On/Near Site

The buildings and facilities near Conservation Dam No. 2845 have utilities; however, it is not known whether underground utilities exist at the site. NSWC Crane did not have utility maps available for review. The Public Works Department indicated that no maps were available and field verification of utilities would be required.

5.9. Land Use

Conservation Dam No. 2845 is no longer used for pyrotechnic/dye marker testing and is considered closed. The area is to remain closed for such use and continue its use as a recreational and fishing area. The land use is not anticipated to change during the foreseeable future; therefore, the reasonably anticipated future land use for the area is recreation. Conservation Dam No. 2845 is currently used by Navy personnel and authorized visitors for fishing. According to Mr. Allen, the lake has never been dredged, and there are no future plans to dredge the pond.

5.10. Access Controls / Restrictions

Access to the NSWC Crane is restricted. NSWC Crane property is surrounded by locked, secured gates, with security at all entrances, as well as a security patrol. There are no access controls or restrictions in place to limit access to Conservation Dam No. 2845 once on the installation. Navy personnel, contractors, and visitors are not specifically restricted from the former test area. There are no known zoning/land use restrictions for Conservation Dam No. 2845.

5.11. Conceptual Site Model

This CSM was developed following guidance documents issued by the U.S. Environmental Protection Agency (USEPA) for hazardous waste sites and the U.S. Army Corps of Engineers (USACE) for ordnance and explosives (OE) sites. Guidance documents included the USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (EPA/540/G-89/004) and the USACE CSM Guidance Development of Integrated Conceptual Site Models for Environmental OE Sites, which was final as of February 2003.

The CSM describes the site and its environmental setting. The CSM presents information regarding: 1) MEC and/or MC known or suspected to be at the site; 2) current and future reasonably anticipated or proposed uses of the real property; and 3) actual, potentially complete, or incomplete exposure pathways that link them. The CSM is the basis for the risk evaluation, prioritization, and remediation cost estimate.

The CSM is presented in a series of information profiles that presents information about the site. The information profiles are included in Table 5.11-1.

Table 5.11-1: Conceptual Site Model Information Profiles – Conservation Dam No. 2845		
Profile Type	**Information Needs**	**Preliminary Assessment Findings**
Range/Site Profile	Installation Name	NSWC Crane
	Installation Location	Crane, Martin County, Indiana
	Range/Site Name	Conservation Dam No. 2845
	Range/Site Location	East of Building 3256 in the southwest portion of NSWC Crane off of Highway 527
	Range/Site History	In the late 1970s, the lake was used for testing floating type pyrotechnics.
	Range/Site Area and Layout	The lake is approximately four acres in size.
	Range/Site Structures	Grass covered earthen dam
	Range/Site Boundaries	N: Hazard zone for Ordnance Test Area S: Undeveloped property and swampland W: Undeveloped property and Building 3256 E: Highway 30
	Range/Site Security	Access to the installation is controlled by a 24-hour surveillance system. Once inside the installation fence-line, there are no other barriers to the site.
Munitions/ Release Profile	Munitions Types	Floating type pyrotechnics (none specified).
	Maximum Probability Penetration Depth	Any munitions used would have been deployed within the water column of the lake; therefore, no penetration of the lakebed is expected to have occurred.
	MEC Density	Minimal range related debris is expected to be at the site based upon the Navy operating procedures to collect and remove related debris immediately after testing. Partially consumed flares and their associated components may have settled to the bottom of the lake and may be present in the lake sediments.
	MEC Scrap/Fragments	None found along the dam. The team did not go into the water of the lake to investigate.
	Associated Munitions Constituents	Minimal amount of metals and other inorganics. No explosives were found during the site visit.
	Migration Routes/Release Mechanisms	Contaminants could migrate via surface water and sediments.
Physical Profile	Climate	Temperate climate zone, which has a wide temperature range between summer and winter

Table 5.11-1: Conceptual Site Model Information Profiles – Conservation Dam No. 2845		
Profile Type	Information Needs	Preliminary Assessment Findings
	Topography	Water
	Geology	The area is located on the eastern flank of the Illinois Basin consisting of shale, sandstone, limestone, and coal beds. The specific geology of the site is unknown.
	Soil	Sediments have a relatively large percentage of sand-sized particles. Soils surrounding the lake include Wa and WeD3.
	Hydrogeology	Specific hydrogeology of the site is unknown.
	Hydrology	The lake is approximately four acres. At its deepest point, the lake is approximately ten feet.
	Vegetation	Water. Surrounding vegetation is grass and woodland.
Land Use and Exposure Profile	Current Land Use	The lake is used for recreational fishing.
	Current Human Receptors	Naval personnel, contractors, trespassers, authorized visitors, and recreational users.
	Current Activities (frequency, nature of activity)	The lake is currently used for recreational fishing.
	Potential Future Land Use	No change in land use is expected.
	Potential Future Human Receptors	Naval personnel, contractors, trespassers, authorized visitors, and recreational users.
	Potential Future Land Use-Related Activities:	No change in land use is expected.
	Zoning/Land Use Restrictions	No known zoning/land use restrictions.
	Demographics/Zoning	NSWC Crane employs approximately 4,000 personnel, both civilian and military. Martin County has a population of 10,383, which comprises 0.16 percent of the state's population. The population per square mile in Martin County is 30.9.
	Beneficial Resources	Recreational resource
Ecological Profile	Habitat Type	Lacustrine
	Degree of Disturbance	If current conditions continue, the degree of disturbance at the site will be low. Low – Site is/will be unused; habitat and species present are/will be undisturbed.
	Ecological Receptors	

Table 5.11-1: Conceptual Site Model Information Profiles – Conservation Dam No. 2845		
Profile Type	Information Needs	Preliminary Assessment Findings
	Federal Endangered Species:	No federal endangered species are known at the site.
	Federal Threatened Species:	The Bald Eagle *(Haliaeetus leucocephalus)* could be located at the site based on the large hunting range of the bald eagle.
	State Endangered Species:	None have been identified at the site.
	State Threatened Species:	The Bald Eagle (Haliaeetus leucocephalus) could be located at the site based on the large hunting range of the bald eagle.
	Other Ecological Receptors:	The habitat at the site includes aquatic plants and animals, and the habitat in the surrounding area is home to many woodland wildlife species, such as deer, rabbits, raccoons, and wild turkeys.
	Relationship of MEC/MC Sources to Habitat and Potential Receptors	Receptors, both human and ecological, may come into direct contact with MC in the sediment or surface water. Wildlife that inhabit or utilize the area may come into contact with MC that have been incorporated into the food chain (bioaccumulated in plants and animals). Ecological receptors may come into contact with MEC in the sediment.

