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REVISED FINAL SITE INSPECTION REPORT FOR MUNITIONS RESPONSE PROGRAM SITE UNEXPLODED ORDNANCE 2 NWS YORKTOWN VA

06/01/2011

CH2M HILL

Revised Final

Site Inspection Report
Munitions Response Program Site UXO-2

Naval Weapons Station Yorktown
Yorktown, Virginia

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic Division

Contract No.
N62470-08-D-1000
CTO-WE23

June 2011

Prepared by

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Under the

NAVFAC CLEAN 1000 Program
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Prepared by

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Virginia Beach, Virginia

Executive Summary

This report summarizes the Site Inspection (SI) desktop review activities conducted for Munitions Response Site (MRS) Unexploded Ordnance (UXO)-2 (formerly Site 2) located within the Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia. This SI Report was prepared under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000, Contract Task Order WE23 (Mod 1) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The primary objectives of this investigation were to summarize previous environmental and munitions related investigations and reports, review the current status of UXO-2, and identify areas of UXO-2 requiring further investigation.

UXO-2, Turkey Road Landfill, is a 5-acre landfill bordered to the south by Turkey Road and to the east, west, and north by two unnamed tributaries to the Southern Branch of Felgates Creek. Disposal activities were conducted at the site from the 1940s until 1981, peaking around 1968. Waste disposed in the landfill during this time period reportedly included mercury and carbon-zinc batteries, tree stumps and limbs, construction rubble, missile hardware (e.g., wings, fins and power packs), electrical devices, and unmarked drums and/or tanks. Investigations of site soil, groundwater, surface water, and sediment were initially conducted under the Environmental Restoration Program (ERP) from 1984 to 2005, until the discovery of a potential ordnance item in July 2005. Due to the potential for munitions and explosives of concern (MEC) or material potentially presenting an explosive hazard (MPPEH) to be present onsite, Site 2 was transferred to the Military Munitions Response Program (MMRP) and designated as UXO-2 for further investigation. A non-intrusive geophysical investigation was performed in April 2010 in the southern area of the site to identify the previously undefined southern waste boundary of the site. This survey confirmed that the majority of the waste present is concentrated around the site periphery, indicating that waste was likely pushed from the site out into the surrounding low lying areas as it was disposed.

Although a targeted surface debris removal was conducted in 1994 to remove potential sources of contamination, miscellaneous surface debris and buried waste remain in place. As a result, there is potential risk to human and ecological receptors from direct contact with exposed waste, direct contact with exposed MEC or MPPEH, if present, or ingestion or dermal contact with contaminants leached from waste and munitions items. The Human Health Risk Assessment (HHRA) conducted as part of the Round II Remedial Investigation (RI) indicated concentrations of cadmium currently present might pose potentially unacceptable risk to hypothetical future adult and child residents. The Ecological Risk Assessment conducted as part of the Round II RI did not identify any ecological risk drivers in site surface water or sediment. However, there remains the potential for contaminant concentrations to increase, due to leaching from buried waste, and migrate to downgradient media as long as a source of contamination remains in place. Additional investigation is required to define the lateral and vertical extent of waste, the nature and extent of contamination present in site media, and the potential for contaminant migration.

Investigation activities at UXO-2 were halted due to the discovery of a munitions item that could not be readily identified in the field, which was subsequently identified as inert. To date, only inert munitions have been identified onsite. Due to the low probability of encountering MEC or MPPEH, it is recommended that investigation activities to delineate the landfill boundary and the nature and extent of contamination recommence under an Explosive Safety Submission (ESS) determination request (to be submitted and approved by the Naval Ordnance Safety and Security Activity). As a conservative measure, UXO personnel should be onsite and provide construction support during all intrusive activities, and all site workers should receive site specific UXO awareness training. Prior to the start of fieldwork, the current Soil Investigation Work Plan should be reviewed and revised to ensure that the current scope of work reflects the most current available data.

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Acronyms and Abbreviations

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
CTO	Contract Task Order
°F	degrees Fahrenheit
DGM	digital geophysical mapping
EOD	Explosive Ordnance Disposal
ERA	Ecological Risk Assessment
ERP	Environmental Response Program
ESS	Explosives Safety Submission
HHRA	Human Health Risk Assessment
HI	hazard index
IAS	Initial Assessment Study
MC	munitions constituents
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command
NOAA	National Oceanic and Atmospheric Administration
NSWC	Naval Surface Warfare Center
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
RI	Remedial Investigation
SI	Site Inspection
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
WPNSTA	Naval Weapons Station

SECTION 1

Introduction

This Site Inspection (SI) Report summarizes previous investigation activities and reports that were completed for Military Munitions Response Program (MMRP) Unexploded Ordnance (UXO)-2 (formerly Site 2), Turkey Road Landfill, located at Naval Weapons Station (WPNSTA) Yorktown in Yorktown, Virginia. It has been prepared under Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000, Contract Task Order (CTO) WE23. The conclusions and recommendations provided in this report will be used by the Navy to evaluate future investigations or activities that may be necessary at the site.

1.1 Objectives of the Site Investigation

The primary objectives of this investigation/desktop review were to:

- Summarize previous and existing environmental and munitions response investigations and reports for UXO-2, Turkey Road Landfill.
- Identify areas requiring further investigation.
- Provide conclusions and recommendations for future activities at UXO-2.

To accomplish these objectives, the scope of work for this SI included a desktop review of all available documents and data. The findings were compiled into this SI report.

1.2 Organization of the SI Report

This SI Report is organized as follows:

- **Section 1, Introduction:** Provides the objectives of the SI and overall format of the report.
- **Section 2, Facility Description and History:** Provides a description and history of WPNSTA Yorktown. Describes the physical characteristics, such as physiography, climate, and ground and surface water hydrology of the base.
- **Section 3, Site Description and History:** Provides a description and history of UXO-2. Describes the physiography, hydrogeology, ecological resources, and natural settings of the site.
- **Section 4, Previous Investigation:** Discusses previous investigation activities at UXO-2.
- **Section 5, Conclusions and Recommendations:** Summarizes the conclusions and recommendations for UXO-2.
- **Section 6, References:** Lists the documents used in preparation of the SI Report.

Figures are presented at the end of each section, as applicable. Appendices are provided at the end of the report.

SECTION 2

Facility Description and History

2.1 Naval Weapons Station Description

WPNSTA Yorktown is a 10,624-acre installation located on the York-James Peninsula in York and in James City counties and the city of Newport News, Virginia (**Figure 2-1**). WPNSTA Yorktown is bounded on the northwest by Cheatham Annex, on the northeast by the York River and the Colonial National Historic Parkway, on the southwest by Route 143 and Interstate 64, and on the southeast by Route 238 and the town of Lackey.

Originally named the United States Mine Depot, WPNSTA Yorktown was established in 1918 to support the laying of mines in the North Sea during World War I. For 20 years after World War I, the depot continued to receive, reclaim, store, and issue mines, depth charges, and related materials. During World War II, the facility was expanded to include three trinitrotoluene loading plants and new torpedo overhaul facilities. A research and development laboratory for experimentation with high explosives was established in 1944. In 1947, a quality evaluation laboratory was developed to monitor special tasks assigned to the facility that included the design and development of depth charges and advanced underwater weapons. On August 7, 1959, the depot was renamed the U.S. Naval Weapons Station Yorktown. Today, the primary mission of WPNSTA Yorktown is to provide ordnance, technical support, and related services to sustain the war-fighting capability of the Armed Forces in support of national military strategy.

2.2 Physiography, Climate, and Surface Water Hydrology

WPNSTA Yorktown is located on the York-James Peninsula, which is an embayed portion of the Atlantic Coastal Plain physiographic province. This elongated peninsula is situated due northwest of the mouth of the Chesapeake Bay and trends northwest to southeast. The York-James Peninsula occupies an area approximately 1,752 square miles, of which WPNSTA Yorktown covers approximately 16 square miles. The peninsula is bordered on the southwest by the James River, on the northeast by the York River, and on the southeast by the confluence of the James River and the Chesapeake Bay. At WPNSTA Yorktown, the peninsula is approximately 6 miles wide. The local terrain is gently rolling and dissected by ravines and stream valleys trending predominantly northeastward toward the York River. Ground elevations at WPNSTA Yorktown range from sea level along the eastern boundary, which borders the York River, to a maximum elevation of approximately 90 feet above mean sea level (msl) near the central portions of the York-James Peninsula, roughly coincident with the Old Williamsburg Road. Valleys consisting of 40-foot to 60-foot ravines with steep slopes (i.e., slopes exceeding 10:l gradient) occur along several of the creeks that drain WPNSTA Yorktown, particularly in the northern section of the Station along the York River.

The main tributaries of the York River in the vicinity of WPNSTA Yorktown are King Creek on the northwestern boundary of the Station, Ballard Creek on the eastern boundary of the Station, and Felgates and Indian Field Creeks in the northeastern region of the Station where

UXO-2 is located. The portion of WPNSTA Yorktown located south of the York County/ James City County boundary and Old Williamsburg Road is situated in the James River Basin. The Commonwealth of Virginia classifies its surface waterways according to potential uses based on water quality. The streams found on the main section of WPNSTA Yorktown are in Section 1 of the York River Basin and are classified as Class 2 waters. A Class 2 water body means that the water is able to sustain fish populations, but is lacking in aesthetic quality, productivity, or in some structural characteristic. The Class 2 water body maintains good water quality, temperature, and summer flow; adjacent land is not extensively developed. The main surface waterways are tidal and brackish and are; therefore, not potable. However, these estuaries are highly productive areas for the development of aquatic communities and are therefore subject to the Virginia Department of Environmental Quality (VDEQ) Water Division's surface water quality criteria standards.

The climate of the Virginia Peninsula is maritime and influenced by the moderating effects of the Atlantic Ocean. This results in mild winters and long, warm summers. High humidity occurs frequently along the coast and less frequently inland. Freezing temperatures occur intermittently from October through March. Average monthly temperatures in the area range from approximately 38.8 degrees Fahrenheit (°F) in January to 77.4°F in July.

Because of its location near the coastline, York County is subject to easterly storms throughout late summer and early fall, causing high tides and flooding. Intense tropical hurricanes occasionally sweep the coast. Winter storms that move along the eastern seaboard are often associated with high winds and precipitation, occasionally in the form of snow, ice pellets, or rain; however, the snow is seldom prolonged or heavy. The average annual precipitation is 44.15 inches, with the summer months being the wettest and the winter months being the driest (Baker, 1995).

