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Final

Site Inspection Report
Munitions Response Program Area UXO 1

St. Juliens Creek Annex
Chesapeake, Virginia

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic

Contract No.
N62470-08-D-1000
CTO-WE10

September 2010

Prepared by

CH2MHILL

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Virginia Beach, Virginia

Executive Summary

This report summarizes the Site Inspection (SI) results conducted at Munitions Response Program (MRP) Area UXO1 located within the St. Juliens Creek Annex (SJCA), Chesapeake, Virginia. The SI was conducted under the United States Navy (Navy) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The primary objective of this investigation was to assess whether or not there is evidence that the ordnance loading activities at the wharfs at Area UXO 1 resulted in munitions and explosives of concern (MEC) being dropped into the Southern Branch of the Elizabeth River.

This SI report was prepared under United States Navy (Navy) Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000, Contract Task Order WE10, for submittal to the SJCA Tier I Partnering Team, consisting of representatives from NAVFAC Mid-Atlantic, United Stated Environmental Protection Agency Region 3, and Virginia Department of Environmental Quality.

Area UXO 1 includes current and former wharf areas at SJCA. Anecdotal evidence obtained through individual interviews indicated there is a potential for munitions to have been dropped during historic loading operations, resulting in an accumulation of munitions and explosives of concern (MEC), in particular discarded military munitions, in the sediment adjacent to the wharfs. Previous investigations identified potential metallic anomalies around the two wharf areas; however, no MEC has ever been encountered at Area UXO 1 nor have the metallic anomalies been investigated to determine whether or not they are munitions-related. To further assess whether previous site activities resulted in MEC being dropped into the water, an underwater geophysical survey was conducted to the extent practicable using digital geophysical mapping (DGM) techniques within the northern and southern wharf areas. Based on the evaluation of data from this SI, a total of 1,651 individual ferrous anomalies were detected across the wharf areas.

The recommended action at Area UXO 1 is to dredge and visually inspect a selected subset of the anomalies identified during the SI and from areas where data was not able to be collected. Sediment samples may be collected from the dredged material to assess the potential of leaching of MEC-related contaminants to surrounding media. The additional data collected will be presented in an SI Addendum Report or Remedial Investigation Report and will be used to determine if further investigations or remedial actions are warranted at Area UXO 1.

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Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
°F	degrees Fahrenheit
DGM	digital geophysical mapping
DMM	discarded military munitions
ft	feet; foot
GPS	global positioning system
IAS	Initial Assessment Study
IR	Installation Restoration
m	meter
MEC	munitions and explosives of concern
MRP	Munitions Response Program
MRSPP	Munitions Response Site Prioritization Protocol
msl	mean sea level
NAD	Naval Ammunition Depot
NAVFAC	Naval Facilities Engineering Command
NOAA	National Oceanographic and Atmospheric Administration
nT/m	nanotesla per meter
PA	Preliminary Assessment
QC	quality control
RRR	Relative Risk Ranking
RTK	real-time kinematic
SI	Site Inspection
SJCA	St. Juliens Creek Annex
SSA	Site Screening Assessment
TMI	total magnetic intensity
TVG	transverse gradiometer
USACE	United States Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VDEQ	Virginia Department of Environmental Quality
WW	World War

SECTION 1

Introduction

This report summarizes the Site Inspection (SI) conducted for Munitions Response Program (MRP) Area UXO 1 within St. Juliens Creek Annex (SJCA) in Chesapeake, Virginia. This report also includes historical data from previous investigations, as applicable, for the purposes of holistic data evaluation and making site-specific determinations. The investigation was conducted in accordance with *Quality Assurance Project Plan Site Inspection, Phase 1 Underwater Geophysical Survey Area UXO-001 (*CH2M HILL, 2010a), herein referred to as the work plan. Field activities were initiated on January 18, 2010 but due to site conditions being different than previously understood (as discussed in Section 4.1), were aborted on January 19, 2010. After revising the investigation approach (as discussed in Section 4.1), the work resumed on February 12, 2010 and was completed on February 18, 2010.

This SI report was prepared under Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000, Contract Task Order WE10, for submittal to the SJCA Tier I Partnering Team, consisting of representatives from NAVFAC Mid-Atlantic, United Stated Protection Agency (USEPA) Region 3, and Virginia Department of Environmental Quality (VDEQ).

1.1 Objectives of the Site Investigation

The primary objective of this investigation was to assess whether or not there is evidence that the ordnance loading activities at the wharfs at Area UXO 1 resulted in munitions and explosives of concern (MEC) being dropped into the Southern Branch of the Elizabeth River. CH2M HILL performed the following field tasks in support this objective:

- A bathymetric survey to determine the topography and morphology of the river bottom in order to effectively plan the digital geophysical mapping (DGM) survey.
- A side-scan sonar survey to identify the presence of debris protruding from or on the river bottom that presented a safety hazard or could impact DGM data collection and/or damage the equipment.
- A DGM survey using a magnetometer to identify geophysical anomalies on or in the river sediment in the investigation area that potentially represent discarded military munitions (DMM).

1.2 Organization of the SI Report

This SI report is organized as follows:

- **Section 1, Introduction:** Provides the objectives of SI and overall format of the report.
- **Section 2, Site Background:** Provides a description of the site location and history, as well as summaries of previous investigations conducted at SJCA that are relevant to the SI.
- **Section 3, Physical Characteristics:** Describes the physical characteristics, such as physiography, climate, and surface water hydrology of SJCA in general and Area UXO 1 in particular.
- **Section 4, Investigation Methodology:** Provides the SI and data collection activities.
- **Section 5, Conclusions and Recommendations:** Summarizes the conclusions and recommendations made for each area.
- **Section 6, References:** Lists the documents used in preparation of the SI report.

Tables and figures are presented at the end of each section, as applicable. Appendices are provided at the end of the report.

SECTION 2

Site Background

2.1 Facility Description and History

The SJCA facility is approximately 490 acres and is situated at the confluence of St. Juliens Creek and the Southern Branch of the Elizabeth River in the City of Chesapeake in southeastern Virginia (**Figure 2-1**). Most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries.

In 1896, approximately 48 acres of land (the start of present SJCA) were purchased from Mr. Edward M. Watts to accommodate the construction of five magazines, two personnel quarters, an administration building, and two wharves adjacent to Magazine, Fort Norfolk. By 1898, ordnance material and equipment were removed from Craney Island and installed at Magazine, Fort Norfolk, which was then renamed U.S. Arsenal, St. Juliens Creek. In 1902, the name was changed to U.S. Naval Magazine, St. Juliens Creek. The Magazine was at that time fully operational and provided critical support to the fleet during the end of the Spanish-American War. The original Wharf 1 and Wharf 2 (southern wharf area) had been constructed by 1903 (**Figure 2-2**). In 1917, the facility installed equipment for loading Mark VI mines, including Wharf 3 (northern wharf area). That same year, the facility's name was changed again, to Naval Ammunition Depot (NAD)–St. Juliens Creek, and operated under the Commandant Fifth Naval District.

Between World War (WW) I and WW II (1919 through 1941), the facility assumed a peacetime mission of supplying ammunition to the fleet. The mission of NAD St. Juliens Creek during WW II included loading, assembling, issuing, and receiving naval gun ammunition. The depot also served as the principal experimental and test loading facility for new ammunition types for the Bureau of Ordnance.

The depot supplied ammunition during the Korean War (1950–1953). After the war, the depot again resumed its mission of peacetime service to the fleet. In 1964, the depot was a significant source of gun ammunition for the Navy and Marine Corps operations in Southeast Asia. In October 1969, after 50 years as an independent facility, NAD St. Juliens Creek was disestablished under the Department of Defense "Project 703," and was consolidated as an annex to the Naval Weapons Station Yorktown, Virginia, and became known as SJCA. On October 1, 1977, the Annex was transferred to Norfolk Naval Shipyard.

The annex was one of the largest ammunition depots in the United States involving wartime transfer of ammunitions to other naval facilities. Specific ordnance operations and processes conducted at SJCA included stockpiling Explosive D (ammonium picrate, or picrate acid) for use in projectiles, manufacturing Mark VI mines, assembling small-caliber guns and ammunition, storing torpedoes, filling shells, testing ordnance, and distributing and receiving ammunition. By 1975, all ordnance operations had been transferred to Naval Weapons Station Yorktown. As a result, decontamination was performed in, around, and under ordnance-handling facilities at SJCA in 1977.

SJCA has also provided non-ordnance services, including degreasing operations; operation of paint shops, machine shops, vehicle and locomotive maintenance shops, pest control shops, battery shops, print shops, electrical shops, boiler plants, wash racks, and potable water and salt water fire-protection systems; firefighter training; and storage of oil and chemicals.

Activity at SJCA has decreased in recent years and many of the aging structures are being demolished. The current primary mission of SJCA is to provide a radar-testing range and various administrative and warehousing facilities for nearby Norfolk Naval Shipyard and other local naval activities. SJCA also provides administrative offices, light industrial shops, and storage facilities for several tenant commands, including Defense Reutilization and Marketing Office storage, Space and Naval Warfare Systems Command, Mid-Atlantic Regional Maintenance Center, and a cryogenics school.

2.2 Area UXO 1 Description and History

Area UXO 1 consists of two separate wharf areas along the Southern Branch of the Elizabeth River. In total, Area UXO 1 comprises approximately 2,230 linear feet of current and former wharf. The northern wharf is approximately 1.7 acres in size, while the southern wharf area is approximately 4.49 acres in size (**Figure 2-2**).

The northern wharf area located in the northeast portion of SJCA, adjacent to Building M-5 and former Building 190, is designated as Wharf 3 in historical records. Wharf 3 was built in 1917 and 1918, constructed from wood pilings to a length of approximately 550 feet. The wharf was specialized for the loading of Mark VI mines produced at SJCA. Following WW I, Wharf 3 rapidly deteriorated and annual reports conducted by the Bureau of Ordnance reported as early as 1926 indicated that the wharf was in extremely poor condition. However, repairs were not recommended because the wharf was no longer in use (NAD-St. Juliens, 1926). In 1937, approximately 200 feet of the wharf was removed for fire prevention (NAD-St. Juliens, 1937). Since this time, the wharf has deteriorated considerably and presently there are only a few pilings seen protruding out of the water at low tide. The proposed future land use for the northern wharf area is not currently known; however, the Navy has plans to remove the remaining pilings from the sediment.

The southern wharf area is designated as Wharf 1 and Wharf 2 in historical records. The southernmost wharf, Wharf 1, was constructed around 1898 for ordnance loading during the Spanish-American War. Wharf 2 was constructed just north of Wharf 1 sometime between 1898 and 1903 to aid in ordnance loading. Wharf 1 was used heavily throughout the first 20 years of SJCA. In 1931, annual reports indicate the wharf was deemed unsafe for further use, and ordnance-loading operations at Wharf 1 were ceased (NAD-St. Juliens, 1931). In 1940, the wharf was replaced and resumed ordnance loading operations. In 1944, an extension to Wharf 2 connected it to Wharf 1, a concrete extension to the wharf was constructed, and a dolphin pier/catwalk for lighter storage was built. Ordnance loading activities continued until the early 1970s, when production declined commensurate with the disengagement policy and the reduced operations in Southeast Asia. The condition of Wharf 1 (currently known as Dock 2) has deteriorated and it is now considered condemned, largely due to damage caused to this section of the wharf after it was struck by two vessels in 1975. Current condition of Wharf 2 (currently known as Dock 1) is considered fair. This section of

wharf consists of approximately 400 ft on concrete piles and is still used for the occasional mooring of contractor and cable supply ships (CH2M HILL, 2009). The potential future land use for the southern wharf area will be to continue operating as a loading/unloading point for non-ordnance-related material. The southern portion of the southern wharf (Wharf 1) is scheduled to be demolished.

Potential future human receptors at both the northern and southern areas may include Navy personnel, future construction workers (for maintenance activities at the wharfs or vessels, demolition of damaged portions of the wharf, river dredging, or future land construction in the area), fishermen, and recreational users of the Southern Branch of the Elizabeth River (e.g., boaters, divers). Although ecological receptors do not typically engage in activities that expose them to the ordnance if present, release of MC through degradation and potential activities in support of munitions response, such as blow-in-place (BIP) operations, could affect the ecological receptors.

2.3 Previous Studies and Investigations

2.3.1 Initial Assessment Study (NEESA, 1981)

The Initial Assessment Study (IAS) Report indicated that explosive ordnance disposal team divers visually searched Installation Restoration (IR) Site 20 (northern wharf) area and identified metal and thick silt deposits near the former wharf. The IAS report indicated that it was a reasonable assumption that ordnance had been dropped into the sediment adjacent to the former wharf area during loading and unloading operations. The assumed ordnance presence was not considered a hazard as long as the sediment was not disturbed. The IAS recommended that real estate records be annotated to indicate that ordnance may be present.

2.3.2 Relative Risk Ranking (CH2M HILL, 1996a)

During the Relative Risk Ranking (RRR), a site reconnaissance, a magnetometer survey, and sediment sampling were conducted in the IR Site 20 (northern wharf) area. Approximately 68 contacts were identified in three areas around the former wharf pilings; however, contacts indicate all types of buried metallic objects and do not necessarily indicate the presence of DMM. No visual confirmation of the contacts was made. One volatile organic compound, multiple semivolatile organic compounds, one pesticide, one explosive, and multiple inorganics were detected in the sediment. The locations of the anomalies and samples are shown on **Figure 2-3**.

2.3.3 Site Screening Assessment (CH2M HILL, 1996b)

As part of the Site Screening Assessment (SSA), the analytical results from the IR Site 20 sediment samples collected during the RRR were used to conduct human health and ecological risk screenings. No unacceptable risk was identified to human receptors. Potentially unacceptable ecological risk was identified for benthic organisms in the sediment. The risk was considered minimal and no further evaluation of ecological risk was recommended. During the July 2001 partnering team site visit, consensus was reached for no further action for IR Site 20 under Comprehensive Environmental Response, Compensation,

and Liability Act (CERCLA) based on the findings of the human health and ecological risk screenings and the fact that potential risk from DMM would be addressed under the Navy's Range Program. The no further action decision was documented in the SSA.

Based on recommendations made in the SSA, signs were posted in the area to prohibit intrusive activities, and the United States Army Corps of Engineers (USACE) was notified of the potential presence of unexploded ordnance. A note has been added to internet Navy Facility Assets Data Store under the SJCA Wharf Property Record Cards stating: "Unexploded ordnance may exist along all of the St. Juliens Creek Annex Wharfs." Additionally, the area is identified in the Environmental Restoration Plan Geographic Information System, which identifies areas of concern, is used during operational planning and decision-making at the facility, and is updated annually or when conditions change. The Navy's Range Program was never fully implemented and ordnance sites are now addressed under the MRP. Because site history indicates there may be DMM present, in 2008 the wharf areas (northern and southern) were included under the MRP and identified as MRP Area UXO 1.

2.3.4 Sonar Imagery

In 2008 the Navy performed a sonar imagery survey of portions of the SJCA wharf areas. The investigation consisted of side scans using sonar technology to identify features of the sediment surface and physical anomalies. The northern area of interest (Wharf 3) was oriented in a circle in the vicinity of the pilings still present. The southern wharf area of interest (Wharfs 1 and 2) was oriented in a large rectangle adjacent to the wharf and extending into the channel. The investigation detected ten physical anomalies along the bottom of the river in the immediate vicinity of the southern wharf. The approximate sonar survey areas are shown on **Figure 2-3**.

2.3.5 Preliminary Assessment (CH2M HILL, 2009)

The Preliminary Assessment (PA) Report addressed the history of munitions use at the wharf areas that make up Area UXO 1. Onsite and offsite sources were researched to determine the potential for munitions to have been dropped into the water during ordnance loading operations at the wharfs from 1898 to the late 1970s. Although no documentation was found to confirm the presence of munitions in the vicinity of the wharf areas, anecdotal evidence obtained through individual interviews indicated there was a potential for munitions to have been dropped during loading operations, which may have resulted in DMM being present in the sediment along the wharf areas. No site visits or sampling was performed as part of the PA because Area UXO 1 is underwater.

Based upon information obtained during the PA and the hazards associated with potential DMM that may be present, the PA recommended further investigation at the site. The PA suggested that the subsequent investigation could include anomaly detection and investigation in both the northern and southern wharf areas. It was recommended that no additional investigation be performed in the dolphin pier area, which was an area used for light storage.

2.4 Basis for Further Investigation

Since it is possible for DMM to be present at the site, the site was prioritized for investigation using the Munitions Response Site Prioritization Protocol during the PA, which continues to be updated as more information is learned about the site. The most recent update is provided in **Appendix A**.

Legend
SJCA Boundary
UXO-001 Boundary

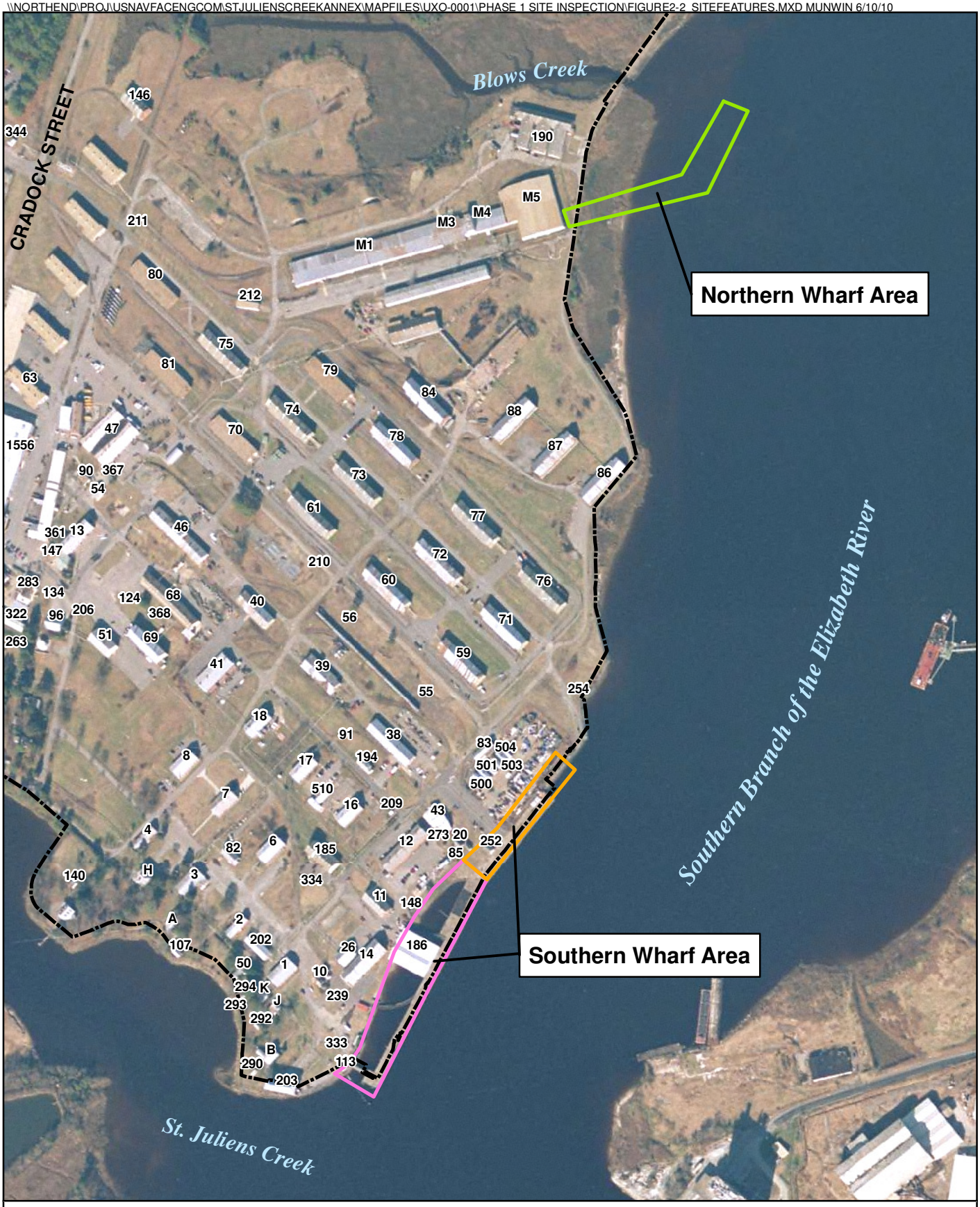
Southern Wharf: 4.49 acres
Northern Wharf: 1.70 acres

N
W E
S

0 500 1,000
Feet

Figure 2-1
Base and Site Location
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