A key element of the CSM is the exposure pathway analysis. For MEC, a complete or potentially complete exposure pathway must include the following components: 1) a source (e.g., locations where MEC are expected to be found); 2) access (e.g., controlled or uncontrolled access, items on the surface or within the subsurface); 3) an activity (e.g., non-intrusive grounds maintenance or intrusive construction); and 4) receptors (e.g., Navy personnel, construction workers, recreational users or authorized visitors). It is important to recognize that environmental mechanisms (e.g., erosion) and/or human intervention may result in the repositioning of MEC.

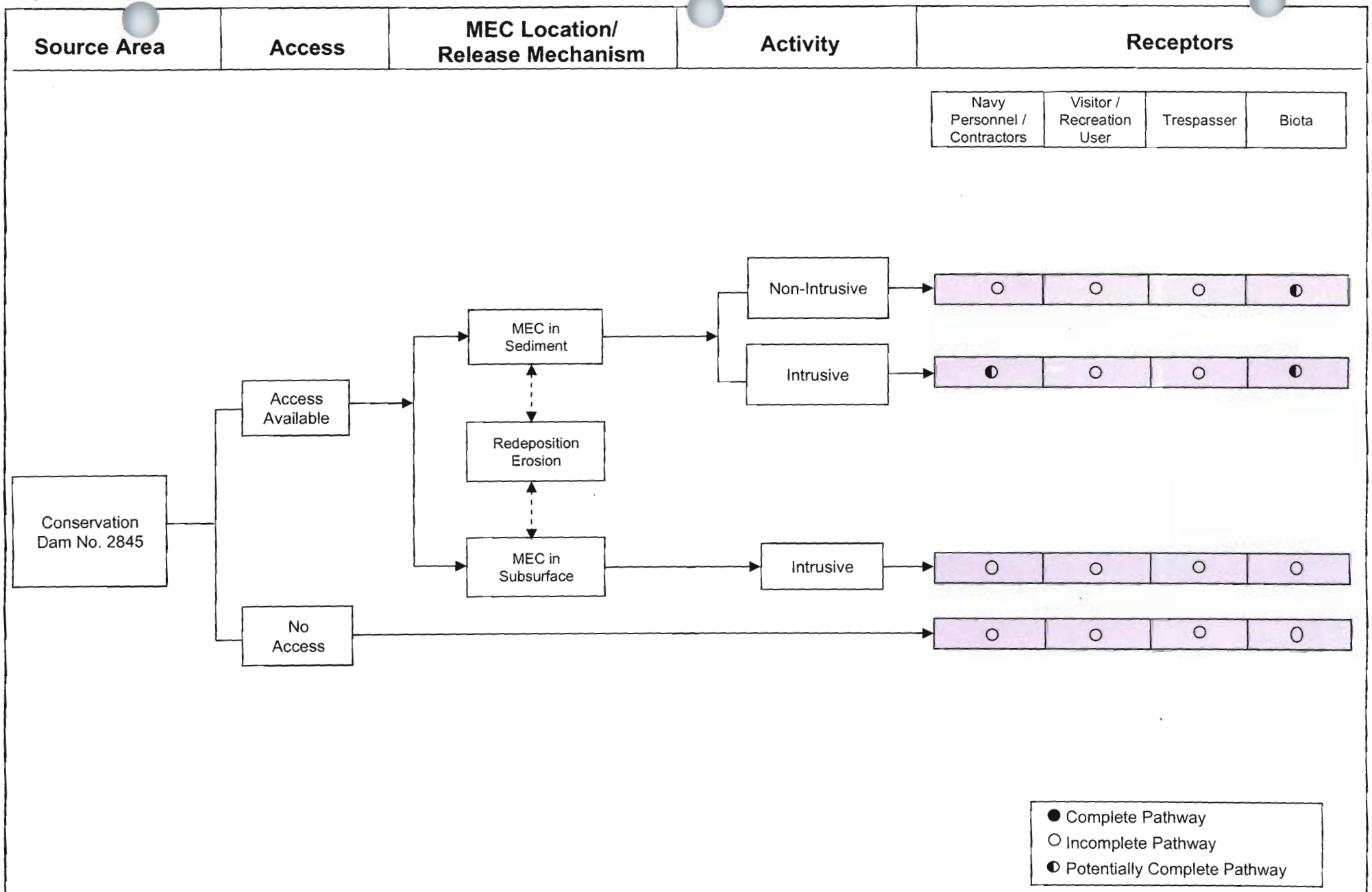
For MC, a complete or potentially complete exposure pathway must include the following components: 1) a source (e.g., locations where MC are expected to be found); 2) an exposure medium (e.g., surface soil); 3) an exposure route (e.g., dermal contact); and 4) receptors (e.g., Navy personnel, construction workers, recreational users or authorized visitors). If the point of exposure is not at the same location as the source, the pathway may also include a release mechanism (e.g., volatilization) and a transport medium (e.g., air).

The potential interactions between the source and receptors are assessed differently between MEC and MC. For MC, interaction between the source and receptors involves a release mechanism for the MC, an exposure medium that contains the MC, and an exposure route that places the receptor into contact with the contaminated medium. For MEC, interaction between the potential receptors and an MEC source has two components. The receptor must have access to the source and must engage in some activity that results in contact with individual MEC items within the source area.