\\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE2-1_LOCATION_MAP.MXD MUNWIN 12/3/10

Legend

- Yorktown Naval Weapons Station Base Boundary
- Interstate 64
- County Lines

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Miles

Figure 2-1
WPNSTA Yorktown Location Map
Naval Weapons Station Yorktown
Yorktown, Virginia

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SECTION 3

Site Description and History

3.1 Site Description and History

Turkey Road Landfill is a 5-acre landfill located in the central portion of WPNSTA Yorktown (**Figure 3-1**). The study area is bordered to the south by Turkey Road and to the north, east, and west by unnamed tributaries to the Southern Branch of Felgates Creek (**Figure 3-2**). Southwest of Turkey Road Landfill is Site 28 (**Figure 3-2**) which consists of the Building 28 X-Ray Facility and septic tank drain field and a portion of an unnamed tributary that drains into the southern branch of Felgates Creek. Prior to utilization as a landfill, the area was predominantly marshland. The site appears to have been created by pushing debris into the marshland and filling a low-lying area. The site is bounded by stream channels on the eastern and western sides that join in forming the marshy area surrounding the site to the north. The majority of the site is covered with scrub brush and grasses and a few small trees. Disposal activities were conducted from the 1940s until 1981, peaking around 1968. Extensive ground scarring in the area is visible in historical photographs during this time period (Bionetics, 1992). Photographs from this analysis are included in Appendix **A**. Waste disposed in this landfill reportedly included mercury and carbon-zinc batteries, tree stumps and limbs, construction rubble, missile hardware (e.g., wings, fins and power packs), electrical devices, and unmarked drums and/or tanks. In total, an estimated 240 tons of waste were disposed during the period of use. Based on boring logs, the maximum contamination depth is estimated to be approximately 6 feet (Baker, 2004).

In 1984, the site was designated as Site 2 under the Environmental Restoration Program (ERP) based upon the potential for a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) related release to the surrounding environment. Investigations of site soil, groundwater, surface water, and sediment were conducted under the ERP from 1984 to 2005, until the discovery of a potential ordnance item in July 2005. Due to the potential for munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) to be present onsite, Site 2 was transferred to the MMRP and designated as UXO-2 for further investigation.

3.2 Site Physiography and Hydrogeology

UXO-2 is currently an open field with some tree cover around the perimeter of the site. Topography in the central portion of the site is relatively flat, ranging from 16 to 10 feet above msl, and sloping steeply down to sea level toward the unnamed tributaries along the northern, eastern, and western boundaries (**Figure 3-3**).

The uppermost hydrogeologic unit at UXO-2 is the Columbia aquifer, characterized by unconsolidated deposits of gray to brown silt with varying percentages of sand and clay. This unit extends approximately 5 to 20 feet below ground surface (bgs). This geologic unit is underlain by increasing concentrations of clay characteristic of the Cornwallis-Cave confining unit. No boring logs at the site have extended beyond this confining unit;

however, it has been found to extend at least 22 feet thick at other sites at the facility. Groundwater at the site is first encountered between 8 to 12 feet bgs and is expected to flow radially from the center of the site towards the surrounding unnamed tributaries. Available data indicates that shallow groundwater is not tidally influenced (Baker/Weston, 1993).

3.3 Ecological Settings and Natural Resources

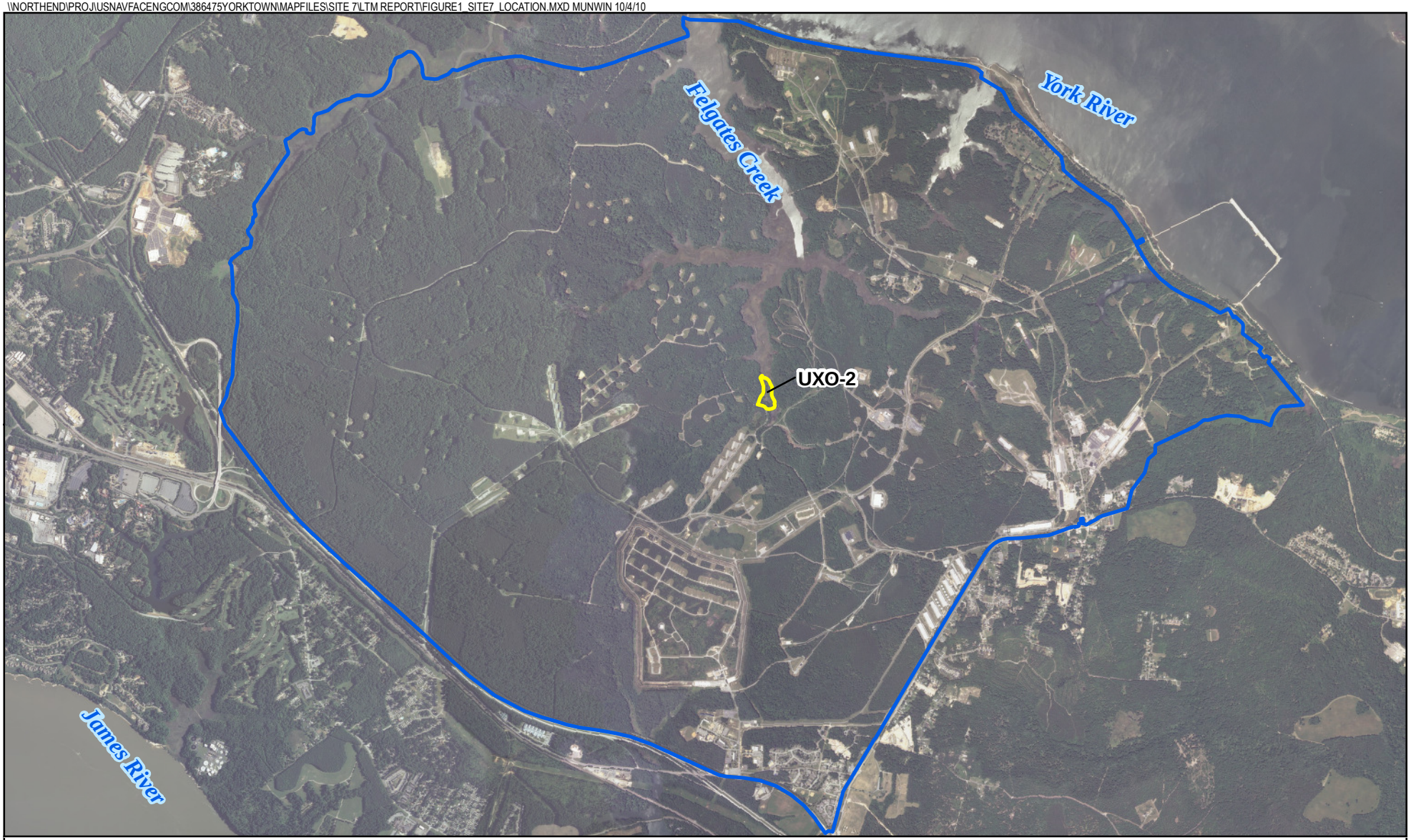
Four distinct ecological habitats are present in the vicinity of UXO-2. These include a deciduous upland forest, an open area on top of the disposal area, an ecotone (transitional zone) along the edges of the disposal area, and wetlands along the tributaries to Felgates Creek, as shown in the biohabitat map included as **Appendix B (Baker, 1995)**. The upland forest is present along Turkey Road and on the higher ground to the east and west of the site. Various upper canopy and mid-canopy tree species are found in the upland forest. Vegetation on the forest floor is also sparse and is comprised of species typical of acidic soils. Within the open field there are no trees, shrubs, or vines present. Grasses are the dominant species. These grasses are mixed with few herbaceous annuals or perennials because of regular mowing. Between the open area at UXO-2 and the wetland, an ecotone or transition zone is present. This ecotone area includes a variety of trees, shrubs, woody vines, and herbaceous plants, none of which is dominant. Young trees and saplings in the ecotone are mixed with shrubs. A few species of woody vines are also present in the ecotone. Herbaceous annuals and perennials are also common in the ecotone, particularly along the edges of the open area.

Wetlands are present along both tributaries to Felgates Creek that flank the disposal area and along Felgates Creek itself. These wetlands represent three different sub-habitats. The wetland to the south of the disposal area between Turkey Road and the rail line was formed when beavers dammed the eastern tributary of Felgates Creek. This wetland is classified as a palustrine, scrub shrub wetland. Stressed and dead trees still stand in this wetland area. Various rushes and sedges are also present. The wetland downstream of the palustrine scrub shrub wetland and the wetland to the west of the disposal area are both classified as palustrine forested wetlands. In these areas upland forest is present to the edges of the lower wetland areas, which can be delineated by topography and wetland vegetation. Shrubs are not present. As the tributary flows from the wooded area into Felgates Creek sedges, rushes, and cattails appear. These palustrine forested wetlands grade into estuarine wetlands where the tributaries meet Felgates Creek. The wetlands along Felgates Creek are estuarine and consist primarily of tidal saltmarsh.

Because of the varied habitats present at UXO-2, avifauna at the site are abundant and diverse. Sixteen different species of birds were identified during a 1994 Habitat Evaluation Study (Baker, 1995) as being in the vicinity of UXO-2. Evidence of four mammal species was also observed during the habitat evaluation. Whitetail deer (*Odocoileus virginianus*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), and groundhog (*Marmota monax*) are all present near UXO-2. One reptile, the box turtle (*Terrapene carolina*), and one amphibian, the green frog (*Rana clamitans*) were also identified (Baker, 1995). The Integrated Natural Resource Management Plan for WPNSTA Yorktown identifies only one federally listed threatened species, the Bald Eagle (*Haliaeetus leucophalus*), and one state listed endangered species, the Mabee's salamander (*Ambystoma mabeei*), that reside on the station (Geo-Marine, 2004).

Neither of these species were identified at UXO-2 during the 1994 habitat evaluation (Baker, 1995).

