ENGINEERING EVALUATION/ COST ANALYSIS

NON-TIME-CRITICAL REMOVAL ACTION
PISTOL RANGE (UNEXPLODED ORDNANCE 1)
AND TRAP AND SKEET RANGES #1 AND #2
(UNEXPLODED ORDNANCE 2)
NAVAL SUPPORT ACTIVITY MID-SOUTH
MILLINGTON, TENNESSEE

Revision: 0

Prepared for:

Naval Facilities Engineering Command
Building 135 North, P.O. Box 30A
Jacksonville, Florida 32212-0030

November 2016
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Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southeast
Building 135 North, P.O. Box 30A
Jacksonville, Florida  32212-0030

Prepared by:

Resolution Consultants
A Joint Venture of AECOM & EnSafe
1500 Wells Fargo Building
440 Monticello Avenue
Norfolk, Virginia  23510
Contract Number N62470-11-D-8013
CTO F271

November 2016

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List of Acronyms

AM Action Memorandum
ARARs Applicable or Relevant and Appropriate Requirements
BEQ benzo(a)pyrene equivalent
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CTO Contract Task Order
CY Cubic yards
EE/CA Engineering Evaluation/Cost Analysis
LUCs Land Use Controls
mm/kg milligrams per kilogram
NSA Naval Support Activity
NAVFAC Naval Facilities Engineering Command
NCP National Oil and Hazardous Substance Pollution Contingency Plan
NEPA National Environmental Policy Act
NTCRA Non-Time-Critical Removal Action
PA Preliminary Assessment
PAH Polycyclic Aromatic Hydrocarbons
PALs Project action levels
RFI Resource Conservation and Recovery Act Field Investigation
RGO Remedial goal options
RI Remedial Investigation
SI Site Investigation
U.S. EPA United States Environmental Protection Agency
UXO Unexploded Ordnance
EXECUTIVE SUMMARY

This document presents an Engineering Evaluation and Cost Analysis (EE/CA) for a non-time critical removal action (NTCRA) to address impacted soils discovered at the former Pistol Range (identified as Unexploded Ordnance [UXO] [site] 1) and Trap/Skeet Ranges #1 and #2 (identified as Unexploded Ordnance [UXO] [site] 2) located at Naval Support Activity Mid-South in Millington, Tennessee. This EE/CA is being completed as part of a NTCRA as required by 40 Code of Federal Regulations Part 300.415(b)(4)(i) of the National Oil and Hazardous Substance Pollution Contingency Plan. Submittal of this document fulfills the requirements for NTCRAs defined by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986. This EE/CA has been prepared in general accordance with the United States Environmental Protection Agency (U.S. EPA) guidance document Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA, PB93-963402, United States Environmental Protection Agency, 1993.

UXOs 1 and 2 are considered for NTCRA because of the human health risk associated with lead and polynuclear aromatic hydrocarbons (PAHs) in soil. Site data indicates that future residential exposure to concentrations of polycyclic aromatic hydrocarbons (PAH) in surficial soil would present a potential cancer risk greater than the upper bound of the U.S. EPA acceptable risk range, 1E-4. Site data on surficial soil lead concentrations were also used to model potential blood lead levels associated with future residential exposure, and the U.S. EPA lead model results indicated a 70 percent probability that blood lead levels would exceed the target blood lead level of 10 micrograms per deciliter, which is greater than the 5 percent probability threshold. Potential unacceptable exposure scenarios were also identified for lead and PAH exposures associated with current site workers and for PAH exposures associated with potential site recreational users.

The following four alternatives evaluated for potential implementation include:

1. Alternative 1 — No Action.

2. Alternative 2 — Soil Removal in the pistol range berm (UXO 1), removal to a 1-foot depth across the open fields of UXO 2, removal of 14 areas from a 10-foot by 10-foot area to an additional depth of 1-foot, and engineering and land use controls (fencing) to restrict access to forested section of UXO 2.

3. Alternative 3 — Soil removal of the pistol range berm, site wide soil removal (fields and forested sections) to a depth of 1-foot, removal of 14 areas from a 10-foot by 10-foot area to an additional 1-foot in depth.

4. Alternative 4 — Engineering and land use controls (fencing) around UXOs 1 and 2.

Through a comparative analysis of the alternatives, Alternative 3 is the recommended remedy and in alignment with NSA Mid-South’s long-term restoration and planning goals and enables unrestricted reuse of the site.
1.0 INTRODUCTION AND SITE CHARACTERIZATION

1.1 Purpose and Objectives

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by Resolution Consultants under the Naval Facilities Engineering Command Comprehensive Long-Term Environmental Action — Navy Contract N62470-11-D-8013, Contract Task Order F271. The purpose of this EE/CA is to recommend an alternative to reduce the release of lead and polycyclic aromatic hydrocarbon- (PAH) in soil at the former Pistol Range (identified as Unexploded Ordnance [UXO] 1) and Trap/Skeet Ranges #1 and #2 (identified as UXO 2) located at Naval Support Activity (NSA) Mid-South in Millington, Tennessee. This alternative will provide a long-term solution and the remedy will eliminate and/or manage future risk to human health associated with potential future unrestricted residential use of the site.

This EE/CA provides the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation to support a non-time-critical removal action (NTCRA) at UXOs 1 and 2. An EE/CA serves an analogous function to, but is more streamlined than, the remedial investigation/feasibility study and promptly addresses health threats and accelerates sites through the CERCLA response process. The goals of an EE/CA are to identify the objectives of alternative remedies, analyze their effectiveness, implementability, and cost.

Upon finalization, the EE/CA will be placed in the Administrative Record and a notice of its availability for public review will be published in the local newspaper. The EE/CA will then be available for a 30-day public comment period. Following the public comment period, responses to significant comments will be prepared and incorporated into the Action Memorandum (AM). This removal action is non-time critical due to the availability of a planning period from the time any comments on the EE/CA are received and addressed to the time of initiation of the removal action. Following the finalization of the EE/CA, the project will be completed in several phases estimated to span two years, as Navy funding allows. This is an estimated schedule for project completion. Critical milestone periods related to the removal action schedule are summarized below:

- Preparation of planning documents
- Performance of field removal action activities
- Preparation of after action report

Submittal of this document fulfills the requirements for non-time critical removal action as defined by CERCLA, the Superfund Amendments and Reauthorization Act, and the National Oil and
Hazardous Substance Pollution Contingency Plan (NCP). This document follows the
United States Environmental Protection Agency’s (U.S. EPA) Office of Solid Waste and Emergency
CERCLA (U.S. EPA 1993).

This document contains the following:

• Site description and background (Section 1.2)
• Previous investigations and actions (Section 1.3)
• Source, nature, and extent of contamination (Section 1.4)
• Conceptual site model (Section 1.5)
• Objectives (Section 2.0)
• Technology screening (Section 3.0)
• Development and description of alternatives (Section 4.0)
• Analysis of alternatives (Section 5.0)
• Recommended alternative (Section 6.0)

1.2 Site Description and Background
NSA Mid-South currently occupies approximately 1,600 acres in north central Shelby County,
Tennessee. NSA Mid-South is approximately 20 miles north of Memphis and 7 miles east of the
Mississippi River (Figure 1-1; all figures are located at the end of each section). In November 1917 the
first base to occupy the NSA Mid-South property was created, an Army Signal Corps Aviation School
designated Park Field. A Naval Reserve Aviation Base commissioned the property on
15 September 1942, and served to train pilots for World War II duty. By 1 January 1943, the
Naval Reserve Aviation Base was officially designated the Naval Air Station Memphis, and incorporated
the current area north of Navy Road. Because of the 1995 BRAC, Naval Air Station Memphis was
operationally closed and realigned as NSA Memphis on 30 September 1995 and subsequently renamed
NSA Mid-South on 1 October 1998. Under the closure and realignment, over 1,800 acres of
government property on the north side of the base were transferred to the Millington Municipal Airport
Authority and the city of Millington. UXOs 1 and 2 are located on the Navy-retained property in the
southern portion of the base, east of Singleton Avenue and south of Polaris Drive.