As seen in Figure 5.11-1, the MEC Exposure Pathway Analysis, the potential exists for MEC in the sediment at the site. Given this potential, the figure identifies the exposure pathways through which site receptors could come in contact with or be impacted by MEC. A potentially complete pathway exists for sediment through intrusive and non-intrusive contact for biota. Biota on the site may disturb the sediment through nesting or feeding. A potentially complete pathway exists for Navy personnel/contractors that may come in contact with MEC in the sediment at the site during intrusive activities in the pond. A pathway does not exist for other human receptors (visitors/recreational users and trespassers) because it is not anticipated that these receptors will enter the water of the pond in order to come in contact with MEC in the sediment at the site. An exposure pathway does not exist for MEC in the subsurface for human or ecological receptors.

As seen in Figure 5.11-2, the MC Exposure Pathway Analysis, the potential for MC exists on the site. Given this potential, the figure identifies the exposure pathways through which site receptors could come in contact with or be impacted by MC. A potentially complete pathway exists for surface water/sediments through dermal contact and ingestion for both human receptors (Navy personnel, contractors, visitors, recreational users, and trespassers) and ecological (biota) receptors. Navy personnel, visitors, recreational users, and trespassers could come into contact with surface water through recreational activities, such as fishing. Contractors may be exposed during site investigations or from potential future land use changes that may require intrusive activities at the dam or in the pond. Biota on the site may disturb the sediment through nesting or feeding. If there is the possibility of dermal contact, the potential for ingestion exists as well. Potential accumulation in game animals can pose a threat to human receptors, as fishing is allowed at the lake. The food chain may also be affected for ecological receptors. An exposure pathway does not exist for MC in the surface soil, subsurface soil for human or ecological receptors.

A graphical illustration of the details of the CSM is included in Figure 5.11-3 at the end of Section 5. The figure illustrates the infiltration and runoff directions and potential areas for MEC/MC contamination. The illustration shows the lake and wooded area that surround the site, creating a potential habitat for flora and fauna. Red arrows indicate the direction of precipitation infiltration and surface water runoff across the site, which follow the topography of the site draining into Conservation Dam No. 2845. In addition, the graphical illustration identifies the suspected groundwater flow direction in accordance with the depicted topography. The suspected MEC and MC area is shown with a red dotted line.



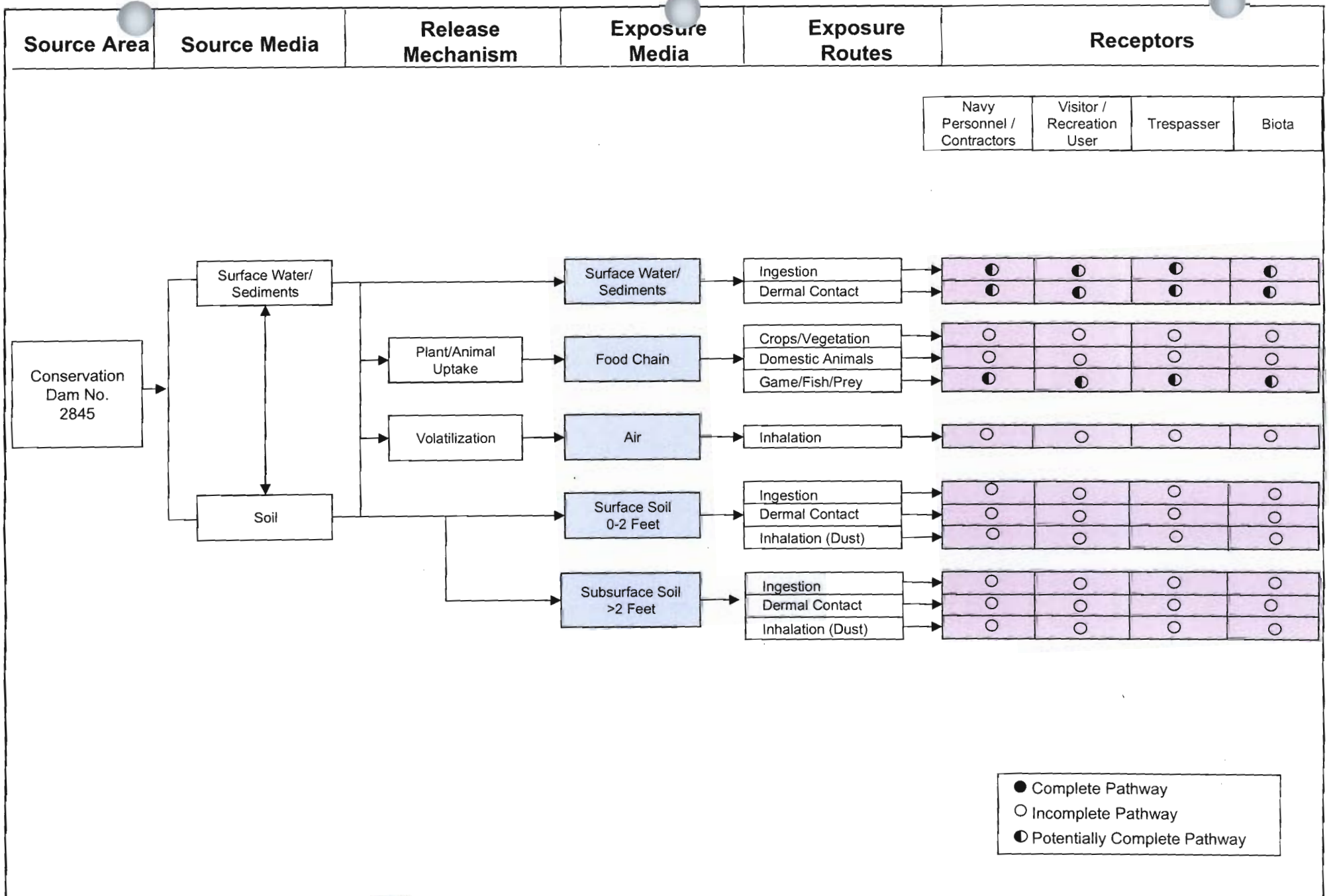
MALCOLM PIRNIE

Prepared for:

WATER AREA MUNITIONS STUDY – FINAL REPORT
CONSERVATION DAM NO. 2845 – MEC EXPOSURE PATHWAY ANALYSIS
NSWC CRANE, INDIANA

MALCOLM PIRNIE, INC.