Legend

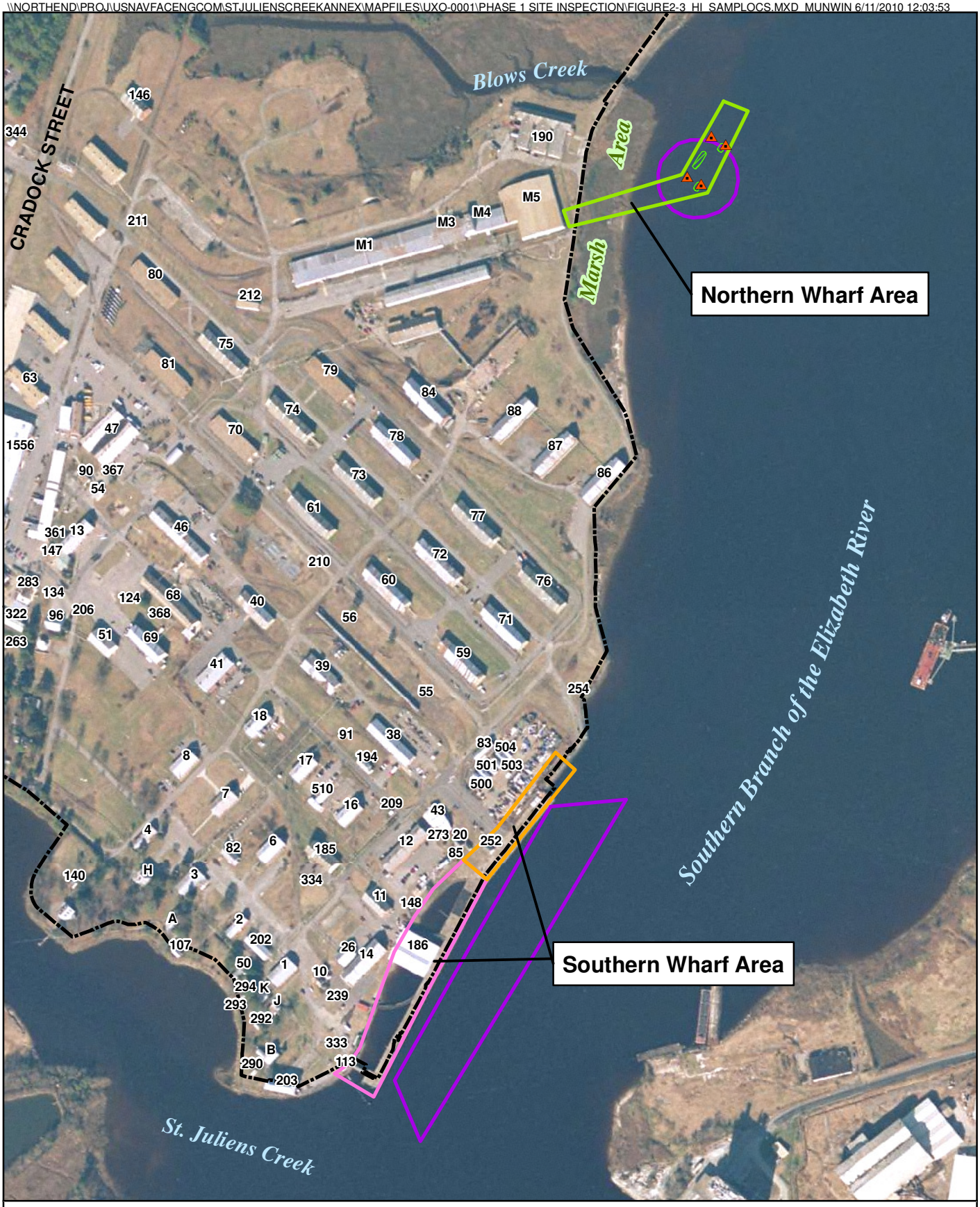
- SJCA Boundary
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3

N
W E
S

0 250 500
Feet

Figure 2-2
Site Features
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



Legend

- SJCA Boundary
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3
- Previous Sediment Sample Locations
- Magnetic Anomaly Concentration Areas (from 1996 Magnetic Investigation)
- 2008 Side-scan Sonar Survey Area (approximated)

N W E S

0 250 500 Feet

Figure 2-3
Historic Investigation and Sample Locations
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 3

Physical Characteristics

3.1 Regional Land Use

The facility is bordered to the north by the Norfolk and Western Railroad and the City of Portsmouth, which includes residential, commercial, and industrial areas; to the west by the City of Chesapeake, which includes residential, commercial, and industrial areas; to the south by St. Juliens Creek; and to the east by the Southern Branch of the Elizabeth River. Most of the surrounding areas are developed, and include residences, schools, recreational areas, and shipping facilities for several large industries. Some undeveloped areas are located in various areas surrounding the facility. There are many neighboring industrial properties near SJCA, with a large concentration along tidally influenced water bodies, such as the Southern Branch of the Elizabeth River and its tributaries.

The Elizabeth River is used for industrial, commercial, and recreational use. The Southern Branch of the Elizabeth River is a main waterway along the Atlantic Intracoastal Waterway, which is described in more detail in the following section.

3.2 Regional and Facility-wide Physiography, Climate, and Surface Water Hydrology

SJCA is located in the eastern part of the Atlantic Coastal Plain Physiographic Province in Chesapeake, Virginia. Low elevations and relatively flat relief, with few elevations greater than 25 feet above mean sea level (msl), characterize this part of the Coastal Plain. SJCA lies within the Deep Creek Swale, with natural elevations ranging from sea level to less than 20 feet above msl in the northeastern portion of the facility. A map showing the topography of SJCA is provided on Figure 3-1.

The area encompassing SJCA lies in the James River drainage basin and receives an average of approximately 46 in. of precipitation annually (FWEI, 1995). Between 50 percent and 70 percent of the precipitation is removed from the area via runoff along the relatively flat topography and via evapotranspiration. The remaining 30 percent to 50 percent (14 to 23 inches) of precipitation recharges the surficial aquifer system by percolation through the upper soils. Approximately 90 percent of recharged groundwater returns to surface water streams as base flow.

The Southern Branch of the Elizabeth River defines the eastern boundary of the land occupied by SJCA. St. Juliens Creek, which is a west-to-east flowing tributary of the Southern Branch of the Elizabeth River, defines the southern boundary of SJCA. The St. Juliens Creek headwaters originate near the Brentwood District of Portsmouth, and the shoreline consists primarily of residential housing. St. Juliens Creek provides drainage for residential districts in Portsmouth and Chesapeake; however, near its confluence with the Southern Branch of the Elizabeth River, it also provides drainage for several industrial

facilities on the creek's southern shore as well as drainage for SJCA. St. Juliens Creek can accommodate larger commercial vessels at its mouth and personal vessels west of SJCA.

From SJCA, the Southern Branch of the Elizabeth River flows north approximately 10 miles to its confluence with the James River. The James River then discharges into the Chesapeake Bay. The Southern Branch of the Elizabeth River (Figure 3-2) is part of the Intercoastal Waterway System.. It is connected to regional water bodies to the south of the James River drainage divide by manmade drainage systems. The Southern Branch of the Elizabeth River is connected to Currituck Sound in North Carolina by the Albemarle and Chesapeake Canal. It is also connected to the Albemarle Sound in North Carolina by the Dismal Swamp Canal. Currituck Sound is a northeastern extension of the larger Albemarle Sound. The Southern Branch of the Elizabeth River and its tributaries (including Blows Creek and St. Juliens Creek) are part of a tidal estuary system. In the vicinity of SJCA, the mean tide range of the Elizabeth River is approximately 2.8 feet and the spring tide range is approximately 3.4 feet. Fresh water inflow to the system is minimal, composed principally of drainage from the Dismal Swamp and stormwater runoff (Fluor Daniel GTI, 1997).

The climate of the Virginia Peninsula is influenced by the moderating effects of the Atlantic Ocean. This results in mild winters and long, warm summers. High humidity frequently occurs along the coast and less frequently inland. Ground fog is frequent in the late summer, especially during the early morning hours. 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.

3.3 Facility Hydrogeology

The hydrogeologic units beneath SJCA are composed of three main uppermost (i.e., youngest) hydrostratigraphic units known as the Columbia Aquifer, Yorktown Confining Unit, and Yorktown-Eastover Aquifer and their corresponding geologic units. These units make up the uppermost 100 to 200 feet beneath the SJCA facility and are the units most likely impacted by historical operations. In the vicinity of Area UXO 1, the Yorktown Confining Unit is incised due to the presence of the Southern Branch of the Elizabeth River. Consequently, the Yorktown Aquifer is hydraulically connected to the overlying Columbia sediments and river sediments. Due to the upward vertical gradient in the vicinity of the river, both the Columbia and Yorktown Aquifers discharge into the Southern Branch of the Elizabeth River and St. Juliens Creek.

3.4 Ecological Settings and Natural Resources

The ecological setting of the site determines the type of ecological receptors that may be expected to inhabit or use the site, if any. This section presents a general description of the environmental setting of the Southern Branch of the Elizabeth River.

The Southern Branch of the Elizabeth River contains estuarine habitats that range from shallow sand/mud flats and tidal streams less than 3 ft deep to trenches up to 43 feet deep (NOAA, 1999). Although the river is capable of providing habitats for a wide variety of aquatic species, many of the habitats associated with the river have been compromised by urban and industrial activities (CH2M HILL, 2009).

Trawl surveys by the Virginia Institute of Marine Science indicate that the Southern Branch of the Elizabeth River provides habitat for numerous estuarine and marine fish species, including:

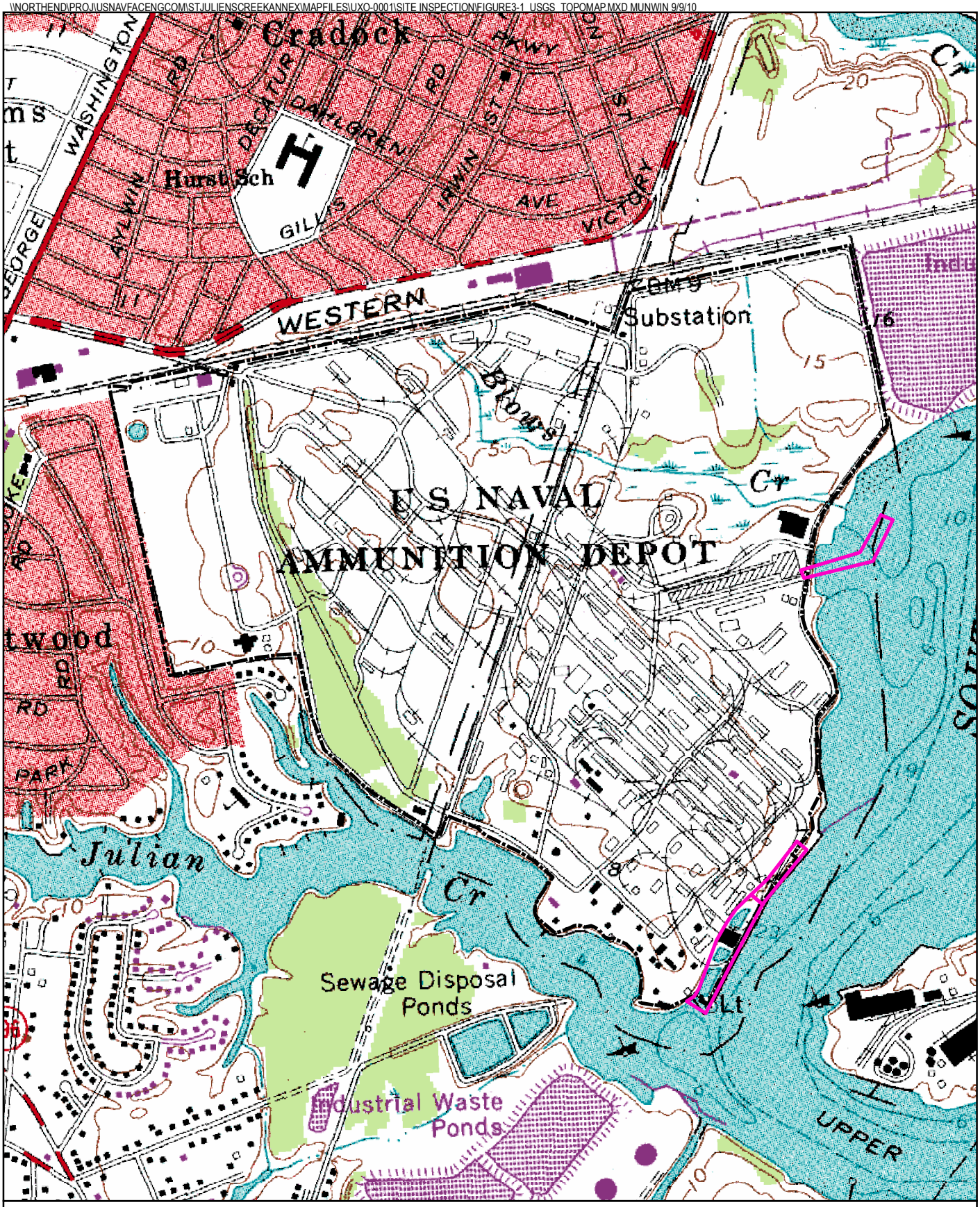
- Year-round resident fish species such as: bay anchovy, oyster toadfish, sheepshead minnow, killifishes, silversides, pipefish, gobies, and hogchoker that spend their entire lives in the river; bluefish, mullets, pinfish, butterfish, and the sciaenids (croaker, weakfish, seatrout, spot, and drum) that spawn offshore in coastal waters and migrate to the estuary as juveniles, where they may spend several years foraging and maturing, and may be found on a seasonal basis as adults (NOAA, 1999).
- Migratory fish species such as: juvenile and adult white perch in tidal freshwater reaches; striped bass, American shad, blueback herring, and alewife in freshwater areas; and juvenile American eels (NOAA, 1999).
- Shell fish such as blue crab, grass shrimp, eastern oyster and northern quahog.

Hampton Roads, near the Elizabeth River outlet in Chesapeake Bay, supports substantial commercial and recreational fisheries. Popular recreational catches are bluefish, croaker, spot, weakfish, flounder, blue crab, oyster, and quahog. However, the Virginia Department of Health (VDH) condemned the collection of molluscan shellfish in May 2009 and has established advisories for a variety of fish species and blue crabs throughout the entire Elizabeth River. A list of the current fish advisories can be found on the VDH website (http://www.vdh.state.va.us/epidemiology/DEE/PublicHealthToxicology/Advisories/JamesRiver.htm).

In addition, riparian wetlands are located sporadically throughout the river. The wetlands are generally in a disturbed condition and are of very low functional value based on their small size, low vegetation diversity, scattered vegetation, disturbed soils, and very minimal wildlife usage. These wetlands are narrow fringe marshes interspersed along the tributaries to the river, often abutting developed uplands. Vegetation in the wetlands generally consists of salt-tolerant grasses and sedges with low shrubs along the higher upland edge. Their small size limits the utility of these habitats for wildlife. The overall value of the wetlands is considered to be further diminished by surface water and sediment contamination in the Elizabeth River. Despite such conditions, these riparian habitats do support small, but stable populations of wildlife, most prominently muskrat (NOAA, 1992).

3.5 Cultural Resources

An archeological survey, conducted by R. Christopher and Associates Inc., identified the southeastern portion of SJCA, including the wharf areas, as a historic district eligible for listing in the National Register of Historic Places. The defined period of significance, spanning the years 1907 to 1919, encompasses the period during which SJCA helped produce the majority of the Mark VI mines used in the North Sea Mine Barrage (Navy, 2008). Additional information regarding cultural resources at SJCA is presented in the Programmatic Agreement for the Navy's Historic Building in Hampton Roads (NAVFAC, 1999).



Legend

SJCA Boundary

Area UXO 1 Boundary

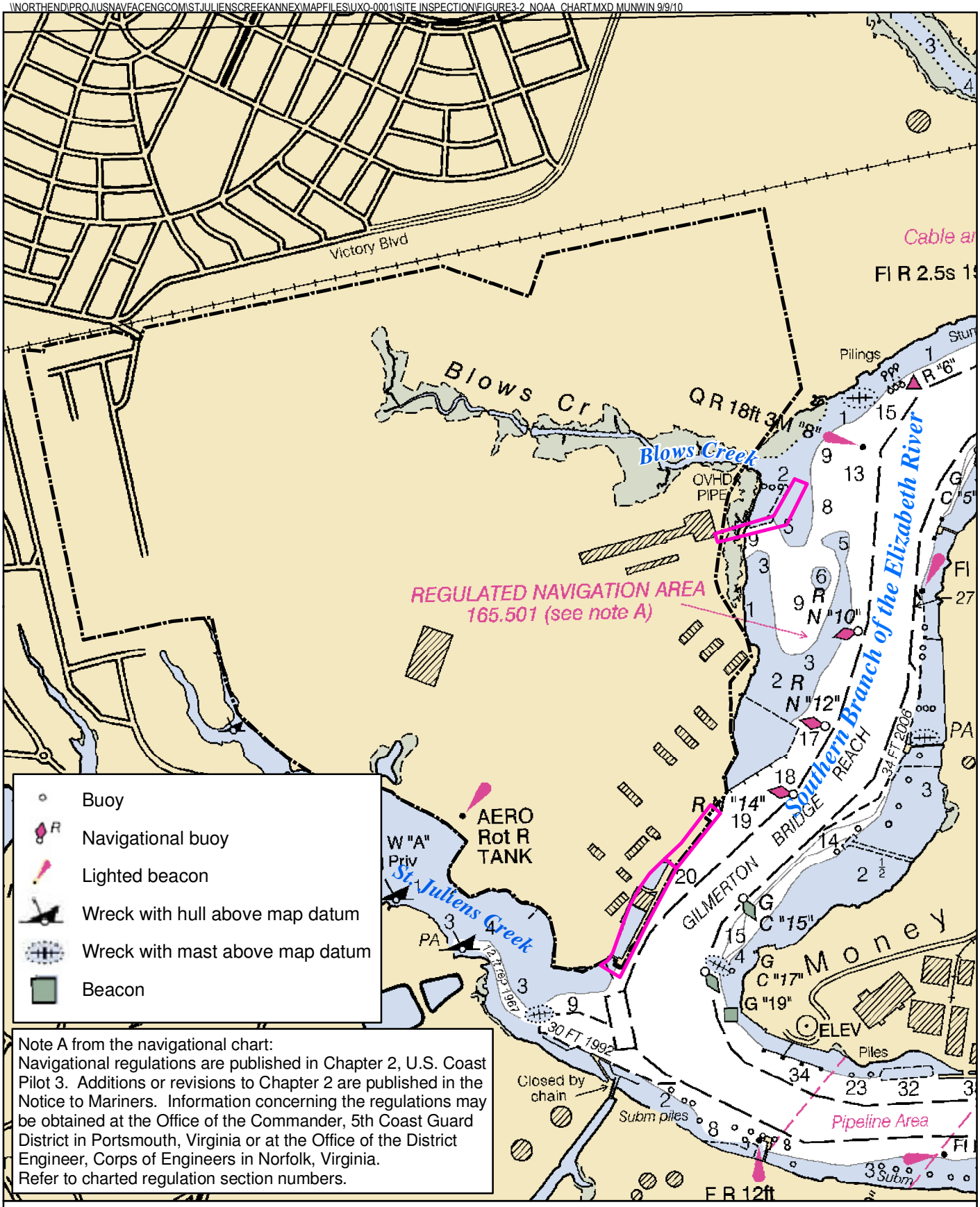
N
W E
S

0 500 1,000
Feet

Figure 3-1
Topographic Map
Area UXO 1 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

Source: USGS Norfolk South, VA Topoquad, 1986.

CH2MHILL



Note A from the navigational chart:
Navigational regulations are published in Chapter 2, U.S. Coast Pilot 3. Additions or revisions to Chapter 2 are published in the Notice to Mariners. Information concerning the regulations may be obtained at the Office of the Commander, 5th Coast Guard District in Portsmouth, Virginia or at the Office of the District Engineer, Corps of Engineers in Norfolk, Virginia.
Refer to charted regulation section numbers.

Legend
SJCA Boundary
Area UXO 1 Boundary

N
W E
S

0 500 1,000
Feet

Source: NOAA Norfolk Harbor and Elizabeth River Nautical Chart (Chart 12253), 2008.

Figure 3-2
NOAA Chart
Area UXO 1 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 4

Investigation Methodology

This section summarizes the field investigation procedures of the SI at Area UXO 1. The investigation activities and data presented below are from the investigation activities conducted from February 12 through 18, 2010, in accordance with the SI work plan (CH2M HILL, 2010a); the investigation activities on January 18 and 19, 2010 did not yield any usable data and are therefore not discussed. The February 2010 investigation activities consisted of a bathymetric survey, side-scan sonar survey, and DGM survey.

4.1 Initial Mobilization

Initial mobilization for the field activities was conducted on January 18 to 19, 2010. However, due to unanticipated site conditions at the time of the survey, the investigation was halted to reconsider the approach. The initial investigation approach was based on historic dredge data and the 2008 sonar imagery survey, which indicated that the river bottom gently sloped away from the wharfs toward the river channel, where there was an abrupt increase in the river depth. Given this information, it was believed that the investigation could be safely conducted without a bathymetric survey or mapping of the river bottom. However, when performing site reconnaissance using the survey boat's depth sensor the bottom of the river was found to be undulating with inconsistent grading towards the river channel possibly caused by propeller wash from channel traffic. Since the underwater DGM equipment was to be towed behind the boat to within 5 feet of the river bottom, the inconsistent slope significantly increased the potential for the DGM equipment to contact the river bottom (which was not an option due to the potential presence of DMM) when meeting the 5-foot metric. The investigation could have been conducted by towing the DGM equipment at considerably higher levels above the bottom of the river (estimated 15 to 20 ft); however, doing so would have significantly reduced the quality of the DGM data and would not have allowed for the identification of smaller anomalies in or on the sediment.