Land use on the installation is primarily administrative in nature, as NSA Mid-South serves as the
Navy’s Human Resources Center of Excellence. Its largest commands are the Navy Personnel
Command, Navy Recruiting Command, and Navy Manpower Analysis Center, as well as the
U.S. Army Corps of Engineers Finance Center. More than 7,500 military, civilian, and contract personnel are assigned to or work on the base. As the landlord of the installation, NSA performs the many tasks necessary for the proper functioning of a self-contained city, including housing, food service, utilities, and facilities for purchase of essential food stuffs and personal items.

UXO 1, the former Pistol Range, is within the Trap/Skeet Ranges (Figure 1-2) and was used for small arms training from approximately 1948 until 1994. Munitions use was limited to small arms ammunition, reportedly including .22-caliber, .30-caliber, 9-millimeter (mm), .38-caliber, and .45-caliber ammunition (Malcolm Pirnie 2005). Property records indicate that the range, when active, consisted of a berm backstop for the range, shooting stations, targets, and an armory. The firing line maintained 16 firing positions with targets that operated via a manual, mechanical cable system operated from behind the firing lines. With the exception of the berm and three of the five target lines, no structures remain at the site today. Clay pigeon pieces are present on the outsides of the berm surface from the former and concurrent operation of the adjacent Trap/Skeet Ranges (UXO 2). Today, the U-shaped berm, approximately 10 to 15 feet tall and 500 feet long, contains an overgrowth of small trees, bushes, and grass.

During the Site Investigation, two 40-mm riot-control training rounds were identified on the berm surface; however, subsequent interviews with Base and Naval Facilities Engineering Command (NAVFAC) Midwest personnel failed to uncover their origin (Tetra Tech 2010). During the RFI, two 20-mm heavily corroded target-practice rounds were found on the berm face but were concluded not to pose an explosive hazard. Base personnel believed both discoveries were from inappropriate disposal versus their use at the site. No other evidence or history of munitions or explosives of concern were identified.

UXO 2, the former Trap/Skeet Ranges #1 and #2, consists of approximately 79 acres and as mentioned above, encompass the former Pistol Range (Figure 1-2). Trap/Skeet Range #1, comprising the northern portion of the site and constructed around 1943, has an unrecorded closure date sometime after World War II. Trap/Skeet Range #2, comprising the southern portion of the site, closed in 2005. No environmental remedial efforts have taken place at either of the ranges.

Property records indicate the ranges, when active, had firing lines, a skeet office and armory, two clay pigeon storage buildings, an ammunition storage building, instruction building, and multiple shooting stations. Munitions use was limited to common small arms ammunition, primarily 12- and 20-gauge shotgun shells.
Today, the vast majority of the site is vacant, consisting of woods along the eastern half, and maintained grass fields along its western half with very little evidence of the former ranges. A small cinder-block building that was used to house clay pigeons is the only remaining structure and is present at the southwest corner of the Trap/Skeet Range #2. Solid Waste Management Unit 2, a closed 42-acre solid-waste landfill used between 1942 and 1970, borders and overlaps with the southern footprint of Trap/Skeet Range #2; however, the existing Solid Waste Management Unit 2 remedy (fencing and land use controls) includes the overlap area, therefore the NSA Mid-South Base Cleanup Team decided not to investigate the overlap area.

The Commissary grocery store, Midway recreational vehicle Park, dog park, band storage building, and water tower are all located within the northern footprint of the site (Figure 1-2). An active temporary magazine for small arms is also present within the north-central section of the site.

1.3 Previous Investigations

Previous investigations of UXOs 1 and 2 include a Preliminary Assessment (PA) conducted by Malcolm Pirnie (2005), a Site Investigation (SI) conducted by Tetra Tech (2010), and a Resource Conservation and Recovery Act Facility Investigation (RFI) and RFI Addendum conducted by Resolution Consultants (2013 and 2014).

The PA (Malcolm Pirnie, 2005) identified the UXO 1 and the Trap/Skeet Range #1 portion of UXO 2 as Military Munitions Response Program eligible closed sites (UXO 1 and Area of Concern 1). Trap/Skeet Range #2 was active during the PA and was added to the list of inactive ranges after its 2005 closing date. Given the lengthy site histories, the PA recommended SIs for both sites. Because the footprints of Trap/Skeet Ranges #1 and #2 overlapped, the two sites were designated as UXO 2 — replacing the former Area of Concern 1 designation for Trap/Skeet Range #1.

The SI (Tetra Tech, 2010) was designed to collect information to supplement the PA and to determine whether munitions constituents such as lead, nitroglycerine, or PAHs, from previous site activities or operations at the subject Military Munitions Response Program sites, had impacted soil. For UXO 1, a visual inspection of the former Pistol Range identified expended ammunition and broken clay pigeons on the surface of the berm. Subsequent soil sample analytical data generated from the SI indicated lead in the surface soil of the berm at concentrations that could potentially affect human health. Nitroglycerin was not detected in composite soil samples collected at the firing lines; therefore, nitroglycerin was not recommended for further evaluation; however, given the elevated lead and PAH concentrations in soil, the SI recommended a work plan for remediating the contaminated sections
of the Pistol Range berm and a Focused Feasibility study to evaluate remedial options for the identified soil impacts (Tetra Tech 2010). Since the SI delineated the eastern extent of lead and PAH concentrations above the project action levels (PALs), the Navy decided an RFI was warranted to better refine the nature and extent of PAHs and lead releases in soil and to conduct a human-health risk assessment.

1.4 Site Characterization
Lead exceeding the 400 milligrams per kilogram (mg/kg) screening project action level (PAL) was predominately detected in the uppermost 1 foot of soil (or 13 of 31 samples) of the pistol range berm while samples from the berm interior (1 to 15 feet) exceeded the PAL at only 4 of 76 samples. However, PAH concentrations exceeding the benzo(a)pyrene⁠¹ equivalent background of 0.565 mg/kg PAL for NSA Mid-South were prevalent throughout the berm (9 of 11 surface and 52 of 86 samples). Soil beneath the natural berm grade also contained PAH impacts likely resulting from the trap and skeet range operations preceding the berm construction. Lead and PAH concentrations detected in the Pistol Range berm are shown on Figures 1-3 and 1-4.

Within UXO 2, lead and PAH exceedances of the PALs corresponded with the expected shot- and clay-pigeon fall-areas, generally over areas extending 600 and 220 feet away, respectively, from the shooting stations. Lead concentrations above the PAL is primarily limited to the surface-soil interval where 41 of 111 samples exceeded the PAL while only 2 of 34 sub-surface soil samples exceeded the PAL. PAH concentrations exceeding the PAL were limited to 54 of 100 surface soil samples and 14 of 43 (1-2 foot) subsurface soil samples. Approximately 12.5 acres exceed the residential lead PAL for surface soil and 7 acres exceed the PAH PAL for surface soil. Lead and PAH concentrations detected at UXO 2 are shown on Figures 1-5 through 1-8.