FIGURE 5.11-1 DRAFT FINAL
APRIL 2005



MALCOLM PIRNIE

Prepared for:

WATER AREA MUNITIONS STUDY – FINAL REPORT
CONSERVATION DAM NO. 2845 – MC EXPOSURE PATHWAY ANALYSIS
NSWC CRANE, INDIANA

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FIGURE 5.11-2 DRAFT FINAL
APRIL 2005

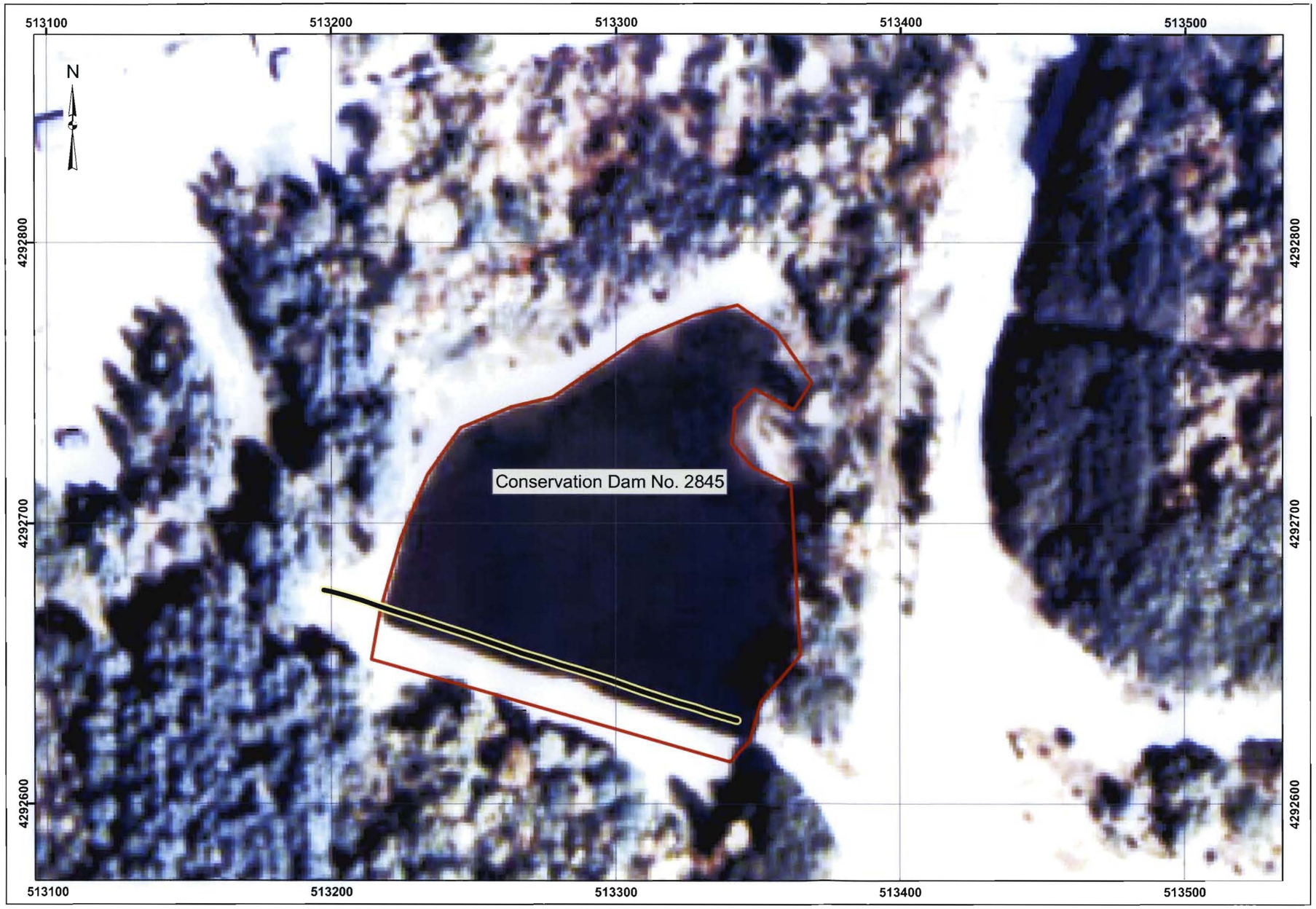
FIGURE 5.11-3
CONSERVATION DAM NO. 2845
GRAPHICAL ILLUSTRATION

DISCLAIMER

THIS ILLUSTRATION IS INTENDED FOR USE IN CONJUNCTION WITH THE REPORT IN WHICH IT WAS SUBMITTED AND IS NOT INTENDED TO BE USED AS A STAND ALONE DOCUMENT.

5.12. Summary

The 4.1-acre Conservation Dam No. 2845 was used in the late 1970s for testing floating type pyrotechnics. According to installation personnel, testing of marking dye (greens and orange) on life vests was conducted. Naval personnel currently use Conservation Dam No. 2845 for recreational fishing. There are no current plans to change that use. There is a potential for MEC to be present in the sediment at the site as a result of partially consumed dye markers and their associated components settling to the bottom of the lake. There is also a potential for MC to be present at the site because of the MC associated with the munitions themselves. In addition, since the site was used for limited range use and the dye markers were fired over the water, evidence of MEC or MC in the surface water would have dissipated over the years. Potential receptors at the site include Navy personnel, contractors, authorized visitors, and trespassers who work in the nearby facilities or use the lake for recreation, as well as biota.