To ensure that the investigation could be conducted safely without contacting the sediment surface, the investigation approach was changed to include a bathymetric survey and to allow for the DGM equipment to be towed within 10 ft of the river bottom. Additionally, the equipment selected for conducting the DGM investigation was reconsidered and the one magnetometer system was replaced by an array with two magnetometers. The array was selected in order to give the survey team better vertical control of the DGM equipment so they would be able to adjust the sensor depths, as necessary, to better mirror changes in the river bottom. The SJCA partnering team concurred upon these changes and the work plan was revised and distributed prior to resuming the investigation activities on February 12, 2010.

4.2 Bathymetric Survey

A bathymetric survey was conducted using a single beam echo sounder within the investigation areas to determine the topography and morphology of the river bottom; the investigation areas are shown on **Figure 4-1**. Survey lines for the bathymetric survey were spaced at no more than 20 meter (m) intervals and data was processed and analyzed in the field. This information was used for planning the DGM survey, as the data was used to:

- Establish the survey lines for the DGM survey that would allow the DGM survey to be conducted with the magnetometers remaining at relatively constant elevation and within 10 feet of the bottom of the river.
- Increase the safety of the survey team and reduce the risk associated with towing equipment by allowing the survey team to adjust the depth of the towed equipment to account for changing depths in the river and undulations in the river bottom.
- Provide additional quality assurance to the accuracy of magnetometer vertical positioning and reference by allowing comparison of the pressure depth plus altimeter value to the absolute depth as measured along the survey line by the vessel.
- The river water levels and atmospheric information recorded by the National Oceanographic and Atmospheric Administration (NOAA) at the Money Point station are provided in **Appendix B**; this is the station closest to the investigation area. Due to the location of the station in relation to the site, fluctuations in the water levels at Money Point should be representative of fluctuations in the water levels at the investigation area and the depth of the river throughout the survey. The fluctuations in the water level in the river were taken into account when conducting the DGM investigation and the depth of the sensors were adjusted accordingly.

4.3 Side-Scan Sonar Survey

A side-scan sonar survey was conducted using a Klein 3000 side-scan system to identify the presence of debris protruding from or on the river bottom that presented a safety hazard or could impact magnetometer data collection and damage the equipment. Areas within the site that potentially posed a risk to personnel safety or the equipment were plotted for reference and avoidance during the remainder of the investigation. Survey lines for the side-scan survey were spaced at no more than 20-m intervals and data was processed and analyzed in the field.

4.4 DGM Survey

The DGM survey was conducted using two Geometrics G-882 cesium vapor magnetometers to identify geophysical anomalies on or in the river sediment in the investigation area that potentially represent DMM. The magnetometers were positioned 1.5 m apart using a transverse gradiometer (TVG) and centered on survey lines that were approximately 1 m apart. The TVG was also equipped with two pressure depth sensors and an altimeter that allowed the survey team to continually measure the TVG height above the river bottom. In the northern investigation area the TVG was maintained at a constant height by attaching

buoys to the TVG and floating it off the bottom of the river. In the southern investigation area the depth of the sensors was adjusted by varying the length of cable between the survey boat and the TVG and with small adjustments to the boat's speed.

Data from the DGM survey was reviewed, processed, and interpreted by geophysicists with ARM Geophysics (the subcontractor to CH2M HILL) and CH2M HILL. Items were identified by analyzing the total field analytic signal recorded by the magnetometers and adjusted, as necessary, to account for the background conditions at the site. The resulting measurement, referred to as the residual total magnetic intensity (TMI), was then analyzed and anomalies were identified using the Blakely Algorithm where the residual TMI had a nominal threshold of 5.0 nanotesla per meter (nT/m).

4.5 Deviations from the Work Plan

Although efforts were taken to conduct all aspects of the investigation within the specifications established in the work plan, there were instances where the investigation team deviated from the work plan. The deviations from the work plan are detailed below:

- The DGM survey in the northern area could not be conducted over the entirety of investigation area identified in the work plan. As shown on **Figure 4-2**, approximately 5.5 of the 12.3 acres could not be surveyed. The survey team was unable to safely access this portion of the northern investigation area due to the depth of the water and the presence of the pilings from the demolished wharf.
- The DGM survey in the southern area could not be conducted over the entirety of investigation area identified on Figure 5 of the work plan. As shown on **Figure 4-2**, approximately 2.9 of the 15.7 acres could not be surveyed.
  - The interior areas of the wharf could not be accessed because of the current condition of the wharf.
  - The area immediately east of the wharf could not be safely surveyed due to the river current and concerns with snaring the equipment on the wharf structure.
  - The southwest and northwest portions of the investigation area could not be safely accessed due to the limited depth of water.
- The height of the magnetometers exceeded 10 feet off the river bottom in the northeast portion of the northern investigation area (approximately 1.2 acres [**Figure 4-2**]). This deviation was due to the TVG being attached to buoys and floated over the site and the rapidly changing depth at this location. Commercial barges that had been moved to allow the survey to be conducted in this area were moved back before the survey team was able to resurvey this area with the magnetometers within 10 feet of the river bottom, and conducting the survey with the barges present would have created too much magnetic interference to obtain usable data. However, the data collected above the 10-foot metric is believed to be adequate for the purpose of identifying anomalies in this location because a review of the data concurrent with the survey indicated that the sensors detected anomalies with varying signal strength, which potentially indicates items of different size, orientation, or depth.

As a result of not being able to conduct the DGM survey over the entire site, there are data gaps associated with the areas that could not be investigated. While it is preferred to have this data, these data gaps did not prevent satisfying the investigation objective because the intent of this investigation was identify if there was a potential for past site activities to have led to DMM being present in the river sediment at the site and not to fully characterize the site.

4.6 Quality Assurance/Quality Control

Equipment was tested at the start and/or completion of each day in order to verify that equipment was functioning properly. If equipment response failed quality control (QC) criteria, equipment was recalibrated and then retested until results were satisfactory. The real time kinetic global positioning system (GPS) was tested using existing monuments (Third Order Class II) in order to ensure the real-time kinematic (RTK) GPS was accurately recording the location of the survey. The DGM survey equipment was placed near the survey boundaries at the boat launch point at the Elizabeth River Boat Landing and Park in an area free of metallic contacts and collected data for at least a one-minute period in order to determine if unusual levels of instrument or ambient noise existed. In addition, equipment was subjected to daily vibration tests to ensure that shaking the instrument did not result in spikes in the recorded data. There were no unusual levels of instrument or ambient noise identified during these checks nor did the cable shake result in spikes in the data collection.

During investigation activities, 2 percent of the total investigation area (approximately 0.5 acres) was resurveyed in order to demonstrate replecability of results.

Hand-recorded notes were generated by the CH2M HILL Field Team Leader in accordance with the standard operating procedure entitled *Preparing Field Log Books* presented in the work plan (CH2M HILL, 2010a) during the investigation. Work accomplished, variations from the work plan, field conditions, the results of QC checks, and other pertinent data/ information that could be used to help identify gaps, discrepancies, and oddities in the data were recorded (**Appendix C**).

Both the CH2M HILL and DGM subcontractor performed QC of the geophysical data and data deliverables at each step of the processing path. Data did not move to the next stage of analysis until they passed the QC check.

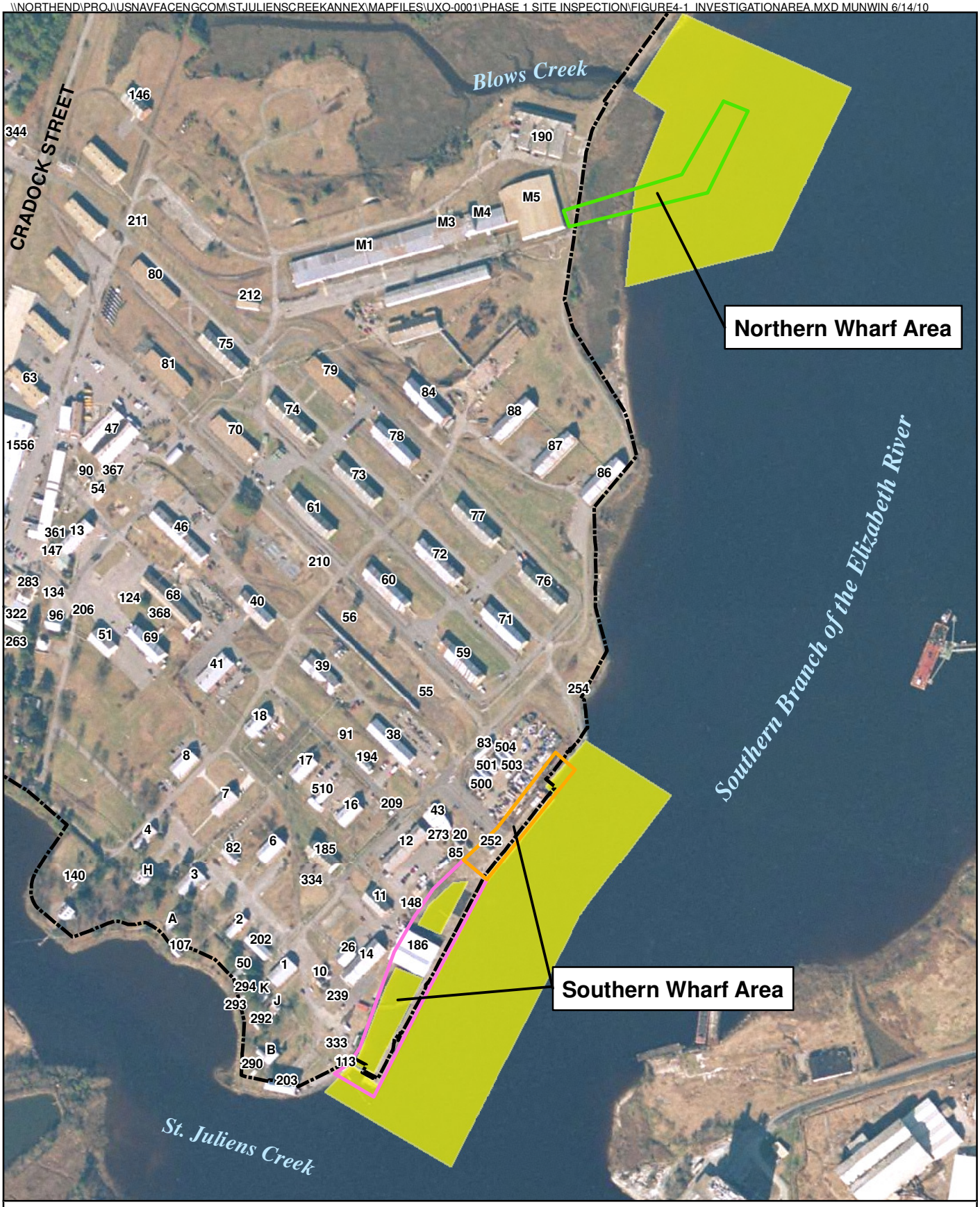
4.7 Data Analysis

Once QC inspection of all geophysical data was performed, the data was evaluated to determine the presence of geophysical anomalies in the sediment at the site. The data was reviewed by MRP-experienced data-processing geophysicists. The geophysicists used the following criteria for selecting significant anomalies:

- Maximum amplitude of the response with respect to local background conditions
- Lateral extent (plan size) of the area of response

- Shape of the response
- Location of the response with respect to the edge of the grid, unsurveyable areas, and underwater features

The magnetometer data was also compared to the side-scan sonar results to determine if anomalies detected on the sediment surface during the side-scan were in the same locations as magnetic anomalies. The purpose of this comparison was to determine if the images from the side-scan survey would be able to confirm or eliminate anomalies as potential DMM.



Legend

- SJCA Boundary
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3
- Investigation Area

N
W E
S

0 250 500
Feet

Figure 4-1
Investigation Area
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Legend

- SJCA Boundary
- Investigation Area
- Unable to complete DGM survey
- DGM survey complete
- DGM survey complete; sensor height > 10 ft
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3

N
W E
S

0 350 700
Feet

Figure 4-2
Deviations from the Work Plan
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

SECTION 5

Investigation Results

5.1 SI Activities and Data Result Summary

5.1.1 Bathymetric Survey

The results of the bathymetric survey are presented in **Figure 5-1.** The river depths in the northern area (Wharf 3) range between 1 foot (measured from msl) near the river bank to 13 feet in the northeastern portion of the area; the slope is not uniform across the investigation area and has several locations where the depth changes rapidly. The PA Report states that this area was dredged to a depth of 14 feet at mean low water when the wharf was constructed, indicating that approximately 1 to 16 feet of sediment may have deposited in the investigation area since the wharf was removed. However, the actual depth of the sediment and amount of deposition in the area are unknown.

The river depths in the southern area (Wharfs 1 and 2) range from 22 to 29 feet (measured from msl) at the eastern edge of the wharf to 40 to 45 feet at the river channel; the slope is not uniform across the investigation area and has several locations where the depth changes rapidly. The PA Report states that the portion of this area immediately adjacent to the wharf was dredged to a depth of 22 feet at mean low water when the wharf was first constructed, indicating that the depth of the river in this location may be within 7 feet of that when the wharfs were in operation. However, the actual depth of the sediment and amount of deposition in the area is unknown.

5.1.2 Side-Scan Sonar Survey

The side-scan sonar survey identified debris in both the northern and southern investigation areas that posed potential safety risks to the survey team and areas where the DGM equipment could become ensnared, trapped, or damaged. These areas were noted and the depth of the magnetometers used for the DGM survey were adjusted as necessary to mitigate the safety risk associated with the debris and to prevent the debris from damaging the DGM equipment. The images from the side-scan sonar survey are provided on **Figures 5-2** and **5-3**.

5.1.3 DGM Survey

The DGM survey identified individual anomalies and clusters of anomalies. For smaller, well-constrained anomalies, the target positioning was clear and the analysis of the data was relatively simple. However, for larger anomalies and clusters of anomalies there were many 'peaks' in the residual TMI data that required additional analysis to accurately interpret the data and define the targets. The data gathered during the survey identified:

- 265 anomalies in the northern area (Wharf 3)
- 1,386 anomalies in the southern area (Wharfs 1 and 2)

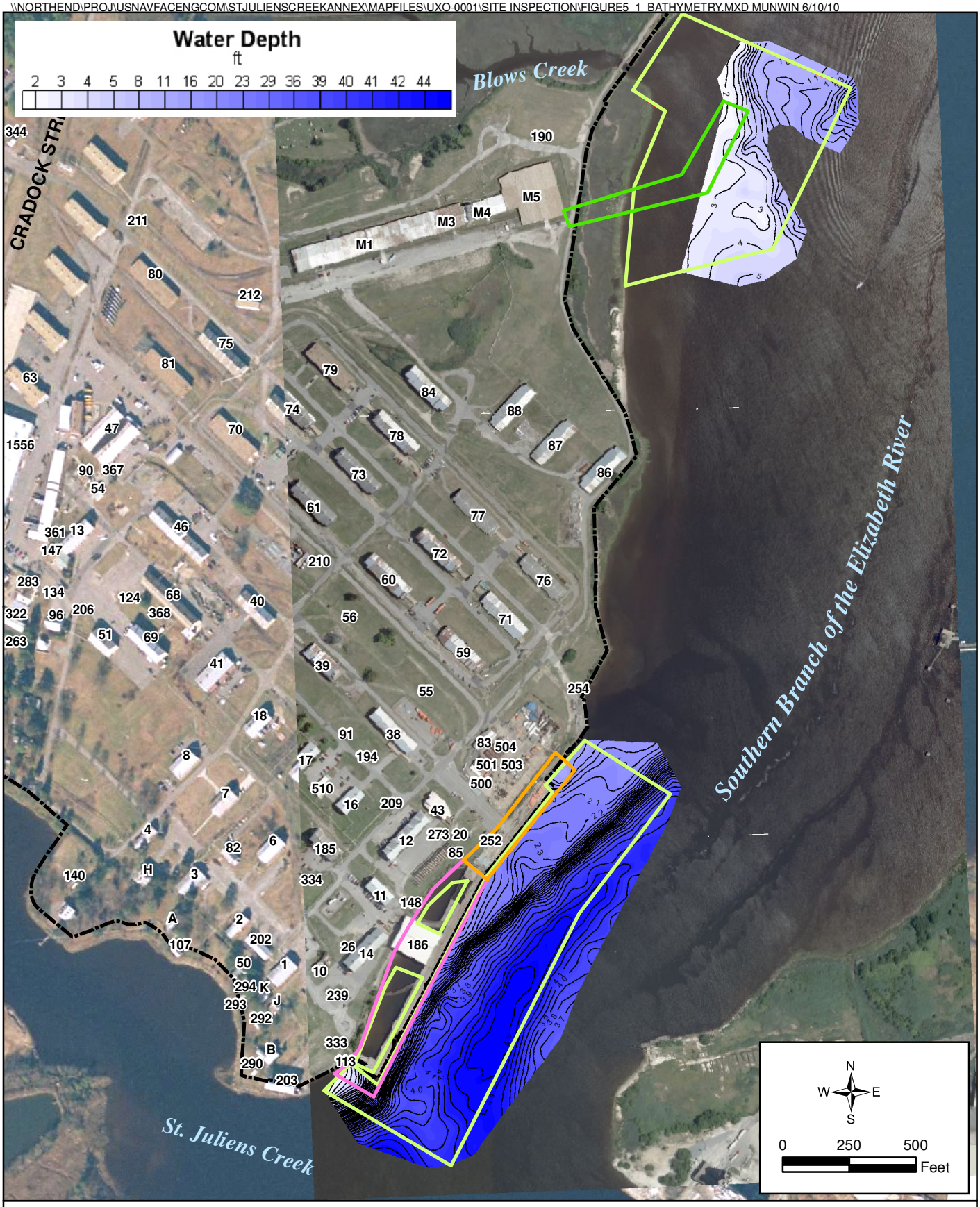
Figure 5-4 shows the locations of anomalies detected at Area UXO 1. The points shown on the figure correspond to locations where the magnetometer data analysis and interpretation indicate anomalies exist. The mosaics from the DGM survey, showing the anomalies and residual TMI fields, are provided in **Appendix D.**

Whether the anomalies identified by the DGM survey represent DMM cannot be determined without further investigation. The magnetic signature from the anomalies located in the sediment are an indication that ferrous items are in the locations identified; however, the historic and widespread use of the river in the vicinity of the wharf areas introduce too many variables to be able to determine the nature of the anomalies detected without additional investigation. Additionally, a comparison of the DGM data to the side scan sonar survey data did not allow for a visual identification of the items.

5.2 Conceptual Site Model

The data presented in the previous sections, along with the results of SI, were used to update the conceptual site model (CSM) profile presented in the work plan; the revised CSM is presented in **Figure 5-5**. 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 DMM, potential receptors and exposure pathways, and land use data for the site.

Since there was only a limited amount of data collected during the investigation activities, the CSM has only been revised to show the location of anomalies detected within the sediment at Area UXO 1. Human exposure pathways include direct contact with DMM during construction and recreational activities that could result in unintentional detonation of the item, contact with MC that has leached from DMM into the sediment and surface water, and ingestion of fish, shell fish, and other edible items from the river environment. Similarly, marine organisms may be impacted if an item detonates or exposed to MC if the organism ingests the river water and sediment, which can propagate through the food chain as they are eaten by higher level species feeding in or on the river.