\\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 7\LTM REPORT\FIGURE1_SITE7_LOCATION.MXD MUNWIN 10/4/10



Legend
- Study Area Boundary
- Naval Weapons Station Yorktown Boundary

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Feet

Figure 3-1
UXO-2 Location Map
Naval Weapons Station Yorktown
Yorktown, Virginia

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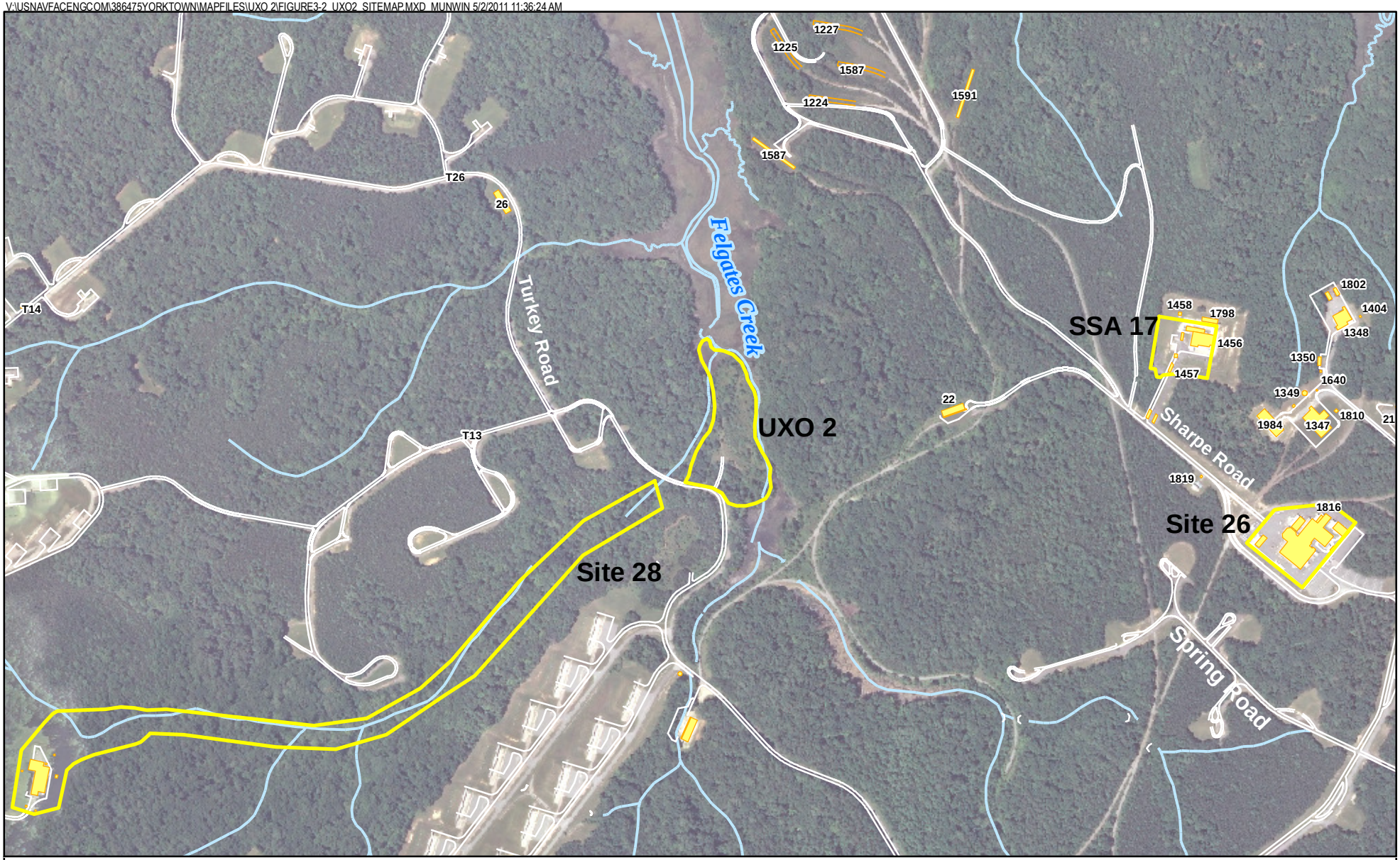
V:\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\UXO 2\FIGURE3-2_UXO2_SITEMAP.MXD MUNWIN 5/2/2011 11:36:24 AM



Legend

- Study Area Boundary
- Buildings
- Water Features

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0 400 800
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Figure 3-2
UXO-2 Site Map
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

V:\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\UXO 2\FIGURE3-3_UXO2.MXD MUNWIN 4/28/2011 10:51:09 AM

Legend

- Study Area Boundary
- Unnamed Tributary
- Elevation Contours (5 ft interval)

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Feet

Figure 3-3
UXO-2 Site Map
Naval Weapons Station Yorktown
Yorktown, Virginia

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SECTION 4

Previous Investigations

4.1 Initial Assessment Study (C .C. Johnson and CH2M HILL, 1984)

In 1984, the Initial Assessment Study (IAS) was performed to identify sites at WPNSTA Yorktown that may pose a potential threat to human health and the environment resulting from historical site-related activities. Site 2 was identified as a potentially contaminated site based on information from historical records, aerial photographs, field inspections, and personnel interviews. Historical documentation indicated waste disposal in the area and a site visit in July 1983 revealed the presence of several unmarked drums and tanks. The IAS concluded that Site 2 might pose a potential threat to human health and the environment and warranted further investigation.

4.2 Remedial Investigation Interim Report (Versar/Baker, 1991)

In 1986 and 1988, two rounds of sampling were conducted as part of the *Step 1A Confirmation Study Round One and Two* (Dames & Moore, 1986; 1988). In 1986 and 1988, two rounds of four groundwater and three co-located surface water and sediment samples were collected from the same locations (**Figure 4-1**). All samples collected were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semivolatile organic compounds (SVOCs) (referred to as base/neutral/acid extractable organics and phenols in the report), pesticides, polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals. The results of the Step 1A Confirmation Studies were summarized and compared to screening criteria in the Interim Remedial Investigation (RI) Report. Groundwater data was screened against USEPA Maximum Contaminant Levels (MCL) and Virginia State Ground Water Standards (VGS). Surface water data was screened against Federal Ambient Water Quality Criteria (FAWQC) and Virginia State Ambient Water Quality Criteria (VAWQC). There were no Federal or State standards or criteria applicable to soil or sediment at the time of this report. However, a 1984 background survey that measured background levels of 50 inorganic chemical elements in hundreds of background soil samples from throughout the eastern United States and Virginia was used to assess whether the metals concentrations observed in sediment samples were within the range of concentrations observed for regional soils.

Concentrations of phenols, total arsenic and total zinc detected in groundwater exceeded the VGS. Concentrations of phenols, total copper, and total silver detected in surface water exceeded the VAWQC (copper was also found at levels that exceeded the FAWQC). The Interim RI Report concluded that additional investigation was required to further characterize the nature and extent of contamination at Site 2. Additionally, a limited visual survey with the aid of a metal detecting device was suggested to delineate the boundaries of the site.

4.3 Round One Remedial Investigation Report (Baker/Weston, 1993)

From June to October 1992, additional sampling was conducted based on the recommendations in the Interim RI Report. A total of four groundwater samples from existing monitoring wells, seven co-located surface water and surface/subsurface sediment samples, and two additional independently placed surface/subsurface sediment samples were collected in order to characterize the nature and extent of contamination (**Figure 4-1**). All analytical samples were analyzed for TCL VOCs, TCL SVOCs, pesticides, PCBs, explosives, and TAL metals. In addition, a geophysical investigation using electromagnetic (EM31) survey was conducted to delineate the lateral and vertical extent of the waste and presence of subsurface anomalies.

Analytical results indicated that several total metals were detected above either VGS or federal MCLs in groundwater. However, the only metal that exceeded both the VGS and MCL was arsenic at one sample location. Total and dissolved metals samples collected from three monitoring wells contained concentrations of several metals above background levels.

Concentrations of total and dissolved copper and nickel in surface water and toluene and silver in sediment exceeded the VWQS and CWA criteria in one or more samples.

The concentrations of Aroclor 1248 and 4,4-DDE exceeded the National Oceanic and Atmospheric Administration (NOAA) low effects range criteria in one sediment sample (the two compounds were found in samples at different locations). A few of the metals concentrations exceeded the metals levels found in the background sediment samples. Silver concentrations also exceeded the NOAA median effects range and Apparent Effects Threshold (AET) criteria in five of the sediment samples.

The results of the geophysical investigation indicated minimal waste was present along the southern portion of the site and that the majority of the waste was located along the perimeter of the site adjacent to the drainage ways (**Appendix C**). Due to the peripheral distribution of waste, the report concluded that the waste was likely graded into the adjacent marshland during disposal. Analytical results indicated minimal site-related impacts to groundwater. Although exceedances of screening values were detected in surface water and sediment, the report concluded that detected concentrations were not site related because elevated concentrations of these constituents were not detected in groundwater samples. Based on the waste types, quantities, and locations within the landfill, as well as the distribution of contaminants detected, Site 2 was identified as a minimal impact site. The report recommended a removal action to address surficial waste and debris, followed by surface soil sampling to aid in the completion of a risk assessment.

4.4 Mine Casing and Debris Removal Action Closeout Report (IT Corporation, 1995)

A removal action was conducted from September to December 1994 in order to remove surface and near surface debris found within the first three feet of soil in designated areas of Site 2 and to collect surface soil samples from within these removal areas. Subsurface waste was not addressed as part of this action. The main objective of the removal action was to

eliminate risk from direct exposure to waste and remove potential sources of contamination. A UXO supervisor with the support of a UXO technician inspected and mechanically vented all munitions items encountered using conventional hand tools. In situations where positive identification and certification could not be made in the field, Station Explosive Ordnance Disposal (EOD) Detachment personnel were contacted to transfer the munitions items to the Naval Explosives Development Engineering Department laboratory on base for identification and disposal. Prior to site restoration, forty post-removal surface soil samples were collected from the perimeter of the site (**Figure 4-1**). Each sample was analyzed for TCL VOCs, TCL SVOCs, pesticides, PCBs, explosives, and TAL metals. The analytical results for these samples were not reported or discussed within the closeout report; however, they were later utilized in the HHRA and ERA performed during the Round 2 Remedial Investigation (Baker, 2004).

Following the collection of the post-removal soil samples, all the excavated areas were backfilled, revegetated, and mulched. General backfill was obtained from an on-base source, was sampled, and deemed appropriate for use at the site. Topsoil was obtained from an off-base source, was sampled, and deemed appropriate for use at the site as well. The backfill was placed and compacted by heavy equipment. The central portion of the site was crowned to promote positive surface water runoff. After the backfill was placed, approximately 6 inches of topsoil from an outside vendor was spread over the entire area. After regrading was completed, an erosion control blanket was placed along the embankment and silt fencing was left intact to minimize erosion during the establishment of the vegetation.

In total, approximately 2 tons of tar emulsion, 6 tons of non-fibrous filter material, 365 tons of batteries, and three drums were removed from Site 2. An additional 4,323 pieces of inert munitions were removed from multiple sites during excavation activities; however, the exact amount of inert munitions items from each site was not recorded. It is estimated that approximately ninety percent of the inert munitions items removed came from Site 2 (**Figure 4-2**). A list of the types and amount of each inert munitions item identified during the removal action is provided in **Appendix D**. Photographs detailing the types of debris removed from Site 2 are provided in **Appendix E**.

4.5 Round 2 Remedial Investigation (Baker, 2004)

From August to September 1996 and January to February 1997, additional sampling was conducted to fill identified data gaps. A total of 20 subsurface soil samples collected from two discrete depth intervals at 10 sample locations, seven groundwater samples from one existing and three newly installed monitoring wells, nine co-located surface water and surface/subsurface sediment samples, and three additional independently placed surface/subsurface sediment samples were collected in order to characterize the nature and extent of contamination. Three previously installed monitoring wells were found submerged under water during this investigation and were subsequently abandoned. More suitable locations were identified for the three replacement wells that were installed during this investigation (**Figure 4-1**). Each sample was analyzed for TCL VOCs, SVOCs, pesticides, PCBs, explosives, TAL metals, and cyanide. Data collected during the Round I RI, removal action, and Round II RI were combined to perform a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA). Soil and groundwater results (under a

beneficial use scenario) were compared to human health risk-based USEPA Region III Risk Based Concentrations (RBCs) during the HHRA. For the ERA, medium-specific screening values were established for ecologically relevant media including soil, surface water, and sediment. The soil, surface water, and sediment screening values used in the ERA were USEPA Region III Biological Technical Assistance Team (BTAG) screening values.