Water Area Munitions Study
NSWC Crane, Indiana

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Map 5-1
Visual Survey
Conservation Dam No. 2845

Legend

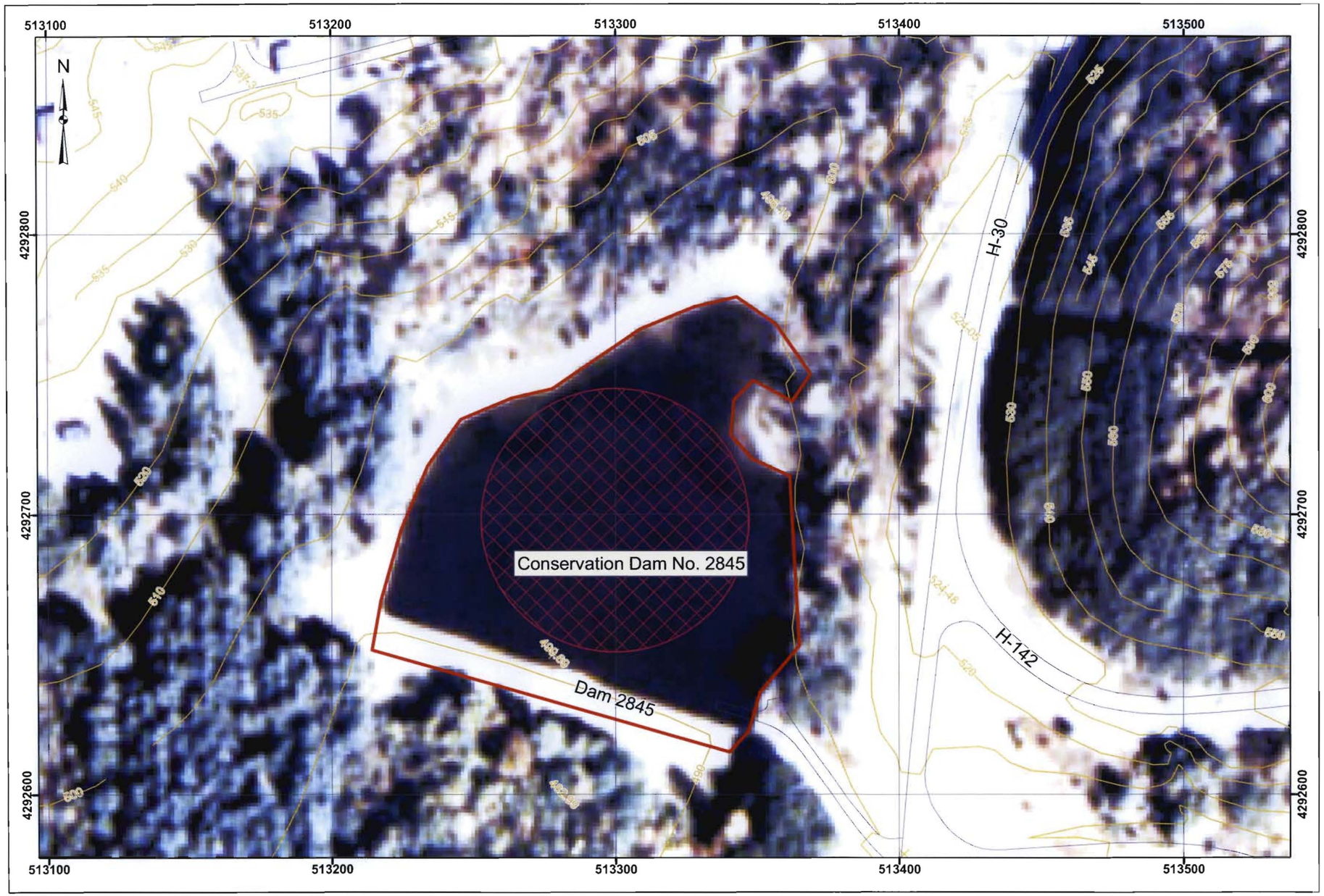
- Installation Boundary
- Conservation Dam No. 2845
- Site Reconnaissance

25 0 25 50 75 Meters

Data Source: NSWC Crane, Orthophoto, 1998
NSWC Crane, GIS Data, 2003

Coordinate System: UTM Zone 16N
Datum: NAD83
Units: Meters

Contract: N62472-02-D-1300
Edition: Final Water Area Munitions Study
Date: April 2005



Water Area Munitions Study
NSWC Crane, Indiana

Map 5-2
Range/Site Details
Conservation Dam No. 2845

Legend

- Installation Boundary
- Contours
- Roads
- Target Area
- Conservation Dam No. 2845

25 0 25 50 75 Meters

Data Source: NSWC Crane, Orthophoto, 1998
NSWC Crane, GIS Data, 2003

Coordinate System: UTM Zone 16N
Datum: NAD83
Units: Meters

Contract: N62472-02-D-1300
Edition: Final Water Area Munitions Study
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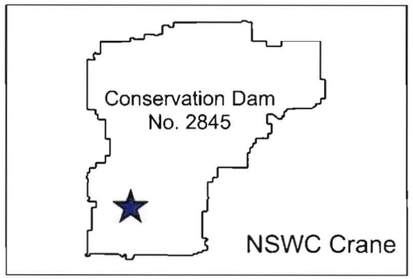