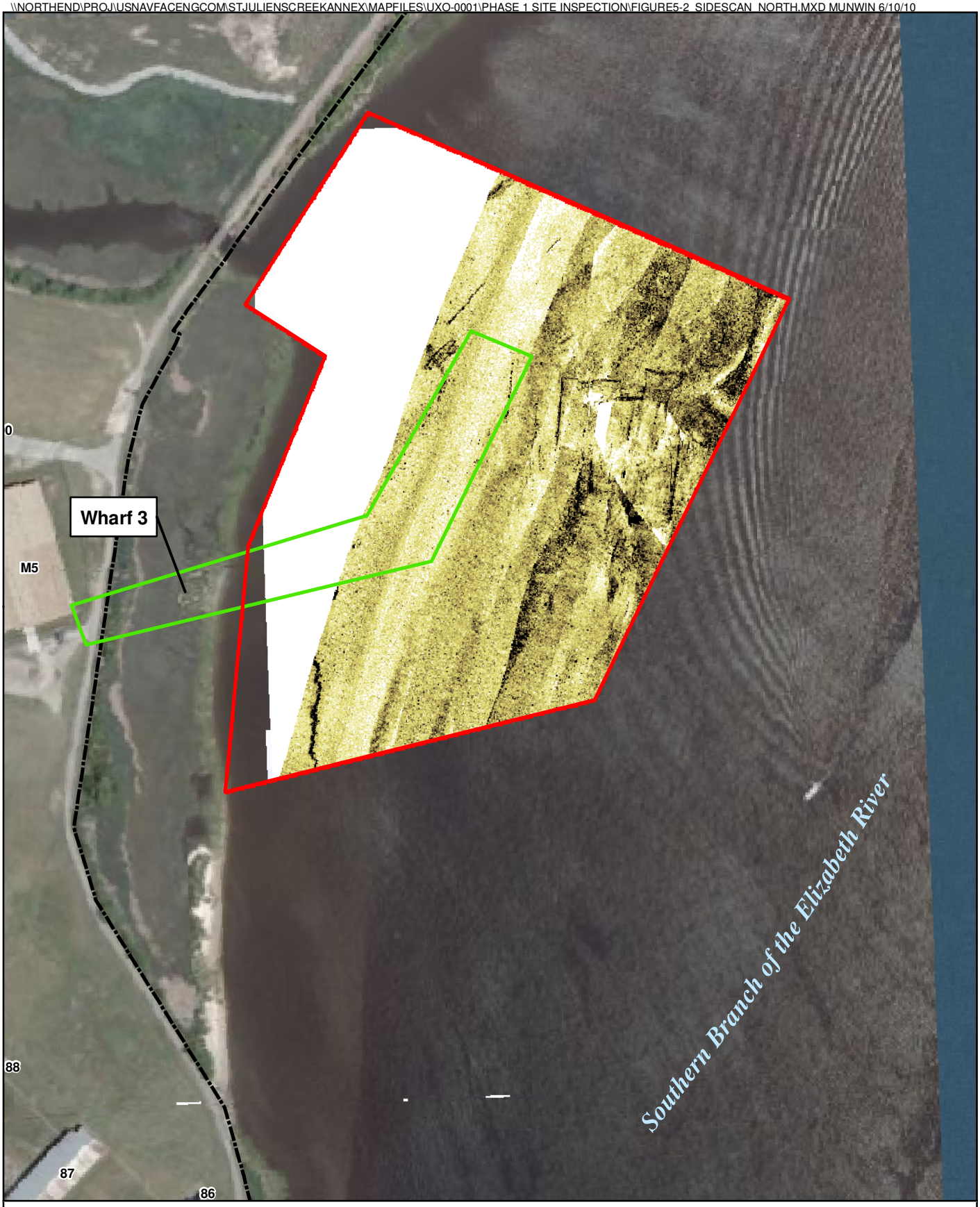
Legend

- SJCA Boundary
- Wharf 1 (also Dock 2)
- Wharf 2 (also Dock 1)
- Wharf 3
- Investigation Area

Depths are relative to mean sea level.
Contours are in feet.

Figure 5-1
Bathymetric Survey Results
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



Legend
- SJCA Boundary
- Wharf 3
- Survey Area

N
W E
S

0 100 200
Feet

Figure 5-2
Side-Scan Sonar Survey Results-
Northern Area
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

Legend

- SJCA Boundary
- Wharf 1
- Wharf 2
- Survey Area

N
W E
S

0 125 250
Feet

Figure 5-3
Side-Scan Sonar Survey Results-
Southern Area
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\STJULIENSCREEKANNEX\MAPFILES\UXO-0001\SITE INSPECTION\FIGURE5-4_DGM_ANOMALIES_DETECTED.MXD MUNWIN 6/11/10

Legend

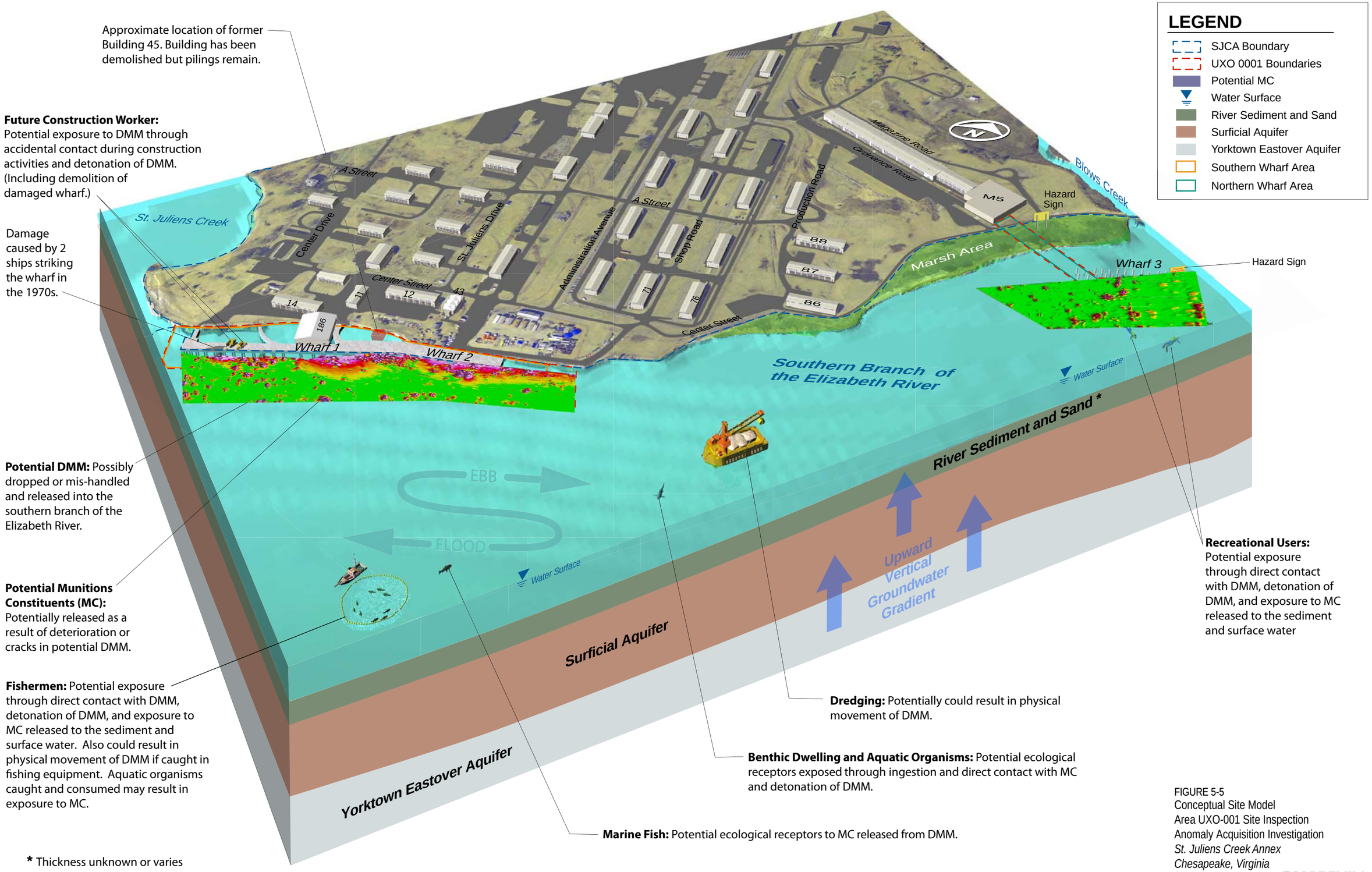
- Anomaly
- SJCA Boundary
- Survey Area
- Wharf 1
- Wharf 2
- Wharf 3

N
W E
S

0 350 700
Feet

Figure 5-4
DGM Survey Anomalies Detected
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL



* Thickness unknown or varies

FIGURE 5-5
Conceptual Site Model
Area UXO-001 Site Inspection
Anomaly Acquisition Investigation
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

ES052810062247WDC (orig. ES032009004GNV) UXO-0001_3D_Conceptual_Site_Model_ver5.ai 8-10-10 mlb

SECTION 6

Conclusions and Recommendations

The SI resulted in the identification of 1,651 anomalies within the investigation area at Area UXO 1. As discussed previously, the results of the SI cannot be used to determine whether or not the anomalies detected in the river sediment at SJCA Area UXO 1 are DMM. Therefore, anomalies will have to be visually inspected to make the determination of the nature of the anomalies and, if the anomalies are determined to be DMM, the identification of the DMM items.

Investigation of a small subset of the anomalies identified during the DGM survey is recommended. This subset will be representative of the anomalies detected at the site and will aid in the determination whether or not additional anomalies should be investigated. In addition, based on the assumption that items would be dropped close to the wharf if they were dropped at all during the munitions loading process, areas should be investigated in the location adjacent to the southern area where the survey team was unable to collect data. Investigation of this area will help fill the data gaps and aid in developing a more complete understanding of the site.

Fifteen locations are recommended for additional investigation based on the results of the investigation. The locations of the areas identified for further investigation are presented on **Figures 6-1** and **6-2** and the rationale for each location is discussed in this section.

6.1 Northern Wharf

Four locations in the vicinity of the Wharf 3 were selected for further investigation. A discussion of the rationale for each location is provided below, while a map of the proposed locations is provided in **Figure 6-1**.

- **Locations 1–3**: Anomalies detected in this location were in the vicinity of the former structure of Wharf 3, indicating the potential for the anomalies to be the result of munitions loading activities.
- **Location 4**: VDEQ requested that the Navy investigate this line of anomalies.

6.2 Southern Wharf

Eleven locations in the vicinity of the Wharfs 1 and 2 were selected for further investigation. A discussion of the rationale for each location is provided below, while a map of the proposed locations is provided in **Figure 6-2**.

- **Location 5 and 8**: A cluster of anomalies was detected in these locations, which are approximately 45 ft away from the edge of Wharf 2. Ships used prior to WW II were narrower than their WWII counterparts, which ranged from 60 feet to 63 feet (Clancy, 1998). Therefore, detected anomalies at these locations may be the result of ammunitions loading activities prior to WW II.

- **Locations 6, 10, and 14**: Due to interference from the wharf and safety concerns with getting too close to the wharf, the DGM survey was not conducted in this location. However, based on the assumption that munitions could have been dropped between the wharf and boat during munitions loading, there is potential for munitions to be present. The equipment and procedures used for acquiring the anomalies will not present the same safety issues as the DGM survey.
- **Locations 7, 9, 13, and 15**: A high density of anomalies was detected in this location, which is approximately 60 ft away from the edge of Wharf 2. The beam of ammunition ships (largest width) used during WW II ranged from 60 feet to 63 feet (Clancy, 1998); therefore, detected anomalies may be the result of ammunitions loading activities on the starboard side of an ammunition ship used during WW II.
- **Location 11:** Anomalies were detected in this location in close proximity to the edge of Wharf 1.
- **Location 12**: A cluster of anomalies was detected in this location and identified to allow for more complete coverage of the southern wharf area.

The data collected during the SI should be used to develop a work plan for a future investigation and an accompanying Explosives Safety Submission. Following the completion of the investigation, the Munitions Response Site Prioritization Protocol (MRSPP) should be updated, as appropriate, to include any information about the nature of the items observed during the investigation. The data should be reported and used to determine whether additional investigation or action is warranted at the site.

Legend

- Anomaly
- SJCA Boundary
- Investigation Area
- Unable to complete DGM survey
- DGM survey complete
- DGM survey complete; sensor height > 10 ft
- Location recommended for further investigation/ anomaly acquisition and inspection

N
W E
S

0 150 300 Feet

Figure 6-1
Anomalies Recommended for Further Investigation - Northern Area
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\STJULIENSCREEKANNEX\MAPFILES\UXO-0001\SITE INSPECTION\FIGURE6-2_DGM_ANOMALIES_DETECTED_SOUTH.MXD MUNWIN 6/11/10

Legend

- Anomaly
- SJCA Boundary
- Survey Area
- Unable to complete DGM survey
- DGM survey complete
- Location recommended for further investigation/ anomaly acquisition and inspection

N W E S

0 150 300 Feet

Figure 6-2
Anomalies Recommended for Further Investigation - Southern Area
Area UXO-001 Site Inspection
St. Juliens Creek Annex
Chesapeake, Virginia

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SECTION 7

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Appendix A
Munitions Response Site Prioritization Protocol

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.	~~15~~
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.

Exact Munitions potentially present is unknown. Based upon shipping records, the potential exists for items to have been dropped from the piers. Potential items may include small arms, 2"-16" projectiles, practice bombs, hand grenades, and several other items (Final PA, 2009).

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.	5
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).	2

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

The MRS is a transfer point to load/unload ships (Final PA, 2009)

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).	10

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

The PA details the results of the investigation. Physical evidence including one sediment sample and previous magnetic investigations, as well as historical evidence (historical records) of munitions loading/unloading operations at the site, indicate the potential exists for munitions to have been dropped during transfer operations, particularly during the increased wartime activities (Final PA, 2009).

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 **<u>the single highest score</u>** 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 wharf area and investigation area extends out into a public waterway.

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.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

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

The wharf area and investigation area extends out into a public waterway

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.	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).	5

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

Highest census tract within 2-miles is #2118 (Portsmouth) at 5,907 persons per square mile.

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 **<u>the single highest score</u>** 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.

(Final PA, 2009)

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.	~~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 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.

Per Site Management Plan, most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries (Final PA, 2009).

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.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

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

The northern Wharf investigation area includes a wetland designated on the National Wetland Inventory. No cultural resource determination has been made for UXO 0001.

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	17
Source of Hazard	Table 2	2	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	23
Ease of Access	Table 4	8	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	5	18
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			58

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	E

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.

No evidence of CWM. Evidence of CAIS on the surface or subsurface does not exist at UXO 0001, and no training using CAIS was documented at SJCA. Documentation does exist that these sets were stored in Building 163 at SJCA, and may have been transferred to/from ship at the wharfs. However, storage an transfer of CAIS does not qualify as a source of CWM hazard.

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.	~~0~~
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 evidence of CWM. CAIS as a Source of CWM is only evaluated for presence in the surface or subsurface or for use at former training facilities. Evidence of CAIS on the surface or subsurface does not exist at UXO 0001, and no training using CAIS was documented at SJCA.

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.	~~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.

No evidence of CWM. No physical or historical evidence exists confirming or indicating CAIS is or may be on the surface or subsurface at UXO 0001

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 **<u>the single highest score</u>** 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 wharf area and investigation area extends out into a public waterway.

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 **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	5

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

The wharf area and investigation area extends out into a public waterway.

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).	5

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

Highest census tract within 2-miles is #2118 (Portsmouth) at 5,907 persons per square mile.

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.	~~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 **<u>the single highest score</u>** 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.

(Final PA, 2009)

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.

Per Site Management Plan, most surrounding areas are developed and include residences, schools, recreational areas, and shipping facilities for several large industries (Final PA, 2009).

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.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **<u>the single highest score</u>** from above in the box to the right (maximum score = 5).	3

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

The northern wharf investigation area includes a wetland designated on the National Wetland Inventory. No cultural resource determination has been made for UXO 0001.

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	13
Ease of Access	Table 14	8	
Status of Property	Table 15	5	
Receptor Factor Data Elements			
Population Density	Table 16	5	18
Population Near Hazard	Table 17	5	
Types of Activities/Structures	Table 18	5	
Ecological and/or Cultural Resources	Table 19	3	
CHE MODULE TOTAL			31

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	

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
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 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).	

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).	

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
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 (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
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 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).	

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).	

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
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
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 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).	

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).	

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
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 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).	

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).	

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 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)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)					
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)					
Surface Soil (Table 26)					

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	

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				6	

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: Area UXO 0001

Component: U.S. Navy

Installation/Property Name: St. Juliens Creek Annex

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

Site Name/Project Name (Project No.): See Munitions Response Site Name

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:
A detailed description of SJCA and Area UXO 0001 is provided in the PA. UXO 0001 was used to load/unload munitions from Navy ships from approximately 1898 to 1975.

Description of Pathways for Human and Ecological Receptors: Potential pathways may be through physical contact with munitions during construction activities, fishing/dredging, or recreational use. Ecological receptors may be exposed if any munitions released MC.

Description of Receptors (Human and Ecological): Potential receptors may include: Human - Construction workers, fishermen, recreational divers; Ecological - aquatic vegetations (wetlands), benthic organisms, estuarine and marine fish, and wildlife.

Appendix B
Money Point Station Water Levels

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/9/2010	0:00	21.81	-1.38	0.006	196.749	0.194	30.64	44.43	1022.61
	1:00	22.09	-1.09	0.894	358.002	1.326	30.19	44.35	1022.73
	2:00	22.58	-0.61	0.000	252.356	0.000	29.10	44.40	1022.33
	3:00	23.18	-0.01	1.263	212.453	1.814	28.26	44.28	1022.73
	4:00	23.75	0.57	0.002	231.607	0.330	28.59	44.22	1022.30
	5:00	24.15	0.96	2.237	102.711	3.353	28.71	44.04	1021.63
	6:00	24.27	1.09	0.449	343.138	0.937	28.48	43.95	1021.55
	7:00	24.16	0.97	1.996	107.922	2.630	29.17	43.95	1021.50
	8:00	23.81	0.63	2.302	108.150	3.093	31.61	43.91	1020.63
	9:00	23.28	0.09	1.580	217.330	2.391	33.32	43.97	1021.77
	10:00	22.66	-0.52	1.473	167.672	1.956	35.86	43.94	1021.89
	11:00	22.16	-1.02	4.261	155.819	5.596	37.82	43.93	1021.56
	12:00	21.92	-1.26	6.700	147.103	8.287	40.12	44.21	1019.27
	13:00	21.96	-1.23	4.595	147.912	5.660	41.95	44.53	1017.46
	14:00	22.23	-0.95	7.789	155.960	10.433	41.93	44.60	1016.33
	15:00	22.69	-0.50	6.965	136.117	10.724	40.94	44.65	1014.49
	16:00	23.22	0.04	5.744	130.423	8.388	39.87	44.79	1013.35
	17:00	23.65	0.47	3.316	128.120	5.559	37.51	45.06	1012.50
	18:00	23.84	0.66	4.677	112.623	8.273	35.63	45.31	1010.65
	19:00	23.77	0.58	4.760	45.231	5.966	36.54	45.40	1010.21
	20:00	23.48	0.30	7.919	64.545	12.075	36.83	45.39	1007.99
	21:00	23.02	-0.17	4.780	340.141	8.636	37.82	45.27	1007.18
	22:00	22.45	-0.73	2.282	74.369	3.586	37.93	45.06	1005.15
	23:00	21.97	-1.21	2.817	354.360	4.195	39.66	45.13	1003.70
2/10/2010	0:00	21.73	-1.45	1.895	30.959	3.404	39.41	45.31	1001.46
	1:00	21.79	-1.40	3.544	334.911	6.098	39.63	45.42	999.89
	2:00	22.09	-1.09	2.502	9.495	4.348	38.92	45.48	998.26
	3:00	22.6	-0.59	1.952	314.138	2.440	38.51	45.65	997.26
	4:00	23.23	0.05	3.338	333.831	4.269	38.34	45.85	996.13
	5:00	23.84	0.66	3.167	298.732	4.012	38.09	46.30	995.42
	6:00	24.24	1.05	5.725	278.990	7.876	37.08	46.46	995.32
	7:00	24.35	1.16	13.716	288.295	19.454	35.78	46.45	995.80
	8:00	24.18	0.99	13.364	296.949	20.416	35.04	46.22	995.91
	9:00	23.77	0.58	14.178	297.715	25.023	31.56	45.96	996.32
	10:00	23.17	-0.02	15.452	297.387	25.583	26.52	45.55	997.31
	11:00	22.53	-0.66	17.187	304.812	28.310	25.98	44.97	997.52
	12:00	22.05	-1.14	11.694	327.410	17.592	28.67	44.90	997.27
	13:00	21.85	-1.34	14.561	332.422	21.297	30.03	44.83	996.53
	14:00	21.93	-1.25	14.901	329.390	23.960	31.14	44.80	996.14
	15:00	22.26	-0.93	17.259	307.363	27.272	31.87	44.73	996.10
	16:00	22.78	-0.41	13.568	313.789	19.747	33.91	44.70	996.32
	17:00	23.36	0.17	12.734	299.515	23.023	34.72	44.68	996.25
	18:00	23.8	0.61	11.494	300.647	17.296	34.29	44.61	996.49
	19:00	23.96	0.78	12.841	311.622	27.846	34.41	44.50	997.26
	20:00	23.84	0.65	10.969	327.049	17.207	33.79	44.47	998.38
	21:00	23.48	0.30	13.344	330.490	21.635	33.50	44.56	999.28
	22:00	22.94	-0.24	12.441	329.000	21.188	33.62	44.60	1000.60
	23:00	22.34	-0.84	11.700	330.467	15.850	33.59	44.09	1001.16
2/11/2010	0:00	21.86	-1.32	7.587	332.064	12.559	33.77	43.87	1002.30
	1:00	21.66	-1.53	12.209	328.878	17.813	33.90	43.68	1002.83
	2:00	21.76	-1.43	7.464	328.333	10.382	32.66	43.66	1003.77
	3:00	22.12	-1.07	8.009	333.315	11.836	32.71	43.78	1004.66
	4:00	22.69	-0.49	8.347	334.609	11.051	32.83	44.03	1005.63
	5:00	23.38	0.20	6.504	334.724	8.703	32.60	44.28	1006.60
	6:00	24.01	0.82	6.959	330.611	9.536	32.07	44.35	1007.08
	7:00	24.37	1.18	5.456	328.202	8.357	31.83	44.38	1008.05
	8:00	24.41	1.22	5.933	330.810	8.986	32.85	44.26	1008.87
	9:00	24.15	0.96	8.724	338.959	12.446	34.87	44.09	1009.44
	10:00	23.64	0.46	9.200	330.742	12.606	37.01	44.14	1010.01
	11:00	22.98	-0.21	11.877	338.707	22.515	39.79	44.25	1009.65
	12:00	22.33	-0.86	13.107	338.370	22.080	40.76	44.06	1009.28
	13:00	21.89	-1.29	10.944	355.352	19.987	42.39	43.83	1009.18
	14:00	21.77	-1.42	9.222	332.208	12.483	44.32	43.85	1008.95
	15:00	21.93	-1.25	10.816	350.020	16.974	45.09	44.23	1008.78
	16:00	22.35	-0.83	5.445	349.022	8.607	45.66	44.72	1008.84
	17:00	22.95	-0.24	5.184	346.203	8.549	45.07	45.28	1009.57
	18:00	23.56	0.38	3.582	338.412	6.809	43.45	45.31	1010.35
	19:00	23.98	0.79	3.240	335.057	4.879	42.19	45.33	1010.73
	20:00	24.07	0.89	3.886	334.482	6.640	40.58	45.28	1011.29
	21:00	23.86	0.68	4.187	324.079	5.923	38.97	45.07	1012.10
	22:00	23.42	0.23	4.080	333.398	6.008	37.67	44.77	1012.04
	23:00	22.81	-0.37	5.812	351.420	8.549	36.53	44.76	1012.32