1.5 Conceptual Site Model
Based on data from the SI (Tetra Tech 2010) and RFI (Resolution Consultants, 2013 and 2014) soil contaminated with lead and PAHs are present across the two sites with most of the PAH impacts nearest the shooting stations and lead impacts extending over a larger area. The source of contamination is isolated to the site. RFI sediment samples collected from the wet weather conveyances/drainage ditches across the site did not indicate lead or PAH accumulation, indicating relatively immobility of the contaminants. Additionally, the vertical extent of contaminants is

¹ (Benzo(a)pyrene is used as a standard by which PAHs are assessed and is based on the toxicity sum of seven PAHs and their potential to cause cancer relative to benzo(a)pyrene. Therefore, reference to PAHs are relative to their collective benzo(a)pyrene equivalent [or BEQ] sum of toxicities.)
predominately in the uppermost 1-foot of soil, with minor exceptions across the site. Given the delineation of the vertical extent of impacted soil and the low mobility of the contaminants, the NSA Mid-South Base Cleanup Team decided not to evaluate groundwater following the RFI.

There are no surface water bodies or wetlands on the site. The nearest surface water body is the Big Creek Drainage, 300 feet south of the UXOs 1 and 2. The property lies within the 100-year floodplain and was flooded in 2010.

### 1.6 Threats to Public Health and Environment

The human health risk evaluation concluded that lead and PAH concentrations in soil above 418 mg/kg and 1.5 mg/kg, respectively, posed a residential risk to hypothetical user of the property. Direct contact, inhalation, and ingestion were evaluated as the primary exposure pathways to human health risk. Under a site worker scenario, lead and PAHs were concluded to pose an excessive risk, and under a recreational reuse, PAHs were considered to pose an excessive risk. The Navy prepared a screening Level Ecological Risk Assessment (NAVFAC Atlantic, 6 January 2014) which concluded a slight hazard (hazard quotient [HQ] of 7) for the shrew and robin because of lead in soil; however, the evaluation was based on using the maximum lead concentration (51,900 mg/kg) and is therefore biased high. The site mean lead concentration is 1,584 mg/kg.

At UXO 2, the RFI found most of the samples collected from the wooded and field areas exceeded the lead and benzo(a)pyrene equivalent (BEQ) remedial goal options (RGOs) for a site resident (418 mg/kg and 1.5 mg/kg, respectively). An area of roughly 20 acres was identified with impacts above either the PAH or lead residential RGOs with most of the impacts being limited to the uppermost 1-foot of depth; however, 10 locations were identified in UXO 2 and four locations at UXO 1 where the RGO exceedances were identified at 1 to 2-foot depth interval.

Under a site worker scenario, the lead footprint for RGO exceedances is similar to residential but smaller due to its higher RGO (21.1 mg/kg). Lead is not a chemical of concern under a recreational land use since the U.S. EPA's lead model results indicated there would be a less than 5 percent probability (threshold criteria) for blood lead levels to exceed the target blood lead level of concern. Therefore, the footprint of acceptable recreational reuse is driven solely by BEQ in soil. The recreational RGO for BEQ (6.9 mg/kg) is more conservative than the RGO for site workers (21.1 mg/kg). Therefore, a slightly larger risk management area exists in surface soil for a recreational reuse than a site worker reuse, and generally corresponds with the UXO 2 clay pigeon target-fall zone.
Releases of lead and PAH from the site, if not addressed by a response action, may present a potential threat to public health, welfare or the environment. The following figures illustrate site conditions and locations where lead and PAHs exceeded the residential, recreational, and site worker RGOs.
Lea

Notes:
- Lead Results shown as milligram per kilogram (mg/kg) or parts per million (ppm)

Legend
- Bold indicates result exceeded Residential RSL value

Legend
- Sample Location
- Topographic Contour (2-ft interval)
- Lead > Site Resident RGO (418 ppm)
- Lead > Site Worker RGO (1,235 ppm)
- Lead is not a COC Under a Recreational Reuse Scenario
- Pistol Range
- SWMU 2 Boundary
- Target Lines
- Road

Figure 1-3
Lead Results in Surface and Subsurface Soil Exceeding RGOs
UXO 1 - Pistol Range
NSA Mid-South
Millington, Tennessee
Benzo(a)pyrene Equivalent (BEQ) Results shown as milligram per kilogram (mg/kg) or parts per million (ppm)
- NSA Mid-South Background Value for BEQ = 0.565 mg/kg
- Bold indicates result exceeded background value

Legend
- Sample Locations
- Contour (2-ft interval)
- BEQ > Site Resident RGO (1.5 ppm)
- BEQ > Recreational RGO (6.9 ppm)
- BEQ > Site Worker RGO (21.1 ppm)
- Pistol Range
- Target Lines

Figure 1-4
Benzo(a)pyrene Equivalent Results in Surface and Subsurface Soil Exceeding RGOs
UXO 1 - Pistol Range
NSA Mid-South
Millington, Tennessee

Notes:
- BEQ > Site Resident RGO (1.5 ppm)
- BEQ > Recreational RGO (6.9 ppm)
- BEQ > Site Worker RGO (21.1 ppm)
- Bold indicates result exceeded background value
Legend
- Sample Locations
- Topographic Contour (2-ft interval)
- Structures
- Lead > Site Resident RGO (418 ppm)
- Lead not a COC under a Recreational Rationale
- Lead > Site Worker RGO (1,235 ppm)
- Swimmer-2 Boundary
- Grass Fields
- Pavement

Notes:
- Lead Results shown as milligram per kilogram (mg/kg) or parts per million (ppm)
- U.S. EPA Residential Regional Screening Level (RSL) for Lead = 400 mg/kg
- U.S. EPA Industrial RSL for Lead = 800 mg/kg
- Bold indicates result exceeded Residential RSL value
- SRS = RFI Sample Designation

Figure 1-5
Lead in Surface Soil Exceeding RGOs UXO 2 - Trap/Skeet Ranges #1 and #2
NSA Mid-South
Millington, Tennessee

REQUESTED BY:  
N. Rinehart  
B. Brantley

TASK ORDER NUMBER: F271
Sample Locations

- Lead > Site Resident RGO (418 ppm)
- Lead > Site Worker RGO (1,235 ppm)
- Structures
- Lead not a COC under a Recreational Reuse Scenario

Legend

- Sample Locations
- Topographic Contour (2-ft interval)
- Structures
- Lead > Site Resident RGO (418 ppm)
- Lead not a COC under a Recreational Reuse Scenario
- Lead > Site Worker RGO (1,235 ppm)

Notes:
- Lead Results shown as milligram per kilogram (mg/kg) or parts per million (ppm)
- U.S. EPA Residential Regional Screening Level (RSL) for Lead = 400 mg/kg
- U.S. EPA Industrial RSL
- Lead = 800 mg/kg
- Italics indicates result exceeded Residential RSL value
- TBR - SRI Sample Designation
- SRS - RFI Sample Designation

Figure 1-7
Lead in Subsurface Soil Exceeding RGOs
UXO 2 - Trap/Skeet Ranges #1 and #2
NSA Mid-South
Millington, Tennessee
Notes:
- Benzo(a)pyrene Equivalent (BEQ) Results shown as microgram per kilogram (mg/kg) or parts per million (ppm)
- NSA Mid-South Background Value for BEQ = 0.565 mg/kg
- Bold indicates result exceeded background value
- TSR indicates SI sample designation
- SRS indicates RFI sample designation

Legend
- Sample Location
- Topographic Contour (3-ft interval)
- BEQ > Site Resident RGO (1.5 ppm)
- BEQ > Recreational RGO (6.9 ppm)
- BEQ > Site Worker RGO (21.1 ppm)
- SWMU 2 Boundary
- Pavement

Figure 1-8
Benzo(a)pyrene Equivalent in Subsurface Soil
Exceeding RGOs
UXO 2 - Trap/Skeet Ranges #1 and #2
NSA Mid-South
Millington, Tennessee
2.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

As discussed in Section 1, lead- and PAH-impacted surface and subsurface soils present a potential unacceptable human health risk. The general removal action objectives are to protect the environment and to meet the property end use goal for unrestricted reuse.