An exposure assessment was conducted as part of the HHRA to address each potential current and future exposure pathway in soil, groundwater, surface water, sediment, and air at Site 2. The exposure assessment identified that there is currently no Station housing at Site 2 and that at the site real estate is encumbered by an Explosive Safety Quantity Distance (ESQD) arc and, therefore, cannot be developed for Station housing of enlisted personnel. It was also noted that there are no drinking water wells installed in aquifers situated below WPNSTA Yorktown; drinking water is supplied by the City of Newport News. Potential human receptors to COPCs identified at Sites 2 were on-Station adult and adolescent recreational users and trespassers. Although future residential development of Sites 2 is highly unlikely, future residential exposure for potential adult and young child (ages 1 to 6 years) receptors was evaluated in accordance with health-conservative USEPA guidance. Since the shallow aquifer system within WPNSTA is not used as a potable water source, a beneficial use scenario was evaluated which considers groundwater being used for non-potable purposes, like car washing and lawn watering. Under the beneficial use scenario, young child and adult residents were considered to be potentially exposed to organic and dissolved inorganic COPCs in the Cornwallis Cave aquifer at the site.

The HHRA indicated potentially unacceptable noncarcinogenic risk from surface soil to hypothetical future adult and child residents from combined exposure to cadmium, thallium, Aroclor-1254, and copper under reasonable maximum exposure concentrations. However, cadmium was the only individual constituent exceeding United States Environmental Protection Agency (USEPA) acceptable target hazard index (HI) of 1.0. Under central tendency exposure concentrations, no individual constituent exceeded the target hazard index of 1.0 for either receptor; however, the total cumulative site HI still exceeded the target value for future child residents. Therefore, the HHRA concluded that concentrations of cadmium in the surface soil might pose potentially unacceptable risk to future residents. The ERA identified potentially unacceptable risk to aquatic lower trophic level receptors from exposure to silver in sediment. However, due to the presence of elevated silver concentrations detected upgradient of Site 2, the report concluded that Site 28 was the source of silver in unnamed tributary sediments.

The report recommended further characterization of polynuclear aromatic hydrocarbons (PAHs), Aroclor-1254, cadmium, and mercury in site soil to evaluate the potential for migration to and accumulation in downgradient media. Although current levels of exposure did not indicate the potential for unacceptable risk to aquatic receptors from these chemicals, the potential for continued source release and future exposures elevated above those measured in the current dataset warranted additional investigation.

4.6 Work Plan for the Pre-Removal Characterization of Soil (Baker, 2005)

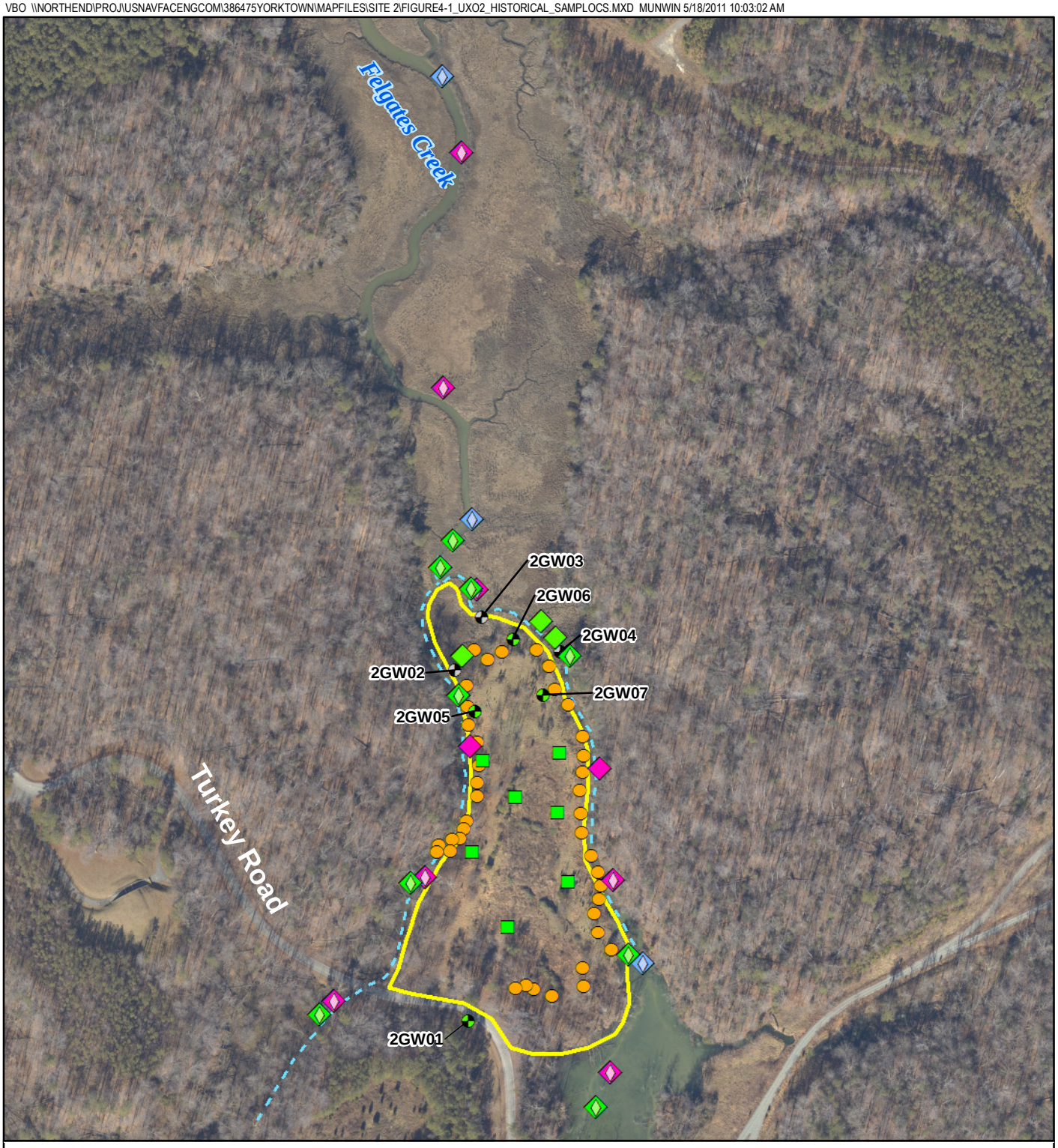
A Work Plan was developed outlining the sampling approach for exploratory trenching and additional soil sampling at Site 2 to define the extent of waste and concentrations of PAHs, Aroclor-1254, cadmium, and mercury. In June 2005, during investigation activities, an ordnance item was discovered that could not be deemed inert in the field. The EOD, Mobile Unit Two, Detachment Yorktown provided emergency response. Because the item potentially exceeded the Yorktown EOD range capability, the item was turned over to the Naval Surface Warfare Center (NSWC) Indian Head Detachment Yorktown who identified the item as a training round for the Bullpup A (AGM-12A). The item was identified based on markings present indicating that it was filled with concrete. The markings further indicated that it weighed 247 pounds and contained 107.1 pounds of filler. The item was drilled and tested by NSWC Indian Head Detachment Yorktown and determined to be inert. However, because of the identification of the potential ordnance item, the site was designated as a Munitions Response Site (MRS) and the Pre-Removal Characterization of Soil Investigation was halted. Once identified as a MRS, Site 2 was designated as UXO-2, a Munitions Response Site Prioritization Protocol (MRSPP) scoring (**Appendix F**) was completed, and a public announcement regarding its availability was published in local newspapers in May 2008.

4.7 Non-Intrusive Geophysical Investigation (CH2M HILL, 2010)

A non-intrusive geophysical survey was conducted in April 2010 to delineate the southern boundary of the landfill. The investigation was conducted across a 3-acre area in the southern portion UXO-2 and consisted of five foot wide transects evenly spaced across the investigation area for a total of 0.29 acres mapped. Data was collected using a Geometrics G-858 magnetometer and extrapolated to provide complete coverage of the investigation area. These survey results provide the approximate locations of buried ferrous metal. Detected anomalies are not necessarily munitions-related. Additional investigation would be necessary to identify the exact locations of individual anomalies to perform excavation and visual inspection of items to determine if they represent munitions-related items.

The data collected were used to confirm and supplement the results of the EM31 survey performed as part of the Round I RI (Baker/Weston, 1993). Results generally agreed with the findings of the EM31 survey; no distinguishable southern boundary of the site could be identified. The data also supported the conclusion that debris and waste were likely pushed out toward the wetlands surrounding the site and filled into the surrounding low lying areas. This is shown in the digital geophysical mapping (DGM) results by the lack of response in the central portion of the survey area. Isolated subsurface anomalies were detected in the northern and southern portions of the eastern boundary of the investigation area. The greatest concentration of anomalies was detected along the eastern boundary of the site (**Figure 4-3**). Further investigation would be required on the southeastern side of the investigation area to delineate the extent of debris in this area.

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE4-1_UXO2_HISTORICAL_SAMPLOCS.MXD MUNWIN 5/18/2011 10:03:02 AM



Legend

- Study Area Boundary
- Unnamed Tributary

Round 1 and 2 Confirmation Study
- Sediment Sampling Location
- Surface Water Sampling Location

Removal Action Confirmation Samples
- Surface Soil Sampling Location

Round 1 RI
- Abandoned Monitoring Well
- Sediment Sampling Location
- Surface Water Sampling Location

Round 2 RI
- Monitoring Well
- Subsurface Soil Sampling Location
- Sediment Sampling Location
- Surface Water Sampling Location

Figure 4-1
UXO-2 Historical Sampling Locations
Naval Weapons Station Yorktown
Yorktown, Virginia

N
W E
S

0 150 300
Feet

CH2MHILL

VBO \\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE4-2_TARGET_SURFACE_WASTE_REMOVAL.MXD MUNWIN 6/6/2011 3:26:16 PM

Legend

- Study Area Boundary
- Approximate Waste Disposal Area (based on Mine Casing and Debris Removal Action Closeout Report [IT Corporation, 1995])
- 1994 Surface Removal
- Unnamed Tributary