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/12/2010	0:00	22.18	-1.00	5.894	352.610	7.913	35.87	44.64	1013.16
	1:00	21.73	-1.46	7.008	353.184	10.786	35.10	44.49	1013.80
	2:00	21.58	-1.60	4.689	352.287	7.181	34.11	44.29	1013.99
	3:00	21.77	-1.42	2.523	334.766	3.538	32.24	44.25	1013.96
	4:00	22.22	-0.96	3.334	331.582	4.397	31.52	44.59	1014.27
	5:00	22.88	-0.31	3.956	301.086	5.377	30.15	44.61	1014.67
	6:00	23.61	0.42	2.780	332.351	4.817	29.86	44.85	1014.74
	7:00	24.21	1.02	4.597	358.664	7.569	31.68	45.06	1015.53
	8:00	24.48	1.30	4.500	13.934	7.497	31.75	44.98	1016.05
	9:00	24.41	1.22	5.901	14.412	9.531	32.46	44.71	1016.21
	10:00	24.03	0.85	3.627	14.850	5.995	33.54	44.45	1016.38
	11:00	23.43	0.25	4.448	51.542	6.957	34.65	44.19	1015.51
	12:00	22.72	-0.47	2.333	21.226	4.817	35.46	44.06	1014.79
	13:00	22.09	-1.10	3.711	63.016	6.722	36.26	44.06	1013.44
	14:00	21.73	-1.46	1.213	82.234	4.175	36.93	44.20	1012.93
	15:00	21.71	-1.47	0.016	14.694	0.535	38.02	44.45	1012.52
	16:00	22	-1.18	0.420	147.338	1.302	38.20	44.85	1012.25
	17:00	22.53	-0.65	1.633	105.264	3.042	37.61	44.95	1012.11
	18:00	23.2	0.01	1.588	102.423	2.243	37.28	45.29	1011.73
	19:00	23.81	0.62	3.499	149.000	4.276	36.86	45.32	1011.32
	20:00	24.15	0.96	3.378	133.715	4.482	35.80	45.14	1010.99
	21:00	24.14	0.96	3.244	143.838	4.251	35.11	45.09	1011.00
	22:00	23.83	0.64	1.784	188.877	2.988	34.78	45.04	1011.18
	23:00	23.29	0.10	1.333	57.675	2.787	34.58	45.03	1009.48
2/13/2010	0:00	22.62	-0.56	2.525	58.400	4.624	34.58	44.80	1007.60
	1:00	21.99	-1.19	2.092	43.605	4.014	34.88	44.73	1006.95
	2:00	21.6	-1.59	6.055	37.443	9.846	35.12	44.71	1006.27
	3:00	21.56	-1.63	5.297	44.356	7.340	32.93	44.65	1005.62
	4:00	21.86	-1.33	7.976	27.017	12.975	32.83	44.62	1005.10
	5:00	22.41	-0.77	7.614	28.166	11.865	31.03	44.67	1005.22
	6:00	23.14	-0.05	4.959	1.758	8.565	31.09	44.70	1004.47
	7:00	23.87	0.68	7.954	355.055	12.569	31.41	44.70	1004.19
	8:00	24.38	1.20	7.521	2.714	14.050	32.45	44.60	1004.99
	9:00	24.53	1.35	7.571	6.618	12.544	32.80	44.41	1005.07
	10:00	24.32	1.14	6.928	1.253	11.208	30.53	43.96	1005.69
	11:00	23.83	0.64	8.318	356.762	13.317	30.68	43.76	1006.22
	12:00	23.14	-0.04	5.402	349.647	9.251	30.72	43.64	1006.39
	13:00	22.41	-0.78	7.750	355.573	11.560	31.00	43.56	1005.82
	14:00	21.83	-1.35	7.515	343.504	11.492	31.86	43.62	1005.87
	15:00	21.6	-1.58	7.816	331.115	12.759	32.38	43.81	1006.00
	16:00	21.74	-1.44	6.716	330.300	10.485	32.93	43.89	1006.39
	17:00	22.17	-1.01	6.998	307.000	10.108	34.16	44.06	1006.50
	18:00	22.8	-0.38	2.953	282.962	4.026	33.59	44.17	1007.08
	19:00	23.49	0.31	2.811	240.297	3.682	31.76	44.28	1007.53
	20:00	24.04	0.86	3.277	256.129	4.224	31.10	44.28	1007.88
	21:00	24.27	1.09	2.280	278.516	3.110	30.84	44.23	1008.30
	22:00	24.14	0.96	3.147	287.316	4.078	30.57	44.18	1008.77
	23:00	23.72	0.53	3.796	308.048	4.665	30.28	44.14	1009.12
2/14/2010	0:00	23.1	-0.09	4.127	299.888	6.312	30.67	44.08	1009.35
	1:00	22.4	-0.78	4.265	314.459	6.733	30.40	43.86	1009.63
	2:00	21.81	-1.38	5.849	317.713	8.821	30.03	43.38	1010.27
	3:00	21.52	-1.67	5.530	312.200	8.495	29.39	42.93	1009.89
	4:00	21.62	-1.57	5.993	303.025	8.197	28.82	42.60	1010.09
	5:00	22.04	-1.14	5.830	290.864	8.561	28.64	42.61	1010.79
	6:00	22.69	-0.50	4.776	306.435	7.402	27.59	42.46	1010.68
	7:00	23.44	0.25	5.985	301.070	9.774	28.03	42.55	1011.10
	8:00	24.1	0.92	6.821	314.620	10.895	28.98	42.83	1011.80
	9:00	24.49	1.31	5.633	302.767	9.527	31.65	43.15	1012.01
	10:00	24.49	1.31	8.135	312.227	13.094	34.34	43.24	1011.81
	11:00	24.14	0.95	7.898	309.874	13.626	35.68	43.20	1012.04
	12:00	23.53	0.35	9.729	321.321	13.799	36.93	43.30	1011.32
	13:00	22.79	-0.39	6.316	301.993	11.663	38.70	43.10	1010.74
	14:00	22.08	-1.10	9.159	266.452	12.759	39.57	42.72	1010.31
	15:00	21.63	-1.56	8.932	304.109	13.376	41.64	43.20	1010.04
	16:00	21.57	-1.61	5.933	274.734	9.262	42.28	43.60	1009.95
	17:00	21.88	-1.30	9.093	307.294	14.289	43.09	43.83	1010.52
	18:00	22.44	-0.74	4.302	254.338	6.047	41.15	44.02	1011.33
	19:00	23.12	-0.06	2.517	247.233	3.551	39.01	44.47	1011.90
	20:00	23.79	0.60	2.842	256.763	3.617	37.61	44.53	1012.28
	21:00	24.24	1.05	3.244	242.530	4.265	36.26	44.53	1012.81
	22:00	24.33	1.15	3.359	233.804	4.203	35.13	44.48	1013.04
	23:00	24.07	0.88	2.543	245.283	3.555	34.06	44.32	1013.24

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/15/2010	0:00	23.54	0.36	1.691	226.664	2.202	33.34	44.27	1013.33
	1:00	22.86	-0.32	2.865	229.512	3.748	32.67	43.97	1013.57
	2:00	22.17	-1.01	3.038	235.573	4.484	32.30	43.33	1013.43
	3:00	21.67	-1.52	2.055	226.815	2.970	31.81	43.22	1013.29
	4:00	21.53	-1.66	2.638	219.156	3.894	31.54	43.16	1013.00
	5:00	21.77	-1.41	2.572	153.823	3.262	31.42	43.09	1012.79
	6:00	22.31	-0.87	3.106	194.855	4.766	31.42	43.12	1013.16
	7:00	23	-0.19	2.500	162.844	3.343	30.61	43.62	1013.05
	8:00	23.71	0.52	0.468	117.220	1.880	33.04	44.05	1013.29
	9:00	24.27	1.09	2.130	200.208	3.213	36.89	44.23	1012.84
	10:00	24.51	1.32	3.048	147.315	3.940	41.69	44.10	1011.85
	11:00	24.34	1.16	7.192	178.315	10.223	47.37	43.96	1011.31
	12:00	23.85	0.67	9.124	197.273	13.063	51.39	43.85	1009.93
	13:00	23.17	-0.02	8.885	181.092	14.276	52.62	43.73	1008.06
	14:00	22.42	-0.76	5.592	226.400	8.440	53.12	43.80	1007.11
	15:00	21.8	-1.38	5.791	232.284	9.062	54.23	44.36	1006.61
	16:00	21.53	-1.66	12.248	236.715	22.585	54.43	44.84	1006.31
	17:00	21.67	-1.52	10.709	242.570	16.626	53.12	45.06	1005.69
	18:00	22.14	-1.05	11.964	221.039	19.256	52.81	45.15	1004.95
	19:00	22.78	-0.41	9.877	223.839	17.537	52.42	45.54	1004.42
	20:00	23.46	0.28	8.942	238.325	14.487	50.77	45.72	1003.89
	21:00	24.05	0.86	8.695	273.444	11.235	48.97	45.69	1003.72
	22:00	24.37	1.18	9.379	283.737	12.930	46.89	45.43	1003.78
	23:00	24.31	1.13	7.867	260.162	10.631	45.40	45.24	1004.01
2/16/2010	0:00	23.92	0.73	7.107	297.705	10.464	41.64	45.19	1004.27
	1:00	23.31	0.12	7.231	309.716	9.737	39.43	45.23	1004.44
	2:00	22.61	-0.58	6.051	320.813	10.458	35.68	45.12	1004.91
	3:00	21.98	-1.21	7.402	304.273	10.781	33.80	44.77	1004.81
	4:00	21.6	-1.58	6.321	299.139	8.522	32.53	44.45	1004.81
	5:00	21.63	-1.56	6.279	304.500	9.029	31.75	44.35	1004.98
	6:00	22.01	-1.17	8.664	296.878	11.686	32.01	44.34	1005.18
	7:00	22.61	-0.57	7.058	304.560	11.739	31.56	44.52	1005.57
	8:00	23.29	0.11	10.924	294.572	15.160	31.29	44.61	1006.07
	9:00	23.93	0.74	14.003	299.156	21.203	32.42	44.80	1006.47
	10:00	24.36	1.17	14.048	294.843	25.223	33.76	44.97	1006.61
	11:00	24.42	1.24	11.663	328.290	18.544	35.18	44.84	1006.95
	12:00	24.1	0.92	13.148	311.941	19.625	36.22	44.75	1006.78
	13:00	23.5	0.32	11.191	302.137	17.981	37.14	44.68	1006.33
	14:00	22.78	-0.41	9.824	315.522	15.609	38.54	44.51	1005.74
	15:00	22.09	-1.10	11.984	324.296	19.398	39.44	44.47	1005.58
	16:00	21.62	-1.56	7.985	318.897	11.315	38.79	44.74	1005.98
	17:00	21.55	-1.64	9.224	318.542	13.854	38.87	45.12	1006.45
	18:00	21.88	-1.31	8.061	329.157	12.324	36.97	45.36	1007.50
	19:00	22.46	-0.73	7.144	320.774	11.611	35.71	45.52	1008.48
	20:00	23.13	-0.05	5.346	308.451	8.642	34.64	45.94	1008.87
	21:00	23.78	0.59	7.511	294.207	10.355	34.08	46.15	1009.20
	22:00	24.26	1.07	7.849	288.320	12.361	33.77	46.06	1009.54
	23:00	24.43	1.24	7.527	299.324	10.298	33.10	45.84	1009.92
2/17/2010	0:00	24.22	1.03	7.451	298.973	9.849	32.54	45.67	1010.01
	1:00	23.71	0.52	6.220	296.000	8.747	32.00	45.50	1009.90
	2:00	23.04	-0.14	5.797	294.512	9.190	31.33	45.39	1009.70
	3:00	22.37	-0.81	3.711	313.892	6.611	30.07	44.81	1009.27
	4:00	21.85	-1.34	5.381	297.324	6.848	29.79	44.30	1009.35
	5:00	21.63	-1.55	3.950	317.149	5.647	29.16	44.08	1009.25
	6:00	21.81	-1.38	2.953	320.966	4.648	28.87	43.76	1008.94
	7:00	22.28	-0.90	3.149	318.280	4.467	28.41	44.17	1009.36
	8:00	22.9	-0.29	4.784	319.245	8.450	29.69	44.24	1009.63
	9:00	23.53	0.34	5.000	312.793	6.337	31.91	44.56	1009.40
	10:00	24.07	0.88	3.602	336.879	7.173	34.19	45.13	1009.09
	11:00	24.35	1.16	6.905	293.934	10.644	36.34	45.21	1008.82
	12:00	24.25	1.06	7.054	329.176	10.106	38.19	44.91	1007.91
	13:00	23.79	0.60	6.129	329.776	9.272	38.91	44.63	1006.73
	14:00	23.12	-0.06	3.998	324.217	7.766	39.22	44.77	1006.02
	15:00	22.42	-0.76	5.252	1.631	8.114	39.77	44.89	1005.66
	16:00	21.84	-1.34	9.536	333.821	16.235	40.62	45.19	1005.71
	17:00	21.56	-1.62	9.154	314.241	15.623	40.16	45.71	1005.82
	18:00	21.68	-1.50	6.403	303.314	10.571	39.18	45.88	1006.42
	19:00	22.15	-1.03	5.703	300.294	8.026	38.72	46.09	1006.76
	20:00	22.8	-0.39	4.842	285.381	7.216	37.38	46.70	1007.18
	21:00	23.46	0.28	6.800	291.646	9.605	36.68	47.12	1007.34
	22:00	24.04	0.85	7.169	298.089	11.197	36.14	47.12	1007.40
	23:00	24.4	1.21	8.765	299.588	14.431	35.41	47.12	1007.59

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/18/2010	0:00	24.2	1.0	8.710	302.524	12.507	34.64	46.51	1007.75
	1:00	23.7	0.5	7.402	304.157	10.526	33.47	46.63	1008.03
	2:00	23.1	-0.1	6.510	303.044	9.927	32.91	46.46	1008.05
	3:00	22.5	-0.7	6.284	300.127	10.781	32.84	46.20	1007.91
	4:00	22.1	-1.1	5.933	303.281	9.363	32.53	45.42	1007.84
	5:00	21.7	-1.5	8.232	299.674	11.980	32.62	45.00	1008.33
	6:00	21.8	-1.4	7.595	290.686	9.241	32.55	45.15	1008.75
	7:00	22.1	-1.1	7.054	290.222	9.443	32.67	45.39	1009.42
	8:00	22.5	-0.6	8.555	291.376	11.918	33.59	45.57	1010.25
	9:00	23.0	-0.2	6.559	320.925	12.384	36.97	45.74	1010.56
	10:00	23.5	0.4	7.587	314.999	13.175	39.90	46.25	1010.69
	11:00	23.9	0.7	7.252	327.910	11.716	41.97	46.55	1010.61
	12:00	23.9	0.8	8.040	303.208	11.018	43.49	46.58	1010.35
	13:00	23.6	0.4	10.508	334.300	17.287	46.18	46.86	1009.78
	14:00	23.2	0.1	9.708	324.629	13.214	47.73	47.27	1009.31
	15:00	22.7	-0.5	10.765	333.042	16.322	49.16	47.59	1009.12
	16:00	22.2	-1.0	8.594	329.950	13.494	50.30	47.40	1009.22
	17:00	21.8	-1.4	5.363	344.778	7.618	48.84	47.79	1009.87
	18:00	21.7	-1.5	7.206	326.839	10.971	46.90	48.12	1010.70
	19:00	22.0	-1.2	6.415	305.000	10.497	44.97	48.27	1011.44
	20:00	22.6	-0.6	6.609	304.000	10.302	43.52	48.56	1011.60
	21:00	23.2	0.0	7.387	295.000	11.274	42.62	48.74	1011.90
	22:00	23.8	0.6	8.359	291.000	13.218	41.40	49.19	1012.55
	23:00	24.2	1.0	9.136	303.000	12.246	39.92	49.46	1013.40
2/19/2010	0:00	24.3	1.1	8.545	295.165	12.275	38.90	48.86	1014.10
	1:00	24.1	0.9	7.558	301.343	11.037	37.55	48.63	1014.22
	2:00	23.7	0.5	4.848	315.335	8.650	36.26	48.66	1014.39
	3:00	23.0	-0.2	5.515	334.427	8.683	35.69	48.53	1014.12
	4:00	22.4	-0.8	4.067	306.020	5.425	34.94	48.23	1014.54
	5:00	21.9	-1.3	3.890	301.712	5.159	34.58	47.24	1015.34
	6:00	21.6	-1.6	3.711	315.288	4.685	33.38	46.88	1015.94
	7:00	21.7	-1.5	5.070	336.215	6.889	33.50	46.62	1016.11
	8:00	22.0	-1.2	5.419	331.328	8.151	35.39	46.64	1016.78
	9:00	22.4	-0.8	4.131	323.674	6.852	39.09	46.84	1017.48
	10:00	22.9	-0.3	6.650	322.713	9.717	42.44	46.76	1017.50
	11:00	23.4	0.2	10.520	342.469	15.131	44.14	47.54	1017.11
	12:00	23.8	0.6	9.719	300.000	13.024	45.48	47.77	1016.20
	13:00	23.8	0.6	8.456	331.817	12.027	47.58	47.77	1015.59
	14:00	23.3	0.1	9.416	329.391	13.284	49.34	47.67	1015.23
	15:00	22.7	-0.5	10.831	331.239	16.661	50.34	47.62	1015.05
	16:00	22.2	-1.0	9.525	328.000	14.190	50.52	47.79	1015.30
	17:00	21.7	-1.5	7.192	330.000	14.579	50.22	48.15	1015.60
	18:00	21.3	-1.9	7.917	329.926	13.020	48.59	49.03	1016.50
	19:00	21.4	-1.8	5.517	328.294	8.329	47.18	49.31	1017.68
	20:00	21.8	-1.4	3.693	313.000	5.832	45.68	49.28	1017.90
	21:00	22.4	-0.8	3.110	310.000	4.471	43.93	49.46	1018.20
	22:00	23.0	-0.2	2.916	292.000	4.276	42.80	49.82	1018.55
	23:00	23.5	0.3	3.305	294.000	4.471	41.00	50.36	1018.80
2/20/2010	0:00	23.9	0.7	3.481	324.105	5.633	39.37	50.56	1019.08
	1:00	24.0	0.8	2.916	347.000	5.443	38.39	50.22	1019.60
	2:00	23.8	0.6	0.227	304.885	1.176	36.96	49.94	1019.68
	3:00	23.2	0.0	1.555	272.000	2.138	33.76	49.91	1019.50
	4:00	22.5	-0.7	3.110	329.000	4.665	34.68	50.07	1019.60
	5:00	21.9	-1.3	3.104	330.418	5.112	34.96	49.53	1019.80
	6:00	21.5	-1.7	3.097	334.025	4.887	35.30	48.33	1020.05
	7:00	21.4	-1.8	2.144	342.215	4.344	34.58	47.93	1020.60
	8:00	21.6	-1.6	2.982	0.783	4.344	37.39	47.69	1021.18
	9:00	22.0	-1.2	2.795	331.803	4.414	41.30	48.02	1021.40
	10:00	22.4	-0.8	8.121	328.234	12.439	42.71	48.08	1021.30
	11:00	23.0	-0.2	5.421	352.214	8.963	43.78	48.39	1021.07
	12:00	23.4	0.2	3.754	4.020	7.468	46.60	48.81	1020.43
	13:00	23.6	0.4	4.834	355.911	6.856	48.31	48.96	1019.44
	14:00	23.4	0.3	5.052	350.046	7.614	50.86	48.89	1018.81
	15:00	23.0	-0.2	4.628	347.392	7.750	51.62	48.78	1018.37
	16:00	22.5	-0.7	5.231	15.200	6.510	52.05	48.83	1018.40
	17:00	21.9	-1.3	5.557	352.831	6.918	52.05	48.94	1018.51
	18:00	21.5	-1.7	0.583	33.639	1.359	50.12	49.40	1018.84
	19:00	21.5	-1.7	4.471	147.000	6.220	46.40	49.64	1019.49
	20:00	21.8	-1.4	2.962	174.576	3.794	43.53	49.88	1019.45
	21:00	22.3	-0.9	0.972	245.000	1.555	41.72	50.54	1019.81
	22:00	22.8	-0.4	1.361	261.000	1.749	39.00	51.54	1019.90
	23:00	23.4	0.2	0.778	263.000	1.166	37.58	51.62	1019.60