To achieve the goals of the NTCRA, a removal action objective was developed that is protective of human health and the environment and complies with ARARs. The removal action objective for this NTCRA is to:

- Remove lead and PAH affected soil to concentrations below the residential remedial goal options established in the human health risk assessment (Resolution Consultants 2012). Residential RGOs are 418 mg/kg and 1.5 mg/kg for lead and PAHs, respectively.

The objective identifies responses that address potential current and future human-health risk.

2.1 Determination of Removal Action Scope of Work

To achieve the RAO, the scope for the removal action alternatives evaluation will focus on surface and near-surface soils containing lead and PAH concentrations that exceed the residential RGOs to enable an unrestricted site reuse. The key federal statute and guidance considered for the remedy are the National Contingency Plan 40CFR 300.430 (e)(2)(i)(A)(2) and Office of Solid Waste and Emergency Response Directives 9285.6-03 and 9285.7-15-1, as they relates to human health risk. Under a residential reuse, most of the wooded and field areas of UXO 2 exceed the 10-4 upper bound lifetime cancer risk limit for benzo(a)pyrene equivalents or lead toxicity thresholds, and would require corrective measures to mitigate the risk.

2.2 Regulatory Framework

This EE/CA is issued by the Department of the Navy under Section 104 of CERCLA and SARA. Section 104 allows an authorized agency to remove the risk of hazardous substances, pollutants, or contaminants at any time, or to take other response measures consistent with the NCP as deemed necessary to protect public health or welfare and the environment. The Navy is delegated the authority to conduct the removal action on Navy properties by Executive Order 12580, which delegates this authority to all federal agencies. The Navy is the lead agency for this removal action, with oversight from the Tennessee Department of Environment and Conservation.
2.3 Rationale for the Removal Action
A NTCRA has been determined necessary for the Pistol Range (UXO 1) and Trap and Skeet Ranges #1 AND #2 (UXO 2) because they meet the following criteria of 40 CFR 300.415(b)(2):

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants.
- High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate.
- Other situations or factors that may pose threats to public health or welfare of the United States or the environment.

2.4 Removal Action Schedule
The removal action schedule is driven by Navy funding and weather conditions. Given the size of the removal area, the removal action may be conducted incrementally. Conducting the removal action when soils are wet or saturated will create unsafe working conditions. Because the removal action areas will need to be re-vegetated, ideally the work will be completed during the fall, drier period so that vegetation can be reestablished before the winter months. The removal action is tentatively scheduled for beginning in 2017 with the overall completion date pending Navy funding.

2.5 Applicable or Relevant and Appropriate Requirements
The Navy has primary responsibility for identifying potential Applicable or Relevant and Appropriate Requirements (ARARs) at the site, and to the extent practicable, complying with them. Summaries of potentially related environmental regulations are tabulated in Appendix A.

ARAR evaluation is a two-step process: (1) determination of applicability, and (2) even if not applicable, determination of relevance and appropriateness. Requirements must be both relevant and appropriate to be considered ARARs.

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or state environmental or facility laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a CERCLA site. Only state standards that are more stringent than federal standards, have been promulgated at the state
level (i.e., are legally enforceable and generally applicable), and have been identified by the state in a timely manner may be applicable.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements under federal and state environmental and facility laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so that their use is well suited to the particular site. As with applicable requirements, only state standards that are more stringent than federal standards, have been promulgated at the state level (i.e., are legally enforceable and generally applicable), and have been identified by the state in a timely manner may be relevant and appropriate.

As outlined in 40 Code of Federal Regulations §300.415(j), the lead agency may consider the urgency of the situation and the scope of the removal action to be conducted in determining whether compliance with ARARs is practicable. The final determination of ARARs pertinent to this NTCRA will be made when the Navy issues the AM.

The NCP [40 Code of Federal Regulations §300.400(g)(2)] specifies the following criteria to be used in the determination of what requirements of environmental laws and standards are relevant and appropriate:

- Purpose of the requirement in relation to the purpose of CERCLA.
- Medium or media regulated or affected by the requirement.
- Substance(s) regulated by the requirement.
- Actions or activities regulated by the requirement.
- Variances, waivers, or exemptions of the requirement.
- Type of place regulated and the type of place affected by the release or CERCLA action.
- Type and size of the facility or structure regulated by the requirement or affected by the release.
• Consideration of the use or potential use of affected resources in the requirement.

Under CERCLA, only substantive provisions of requirements are considered to be ARARs. Procedural or administrative requirements (e.g., permits) are not considered ARARs. The CERCLA exemption in Section 121(e)(1) [42 U.S. Code, Section 9621(e)(1)] states that “No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with this section.” This exemption applies to all administrative requirements, but substantive requirements of the permits must still be attained.

Under the description of ARARs set forth in the NCP and SARA, state and Federal ARARs are categorized as: chemical-specific, location-specific, and action-specific.

**Chemical-Specific Applicable or Relevant and Appropriate Requirements** — are health or risk management-based criteria or methodologies applied to site-specific conditions that result in the establishment of a cleanup level. These requirements generally set protective cleanup concentrations for each of the chemicals of concern in the designated media or set safe concentrations of discharge for remedial activity.

**Location-Specific Applicable or Relevant and Appropriate Requirements** — restrict remedial activities based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on actions within wetlands or floodplains, the protection of known endangered species, or restrictions for protected waterways. Federal and Tennessee location-specific regulations reviewed are summarized in Appendix A.

**Action-Specific Applicable or Relevant and Appropriate Requirements** — are requirements that govern the implementation of the selected remedy and define acceptable treatment and disposal procedures to ensure the protection of public health and safety. Federal and Tennessee action-specific ARARs that may affect the procedural aspects of removal alternatives are summarized in Appendix A.
3.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

3.1 Development of Alternatives

This section presents the four alternatives evaluated to address the potential health risk associated with lead and PAH in soil. Factors considered in developing the alternatives are:

- Future site use
- Long-term obligations associated with maintaining engineering and land use controls

The purpose of a range of alternatives is to present the decision-makers with technical and economic options for remediation. These alternatives to be evaluated are:

- Alternative 1 — No Action
- Alternative 2 — Limited Soil Removal, Engineering Controls, Land Use Controls (LUCs)
- Alternative 3 — Site Wide Removal
- Alternative 4 — Engineering and Land Use Controls

These alternatives were evaluated against meeting the NCP criteria of effectiveness, implementability, and cost. Please note that all of the alternatives with the exception of Alternative 1 — No Action, though not repeated for each evaluation, include a LUC component for the portion of the Commissary that overlaps the northwest corner of the trap and skeet ranges, which would remain in place until the property use changed and the hardscape surfaces of the Commissary were removed.