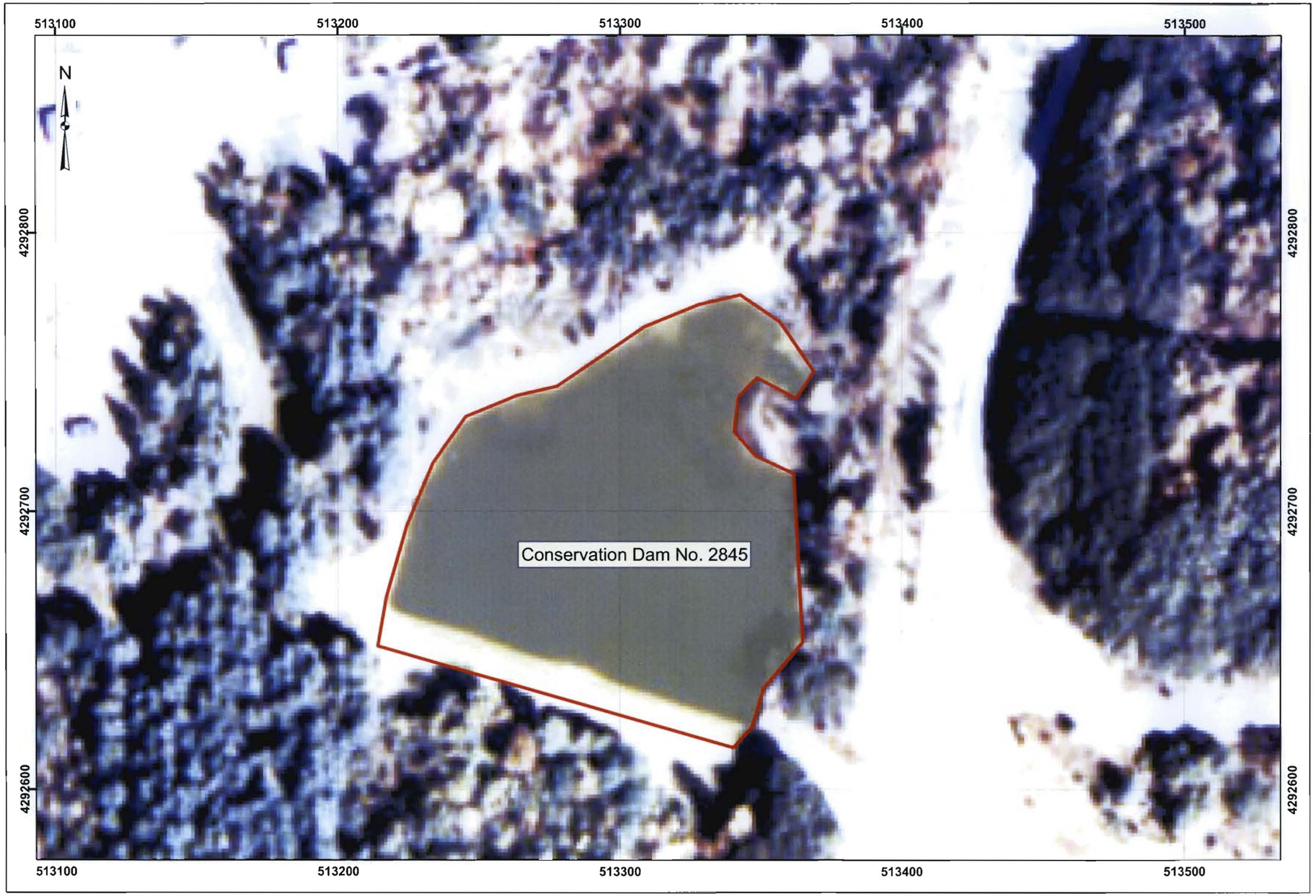

Water Area Munitions Study
NSWC Crane, Indiana

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Map 5-3
Munitions Characterization
Conservation Dam No. 2845

Legend

Installation Boundary

Conservation Dam No. 2845

MEC Presence*

Known

Suspect

* MEC Presence was determined through review of historical documentation, interviews, and visual survey.

25 0 25 50 75 Meters

Data Source: NSWC Crane, Orthophoto, 1998
NSWC Crane, GIS Data, 2003

Coordinate System: UTM Zone 16N
Datum: NAD83
Units: Meters

Contract: N62472-02-D-1300
Edition: Final Water Area Munitions Study
Date: April 2005

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Appendix A

A

Appendix A: References

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Zitzman, Ron. Personal interview by Julie Grim. March 19, 2003.

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NSWC Crane, Restoration Advisory Board
http://www.crane.navy.mil/General/RAB/SWMU.htm.

Maps:

Electronic base map data dated 1998 was received from Tom Brent, Environmental Protection Specialist at NSWC Crane Division. No munitions related ranges or information is depicted on the maps but they establish base map references for the installation. The data layers included:

- Installation boundaries
- Installation landmarks (buildings, pads, roads)
- Topography
- Hydrology
- Environmental features (wetlands, habitat)
- Imagery (aerial photography from current and earlier time periods)

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Crane Naval Ammunition Depot, Indiana. Basic Loading Plant, General Plot Plan Building Locations. Department of the Navy, Bureau of Yards and Docks, District Public Works Office, Ninth Naval District, Great Lakes, Illinois. April 23, 1952. (RG #71 Records of the Bureau of Yards & Docks, 903-32-907 Crane, Indiana)

Naval Weapons Support Center Crane, Indiana. General Development Map, Key Map. Department of the Navy, Naval Facilities Engineering Command. October 1961, additions and deletions April 1974.

U.S. Naval Ammunition Depot, Crane, Indiana. Production Areas. Undated.

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Appendix B

B

Appendix B: Project Source Data – General

(Provided on enclosed CD)

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Appendix C

C

Appendix C: Project Source Data – Site Specific

(Provided on enclosed CD)