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/21/2010	0:00	23.9	0.7	0.972	242.000	1.361	35.08	51.75	1019.50
	1:00	24.3	1.1	0.000	219.000	0.194	34.57	51.24	1019.20
	2:00	24.3	1.1	0.002	255.881	0.198	33.53	50.75	1018.98
	3:00	24.0	0.8	2.333	252.000	3.110	33.13	50.65	1019.40
	4:00	23.5	0.4	1.555	3.000	2.333	34.03	50.67	1019.60
	5:00	23.1	-0.1	0.385	231.873	1.017	33.44	50.46	1019.88
	6:00	22.6	-0.6	1.256	264.112	1.989	31.55	50.42	1020.27
	7:00	22.1	-1.1	1.749	232.000	2.527	32.32	49.93	1020.62
	8:00	21.9	-1.3	0.583	260.000	0.972	35.83	49.30	1021.20
	9:00	22.2	-1.0	0.049	277.518	0.618	41.66	49.28	1021.08
	10:00	22.6	-0.6	1.104	208.085	1.897	48.25	50.02	1020.58
	11:00	22.9	-0.3	3.888	327.000	6.026	51.13	50.11	1020.10
	12:00	23.3	0.1	2.024	322.232	3.892	53.11	50.11	1019.16
	13:00	23.8	0.6	4.323	10.814	7.752	55.22	50.27	1018.38
	14:00	24.0	0.8	5.248	21.000	7.970	56.44	50.18	1017.60
	15:00	23.8	0.6	2.644	355.013	4.519	57.51	50.01	1017.03
	16:00	23.3	0.1	2.721	20.000	3.888	57.92	50.18	1016.60
	17:00	22.7	-0.5	0.778	75.000	2.333	57.70	50.56	1016.60
	18:00	22.2	-1.0	4.082	140.000	4.860	52.34	50.61	1016.70
	19:00	22.0	-1.2	2.440	121.772	4.416	49.10	50.90	1016.90
	20:00	22.0	-1.2	2.980	126.123	4.199	46.04	51.08	1016.80
	21:00	22.2	-1.0	2.970	136.748	4.053	44.56	51.25	1017.04
	22:00	22.5	-0.7	2.916	159.000	3.693	43.34	51.44	1016.80
	23:00	23.0	-0.1	2.333	166.000	2.916	42.80	51.98	1016.60
2/22/2010	0:00	23.6	0.4	3.110	183.000	4.471	42.44	52.34	1016.10
	1:00	24.2	1.0	1.749	210.000	2.333	42.73	52.34	1015.90
	2:00	24.6	1.4	0.972	177.000	1.555	42.89	51.96	1015.40
	3:00	24.5	1.3	1.227	135.860	1.895	41.88	51.36	1014.70
	4:00	24.0	0.8	1.749	129.000	2.138	39.96	51.13	1014.10
	5:00	23.6	0.4	0.449	125.785	1.195	39.06	51.19	1014.27
	6:00	23.2	0.0	2.333	140.000	2.916	38.03	51.22	1013.90
	7:00	22.7	-0.5	2.583	149.978	3.209	38.36	51.11	1013.38
	8:00	22.2	-1.0	2.012	142.983	2.611	41.42	50.89	1013.83
	9:00	22.1	-1.1	3.476	130.589	4.554	45.58	50.58	1012.94
	10:00	22.4	-0.8	2.307	141.479	3.338	50.27	50.38	1012.22
	11:00	22.8	-0.4	3.837	125.168	5.417	51.39	50.30	1011.41
	12:00	23.2	0.0	4.197	133.903	6.102	54.50	50.29	1010.67
	13:00	23.7	0.5	6.181	146.416	8.343	55.06	49.95	1009.51
	14:00	24.2	1.0	4.072	113.626	6.691	55.12	49.69	1008.66
	15:00	24.3	1.1	2.916	139.000	4.665	49.82	49.28	1008.20
	16:00	24.1	0.9	3.693	132.000	5.054	48.61	48.94	1008.00
	17:00	23.6	0.5	3.810	127.273	5.606	48.90	48.48	1007.11
	18:00	23.2	0.0	2.924	121.917	5.227	49.42	48.70	1006.13
	19:00	22.9	-0.3	3.305	129.000	4.860	49.82	48.56	1006.20
	20:00	22.7	-0.5	2.677	99.251	4.039	50.18	48.74	1005.40
	21:00	22.4	-0.7	5.054	134.000	6.220	50.61	49.08	1005.10
	22:00	22.6	-0.6	3.110	159.000	4.082	51.26	49.15	1004.98
	23:00	23.2	0.0	2.129	143.530	2.675	51.27	49.31	1004.37
2/23/2010	0:00	23.8	0.6	2.245	335.851	2.908	51.22	49.85	1004.23
	1:00	24.5	1.3	3.110	346.000	5.054	47.55	50.50	1004.20
	2:00	25.0	1.8	5.248	353.000	7.581	46.83	50.43	1003.90
	3:00	25.2	2.1	6.609	336.000	11.663	45.82	49.73	1003.70
	4:00	25.3	2.1	7.387	337.000	10.691	44.08	49.06	1003.40
	5:00	25.1	2.0	6.415	333.000	9.330	42.87	48.69	1003.70
	6:00	24.8	1.6	4.556	341.006	6.829	41.61	48.75	1004.35
	7:00	24.3	1.1	6.938	336.193	9.593	40.65	48.94	1004.60
	8:00	23.6	0.4	6.803	350.000	11.274	41.27	49.21	1005.10
	9:00	23.1	-0.1	7.562	331.203	11.111	41.94	49.37	1005.63
	10:00	23.1	-0.1	7.581	350.000	10.886	42.66	49.39	1005.90
	11:00	23.3	0.1	9.274	350.613	13.731	43.62	49.63	1006.04
	12:00	23.7	0.5	8.942	331.000	12.635	43.03	50.07	1006.00
	13:00	24.0	0.8	6.957	332.562	9.900	43.56	50.26	1005.59
	14:00	24.3	1.1	8.942	357.000	12.246	44.24	50.74	1005.10
	15:00	24.8	1.6	7.970	324.000	11.857	45.34	51.03	1005.40
	16:00	25.0	1.8	10.497	335.000	18.272	46.99	51.03	1005.60
	17:00	24.9	1.7	8.164	335.000	11.274	48.16	50.67	1006.10
	18:00	24.6	1.4	5.777	332.601	8.450	48.24	50.58	1006.60
	19:00	24.1	0.9	4.082	327.000	5.443	46.96	50.49	1007.10
	20:00	23.6	0.5	7.233	345.475	12.981	46.22	50.47	1007.55
	21:00	23.3	0.1	5.443	335.000	7.775	44.62	50.40	1008.10
	22:00	23.1	-0.1	5.931	339.933	9.536	43.95	50.42	1009.17
	23:00	23.1	-0.1	5.476	347.502	9.517	43.05	50.41	1008.72

Appendix B
Water Levels at Money Point

Date	Time	Feet above Station datum	Feet Above/Below MSL	Wind speed knots	Wind direction degrees	Wind Gusts knots	Air Temperature °F	Water Temperature °F	Barometric Pressure mbars
2/24/2010	0:00	23.4	0.2	4.860	355.000	6.998	42.48	50.58	1008.80
	1:00	24.2	1.0	5.898	352.446	9.606	43.16	50.61	1009.20
	2:00	24.9	1.7	6.312	13.127	11.929	42.18	51.30	1009.11
	3:00	25.3	2.1	6.071	346.019	8.044	41.90	51.02	1009.54
	4:00	25.6	2.4	4.082	8.000	8.553	41.74	50.59	1009.80
	5:00	25.6	2.4	5.141	353.712	9.299	40.87	49.97	1010.51
	6:00	25.5	2.3	3.499	337.000	5.637	40.41	49.58	1011.50
	7:00	25.1	1.9	2.303	2.658	3.616	39.92	49.18	1011.44
	8:00	24.5	1.4	3.693	14.000	6.803	41.58	49.23	1011.90
	9:00	23.9	0.7	8.079	18.478	12.512	42.65	49.19	1011.89
	10:00	23.3	0.2	6.415	29.000	9.136	42.64	49.15	1011.90
	11:00	23.1	-0.1	4.475	19.917	7.361	43.36	49.23	1011.40
	12:00	23.3	0.1	4.082	43.000	7.192	42.51	49.32	1010.50
	13:00	23.6	0.4	1.637	49.307	4.113	41.47	49.82	1010.35
	14:00	24.0	0.8	1.944	20.000	3.110	40.69	50.14	1010.50
	15:00	24.6	1.4	2.721	109.000	4.276	40.24	50.54	1009.90
	16:00	25.0	1.8	1.977	55.283	4.766	39.91	50.92	1009.52
	17:00	25.2	2.0	2.315	56.719	3.792	39.23	50.70	1009.44
	18:00	25.0	1.9	4.216	60.346	6.770	38.34	50.29	1008.61
	19:00	24.7	1.6	3.248	56.860	5.062	38.04	50.14	1007.86
	20:00	24.3	1.2	4.150	39.906	5.880	38.12	50.00	1007.60
	21:00	23.7	0.5	2.527	65.000	4.665	37.76	50.00	1007.80
	22:00	23.2	0.0	3.888	4.000	6.026	37.58	50.18	1007.40
	23:00	23.0	-0.2	3.540	2.831	6.951	35.93	50.18	1006.67
2/25/2010	0:00	23.1	-0.1	3.693	350.000	5.832	34.16	50.18	1006.30
	1:00	23.4	0.3	3.693	348.000	5.637	33.64	50.50	1005.60
	2:00	24.0	0.8	3.693	340.000	5.248	34.47	50.85	1004.60
	3:00	24.8	1.6	5.950	353.184	8.722	35.74	51.71	1003.74
	4:00	25.6	2.4	5.637	3.000	9.525	36.57	51.76	1003.50
	5:00	26.0	2.8	4.828	351.108	6.829	36.95	50.98	1003.29
	6:00	26.1	2.9	5.637	348.000	9.136	37.17	50.04	1003.10
	7:00	26.0	2.8	6.026	351.000	9.719	37.29	49.64	1002.90
	8:00	25.6	2.4	7.581	354.000	11.663	37.24	49.26	1003.40
	9:00	25.0	1.8	9.809	332.964	14.690	37.44	48.85	1003.43
	10:00	24.2	1.0	7.387	343.000	11.274	38.80	49.01	1003.40
	11:00	23.6	0.4	12.246	331.000	18.855	39.83	48.85	1003.20
	12:00	23.2	0.0	9.719	342.000	16.328	41.83	49.14	1002.70
	13:00	23.2	0.1	11.708	334.974	17.497	43.15	49.58	1001.99
	14:00	23.6	0.4	10.691	327.000	14.579	43.27	50.05	1001.60
	15:00	24.1	0.9	10.108	317.000	14.579	43.56	50.34	1001.60
	16:00	24.5	1.4	6.803	348.000	12.635	42.82	50.97	1001.90
	17:00	25.0	1.9	8.543	292.992	13.747	42.70	50.76	1002.04
	18:00	25.4	2.2	11.105	287.936	16.793	40.61	50.51	1002.42
	19:00	25.4	2.2	7.970	296.000	10.108	39.11	50.18	1003.00
	20:00	25.0	1.9	6.026	321.000	14.190	39.02	49.82	1003.30
	21:00	24.4	1.2	9.719	327.000	13.996	37.94	49.80	1003.60
	22:00	23.5	0.3	12.246	309.000	20.799	36.36	49.55	1003.90
	23:00	22.6	-0.6	11.274	295.000	18.661	34.56	49.68	1003.50
2/26/2010	0:00	21.8	-1.4	10.691	293.000	14.968	33.49	49.68	1003.10
	1:00	21.4	-1.8	12.635	273.000	16.717	32.72	49.30	1002.20
	2:00	21.4	-1.8	11.274	297.000	16.523	32.92	49.17	1001.40
	3:00	22.0	-1.2	10.302	281.000	14.384	32.70	49.48	1000.90
	4:00	22.8	-0.4	11.857	286.000	15.162	32.65	49.30	1000.60
	5:00	23.5	0.3	13.801	283.000	21.771	32.94	48.92	1000.70
	6:00	23.9	0.7	13.412	284.000	20.993	33.10	48.97	1000.60
	7:00	23.9	0.8	14.190	285.000	20.799	33.37	49.06	1001.00
	8:00	23.7	0.5	16.616	278.940	24.625	34.33	48.98	1001.25
	9:00	23.1	-0.1	16.523	287.000	21.965	35.74	48.67	1001.10
	10:00	22.4	-0.8	18.348	288.289	27.884	37.61	48.36	1000.82
	11:00	21.7	-1.5	12.991	290.389	22.685	40.10	47.92	1001.08
	12:00	20.9	-2.2	13.412	297.000	20.216	42.26	47.84	1000.80
	13:00	20.6	-2.6	13.801	302.000	21.188	43.84	48.20	1000.50
	14:00	20.9	-2.3	13.939	304.566	22.852	44.96	48.56	1000.10
	15:00	21.5	-1.7	15.300	298.221	24.041	45.86	48.74	1000.34
	16:00	22.1	-1.1	13.218	298.000	19.827	46.76	49.46	1000.70
	17:00	22.7	-0.5	9.136	302.000	13.607	46.58	50.00	1001.40
	18:00	23.5	0.3	9.525	330.000	14.579	45.07	50.18	1002.20
	19:00	24.2	1.0	10.497	330.000	15.745	41.54	49.82	1003.50
	20:00	23.9	0.8	7.581	332.000	12.441	40.46	49.64	1004.10
	21:00	23.2	0.0	7.581	336.000	10.497	39.56	49.28	1004.60
	22:00	22.5	-0.7	4.276	329.000	6.415	39.02	49.10	1004.90
	23:00	21.8	-1.4	8.164	331.000	13.024	39.02	48.92	1005.20

Appendix C
Field Notes

CONTENTS

PAGE	REFERENCE	DATE

Location St Juliens Creek Annex Date 01-19-10

Project / Client SJCA-UXO-001 USNAVY

H Blackwell Clear 45°F

0730 Tim Wenk, H Blackwell, Tamir Klaff
Tim Gannetsen onsite at Norfolk Naval Shipyard pass gate
0815 ARM/AquaSurveyor onsite at passes gate
0945 All site personnel onsite w/ passes
Badged Jen Weiller, Roy Gecelosky, Mark Padover, Mike Telesco
1000 PTSP, 3R training, site safety Brief
1020 Mob to survey points
1040 ARM begin to set up station RTK base
1127 Begin to set up check points
1201 check point is off ~ ARM is checking system. coordinate is OFF Move to different checkpoint to see if RTK needs to be moved & where error is.
1245 RTK and checkpoints are correct they had the RTK set up on the wrong set up point
1320 leave site for ARM to get boat will meet at boat ramp @ 1430
1430 ARM onsite with Boat and prepare to launch.

Location ST Juliens Creek annex Date 01-19-10

Project / Client SJCA-UXO-001 US NAVY

HBlackwell

1505 ARM still preparing boat & equipment to launch

1530 ARM does not have spatial map for activities. Notify Tim Wenik / PM

1545 END of DAY

CH2M Hill will meet ARM at WHARF 1 to set up RTK Station @ 0715 on 01-20-10.

1545 01-19-10 HBlackwell

Location ST Juliens Creek annex Date 01-20-10

Project / Client SJCA-UXO-001 USNAVY

HBlackwell OVERCAST 40°F

0720 - HBlackwell & Roy Gecelosky onsite to set up RTK station

0725 Weather for 01-20-10 45°F with 30% chance of rain

0755 RTK Station is set up.

0800 at WHARF Landing waiting for aqua survey with Boat TAMIR KIAFF onsite

0834 PTSP / Boat Safety checklist takes place on board of Boat at WHARF 1.

0852 Begin ~~Side Sonar activities~~ to determine depths at WHARFS HB

0950 Symetry at WHARF 1 & 2 are not as expected. Depths are from 27.5 ft ⟶ <40 ft at edge of Investigation area. This may cause problems for DGM activities regarding the probe at levels no greater than 1.5 meters

1000 at WHARF 3, Barge is inside of survey area. (approximately 150- inside boundary) Depths range from 4' to 12' inside survey area

Location St Juliens creek Anex Date 01-20-2010

Project / Client SJCA-UXO-001 US NAVY

H Blackwell 42°F overcast

1042- Begin side scan sonar Activities at Wharf's 1 & 2. Tamir KLAFF notes that we should not proceed with side scan sonar at wharf 3 due to the Fact that there is a barge in the area.

LATE ENTRY 1030 Tamir KLAFF Calls PM & Client to inform of situation regarding riverbed depths & grades and they agree to proceed with activities in the scope of work.

1230 Side scan sonar activities Complete at wharf's 1 & 2. Field activities are stopped Until Further notice due to unforseen problems with riverbed grade.

ARM & CH2M Hill offsite

H Blackwell 01-20-2009

Location ST Juliens Creek Annex Date 2/9/10

Project / Client UXO-001

MV William M NJ NJ1968GZ

0800 T Wade, M OST, W Figeac
AT Barge Area PASS NWSY
25°F Air Temp P Cloudy
obj: Prep for Continuation of Survey.
Hold Pre Task Safety on Cold Water Safety
Attending: Kyle Kingman, Dave Roy Geceloskey ARM
0936 Held RAR Training by Nelson Figeac
1000 Set up GPS Reference Station
1230 Underway To STJ From Boat Dock
1300 Calibrate GPS Reference Equip
1400 Commence Bathymetric Survey
1554 Secure Bathymetric Survey
1645 Back at Dock
Pulled Boat out of Water
1700 Personnel Depart Site

Location: ST Juliens Creek Date: 2/10/10
Project / Client: UXO - 001

0700 Arrive AT Dock
Wx: 40°F 20 Knt Wind
Possible Small Craft
Warnings
Pers: ML OST Chem
Kyle Kingman ARM
Dan Ciboletta Alpine
Roy Geczoski ARM
obj: Continue Marine
Survey
0730 Hold Safety/TG: Weather
0857 Holding AT Pier Due To
Conditions And Sea State
40 Knt Gusts 28 Continuous
0908 Underway To ST Juliens
0915 Abort Trip Due To
Weather Conditions
0945 Back AT Dock. Pull
Boat out of water
1100 Return To office

Location: ST Juliens Creek Date: 2/11/10
Project / Client: UXO - 001

0630 Arrive AT Dock
Personnel: ML OST
K Kingman
D Ciboletta
R Geczoski
Wx: 40°F Winds 15 Knots
Clear
0730 Conducted Safety
Brief
0810 Underway To ST Juliens Creek
0820 Side Scan Sensor in Water
0845 Commence Running Grids and
Logging 3-4 Knt Forward Speed
Fish Below Boat
1016 End Logging Side Scan
1115 Return To Dock To Change
Gears
1730 Complete Magnetometer Tests
1740 Departed Site

Location ST Juliens Creek Date 2/12/10

Project / Client UXO-001

32°F, 3 Knt Wind N Clear

0630 Arrive Onsite
MIL OST, Dan Cibulka,
Kyle Kingman, Roy
0645 Place Gradiometer in
Test Frame.
0500 Convert optest on
Gradiometer
Test SAT
0845 Underway To ST. Juliens Creek Annex
Hold Safety Brief.
0857 Delay Due To RR Bridge Down
0859 Proceed Under Bridge
0902 In South ops Area
0931 Ready To Deploy Grad
0935 Barge in Area. Moved out of
Channel
0936 Deploy Gradiometer
0939 Towing Gradiometer AT
Steady Scope
0955 Conduct Line Test 30 m.
Cable out
1024 Recover Grad To Adjust
Stabilizer Fins

Location ST Juliens Creek Date 2/12/10

Project / Client UXO-001

1057 Redeploy Grad 30 m
Scope / Alt: 9.0 3.5 Knt
Tow Speed
1106 Increase Scope To 45m
1145 Hold Survey Pattern Star
2 overtaking Vessels
1208 Resume Survey
1241 Start Northern Section
15 m of Chase out. Mag
Almost on Surface
1645 Secure North Survey
47 lines Done
1720 Arrive At Dock
1745 Mags Test Sat
1800 offsite

MIL OSI

Location St Julians Creek Date 2/13/10

Project / Client UXO-001

0700 Arrive onsite: Mr OST, K Kingman, Dave Cibulka, Roy Gelakowsky

0730 Hold Safety Briefs

0740 Conduct Gradiometer Test

0800 Underway

0815 Gradiometer in Water
Commence Test Runs
35°F overcast. Snow.

1450 Complete Northern Survey

1455 Commence Running QC
Lines (2) in Northern Section
Line 89/90

1503 Complete QC Runs. Remove Mag

1535 Return To Dock
Optest Mag

1600 Depart Site

MLOST

Location ST JULIANS Creek Date 2/14/10

Project / Client UXO-001

0630 Arrive onsite
Mr OST, D Cibulka, K Kingman
Roy Gelakowsky
38°F Clear, 15 knot W Wind

0700 Static Test of Mag Sat

0710 Hold Safety Briefs

0800 Underway from Dock To
Op Area

~~0800 Underway~~

0808 Lost STBD Engine
Bank To Dock To Fix Engine

0818 Restart Engine. Underway.
Ice in Engine

0825 Arrive Op Area

0835 Deploy Gradiometer

1007 Establish Laterally Points
Line 44

1008 Start Survey Line 31 inside
Hoop 1.1

1018 Hoop 1.0

1022 Line 35 Inside Hoop 1.0

1029 Hoop 0.9

1034 Hoop 1.1

1042 Resume Line 40 inside

Location: ST Juliens Creek Date: 2/14/10

Project / Client: UXO-001

1046 HDOP 1.4 Line 40 inside
1051 HDOP 1.3
1100 HDOP 1.2
1103 HDOP 0.9 Line 44 Latency Hit
Consistent.
1111 HDOP 1.3
1117 HDOP 1.2
1122 HDOP 1.2
1126 HDOP 1.0 Line 48 inside
1130 Line 50 HDOP 1.5
1142 HDOP 1.1
1424 Finish inside Section of
Southern Area. Too Much
pipe Noise Line 79 inside
Last Line
1430 Commence outer Survey
of Southern Section
1622 Secure Survey. Recover
Gradiometer
1630 ~~1700~~ Back at Dock
1652 Gradiometer Test SAT
1730 Depart Site.