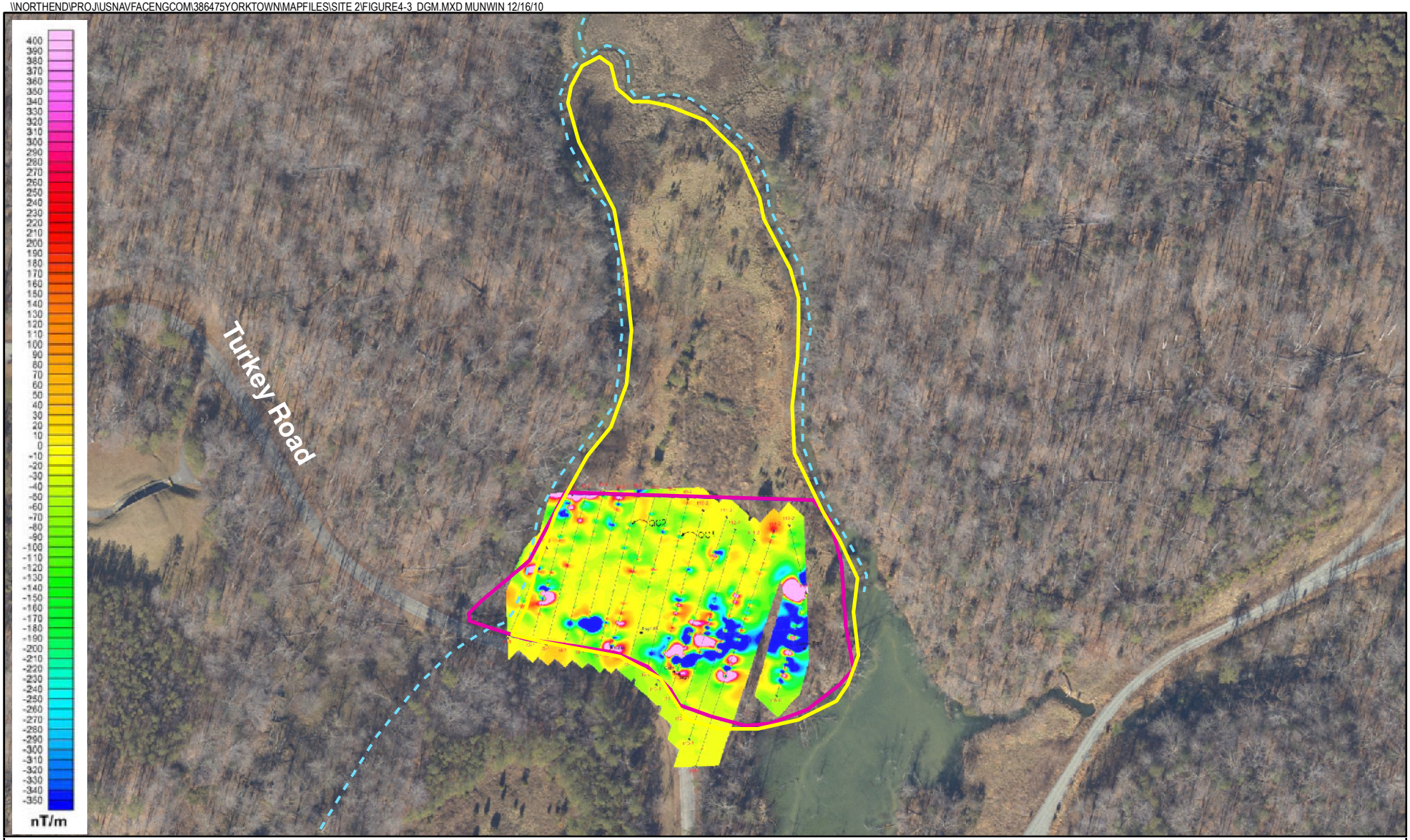
N
W E
S

0 100 200
Feet

Figure 4-2
UXO-2 Targeted Surface Waste Removal Results
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE4-3_DGM.MXD MUNWIN 12/16/10



Legend

- Study Area Boundary
- Magnetometer Investigation Area
- Unnamed Tributary

N
W E
S

0 100 200
Feet

Figure 4-3
UXO-2 Digital Geophysical Mapping Results
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

SECTION 5

Results and Conclusions

5.1 Results

The data presented in the previous sections, were used to develop the conceptual site model (CSM). The CSM is a useful engineering management tool that helps to manage site information and guide decision making throughout the environmental restoration process. CSMs are used to scope investigations, support potential risk management decisions, and aid in defining the effectiveness of potential remedial alternatives. The CSM summarizes the site conditions, the distribution of potential MEC and munitions constituents (MC), potential receptors and exposure pathways, and land use data for the site. For this report, the CSM has been updated to a graphical model format. The graphical CSMs for the UXO-2 are presented in **Figure 5-1**.

Based on the results of historical investigations, the extent of buried waste at UXO-2 is largely limited to the periphery of the site along the low lying wetland areas. Waste identified and removed from the site has consisted of tar emulsion, non-fibrous filter material, mercury and carbon-zinc batteries, unlabeled drums, and inert munitions items. Although a targeted surface debris removal was conducted in 1994 to remove potential sources of contamination, miscellaneous surface debris (including, but not limited to, paint cans, metal cylinders, railroad ties, cables, and miscellaneous metal) and buried waste remain in place. It is unknown whether or not this surface debris and buried waste includes munitions items. There is potential risk to human and ecological receptors from direct contact with exposed waste, direct contact with exposed munitions, or ingestion and dermal contact with contaminants leached from waste and munitions items. The HHRA conducted as part of the Round II RI indicated concentrations of cadmium currently present might pose potentially unacceptable risk to hypothetical future adult and child residents. The ERA did not identify any ecological risk drivers for site surface water or sediment. However, there remains the potential for contaminant concentrations to increase due to leaching from buried waste and migrate to downgradient groundwater, surface water, and sediment as long as waste remains in place.

5.2 Conclusions

UXO-2 was identified as a MMRP site due to the discovery of a munitions item that could not be identified as inert in the field, but was subsequently identified as inert by EOD. No documentation of munitions disposal activities or munitions certification processes was identified for the site; however, of the over 4,000 munitions items recovered and inspected, all were wholly inert training or display munitions items. This would lead to a reasonable belief that an efficient inspection process was in place to ensure that no live munitions (MEC) items were placed in the landfill. Due to the low probability of encountering MEC or MPPEH, it is recommended that investigation activities to delineate the landfill boundary and the nature and extent of contamination recommence under a determination that an

Explosives Safety Submission (ESS) is not required (an ESS Determination Request will be submitted and approved by the Naval Ordnance Safety and Security Activity). As a conservative measure, UXO Personnel should be on site and provide construction support during all intrusive activities, and all site workers should receive site specific UXO awareness training.

Prior to the start of fieldwork, the current Soil Investigation Work Plan should be reviewed and revised to ensure that the current scope of work reflects current data. The HHRA and ERA conducted during the Round II RI utilized screening values that have since been updated on the recommendation of the USEPA. Therefore, a revised HHRA and ERA are recommended prior to initiating sampling activities to reevaluate chemicals of potential concern for sampling. The HHRA should be expanded to assess sediment and surface water for relevant receptors and the ERA should each be expanded to assess surface and subsurface soil for relevant receptors. In addition, groundwater should be examined under a potable use scenario for future residents.

Hypothetical Future Residents:
Potential direct contact with exposed waste and munitions. Potential ingestion and dermal contact with contaminants accumulating in soil, groundwater, sediment, and surface water.

Hypothetical Future Construction Workers:
Potential direct contact with exposed waste and munitions. Potential ingestion and dermal contact with contaminants accumulating in soil, groundwater, sediment, and surface water.

Upper Trophic Level Terrestrial Receptors (white tail deer):
Potential ingestion and dermal contact with contaminants accumulating in soil and biota.

Current/Future Trespassers:
Potential direct contact with exposed waste and munitions. Potential ingestion and dermal contact with contaminants accumulating in soil, sediment, and surface water.

Lower Trophic Level Terrestrial Receptors:
Potential ingestion and dermal contact with contaminants accumulating in soil.

earthworm

Miscellaneous construction and/or demolition debris (Pallets, telephone pole, I-beam)

Tar Waste Piles

Miscellaneous construction and/or demolition debris (Concrete)

Miscellaneous construction and/or demolition debris (Wood intermixed with inert munitions)

Railroad ties, metal debris and cables

Miscellaneous construction and/or demolition debris (telephone pole)

Potential migration of contaminates from waste and munitions to downgradient media.

Battery Waste Pile

Tar Waste Piles

Paint cans and miscellaneous metal debris

Miscellaneous metal debris and cylinders

Turkey Road

Columbia Aquifer

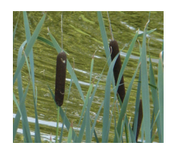
Cornwallis Cave Confining Unit

Felgates Creek

N

Current/Future Base Worker:
Potential direct contact with exposed waste and munitions. Potential ingestion and dermal contact with contaminants accumulating in soil.

Lower Trophic Level Aquatic Receptors:
Potential ingestion and dermal contact with contaminants accumulating in sediment and surface water.



cattails

Upper Trophic Level Aquatic Receptors:
Potential ingestion and dermal contact with contaminants accumulating in sediment, surface water, and biota.

green frog

LEGEND

- Water Table
- Observed during Non-intrusive Geophysical Investigation (CH2M HILL, 2010)
- 1994 Surface Removal (up to 3 ft. of soil/waste removed, area was then backfilled)
- Study Area Boundary
- Approximate Waste Disposal Area (based on Mine Casing and Debris Removal Action Closeout Report [IT Corporation, 1995])
- Approximate Groundwater Flow Direction

FIGURE 5-1
UXO-2 Conceptual Site Model
Naval Weapons Station Yorktown, Yorktown, Virginia

SECTION 6

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Appendix A
Historical Aerial Photographs