3.1.1 Alternative 1 — No Action

The No Action alternative consists of no measures being taken to limit or prevent contact with lead and PAH-impacted soil. No administrative or engineering controls or actions to reduce the toxicity, mobility, or volume of impacted soils would occur under this alternative. As required by CERCLA, the No Action alternative is included in the analysis of removal action alternatives as a baseline for comparison.

3.1.2 Alternative 2 — Limited Soil Removal, Engineering and Land Use Controls

- UXO 1 — The pistol range berm would be removed followed with excavation to a depth of 1-foot below surrounding grade. To confirm lead and PAH cleanup goals have been achieved, a 30-foot by 50-foot grid will be set up across the excavation base and a five-point composite sample would be collected from the floor of each of the 22 grid areas (Figure 3-1). Should an exceedance of lead or PAH residential RGO be identified in any of the grids, an additional 1-foot of soil would be excavated from the excavation floor of the grid and another five-point composite sample collected and analyzed for the exceeded analyte. This process would be repeated until lead and PAH concentrations are documented to be below their residential RGOs.
• **UXO 2** — The open fields of the Trap and Skeet shooting stations approximately 7 acres, would be excavated to 1 foot below grade to remove PAH and lead impacted soil. Confirmation samples will be collected to verify removal effectiveness. A surveyor will shoot a 50-foot by 50-foot grid over the excavation area and a 5-point composite will be collected from each grid. If the analytical data indicate lead or PAH concentrations remain above the screening level, the excavation will be excavated another foot in depth, re-sampled, until laboratory data indicates target lead or PAH concentrations have been achieved. The forested unexcavated areas of UXO 2 (approximately 12.5 acres) would be enclosed with a fence and signage restricting site access. The engineering control and land use control restricting property reuse would be memorialized in the Base’s master development plan. The proposed excavation and fenced areas are shown on Figure 3-2.

• **Over-Excavation Areas** — Following the 1-foot removal across UXOs 1 and 2, a surveyor will re-locate the 14 sample locations where lead and/or PAH concentrations were detected above the RGOs at the 1-2-foot. A 10-foot-by-10-foot square excavated an additional 1-foot in depth, would be removed from each area (locations shown on Figure 3-2). Five five-point composite sample will be collected from each of the 14 supplemental excavations, one from each of the four sidewalls and one from the excavation base. If the analytical data indicate lead or PAH concentrations remain above the screening level, the excavation wall(s) and floor will be further excavated in 1 foot increments, and re-sampled, until laboratory data indicates target lead or PAH concentrations have been achieved.

• **Total Volume** — The volume of the pistol range berm is 4,800 cubic yard (CY). A 1-foot removal across UXOs 1 and 2 (7 acres) generates a volume of 11,290 CY. The additional 1-foot over-excavation at the 14 areas generates an extra 52 CY. The total estimated removal volume for Alternative 2 is 16,140 CYs.

### 3.1.3 Alternative 3 — Site Wide Removal

The lead- and PAH-impacted Soil Removal alternative would include the site-wide removal of accessible soil where it exceeds the residential RGOs for lead and PAHs. Soil removal would include:

• **At UXO 1** — same as outlined in Alternative 2

• **At UXO 2** — Same as outlined in Alternative 2 but inclusion of the 12.5 acre wooded area (for a total of 19.5 acres) to a depth of 1 foot below local grade. Within the densely wooded portion of UXO 2, trees smaller than 12 inches in diameter would be removed while a select number of
larger trees (to be designated by NSA Mid-South personnel) would remain in place. Contaminated soil around trees greater than 12-inches in diameter would be removed using hand tools to minimize damage to root structures.

- Over-excision Areas — same as outlined in Alternative 2

- Total Volume — The volume of the pistol range berm is 4,800 CY. A one-foot removal across 19.5 acres generates a volume of 31,360 CY. The addition 1-foot over-excavation at the 14 areas generates an extra 52 CY. A total estimated removal volume for Alternative 3 is 36,300 CY. The proposed excavation areas are shown on Figure 3-3.

3.1.4 Alternative 4 — Engineering and Land Use Controls
The engineering controls alternative would include enclosing the entire site with fencing, erecting signage and preventing site access. This alternative would include:

- Fencing approximately 21 acres (5,158 linear feet), with access to the enclosed area via locking gates under the control of NSA Mid-South. The location of the proposed fencing is shown on Figure 3-4.

- Annual inspections and maintenance would be required to ensure the fencing and signage remain in place. The LUCs would be memorialized in the Base’s property records and master development plan.
Figure 3-1
Berm Removal and Excavation Area
(0-1 Foot BGS)
UXO 1 - Pistol Range
NSA Mid-South
Millington, Tennessee

DATE: 8/4/2016
DRAWN BY: B. Brantley
REQUESTED BY: N. Rinehart
TASK ORDER NUMBER: F271

Former Sample Locations
10 Foot x 10 Foot x 2 Foot bgs Planned Over-Excavation Area (See Figure 4-2)
Contour (2-ft interval)
Grid for 5-Point Floor (1' bgs) Composite Following Berm Removal. Sample Analyses for PAHs and Lead
Pistol Range
Target Lines

0 20 40 80 Feet

0 40 80 120 Feet

Grid for 5-Point Floor (1' bgs) Composite Following Berm Removal. Sample Analyses for PAHs and Lead

Former Sample Locations
10 Foot x 10 Foot x 2 Foot bgs Planned Over-Excavation Area (See Figure 4-2)
Contour (2-ft interval)

Pistol Range
Target Lines

3-4
TRAP AND SKEET RANGES 1&2 (UXO #2)

Water Tower

Commissary

Midway RV Park

SWMU 2 - SOUTH SIDE LANDFILL

Big Creek Drainage Canal

PISTOL RANGE (UXO #1)

Combined Lead and PAH Removal Areas - 7.0 Acres

Fence Enclosure Area - 12.5 Acres

Perimeter - 4,712 Feet

Lat: 35.329644
Lon: -89.866108

Lat: 35.328332
Lon: -89.866727

Lat: 35.328431
Lon: -89.866726

Lat: 35.328191
Lon: -89.867504

Lat: 35.325542
Lon: -89.866097

Figure 3-2
Alternative #2
NSA Mid-South
Millington, Tennessee
TRAP AND SKEET RANGES 1&2 (UXO #2)

Water Tower

Combined Lead and PAH Removal Area Area - 19.5 Acres Perimeter - 5,438 Feet

Lat: 35.324664
Lon: -89.868111
Lat: 35.324722
Lon: -89.867336
Lat: 35.325027
Lon: -89.867097
Lat: 35.325167
Lon: -89.865558
Lat: 35.329644
Lon: -89.866108
Lat: 35.328332
Lon: -89.866727
Lat: 35.328431
Lon: -89.866726
Lat: 35.328191
Lon: -89.867504
Lat: 35.327360
Lon: -89.86569
Lat: 35.325542
Lon: -89.866097

PISTOL RANGE (UXO #1)

Combined Lead and PAH Removal Area Area - 19.5 Acres Perimeter - 5,438 Feet

Lat: 35.324664
Lon: -89.868111
Lat: 35.324722
Lon: -89.867336
Lat: 35.325027
Lon: -89.867097
Lat: 35.325167
Lon: -89.865558
Lat: 35.329644
Lon: -89.866108
Lat: 35.328332
Lon: -89.866727
Lat: 35.328431
Lon: -89.866726
Lat: 35.328191
Lon: -89.867504
Lat: 35.327360
Lon: -89.86569
Lat: 35.325542
Lon: -89.866097