Location: ST Juliens Creek Date: 2/15/10

Project / Client: UXO-001

0630 Arrive onsite.
ML ost Kyle Kingman
D. Gilchrist, Roy Gelkenki
0635 Hold Safety Brief
High Winds Today W 30 mph
35°F. Sunny.
0716 Moved Ball Closer To Gradiometer
7.75' from STBD Sensor
0750 Depart Boat Ramp
0755 Arrive Southern of Area
0806 Deploy Gradiometer
0823 Run Line 44 Latency Test
HDOP 1.4 SAT.
0847 Stop Survey Due To
Ship Passage
0912 Resume Survey
0922 Stop Survey To Let
Barge Pass and Assist
Stranded Boater
0948 Deploy Survey Gradiometer
0957 Resume Survey
1600 Secure Survey
1617 Recover Gradiometer
1630 Back at Dock

Location: ST Juliens Creek Date: 2/15/10

Project / Client: VXO-001

1640 Gradiometer Test SAT

1700 offsite

MU 2/15/10

Location: ST Juliens Creek Date: 2/16/10

Project / Client: VXO 001

0630 Onsite: MU OST, D Sigulda
K Kingman, Roy Gekstowski

0639 Held Safety Brief
on Cold.

0700 Conduct BPTEST on Gradiometer

0745 Underway To op Area

0751 Arrive Southern ~~operat~~ op area

0811 Deploy Gradiometer 45m out (S2)

0831 Conduct Latency Test

0832 Commence Survey

1540 STBD Engine Quit.

1550 Recover Gradiometer

1600 Back at Dock

1640 Test Gradiometer and do
Cable Shake Test.

1645 Testing Starboard Engine looks
like fuel filter clogged.

1700 Depart Dock for office

MU 2/16/10

Location St Juliens Creek Annex Date 2/17/10

Project / Client UXO-001

0630 Arrive at Boat Launch
McLost, Dan Ciriello III, Kyle Kingman,
Ray Gelezkowski
30°F wind 20 mph Clear
0635 Held Safety Brief.
0715 Conducted optest of Gradiometer
0730 Conducted Cable Shake Test
0740 Fire Stbd Engine
0805 Underway To op Area
0820 Deploy Mag 45 Meter
Scope.
0830 Commence Survey in South op area
0830 Latency Test Line 52
0951 Boat Lurched outside of Survey
Area. May Have Snagged
Gradiometer
0959 Stopped Survey. Recovered gradiometer
Appear To Have Snagged
Underwater Rope (Crab Pot)
Some Damage To Grad Sin,
Tow Cable Twisted. Assessing
Damage
1047 Redeploy Gradiometer
Testing operations

Location St Juliens Creek Annex Date 2/17/10

Project / Client UXO-001

Run Line 52 for Latency
Test. 1st Run Sat.
1050 Commence 3rd Run. Test Sat
Recommence Survey.
1324 Finish Southern Survey
Running 4 lines for QC
1%
1329 Run Line 70 for QC
1334 Run Line 80 for QC
1339 Run Line 79 for QC
1345 Run Line 69 for QC
1351 Recover Gradiometer
1409 Return To Dock
1415 Test Gradiometer
1440 off Site

MLost 2/17/10

Location: ST Juliens Creek Date: 2/18/10

Project / Client: UXO-001

0915 Arrive AT Dock
Test Gradiometer, SAT
Comm Test SAT.

1100 Underway: MK CTT, K Kingman,
D Pinketa, Roy Gelesskamp
45° F Sunny Wind 5-10 mph

1101 Hold Safety Brief.
Obj: Fill DATA gaps
in Southern op Areas.

1110 Arrive South op Area

1115 Deploy Gradiometer
Conduct Lateral Test Line 52
Note: Personnel Working
on Floats West to
Dock. Lot of Mitch

1149 Reset Sliver 17
Inner gaps on South
Ends of Wharfe Area Too
Close To Pier. BAD DATA
Hazardous Navigation.
Leave Gaps Experiencing
intermittent Cable Problems
from yesterdays impacts. Will
Attempt To Run Northward

Location: ST Julien Date: 2/18/10

Project / Client: UXO-001

1200 - Shorten Tow To 35 meters
1224 - Recovering Cable Ends
Tow. Risk To Tow is outweighing
Small DATA Value. Additional
Metal on Pier & complicates
DATA Value. Cable compromise
continues To cause DATA
To Dropout.
1240 Back At Dock. Gradiometer
Cable Broken
1400 Offsite

2/18/10
MK

Appendix D
DGM Mosaics

WARF3 Targets Displayed Over Horizontal Gradient of TMI Data

MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

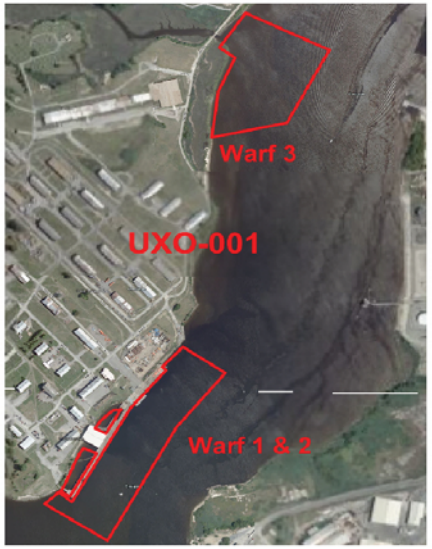
Legend

- Site Boundary
- Target Picked From Analytic Signal Grid of Residual TMI (Base Station Corrected)

Horizontal Gradient (TMI)

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58



Scale 1:2819.41

50 0 50

(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL
PROJECT:	St Juliens Creek Annex
CONTRACTOR:	ARM Geophysics

Created By:	IDW	Verified By:	IDW
Date:	Feb-26-2010	Team:	Geo-A
File:	Warf3		
Coordinate System:	NAD83 UTM Zone 18N Meters		

CH2MHILL ARM GEOPHYSICS

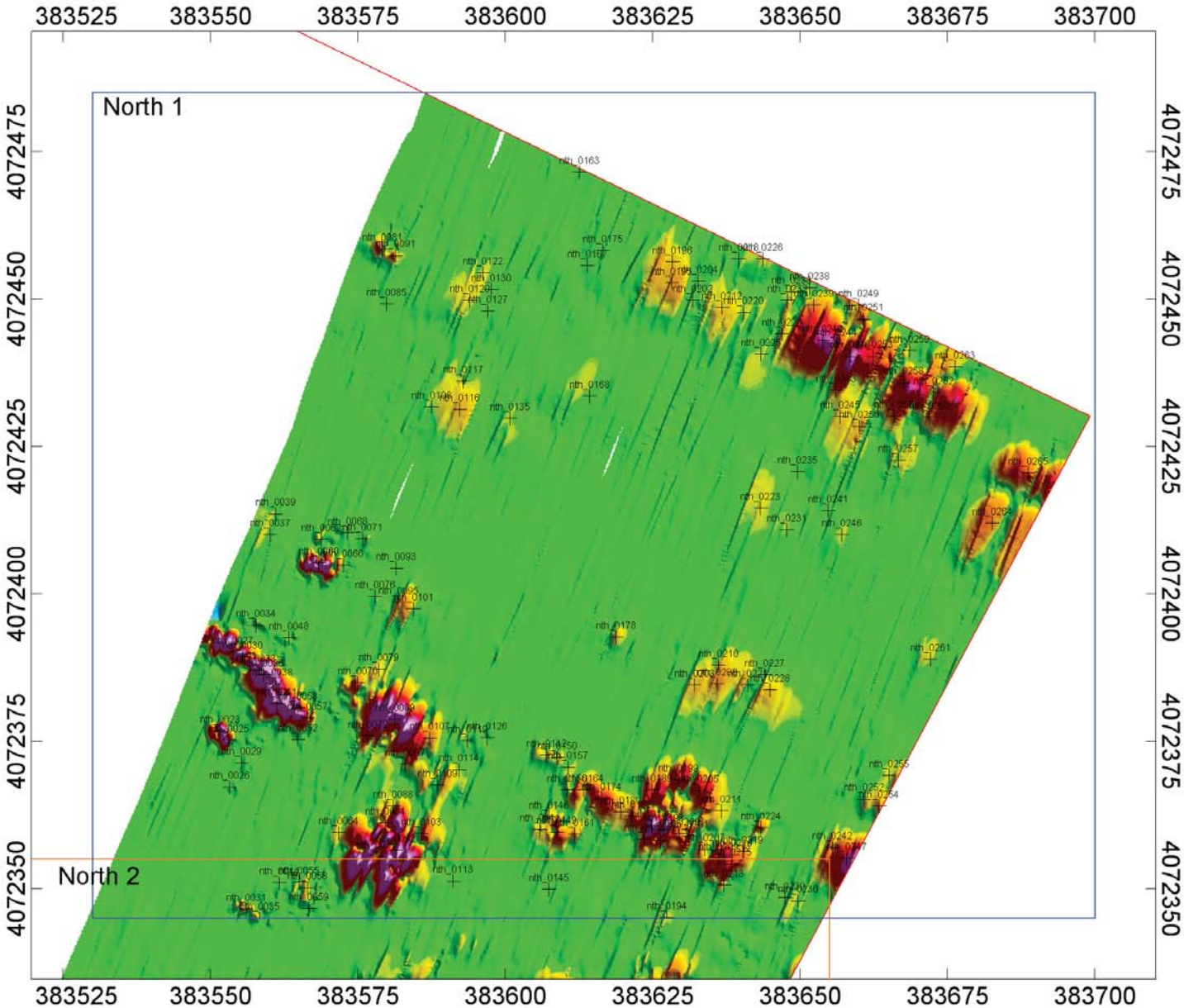
WARF3 Targets Displayed Over Horizontal Gradient of TMI (North 1)

MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA



Legend

- Site Boundary
- Target Picked From Analytic Signal Grid of Residual TMI (Base Station Corrected)

H-Grad

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58

Scale 1:1200

25 0 25

(meters)

NAD83 / UTM zone 18N

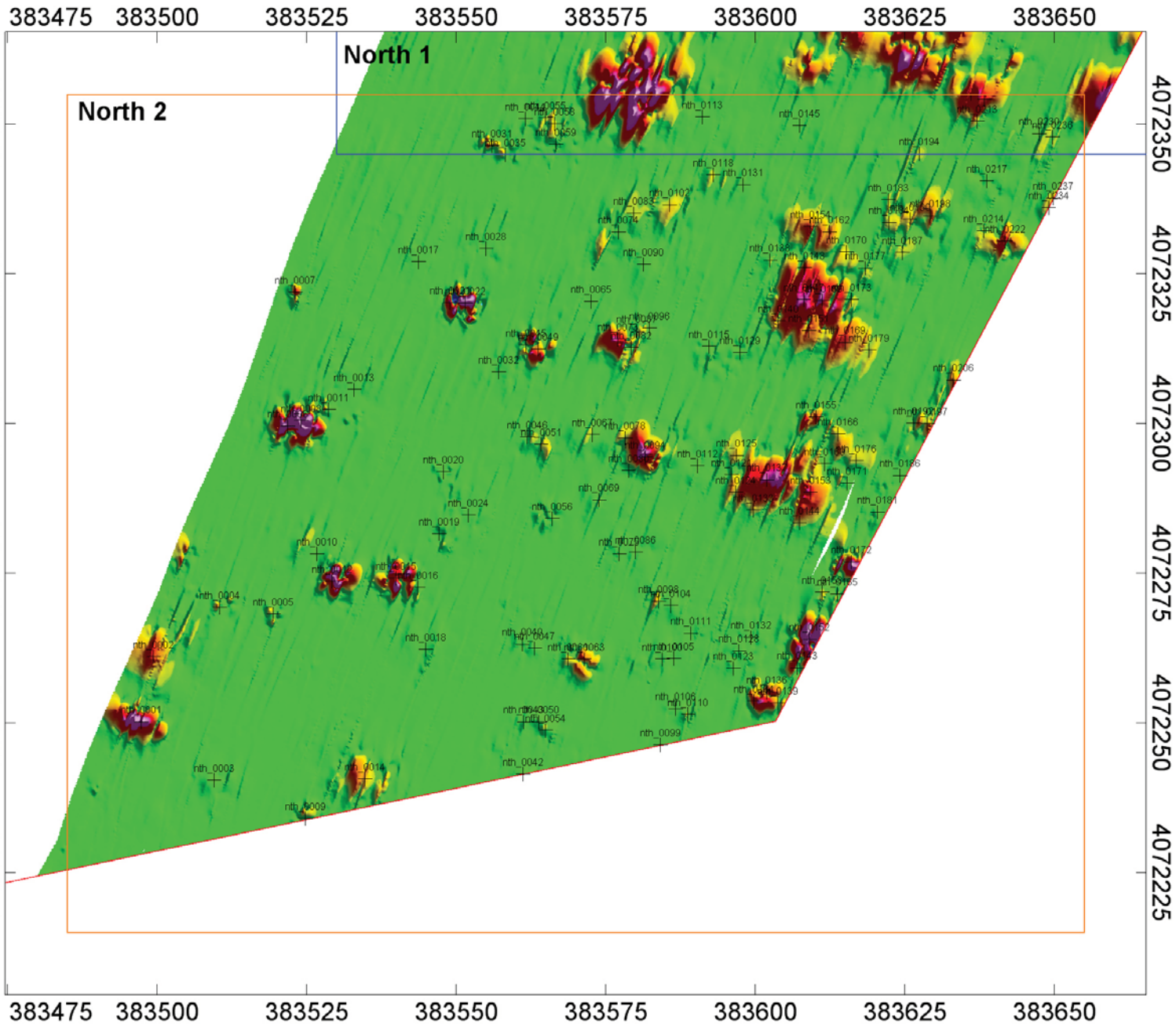
CLIENT:	CH2M HILL
PROJECT:	St Juliens Creek Annex
CONTRACTOR:	ARM Geophysics
Created By: IDW	Verified By: IDW
Date: Feb-26-2010	Team: Geo-A
File: Warf3	
Coordinate System:	NAD83 UTM Zone 18N Meters

CH2MHILL ARM GEOPHYSICS

WARF3 Targets Displayed Over Horizontal Gradient of TMI (North 2)
MAG Geophysical Survey
GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

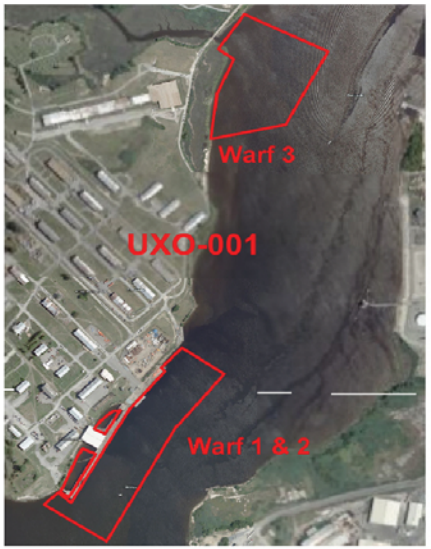


Legend

- Site Boundary
- Target Picked From Analytic Signal Grid of Residual TMI (Base Station Corrected)

H-Grad
nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58



Scale 1:1200

25 0 25

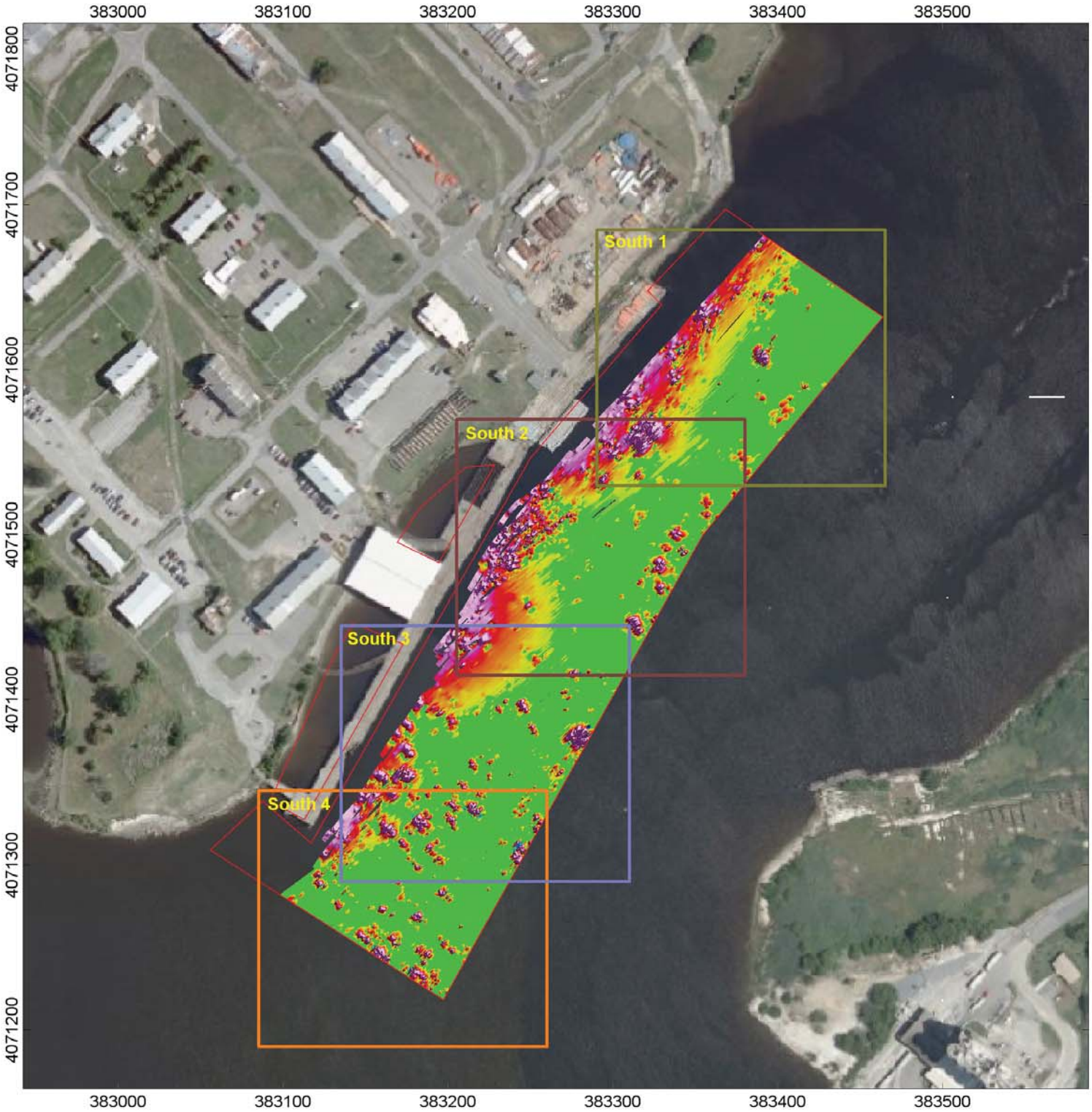
(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL
PROJECT:	St Juliens Creek Annex
CONTRACTOR:	ARM Geophysics