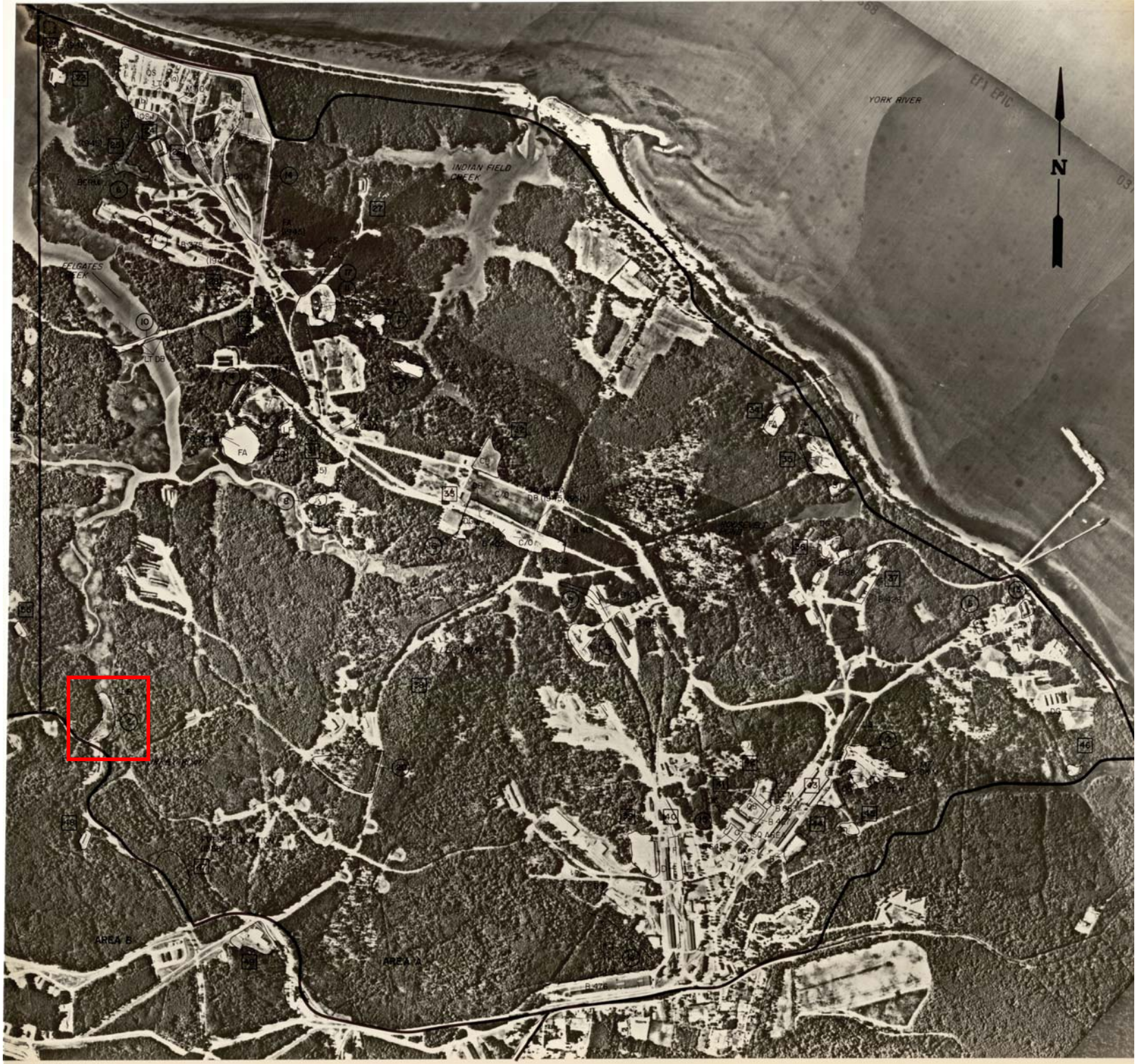


FIGURE 5
YORKTOWN NAVAL WEAPONS STATION

AREA A
JUNE 27, 1960

APPROX. SCALE 1:10,300

LEGEND

B - Building
C - Containers
CL - Clearing
CT - Coarse-Textured
D - Drums
DB - Debris
DG - Disturbed Ground
DK - Dark-Toned
DV - Dead Vegetation
EX - Excavation
EXT - Extraction
F - Foundation
FA - Fill Area
GR - Graded
GS - Ground Scar
HP - Helicopter Pad
HT - Horizontal Tank
LF - Landfill
LQ - Liquid
LT - Light-Toned
M - Material
MT - Medium-Toned
O - Object
OS - Open Storage
OW - Open Water
S - Structure
SQ - Square
ST - Stain
TR - Trench
U - Upland
UO - Unidentifiable Object
VEG - Vegetated
VS - Vegetation Stress
W - Wetland

- Access Road
- Berm
- Channelized Drainage
- Cylindrical Object
- Excavation
- Fence
\# - Known Contamination Sites
- Natural Drainage
\# - Potential Contamination Sites
- Railroad Tracks
- Site Boundary
- Study Area Boundary
- Tidal Drainage

 - UXO-2

FIGURE 6
YORKTOWN NAVAL WEAPONS STATION

AREA A
NOVEMBER 24, 1970

APPROX. SCALE 1:11,100

LEGEND

B - Building
C - Containers
CL - Clearing
CT - Coarse-Textured
D - Drums
DB - Debris
DG - Disturbed Ground
DK - Dark-Toned
DV - Dead Vegetation
EX - Excavation
EXT - Extraction
F - Foundation
FA - Fill Area
GR - Graded
GS - Ground Scar
HP - Helicopter Pad
HT - Horizontal Tank
LF - Landfill
LQ - Liquid
LT - Light-Toned
M - Material
MT - Medium-Toned
O - Object
OS - Open Storage
OW - Open Water
S - Structure
SQ - Square
ST - Stain
TR - Trench
U - Upland
UO - Unidentifiable Object
VEG - Vegetated
VS - Vegetation Stress
W - Wetland

- Access Road
- Berm
- Channelized Drainage
- Cylindrical Object
- Excavation
- Fence
\# - Known Contamination Sites
- Natural Drainage
\# - Potential Contamination Sites
- Railroad Tracks
- Site Boundary
- Study Area Boundary
- Tidal Drainage

 - UXO-2

FIGURE 7
YORKTOWN NAVAL WEAPONS STATION

AREAS A,B & C
OCTOBER 23, 1975

APPROX. SCALE 1:21,152

LEGEND

B - Building
C - Containers
CL - Clearing
CT - Coarse-Textured
D - Drums
DB - Debris
DG - Disturbed Ground
DK - Dark-Toned
DV - Dead Vegetation
EX - Excavation
EXT - Extraction
F - Foundation
FA - Fill Area
GR - Graded
GS - Ground Scar
HP - Helicopter Pad
HT - Horizontal Tank
LF - Landfill
LQ - Liquid
LT - Light-Toned
M - Material
MT - Medium-Toned
O - Object
OS - Open Storage
OW - Open Water
S - Structure
SQ - Square
ST - Stain
TR - Trench
U - Upland
UO - Unidentifiable Object
VEG - Vegetated
VS - Vegetation Stress
W - Wetland

- Access Road
- Berm
- Channelized Drainage
- Cylindrical Object
- Excavation
- Fence
\# - Known Contamination Sites
- Natural Drainage
\# - Potential Contamination Sites
- Railroad Tracks
- Site Boundary
- Study Area Boundary
- Tidal Drainage

 - UXO-2

FIGURE 8
YORKTOWN NAVAL WEAPONS STATION

AREA A
APRIL 17, 1980

APPROX. SCALE 1:11,400

LEGEND

B - Building
C - Containers
CL - Clearing
CT - Coarse-Textured
D - Drums
DB - Debris
DG - Disturbed Ground
DK - Dark-Toned
DV - Dead Vegetation
EX - Excavation
EXT - Extraction
F - Foundation
FA - Fill Area
GR - Graded
GS - Ground Scar
HP - Helicopter Pad
HT - Horizontal Tank
LF - Landfill
LQ - Liquid
LT - Light-Toned
M - Material
MT - Medium-Toned
O - Object
OS - Open Storage
OW - Open Water
S - Structure
SQ - Square
ST - Stain
TR - Trench
U - Upland
UO - Unidentifiable Object
VEG - Vegetated
VS - Vegetation Stress
W - Wetland

- Access Road
- Berm
- Channelized Drainage
- Cylindrical Object
- Excavation
- Fence
\# - Known Contamination Sites
- Natural Drainage
\# - Potential Contamination Sites
- Railroad Tracks
- Site Boundary
- Study Area Boundary
- Tidal Drainage

 - UXO-2

FIGURE 9
YORKTOWN NAVAL WEAPONS STATION

AREA A
OCTOBER 21, 1986

APPROX. SCALE 1:12,320

LEGEND

B - Building
C - Containers
CL - Clearing
CT - Coarse-Textured
D - Drums
DB - Debris
DG - Disturbed Ground
DK - Dark-Toned
DV - Dead Vegetation
EX - Excavation
EXT - Extraction
F - Foundation
FA - Fill Area
GR - Graded
GS - Ground Scar
HP - Helicopter Pad
HT - Horizontal Tank
LF - Landfill
LQ - Liquid
LT - Light-Toned
M - Material
MT - Medium-Toned
O - Object
OS - Open Storage
OW - Open Water
S - Structure
SQ - Square
ST - Stain
TR - Trench
U - Upland
UO - Unidentifiable Object
VEG - Vegetated
VS - Vegetation Stress
W - Wetland

- Access Road
- Berm
- Channelized Drainage
- Cylindrical Object
- Excavation
- Fence
\# - Known Contamination Sites
- Natural Drainage
\# - Potential Contamination Sites
- Railroad Tracks
- Site Boundary
- Study Area Boundary
- Tidal Drainage