Installation Boundary
Midway RV Park
Pistol/Trap/Skeet Range (Original Boundary)
Lead Removal Area - Excavation to 1-Foot Below Grade
PAHs Removal Area - Excavation to 1-Foot Below Grade
10 Foot x 10 Foot x 2 Foot (bgs) Planned Over-Excavation Area
Area Excluded in Alternative - Designated Area Part of SWMU 2
Extent of LUC to Maintain Integrity of Commissary Hardscapes and to Regulate Activities Should Hardscape(s) be Removed

Figure 3-3
Alternative #3
NSA Mid-South
Millington, Tennessee

DATE: 8/16/2016
DRAWN BY: N. Rinehart
REQUESTED BY: B. Brantley
TASK ORDER NUMBER: F271
4.0 ANALYSIS OF ALTERNATIVES
The analysis of alternatives provides the basis for recommending an alternative. Section 4.1 is an overview of the evaluation criteria; Section 4.2 is an analysis of each alternative individually; and Section 4.3 is a comparative analysis of the alternatives.

4.1 Overview of the Evaluation Criteria
The alternatives described in Section 3 have been evaluated using the criteria of effectiveness, implementability, and cost. CERCLA, Section 121, as amended, specifies statutory requirements for removal actions. These four criteria were used to draw sufficient distinctions among the alternatives to allow an alternative to be recommended. Below is a summary of the four criteria and the approach being taken to address each criterion. There also is a discussion on the integration of the National Environmental Policy Act (NEPA) with the CERCLA evaluation.

- Effectiveness. The effectiveness of each alternative is primarily based on its ability to meet the removal action objectives. Specific effectiveness considerations include:
  - Protection of the environment via reduction of potential hazards
  - Compliance with ARARS (Appendix A)
  - Long-term effectiveness and permanence
    - Magnitude of residual risk
    - Adequacy and reliability of controls (including land use controls)
    - Reduction of toxicity, mobility, or volume through treatment
    - Treatment process used and materials tested
    - Amount of hazardous material destroyed or treated
    - Degree of reduction expected in toxicity, mobility, or volume
    - Type and quantity of residuals remaining after treatment
    - Adequacy of handling other miscellaneous, occasional liquid wastes, such as decontamination water
• Short-term effectiveness
  — Protection of the community during the action
  — Protection of workers during the action
  — Environmental impacts
  — Time until removal objectives are achieved

• Implementability. The implementability of each alternative is based on the technical and administrative feasibility and the availability of services and materials required to implement the alternative. Specific implementability factors include:
  — Ability to construct and operate the technology
  — Reliability of the technology
  — Ease of implementing additional response technologies (if necessary)
  — Ability to monitor effectiveness
  — Ability to obtain approval from other agencies
  — Generation of secondary waste
  — Availability of treatment, storage, and disposal services and capacity
  — Availability of equipment, prospective technologies, and specialists

• Cost. The estimated cost of each alternative is presented for comparison purposes. Each cost estimate includes capital and operation and maintenance costs. Cost estimates include labor, material, and equipment to perform the alternative activities including treatability studies, waste treatment, and waste disposal. Costs are unescalated for a 30-year period.

4.2 Individual Analysis of Alternatives
Four alternatives were identified for evaluation in this EE/CA to reduce the risk posed by lead and PAHs in soil. These alternatives included:

• Alternative 1 — No Action
• Alternative 2 — Limited Soil Removal, Engineering, and Land Use Controls
• Alternative 3 — Site Wide Removal
• Alternative 4 — Engineering and Land Use Controls

An evaluation of these alternatives is provided below against meeting the remedial action objectives identified and the NCP criteria of effectiveness, implementability, and cost.
4.2.1 Alternative 1 — No Action

Effectiveness
The No Action alternative will not meet removal action objectives and the release of lead and PAHs to soil will continue to pose a potential human health threat.

CERCLA, Section 121, cleanup standards, including compliance with ARARs, apply only to actions U.S. EPA determines should be taken under CERCLA, Sections 10 and 106 authorities. A No Action decision is made when no action is deemed necessary to reduce, control, or mitigate exposure because the site does not present a threat to human health or the environment. Therefore, there are no ARARs associated with the No Action alternative.

Since under the No Action alternative, no action will be taken, there will be no short-term impacts to the surrounding community, non-remediation workers, and the environment.

The residual, long-term, risk to human health will be unacceptable under the No Action alternative.

Implementation of the No Action alternative will not reduce toxicity, mobility, or volume of lead and PAHs because this alternative does not include remediation or treatment.

Implementability
Since no action will be taken under the No Action alternative, it is inherently implementable. However, it will be difficult to obtain acceptance from the regulators and the public.

Cost
There are no costs associated with the No Action alternative.

4.2.2 Alternative 2 — Limited Soil Removal, Engineering and Land Use Controls

Effectiveness
The Limited Soil Action, Engineering and Land Use Controls provides protection to human health through a combination of a contaminant mass removal and restricted access to areas left behind with lead and PAHs exceeding the action levels. However, unrestricted reuse will not be achieved since the 19.5 acre forested portion of the site will remain encumbered with engineering and LUCs.

This alternative will comply with all chemical-specific, location-specific, and action-specific ARARs.
This alternative will have minimal short-term impacts to the surrounding community during implementing the removal action portion of the remedy.

Long-term effectiveness is provided as long as controls remain in place and maintained during life of alternative.

Implementation of this alternative will remove some of the toxicity, mobility, or volume of lead and PAHs in soil. Sedimentation and erosion control measures will control mobility and volume of contaminant migration into uncontaminated media.

**Implementability**

This alternative is technically easy to implement. A Sub-Title D landfill is only 5 miles from the Base. Dust mitigation efforts will need to be maintained to prevent exposure to site workers from fugitive dust generation for the removal action portion of the remedy. There are no accessibility or interference issues associated with nearby infrastructure.

Long-term maintenance (fencing, signage, etc.) would be required for the forested area containing the engineering controls. Long-term inspection and reporting requirements would also be required to ensure enforcement.

There should be no administrative problems in implementing this alternative.

The State and community acceptance should be easy to obtain since the remedy would be protective.

**Cost**

The cost for implementing this alternative is $2,069,000.

4.2.3 **Alternative 3 — Site Wide Removal**

**Effectiveness**

The Site Wide Removal Alternative provides the highest level of protection to human health and the environment by removing all areas containing lead and PAH-impacted soil.

This alternative would have minimal short-term impacts to the surrounding community and site workers through use of proper person protective equipment (PPE) and maintained engineering controls during the removal action.
Long-term effectiveness is permanent.

This alternative will comply with all chemical-specific, location-specific, and action-specific ARARs.

Maximum reduction in toxicity, mobility, and volume of lead- and PAH-impacted soil.

**Implementability**

This alternative is very implementable. A Sub-Title D landfill is only 5 miles from the Base. The removal activities within the forested portion of the site would require significant more effort due to tree clearing, using hand tools near left behind trees, added health and safety issues associated with tree removal, increased grubbing areas, and chipping.

There should be no administrative problems in implementing this alternative.

The State and community acceptance should be easy to obtain since the remedy is the most protective.

Cost may be a hurdle to implementing.

**Cost**

The cost for implementing this alternative is $3,646,000.