Created By:	IDW	Verified By:	IDW
Date:	Feb-26-2010	Team:	Geo-A
File:	Warf3		
Coordinate System:	NAD83 UTM Zone 18N Meters		

CH2MHILL ARM GEOPHYSICS



WARF1&2 Overview, Horizontal Gradient of TMI Data

MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

Legend

Site Boundary

Map Sub-Areas

Horizontal Gradient

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58

Scale 1:3759.214

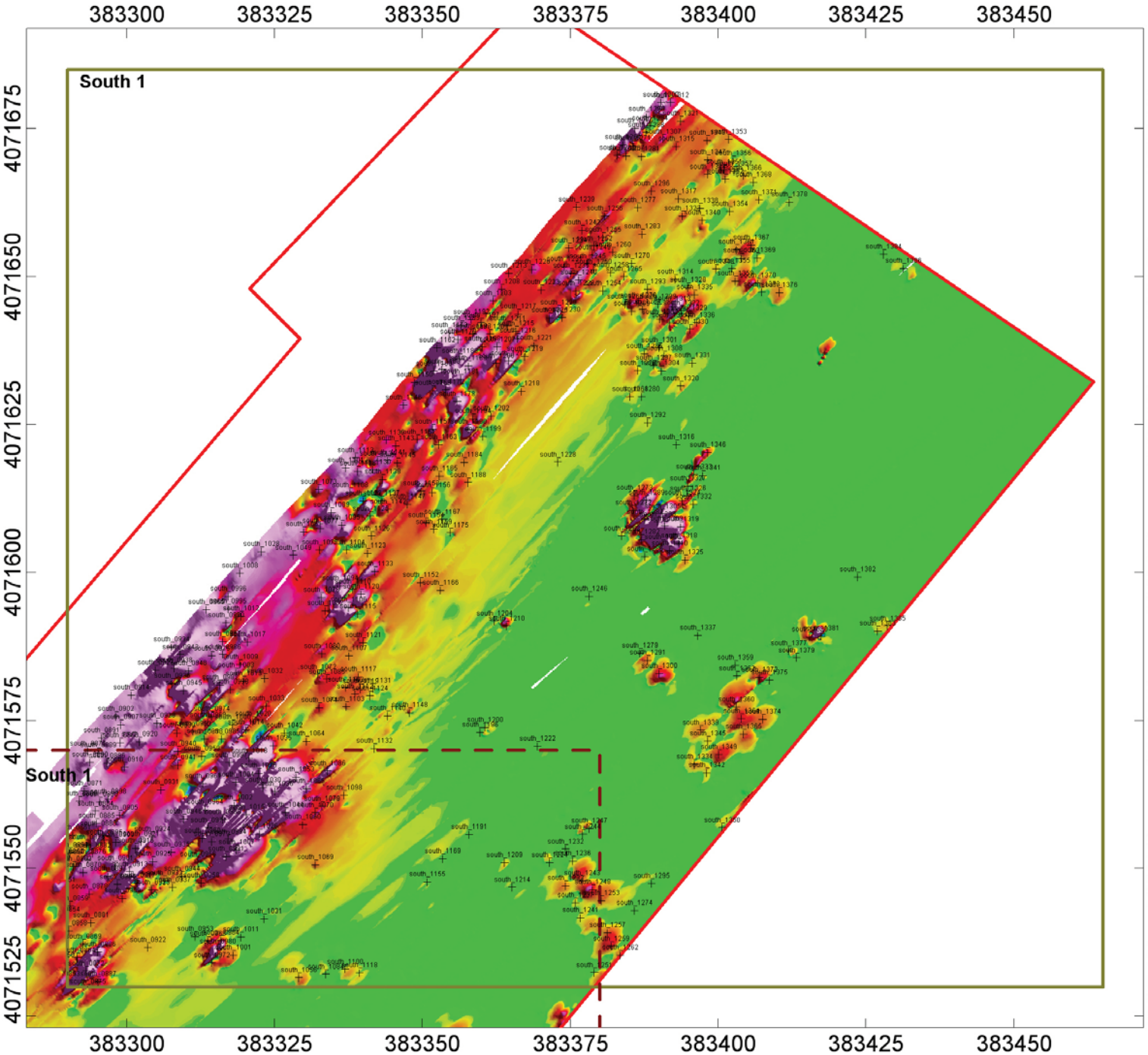
50 0 50 100

(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL
PROJECT:	St Juliens Creek Annex
CONTRACTOR:	ARM Geophysics
Created By: IDW	Verified By: IDW
Date: Mar-02-2010	Team: Geo-A
File: Warf1_2	
Coordinate System:	NAD83 UTM Zone 18N Meters

CH2MHILL ARM GEOPHYSICS



WARF1&2 Targets Displayed Over Horizontal Gradient of TMI Data (South 1) MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

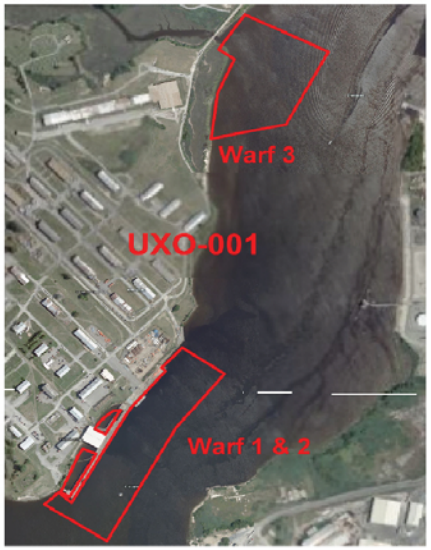
Legend

- Site Boundary
- Map Sub-Areas
- Targets Picked From Analytic Signal Grid of ResidualTMI (Base Station Corrected)

Horizontal Gradient

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58



Scale 1:1100

25 0

(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL		
PROJECT:	St Juliens Creek Annex		
CONTRACTOR:	ARM Geophysics		
Created By:	IDW	Verified By:	IDW
Date:	Mar-02-2010	Team:	Geo-A
File:	Warf1_2		
Coordinate System:	NAD83 UTM Zone 18N Meters		

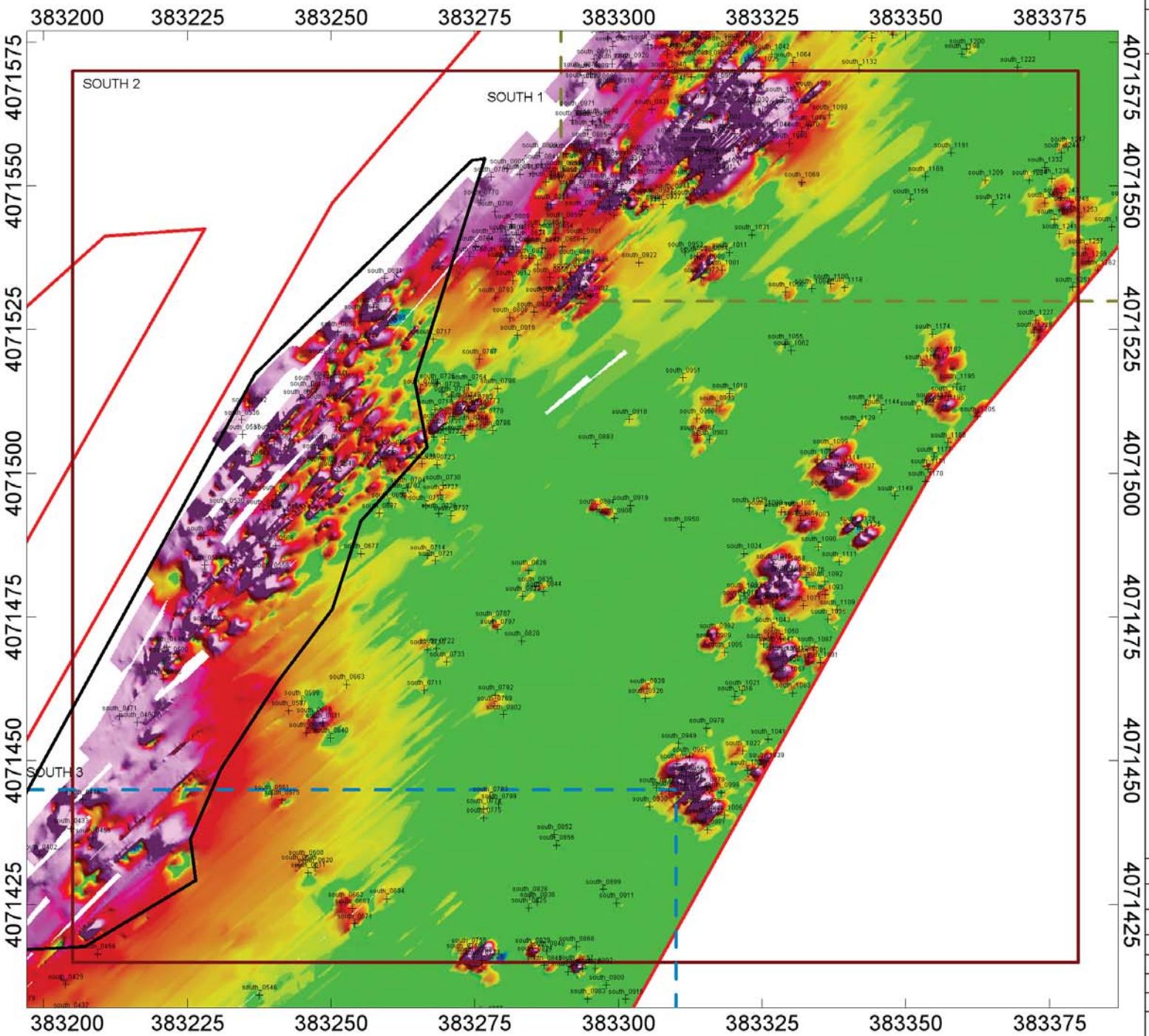
CH2MHILL ARM GEOPHYSICS

WARF1&2 Targets Displayed Over Horizontal Gradient of TMI Data (South 2) MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA



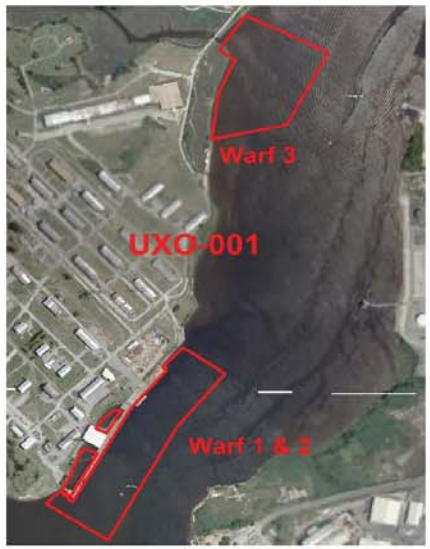
Legend

- Site Boundary
- Map Sub-Areas
- Targets Picked From Analytic Signal Grid of ResidualTMI (Base Station Corrected)
- Response Dominated by Warf (Larger Individual Anomalies Picked)

Horizontal Gradient

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58



Scale 1:1100

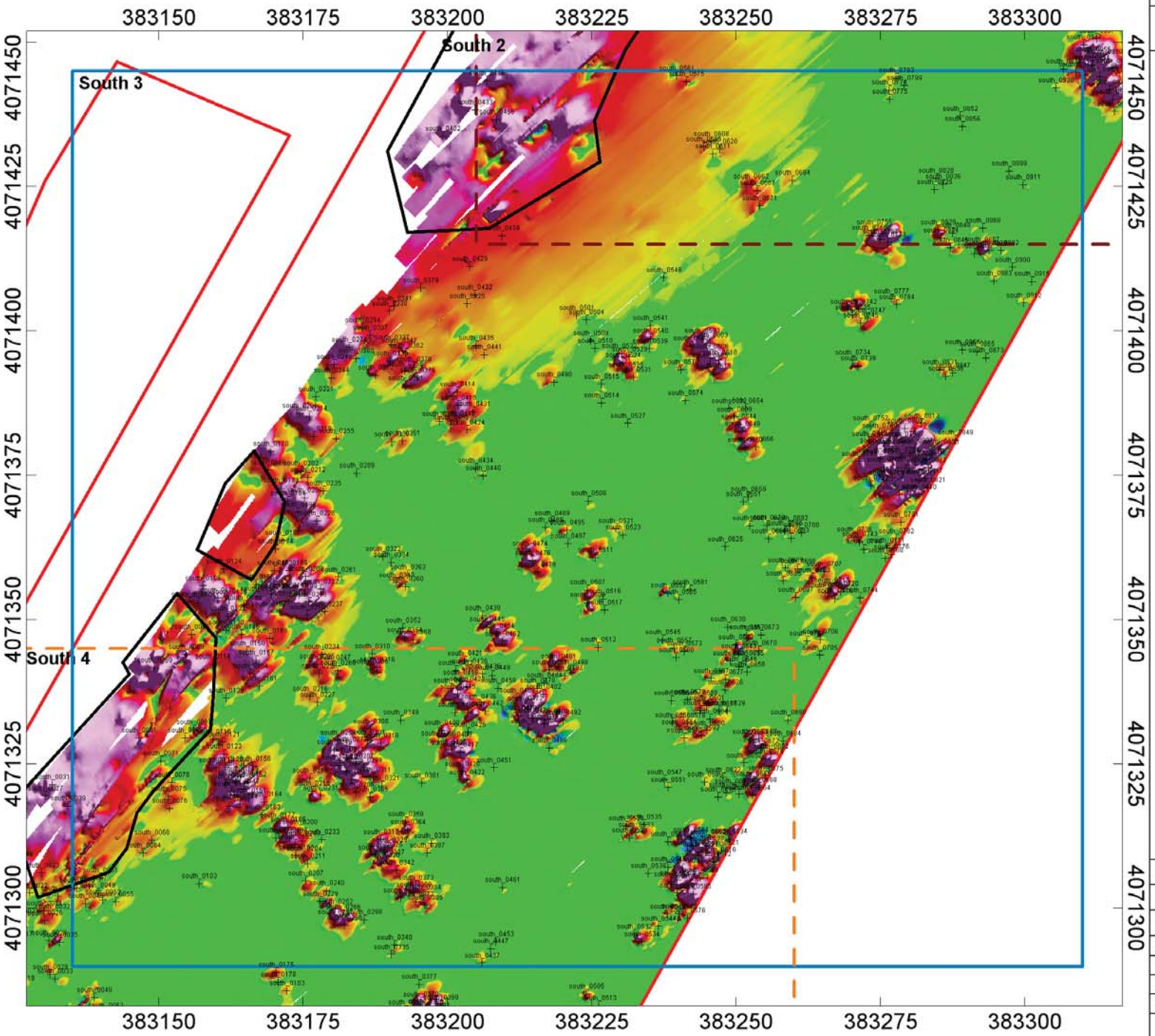
25 0

(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL		
PROJECT:	St Juliens Creek Annex		
CONTRACTOR:	ARM Geophysics		
Created By:	IDW	Verified By:	IDW
Date:	Mar-02-2010	Team:	Geo-A
File:	Warf1_2		
Coordinate System:	NAD83 UTM Zone 18N Meters		

CH2MHILL ARM GEOPHYSICS



WARF1&2 Targets Displayed Over Horizontal Gradient of TMI Data (South 3) MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

Legend

- Site Boundary
- Map Sub-Areas
- Targets Picked From Analytic Signal Grid of ResidualTMI (Base Station Corrected)
- Response Dominated by Warf (Larger Individual Anomalies Picked)

Horizontal Gradient

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58

Scale 1:1100

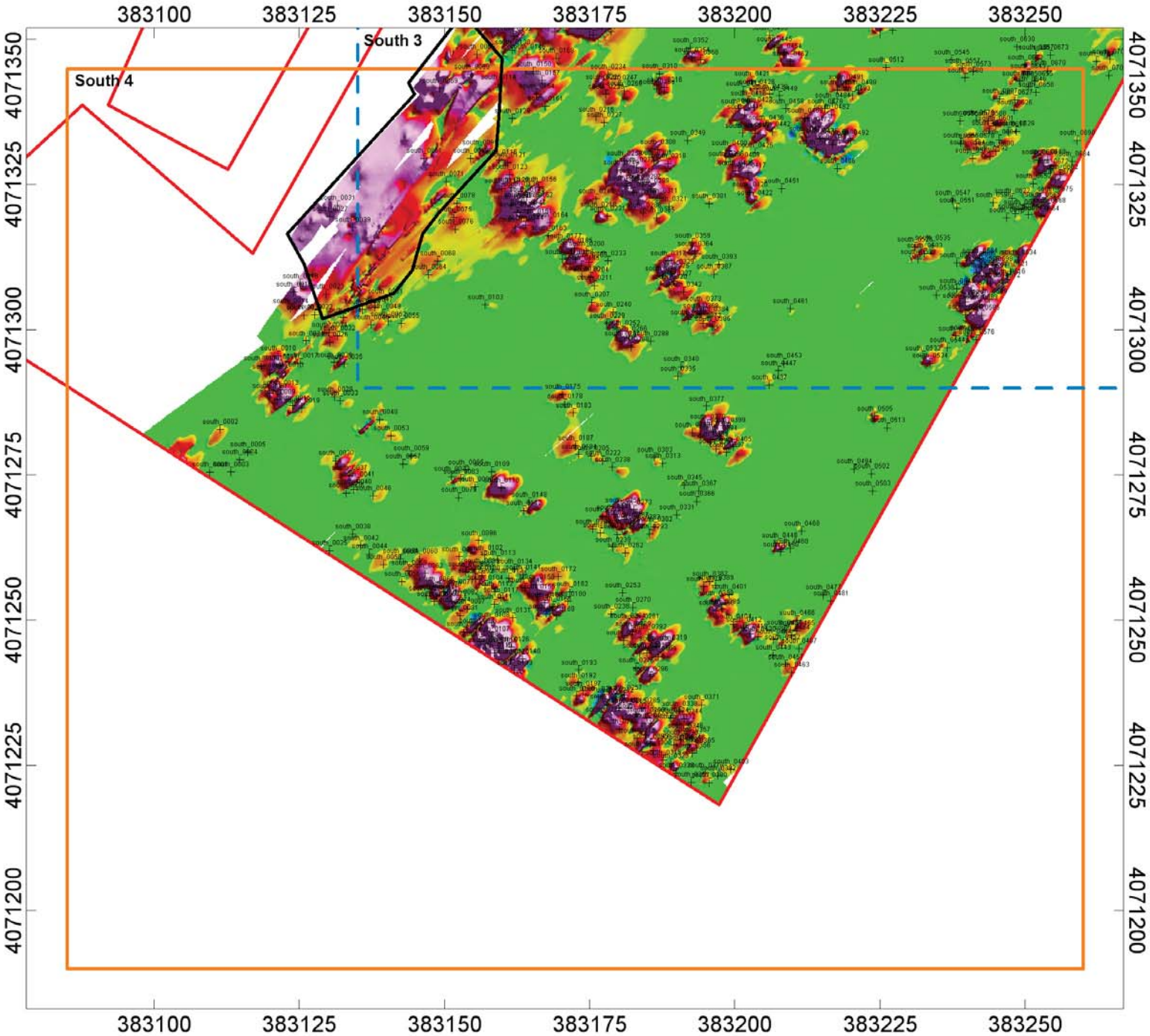
25 0

(meters)

NAD83 / UTM zone 18N

CLIENT:	CH2M HILL		
PROJECT:	St Juliens Creek Annex		
CONTRACTOR:	ARM Geophysics		
Created By:	IDW	Verified By:	IDW
Date:	Mar-02-2010	Team:	Geo-A
File:	Warf1_2		
Coordinate System:	NAD83 UTM Zone 18N Meters		

CH2MHILL ARM GEOPHYSICS



WARF1&2 Targets Displayed Over Horizontal Gradient of TMI Data (South 4) MAG Geophysical Survey

GPS Positioned G-882 Marine Mag

St Juliens Creek Annex UXO-001

Chesapeake, VA

Legend

- Site Boundary
- Map Sub-Areas
- Targets Picked From Analytic Signal Grid of ResidualTMI (Base Station Corrected)
- Response Dominated by Warf (Larger Individual Anomalies Picked)

Horizontal Gradient

nT/m

-70 -37 -26 -19 -12 -6 -2 1 4 6 9 12 16 21 26 33 42 58

Scale 1:1100

25 0

(meters)

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CH2MHILL ARM GEOPHYSICS