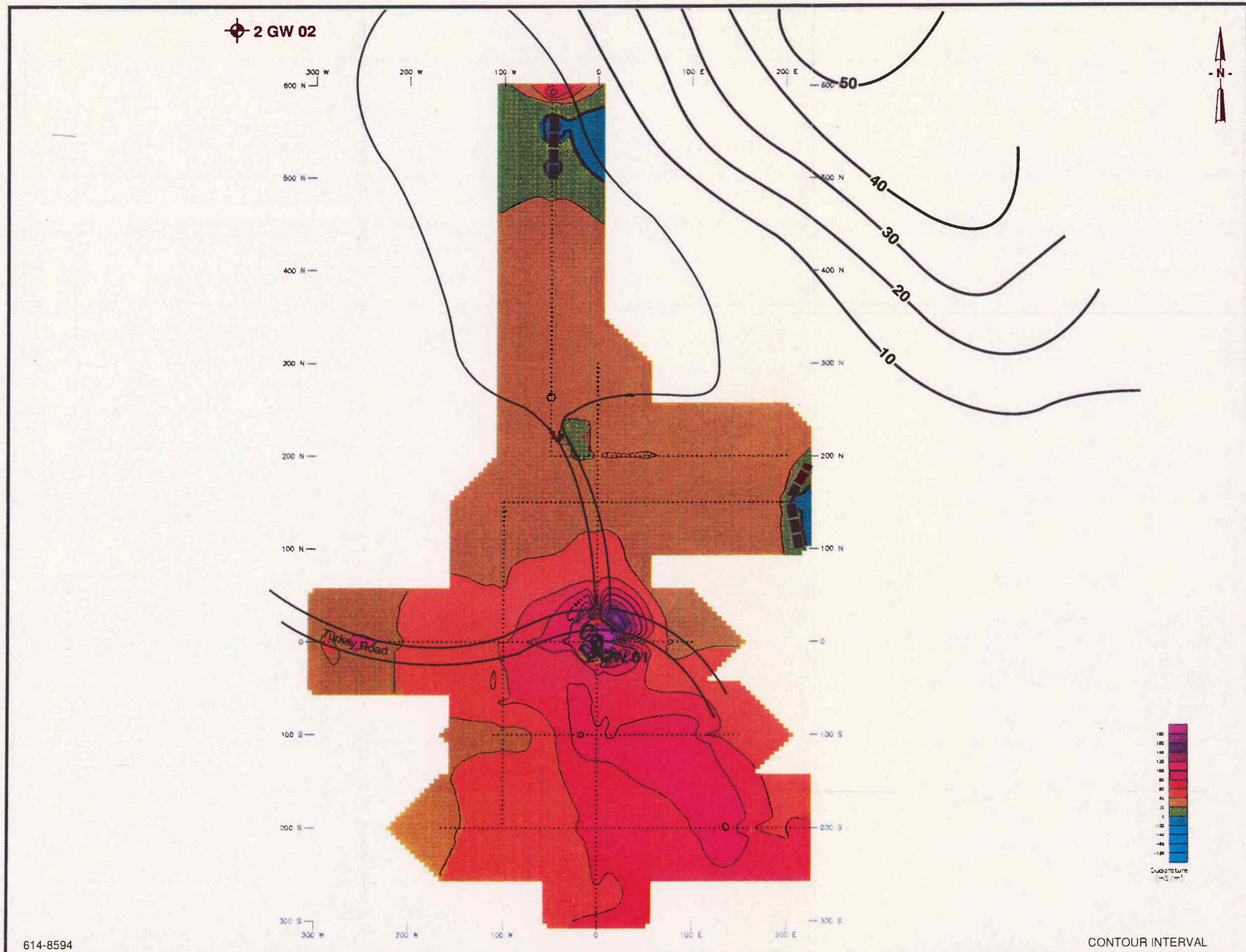
 - UXO-2

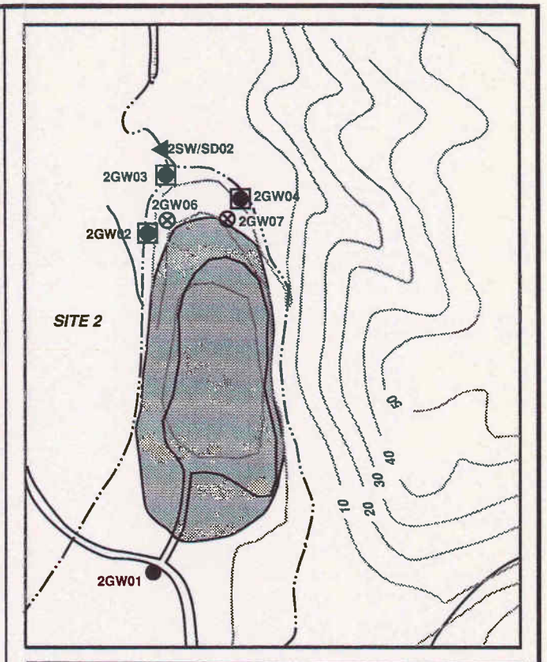
Appendix B
Biohabitat Map from Final Habitat Evaluation Map (Baker, 1995)

FIGURE 3-3
BIOHABITAT MAP
SITE 2

NAVAL WEAPONS STATION YORKTOWN YORKTOWN, VIRGINIA

Appendix C
EM Results for Site 2 from Geophysical Investigations Report (Weston, 1993) Sites 2, 9, and SSA 4





Legend

■■■■■ Interpreted Waste Boundary

Scale 1:6000

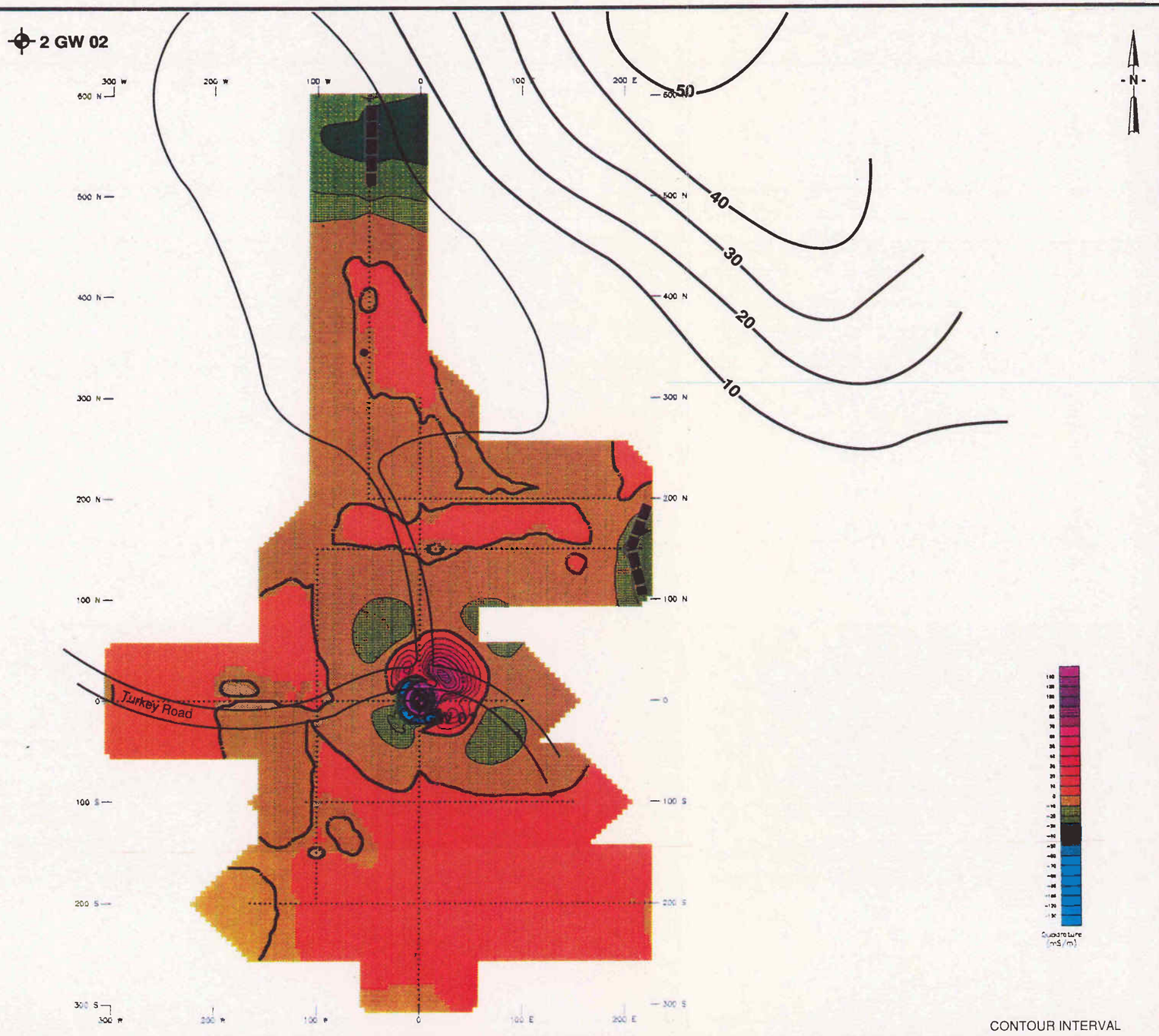
NOTE: Grid Reference:
2GW01 AT 0/0 Node

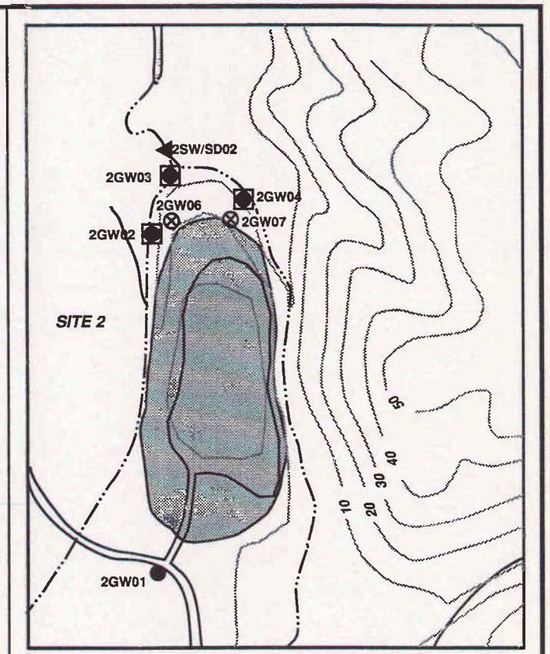
FIGURE 3-2A
SITE 2 (TURKEY ROAD LANDFILL),
EM-31 QUADRATURE

614-8594

CONTOUR INTERVAL

6/28/92





Legend

■■■■■ Interpreted Waste Boundary

Scale 1:600

NOTE: Grid Reference:
2GW01 AT 0/0 Node

FIGURE 3-2B
SITE 2 (TURKEY ROAD LANDFILL),
EM-31 IN-PHASE

614-8594

CONTOUR INTERVAL

6/28/92

Appendix D
Summary of Recovered Ordnance
Sites 2, 9, and SSA 4

Summary of Recovered Ordnance
Sites 2, 9, and SSA-4
Naval Weapons Station
Yorktown, Virginia

Ordnance	Total
100 Pound GP Bomb	10
105mm Projectiles	1
155 mm Projectiles	4
2.75" Rocket	38
2.75" Rocket Launcher	81
2.75" Rocket Warhead	2
20 Pound GP Bomb	11
2000 Pound GP Bomb	1
250 Pound GP Bomb	28
5" R.A.P.	1
5" Rocket	3
500 Pound GP Bomb	9
AN-M Light Case 250 Pound Bomb	1
AN-M43 500 Bomb	1
AN-MG5A1 1,000 Pound Bomb	5
Chaff Dispenser	7
Clock Starter	5
Depth Bomb	234
Depth Charge	123
Empty 55 Gallon Drums	3
Empty Extender Canisters	31
Empty Mine Cages	10
Extender	4
Fragmentation Bombs	2,236
GP Bombs	5
Hedge Hogs	37
Identified Mine	10
LDGP 500 Pound Bomb	3
Mine Anchor	1

Ordnance	Total
Mine Parachutes	4
Missile Sections	58
MK Firing Mechanism	82
MK1 Depth Charge	3
MK10 Mine	74
MK12 Depth Charge	5
MK12 Exploder	8
MK Extender	2
MK12 Mine	1
MK12 Practice Depth Charge	50
MK124 Bomb	2
MK14 Anti-tank Mine	1
MK14 Extender	4
MK15 Mine	8
MK18 Mine	35
MK19 Anti-tank Mines	64
MK19 Bomb	11
MK19 Guided Missile Warhead	1
MK19 MOD-O Guided Missile	2
MK19 Rocket	1
MK19 Rocket with Warhead	3
MK19 Warhead	4
MK2 Depth Charge	6
MK2 Mine Assembly	4
MK25 Mine	170
MK25 Torpedo	3
MK29 Depth Bombs	32
MK3 Bottom Mines	2
MK36 Mine	37
MK39 Ice Breaker	4
MK39 Ice Breaker Mine	4
MK39 Mine	87
MK49 Mine	97

Ordnance	Total
MK5 Depth Charge	1
MK5 Mine	11
MK50 Mine	8
MK51 Mine	45
MK52 Mine	28
MK53/54 Depth Charge	18
MK55 MOD-O Mines	8
MK55 Mine	15
MK55 Mine Casing	6
MK57	2
MK57 Mine	6
MK6 Depth Bombs	91
MK6 Depth Charge	35
MK6 Jato Bottles	3
MK6 Mine	30
MK8 Mine	100
MK8 Moored Mine	0
MK81 250 Pound Bomb	11
MK81 Bomb	4
MK81 Mine	1
MK82 Bomb	1
MK83 Bomb	9
MK84 Bomb	2
Old MK5 Style Depth Charge	1
Projectile Casing	2
Rocket Assist Projo	1
Rocket Guidance Section	25
Teardrop Depth Charge	2
Torpedo Sections	49
Torpedo Warhead	2
Truckloads of Misc. Scrap	3
Unidentified Mine	7
Unidentified Mine Casing	3

Ordnance	Total
Unidentified U/W Mine Case	1
Warhead Storage Containers	24

Appendix E
1994 Debris Removal Photographs


N


N
N


Battery Casing
Metallic Debris

Appendix F
Munitions Response Site Prioritization Protocol

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: Site2, Turkey Road Landfill

Component: U.S. Navy

Installation/Property Name: Naval Weapons Station-Yorktown

Location (City, County, State): Yorktown, Virginia

Site Name/Project Name (Project No.): _____

Date Information Entered/Updated: _____

Point of Contact (Name/Phone): _____

Project Phase (check only one):

☐ PA	☐ SI	☐ RI	☐ FS	☐ RD
☐ RA-C	☐ RIP	☐ RA-O	☐ RC	☐ LTM

Media Evaluated (check all that apply):

☐ Groundwater	☐ Sediment (human receptor)
☐ Surface soil	☐ Surface Water (ecological receptor)
☐ Sediment (ecological receptor)	☐ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:
Dumping ground for inert ordnance items. In use from the 1940s until 1981. The concern is that live ordnance may have been inadvertently discarded.