### 4.2.4 Alternative 4 — Engineering and Land Use Controls

**Effectiveness**

The Engineering and Land Use Controls alternative provides protection to human health by restricting site access and property reuse.

This alternative would have no short-term impacts to the surrounding community and site workers.

Long-term effectiveness is permanent provided controls remain in place and maintained during life of alternative.

This alternative will comply with all chemical-specific, location-specific, and action-specific ARARs.

This alternative does not reduce toxicity, mobility, or volume of lead- and PAH-impacted soil, but does limit potential exposure via controls.
Implementability
This alternative is technically easy to implement.

Long-term maintenance (fencing, signage, etc.) would be required for the forested area containing the engineering controls. Long-term inspection and reporting requirements would also be required to ensure enforcement. Potential response actions based on the inspection and reporting findings may result in additional cost and administrative burdens.

There should be no administrative problems in implementing this alternative.

The State and community acceptance may be more challenging since contaminants remain in place.

Cost
The cost for implementing this alternative is $587,000.

4.3 Comparative Analysis of Alternatives
The screening evaluation for all criteria is summarized in Table 4-1. The alternatives were ranked on a relative scale of 1 (low ranking) to 5 (high ranking) for each of the criteria. It should be noted that for all criteria, a rank of low means least favorable among the alternatives and a high rank means most favorable. Alternative 1: No Action provides a benchmark for evaluation of Alternatives 2, 3, and 4.
### Table 4-1
Comparison of Remedial Alternatives

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Protection of Human Health and the Environment</strong></td>
<td>Criterion is not met.</td>
<td>Meets criterion. For non-removed areas, engineering and ICs must be maintained to protect public from current and future exposure.</td>
<td>Meets criterion. Most protective and permanent.</td>
<td>Meets criterion. Engineering and ICs must be maintained to protect public from current and future exposure.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Compliance with ARARs</strong></td>
<td>Criterion is not met.</td>
<td>Meets criterion. However, relies on ICs to protect the public from current and future exposure.</td>
<td>Meets criterion.</td>
<td>Meets criterion. However, relies on ICs to protect the public from current and future exposure.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Long Term Effectiveness and Permanence</strong></td>
<td>Criterion is not met.</td>
<td>Meets criterion. Engineering and ICs must be maintained for non-removed areas.</td>
<td>Meets criterion. Most protective and permanent. Enables un-restricted reuse of site.</td>
<td>Meets criterion. However, relies on ICs to protect the public from current and future exposure.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Reduction of Toxicity, Mobility, or Volume through Treatment</strong></td>
<td>Criterion is not met.</td>
<td>Meets criterion. Partial reduction in toxicity, mobility or volume of contaminants; however, contaminant mass remains in wooded areas.</td>
<td>Meets criterion. Complete reduction in toxicity, mobility and volume of contaminants.</td>
<td>Criterion is not met. No reduction in toxicity, mobility or volume of contaminants.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Short Term Effectiveness</strong></td>
<td>Criterion is not met.</td>
<td>Meets criterion. May have some potential short term, nuisance effects on surrounding community.</td>
<td>Meets criterion. May have some potential short term, nuisance effects on surrounding community.</td>
<td>Meets criterion. Will have no short term impacts on surrounding community.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td><strong>Implementability</strong></td>
<td>No action needed to implement.</td>
<td>Moderately difficult to implement. Requires long term O&amp;M.</td>
<td>Moderately difficult to implement due to working around trees within forested areas.</td>
<td>Easy to implement but requires significant long term O&amp;M.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
### Table 4-1
Comparison of Remedial Alternatives

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Cost</td>
<td>$0</td>
<td>$2,069,136</td>
<td>$3,646,148</td>
<td>$587,115</td>
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<td></td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total Screening Score¹</td>
<td>15</td>
<td>19</td>
<td>22</td>
<td>20</td>
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</tbody>
</table>

Notes:

ARAR = Applicable or relevant and appropriate requirements
O & M = Operation and maintenance

¹ The alternatives are ranked on a relative scale of 1 (low ranking or least favorable) through 5 (high ranking or most favorable).
5.0  RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 3 is the recommended alternative since it would enable unrestricted reuse of the site, provides the most protection to human health and the environment, and eliminates the toxicity, mobility, and volume of lead- and PAH-impacted soils. While the estimated cost of Alternative 3 is significantly higher than Alternatives 2 and 4; it provides significantly higher utility in that it avoids the long-term future maintenance and enforcement of the engineering and land use controls, particularly if the property ever undergoes transfer and reuse in the future.
6.0 REFERENCES

AECOM. *Naval Support Activity Mid-South Master Plan; Millington, Tennessee.* Los Angeles, California: AECOM. 2012.


Tetra Tech NUS, Inc. *Site Investigation Report for Munitions Response Program Site Inspections at NAVFAC Midwest and BRAC Management Office Southeast Munitions Response Sites and Areas of Concern, Naval Support Activity Mid-South, Millington, Tennessee.* Pasadena, California: Tetra Tech NUS, Inc. 2010


Appendix A

Applicable or Relevant and Appropriate Requirements
### Chemical-Specific ARARs and TBCs

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Media</th>
<th>Citation(s)</th>
<th>Requirements</th>
<th>ARAR Determination</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead and PAHs</td>
<td>Soil</td>
<td>National Contingency Plan 40CFR 300.430 (e)(2)(i)(A)(2)</td>
<td>For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between $10^{-4}$ and $10^{-6}$ using information on the relationship between dose and response.</td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td>Lead and PAHs</td>
<td>Soil</td>
<td>USEPA - Office of Solid Waste and Emergency Response Directives 9285.6-03 and 9285.7-15-1.</td>
<td></td>
<td>TBC</td>
<td>Remedial Goal Options calculated from human health risk assessment</td>
</tr>
</tbody>
</table>

### Remedial Goal Options (RGOs) calculated from Human Health Risk Assessment (Resolution Consultants, 2013)

<table>
<thead>
<tr>
<th>Soil Contaminants of Concern</th>
<th>Units</th>
<th>Direct Exposure Residential</th>
<th>Direct Exposure Site Worker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>418</td>
<td>1,235</td>
</tr>
<tr>
<td>Polynuclear Aromatic Hydrocarbons *</td>
<td>mg/kg</td>
<td>1.5</td>
<td>21</td>
</tr>
</tbody>
</table>

Notes:
- mg/kg - milligrams per kilogram
- * expressed as benzo(a)pyrene equivalents (BEQ) from the HHRA

### Action-Specific ARARs and TBCs

<table>
<thead>
<tr>
<th>Action</th>
<th>Media</th>
<th>Citation(s)</th>
<th>Requirements</th>
<th>ARAR Determination</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanup Action</td>
<td>Air</td>
<td>TDEC 1200-3-8-.01(2)</td>
<td>Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following:</td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TDEC 1200-3-8-.01(1)(a)</td>
<td>- use, where possible, of water or chemicals for control of dust, and</td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TDEC 1200-3-8-.01(1)(b)</td>
<td>- application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces which can create airborne dusts;</td>
<td>TBC</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TDEC 1200-3-22</td>
<td>The technical secretary may require ambient lead monitoring in the vicinity of a source regulated by this Chapter 1200-3-22.</td>
<td>TBC</td>
<td></td>
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<td></td>
<td>Stormwater</td>
<td>TCA 69-3-108(i)</td>
<td>Implement good construction management techniques (including sediment and erosion controls, vegetative controls, and structural controls) in accordance with the substantive requirements of General Permit No. TN12200001 to ensure that storm water discharge:</td>
<td>TBC</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>TDEC 1200-4-10-.03(2)</td>
<td>- does not violate water quality criteria as stated in TDEC 1200-4-3-.03 including but not limited to prevention of discharges that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 1200-4-4;</td>
<td>TBC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TDEC 1200-4-3-0</td>
<td>- does not contain distinctly visible floating scum, oil, or other matter;</td>
<td>TBC</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- does not cause an objectionable color contrast in the receiving stream; and</td>
<td>TBC</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream</td>
<td>TBC</td>
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</table>
## Action-Specific ARARs and TBC Guidance