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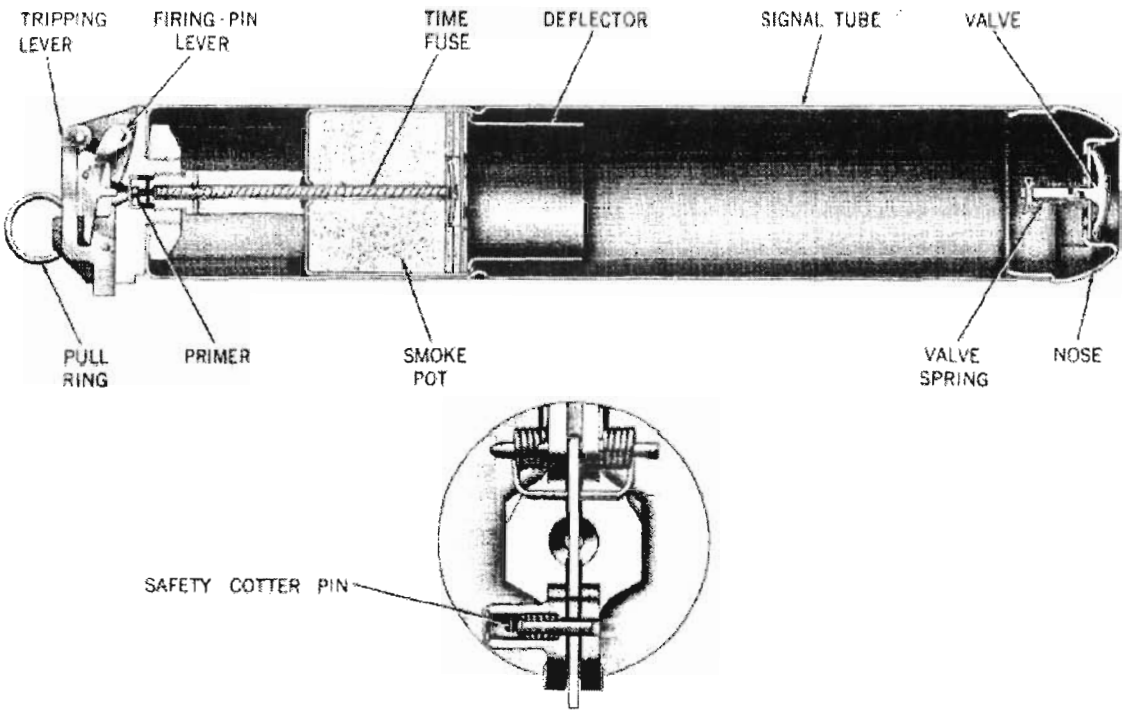
Appendix D

D

Appendix D: Ordnance Technical Data Sheets

Ordnance Technical Data Sheet
Submarine Float Signal Mk2 Mod 2



Nomenclature:	Submarine Float Signal Mk2 Mod 2
Ordnance Family:	Pyrotechnics
DODIC:	Unknown
Filler:	Smoke Composition
Filler weight:	Unknown
Item weight:	1.81 k (4 lbs)
Diameter:	76.20 mm (3 in)
Length:	472.70 mm (18.61 in)
Maximum Range:	N/A
Fuze:	Percussion

Usage: This signaling device was designed to be launched at a maximum depth of 285 feet to produce a red, black, green, or yellow smoke display on the surface.

Description: This signal consists of a cylindrical aluminum tube, which is closed at one end by a rounded nose cap with concave center into which the blowout valve is fitted. At the base end is the firing mechanism. The case is stenciled to show the color of the smoke emitted.

Reference: OP 2213, Pyrotechnic, Screening, and Dye Marking Devices, 1 Oct 1965, Change 19, 1 Jan 1969

Enclosure (2)

February 2007
Water Area Munitions Studies
Site Recommendations

SITE RECOMMENDATIONS

NSWC Crane, Indiana

The following recommendations are made for the Conservation Dam No. 2845, Dugger Lake Facility, Lake Greenwood Pyro Test Area Near Dam, and Lake Oberlin located at Naval Surface Warfare Center Crane Division (NSWC Crane), Indiana. The recommendations are based on data presented in the April 2005 Final Water Area Munitions Study (WAMS) prepared by Malcolm Pirnie, Inc. If additional data are discovered, the recommendations should be reviewed and updated appropriately. Additionally, the recommendations represent the minimal investigation needed to gauge future activities. As such, only the next phase of investigation is provided in the recommendations, it does not reflect all investigations required for closure of the sites.

Recommendations are presented below for munitions and explosives of concern (MEC) and munitions constituents (MC) for the four sites.

Conservation Dam No. 2845

Data Summary

The 4.1-acre Conservation Dam No. 2845 is located in the center of the southern portion of NSWC Crane, located directly west of the intersection of Highway 30 and Highway 142. Conservation Dam No. 2845 was used in the late 1970s for testing floating type pyrotechnics. According to installation personnel, testing of marking dye (greens and orange) on life vests was conducted. MEC would only be associated with floating type pyrotechnics if the munitions did not function as designed. It was Navy policy at the time to remove ordnance after testing. If successful, the munitions tested would not leave any significant debris, and if unsuccessful, the munitions were retrieved intact from the lake surface. Therefore MEC is not expected to be present at the site. Potential MC associated with the smoke filler may include a combination of various chemicals that are contained in burning-type colored smoke munitions and explosive-type colored smoke munitions. Some chemicals used in typical smoke compositions include zinc oxide, sulfur, sodium hydrogen carbonate, sodium chloride, potassium chlorate, and various organics. However, since the site was used for limited range use and the dye markers were fired over the water, evidence of MC in the surface water would have dissipated over the years.

Recommendations

Based on the data collected and presented in the April 2005 Final WAMS, a site inspection (SI) with confirmation sampling for MC is recommended, and NFA is recommended for MEC for Conservation Dam No. 2845. With respect to MC, confirmational sampling to support the decision for NFA should be conducted. Further investigation will provide the necessary information to decide the extent, type and location of MC contamination. Sampling should include the surface water and sediment at Conservation Dam No. 2845 (approximately 4 sampling locations). Sediment samples should be collected from all areas of the site, including at the base of the dam by the unnamed tributary. Surface water samples should be collected from all areas of the lake, including the unnamed tributaries that flow into and out of Conservation Dam No. 2845. The surface water and sediment samples should be analyzed for perchlorate and explosives residuals. With respect to MEC, no physical evidence was observed to indicate MEC remains at the site. NFA is recommended for MEC because MEC is not expected to be present at the site.