Description of Pathways for Human and Ecological Receptors: _____

Description of Receptors (Human and Ecological): _____

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	~~X~~5
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	15

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

During debris removal activities conducted in 1994, several hundred inert ordnance items were recovered. No live items were recovered, however there is no documentation describing the procedures to ensure that live ordnance items would not have been inadvertently discarded at the site.

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	◆ The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	◆ The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	◆ The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	◆ The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	◆ The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	X
Former industrial operating facilities	◆ The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	◆ The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	◆ The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	◆ The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	◆ The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

It has been confirmed that inert ordnance items were discarded at this site. There has been no documentation discovered describing the treatment or inspection prior to the items being placed on this site.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	20

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

This is a wetlands area and any buried DMM would likely surface over time.

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

The site is in a restricted area of the base however it is accessible by foot.

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	• The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. • The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	X 0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The site is on DOD property and is likely to remain so.

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	• There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	• There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	X3
< 100 persons per square mile	• There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

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Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	5
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

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Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	X
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

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Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	• There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	• There are ecological resources present on the MRS.	3
Cultural resources present	• There are cultural resources present on the MRS.	3
No ecological or cultural resources present	• There are no ecological resources or cultural resources present on the MRS.	X 0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	15	20
Source of Hazard	Table 2	5	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	20	28
Ease of Access	Table 4	8	
Status of Property	Table 5	0	
Receptor Factor Data Elements			
Population Density	Table 6	3	13
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	0	
EHE MODULE TOTAL			61

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	D

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	~~0~~
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

None of the previously discovered inert ordnance items were associated with chemical warfare and nothing in the site history suggest that chemical warfare material was ever present at the site.

Table 12

CHE Module: Sources of CWM Data Element Table

DIRECTIONS: Below are 11 sources of CWM hazards and their descriptions. Review these classifications and circle the scores that correspond with **all** the sources of CWM hazards known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, CAIS/DMM, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Live-fire involving CWM	◆ The MRS is a former military range that supported live-fire of explosively configured CWM and the CWM/UXO are known or suspected of being present on the surface or in the subsurface. ◆ The MRS is a former military range that supported live-fire with conventional munitions, and CWM/DMM are on the surface or in the subsurface commingled with conventional munitions that are UXO.	10
Damaged CWM/DMM surface or subsurface	◆ There are damaged CWM/DMM on the surface or in the subsurface at the MRS.	10
Undamaged CWM/DMM surface	◆ There are undamaged CWM/DMM on the surface at the MRS.	10
CAIS/DMM surface	◆ There are CAIS/DMM on the surface.	10
Undamaged CWM/DMM, subsurface	◆ There are undamaged CWM/DMM in the subsurface at the MRS.	5
CAIS/DMM subsurface	◆ There are CAIS/DMM in the subsurface at the MRS.	5
Former CA or CWM Production Facilities	◆ The MRS is a facility that formerly engaged in production of CA or CWM, and CWM/DMM is suspected of being present on the surface or in the subsurface.	3
Former Research, Development, Testing, and Evaluation (RDT&E) facility using CWM	◆ The MRS is at a facility that formerly was involved in non-live-fire RDT&E activities (including static testing) involving CWM, and there are CWM/DMM suspected of being present on the surface or in the subsurface.	3
Former Training Facility using CWM or CAIS	◆ The MRS is a location that formerly was involved in training activities involving CWM and/or CAIS (e.g., training in recognition of CWM, decontamination training) and CWM/DMM or CAIS/DMM are suspected of being present on the surface or in the subsurface.	2
Former Storage or Transfer points of CWM	◆ The MRS is a former storage facility or transfer point (e.g., intermodal transfer) for CWM.	1
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	X
SOURCES OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Sources of CWM*** classifications in the space provided.

No known or suspected activities involving chemical warfare material occurred at this site.

Table 13

CHE Module: Location of CWM Data Element Table

DIRECTIONS: Below are seven classifications of CWM locations and their descriptions. Review these locations and circle the scores that correspond with **all** the locations where CWM are known or suspected of being found at the MRS.

Note: The terms *confirmed, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are CWM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report, that an incident or accident that involved CWM, regardless of configuration, occurred) indicates there are CWM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence, other than the documented presence of CWM, indicating that CWM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that CWM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that CWM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the CWM.	2
Evidence of no CWM	◆ Following investigation of the MRS, there is physical evidence that there is no CWM present or there is historical evidence indicating that no CWM are present.	X 0
LOCATION OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of CWM*** classifications in the space provided.

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Table 14

CHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	◆ There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	◆ There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	◆ There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	◆ There is a barrier preventing access to all parts of the MRS, and there is active continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

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Table 15

CHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD controls access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

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Table 16

CHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	◆ There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	◆ There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	◆ There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

Table 17

CHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	◆ There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	X
16 to 25 inhabited structures	◆ There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	◆ There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	◆ There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	◆ There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	◆ There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

Table 18

CHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structures classifications at the MRS.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known of recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

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Table 19

CHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	◆ There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	◆ There are ecological resources present on the MRS.	3
Cultural resources present	◆ There are cultural resources present on the MRS.	3
No ecological or cultural resources present	◆ There are no ecological resources or cultural resources present on the MRS.	X 0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	0	
Accessibility Factor Data Elements			
Location of CWM	Table 13	0	8
Ease of Access	Table 14	8	
Status of Property	Table 15	0	
Receptor Factor Data Elements			
Population Density	Table 16	3	13
Population Near Hazard	Table 17	5	
Types of Activities/Structures	Table 18	5	
Ecological and/or Cultural Resources	Table 19	0	
CHE MODULE TOTAL			21

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	No Known or Suspected

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Vinyl Chloride	17	1.5	11.33
1,2-Dichloroethene (total)	28	330	0.08
Total Aluminum	16400	36000	0.46
Total Barium	339	7300	0.05
Total Cadmium	2.2	18	0.12
CHF Scale	**CHF Value**	**Sum The Ratios**	~~12.04~~ 38.07
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	(M)
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	(L)
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Groundwater MC Hazard ☐

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
2,4,6-Trinitrotoluene	0.14J	18	0.01
CHF Scale	**CHF Value**	**Sum The Ratios**	0.01
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	(H)
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	H

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	(M)
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ☐

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Carbazole	0.3	2400	0.00
Benzo(a)anthracene	1.4	62	0.02
Chrysene	1.4	6200	0.00
Benzo(b)fluoranthene	1.6	62	0.03
Benzo(k)fluoranthene	0.72	620	0.00
CHF Scale	**CHF Value**	**Sum The Ratios**	~~0.05~~ 2.51
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	(L)
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	(M)
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
None			

CHF Scale	CHF Value	Sum the Ratios	0
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	DIRECTIONS: Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	DIRECTIONS: Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	DIRECTIONS: Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ☐

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Silver	24.6	390	0.06

CHF Scale	CHF Value	Sum the Ratios	0.06
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	(M)
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	(M)
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ☐

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Carbazole	6.6J	2400	0.00
Benzo(a)anthracene	48	62	0.77
Chrysene	50	6200	0.01
Benzo(b)fluoranthene	35	62	0.56
Benzo(k)fluoranthene	33	620	0.05
CHF Scale	**CHF Value**	**Sum the Ratios**	~~1.39~~ 92,10
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	(M)
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	(L)
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard ☐

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: **Only use this table if there are more than five contaminants in any given medium present at the MRS.** This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

	Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
	Table 21 cont.:	----	~~6.6J~~	----	----
	Groundwater	Total Iron	~~48~~ 94900	11000	8.63
	"	Total Manganese	~~50~~ 7550	1700	4.44
*	"	Total Thallium	~~35~~ 7.1K	NA	NA
	"	Dissolved Barium	~~33~~ 344	7300	0.05
	"	Dissolved Iron	92400	11000	8.40
	"	Dissolved Manganese	7670	1700	4.51
	"	Dissolved Thallium	5.8K	NA	NA
	Table 23 cont.:	----	----	----	----
	Sediment	Benzo(a)pyrene	1.3	.91	1.43
	"	Indeno(1,2,3-cd)pyrene	0.89	62	0.02
	"	Dibenz(a,h)anthracene	0.19J	6.2	0.03
	"	Arsenic	21.5	22	0.98
	Table 26 cont.:	----	----	----	----
	Surface Soil	Benzo(a)pyrene	40	.91	13.4
	"	Indeno(1,2,3-cd)pyrene	28	62	0.45
	"	Dibenz(a,h)anthracene	11J	6.2	1.77
	"	Dieldrin	0.04P	3.0	0.01
	"	Aroclor-1254	6.2	1.1	5.64
	"	2,4,6-Trinitrotoluene	0.0017	18	0.00
**	"	4-Amino-2,6-Dinitrotoluene	0.00076	(not in Appendix B)	NA
	"	Antimony	24.3	31	0.78
	"	Cadmium	2460	39	63.08
	"	Cobalt	168	1400	0.12
	"	Copper	14700	3100	4.74
	"	Mercury	16.6	23	0.72
	"	Thallium	26.8	NA	NA

* Thallium listed as "NA" in Appendix B of Primer.

** CAS No 19406-51-0 → no matches in Appendix B

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	M	M	L	MML	E
Surface Water/Human Endpoint (Table 22)	L	H	M	LHM	D
Sediment/Human Endpoint (Table 23)	M	L	M	MLM	E
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)	L	M	M	LMM	E
Surface Soil (Table 26)	M	M	L	MML	E

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	D

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				5	