	Conservation Dam	
Options	**MEC**	**MC**
No Further Action	X	
Site Inspection		X
Remedial Investigation		
Removal Action		

Dugger Lake Facility

Data Summary

The 5.9-acre Dugger Lake Facility is located at the northwest quarter of section 26, township 8 north, range 8 west, in Sullivan County, Indiana on the 48-acre Dugger Lake. Dugger Lake Facility was used for hydro acoustic testing and testing of MK 58 Mod 2 Marine Markers, MK 3 Mod 1 Cable Cutters, Swimmer Recall Devices, SEC and ECD from 1975 through 1994. No evidence of MEC was observed around the rim of the lake, and site personnel indicate that numerous underwater dives at the lake have not identified any MEC. It was Navy policy at the time to remove ordnance after testing. If successful, the munitions tested would not leave any significant debris, and if unsuccessful, the munitions were retrieved intact from an attached cable. It is not expected that MEC remain in the lake. Potential MC expected to be associated with the munitions tested at the site include explosive composition B, black powder, and an assortment of

metals. There is a potential for MC to exist in the lake sediments at the site due to the amount of MC associated with the tested munitions. Because water is pumped from the lake on a continual basis by a local mining company, it is unlikely that MC still remain within the water column.

Recommendations

Based on the data collected and presented in the April 2005 Final WAMS, NFA is recommended for MEC, and additional sampling is recommended for MC at the Dugger Lake Facility. With respect to MEC, no physical evidence was observed to indicate MEC remains at the site. It is unlikely that MEC would remain at the site due to Navy policy at the time to remove all retrievable MEC debris after each testing. With respect to MC, confirmational sampling to support the decision for NFA should be conducted. Sampling should include the surface water and sediment at the Dugger Lake Facility (approximately 6 sampling locations). Surface water and sediment samples should be collected from all areas of the lake, but should be concentrated in the former target area along the southern shore. The surface water and sediment samples should be analyzed for metals and explosives residuals.

	Dugger Lake	
Options	**MEC**	**MC**
No Further Action	X	
Site Inspection		X
Remedial Investigation		
Removal Action		

<u>Lake Greenwood Pyro Test Area Near Dam</u>

Data Summary

The 800-acre Lake Greenwood is located in the north-central portion of NSWC Crane. Highway 5 and Highway 45 parallel the lake to the south. The Lake Greenwood Pyro Test Area Near Dam dates from the 1950s when the site was used for testing of green markers, underwater illuminating flares, and marine markers from a boat floated into the lake and from the shoreline. The following markers and flares were used at the site: Signal, Illumination, Marine, MK 5 Mod 4; Signal, Smoke, Marine, MK 25; Signal, Smoke, Marine, MK 7 Mod 2; Signal, Smoke, Marine, MK 6 Mod 3; and Underwater Illuminating Flares. Flares and pyrotechnics were fired into two specific locations of the lake (the Pyro Test Area Near Dam and the Officer's Club Target Area), the associated MCs are not contained in those areas due to the natural flow of water. There is a potential for MCs to be located in the lake, including in the sediment, as a result of the

underwater illumination flare and marine signal marker testing. Due to the natural flow of water, the expected impacts from MCs would be in the immediate area of the two former test areas and downstream of the test areas. However, there is a minimal probability that MCs are present at the site because of the minimal amounts of MC associated with the flares and/or markers. In addition, since the markers and illuminating flares were fired over the water, evidence of MC in the surface water would have dissipated over the years. MEC would only be associated with marine markers or flares if the munitions did not function as designed. It was Navy policy at the time to remove ordnance after testing. If successful, the munitions tested would not leave any significant debris, and if unsuccessful, the munitions were retrieved intact from the lake surface. Therefore, MEC is not expected to be present at the site.

Recommendations

Based on the data collected and presented in the April 2005 Final WAMS, an SI with confirmation sampling for MC is recommended, and NFA is recommended for MEC for Lake Greenwood Pyro Test Area Near Dam. With respect to MC, confirmational sampling to support the decision for NFA should be conducted. Sampling should include the surface water and sediment at Lake Greenwood (approximately 8 sampling locations). Surface water and sediment sampling locations should include upstream samples, samples at the two former test areas (the Pyro Test Area Near Dam and the Officer's Club Target Area), and downstream samples. The surface water and sediment samples should be analyzed for perchlorate. With respect to MEC, no physical evidence was observed to indicate MEC remains at the site. NFA is recommended for MEC because MEC is not expected to be present at the site.

	Lake Greenwood	
Options	**MEC**	**MC**
No Further Action	**X**	
Site Inspection		**X**
Remedial Investigation		
Removal Action		

Lake Oberlin

Data Summary

The 3-acre Lake Oberlin is located in the northwest corner of NSWC Crane. It is located north of the intersection of Highway 5 and Highway 449, approximately 1,000 feet west of Lake Greenwood, the largest water body at NSWC Crane. The history of Lake Oberlin dates from the

1950s when it used for testing of fluorescence dye markers and submarine flotation flares. Potential MC associated with the smoke filler may include a combination of various chemicals that are contained in burning-type colored smoke munitions and explosive-type colored smoke munitions. Some chemicals used in typical smoke compositions include zinc oxide, sulfur, sodium hydrogen carbonate, sodium chloride, and potassium chlorate. There is a minimal probability that MCs are present at the site because of the minimal amounts of MC associated with the flares and/or markers themselves. In addition, since the flares and dye were fired over the water, evidence of MC in the surface water would have dissipated over the years. MEC would only be associated with fluorescence dye markers and submarine flotation flares if the munitions did not function as designed. It was Navy policy at the time to remove ordnance after testing. If successful, the munitions tested would not leave any significant debris, and if unsuccessful, the munitions were retrieved intact from the lake surface. Therefore, MEC is not expected to be present at the site.

Recommendations

Based on the data collected and presented in the April 2005 Final WAMS, an SI with confirmation sampling for MC is recommended, and NFA is recommended for MEC for Lake Oberlin. With respect to MC, confirmational sampling to support the decision for NFA should be conducted. Sampling should include the surface water and sediment at Lake Oberlin (approximately 3 sampling locations). Surface water and sediment samples should be collected throughout the entire lake, but sampling should focus on the former target area north of the dam. The surface water and sediment samples should be analyzed for perchlorate. With respect to MEC, no physical evidence was observed to indicate MEC remains at the site. NFA is recommended for MEC because MEC is not expected to be present at the site.

	Lake Oberlin	
Options	**MEC**	**MC**
No Further Action	**X**	
Site Inspection		**X**
Remedial Investigation		
Removal Action		