### EECA - UXO 1 and 2; NSA Mid-South

### Action-Specific ARARs and TBCs (continued)

<table>
<thead>
<tr>
<th>Action</th>
<th>Media</th>
<th>Citation(s)</th>
<th>Requirements</th>
<th>ARAR Determination</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Cleanup Action</td>
<td>Soil Waste</td>
<td>RCRA 40 CFR 262.11(a)</td>
<td>Must determine if solid waste is excluded from regulation under 40 CFR 261.4(b); and</td>
<td>Applicable</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>RCRA 40 CFR 262.11(b)</td>
<td>Must determine if waste is listed as hazardous waste under 40 CFR Part 261; or</td>
<td>Applicable</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>RCRA 40 CFR 262.11(c)</td>
<td>Must determine whether the waste is (characteristic waste) identified in Subpart C of 40 CFR part 261 by either:</td>
<td>Applicable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or</td>
<td>Applicable</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used.</td>
<td>Applicable</td>
<td></td>
</tr>
<tr>
<td>Sample Shipping</td>
<td>Soil Samples</td>
<td>RCRA 40 CFR 261.4(d)(1)</td>
<td>Generation of samples of hazardous waste for purpose of conducting testing to determine its characteristics or composition are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 unless:</td>
<td>Applicable</td>
<td>40 CFR 261.4(d)(1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RCRA 40 CFR 261.4(d)(1)(i)</td>
<td>• The sample is being transported to a laboratory for the purpose of testing;</td>
<td>Applicable</td>
<td>40 CFR 261.4(d)(1)(i)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RCRA 40 CFR 261.4(d)(1)(ii)</td>
<td>• The sample is being transported back to the sample collector after testing; and</td>
<td>Applicable</td>
<td>40 CFR 261.4(d)(1)(ii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RCRA 40 CFR 261.4(d)(2)</td>
<td>• The sample collector ships samples to a laboratory in compliance with U.S. Department of Transportation, U.S. Postal Service, or any other applicable shipping requirements, including packing the sample so that it does not leak, spill or vaporize from its packaging.</td>
<td>Applicable</td>
<td>40 CFR 261.4(d)(2)</td>
</tr>
</tbody>
</table>

### Location-Specific ARARs and TBCs

<table>
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<tr>
<th>Location</th>
<th>Citation(s)</th>
<th>Requirements</th>
<th>ARAR Determination</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of Migratory Birds</td>
<td>Migratory Bird Treaty Act 16 USC 703</td>
<td>Protects almost all species of native migratory birds in the U.S. from unregulated &quot;take&quot;, which can include unnecessary impacts during remedial design and construction.</td>
<td>TBC</td>
<td>16 USC 703</td>
</tr>
<tr>
<td>Presence of Floodplains</td>
<td>NEPA 40 CFR 6.302(b)</td>
<td>Shall take action to restore and preserve natural and beneficial values served by floodplains.</td>
<td>Applicable</td>
<td>40 CFR 6.302(b)</td>
</tr>
<tr>
<td></td>
<td>Executive Order 11988 Section 2. (a)(2) Floodplain Management</td>
<td>Shall consider alternatives to avoid, to the extent possible, adverse effects and incompatible development in the floodplain. Design or modify its action in order to minimize potential harm to or within the floodplain.</td>
<td>TBC</td>
<td>Executive Order 11988 Section 2. (a)(2) Floodplain Management</td>
</tr>
</tbody>
</table>
Appendix B
Detailed Cost Estimates
Table B-1
Detailed Cost Estimate - NTCRA at UXO 1 and UXO 2

Alternative 2 - Excavate 7 Acres to 1-foot; Over excavate 14 areas to 2-feet
Access Control for 12.5 Wooded Acres of UXO 2 via Fencing, and LUCs

NSA Mid-South, Millington TN

### Cost Estimate Assumptions

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil excavation volume (cubic yards)</td>
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<td>16,120</td>
</tr>
<tr>
<td>Pistol Range Berm - 4,772 CY; Trap and Skeet Ranges 7 Acres to 1-foot -15,649 CY; 14 10' - squares to 1' - 52 CY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of confirmatory soil samples (lead/PAH)</td>
<td></td>
<td>35/95</td>
</tr>
<tr>
<td>Volume of backfill (cubic yards)</td>
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<td>16,120</td>
</tr>
<tr>
<td>Linear feet of fence</td>
<td></td>
<td>5,000</td>
</tr>
<tr>
<td>Number of gates/signs</td>
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<td>4/100</td>
</tr>
<tr>
<td>Estimated total time for Implementation (see 2.0, below) (weeks)</td>
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### Task Description

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Unit</th>
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<th>Cost</th>
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<tr>
<td><strong>1.0 Planning documents</strong></td>
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<td>$14,560</td>
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<tr>
<td>1.1 HASP</td>
<td>LS</td>
<td>1</td>
<td>$4,680</td>
</tr>
<tr>
<td>1.2 SAP</td>
<td>LS</td>
<td>1</td>
<td>$9,880</td>
</tr>
<tr>
<td><strong>2.0 Implementation</strong></td>
<td></td>
<td></td>
<td>$1,701,939</td>
</tr>
<tr>
<td>2.1 Mobilization/Demobilization</td>
<td>LS</td>
<td>1</td>
<td>$11,008</td>
</tr>
<tr>
<td>2.2 Site Preparation/Haul Road Construction</td>
<td>LS</td>
<td>1</td>
<td>$56,062</td>
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<tr>
<td>2.3 Tree and Shrub Removal</td>
<td>WEEK</td>
<td>2</td>
<td>$27,818</td>
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<td>2.4 Excavation and Confirmatory Sampling</td>
<td>WEEK</td>
<td>10</td>
<td>$25,821</td>
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<tr>
<td>2.5 Soil Transportation and Disposal</td>
<td>TON</td>
<td>33000</td>
<td>$24</td>
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<tr>
<td>2.6 Restoration/Backfill</td>
<td>DAY</td>
<td>40</td>
<td>$8,691</td>
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<tr>
<td>2.7 Fence Installation</td>
<td>DAY</td>
<td>25</td>
<td>$6,197</td>
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<tr>
<td>2.8 Analytical/Confirmation Sampling</td>
<td>LS</td>
<td>1</td>
<td>$17,530</td>
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<tr>
<td><strong>3.0 Close Out Reporting</strong></td>
<td></td>
<td></td>
<td>$10,120</td>
</tr>
<tr>
<td>3.1 Removal Action Summary Report</td>
<td>LS</td>
<td>1</td>
<td>$10,120</td>
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<tr>
<td><strong>4.0 Operations and Maintenance (30 Years)</strong></td>
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<td>$198,158</td>
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<tr>
<td>4.1 O &amp; M for fencing, clearing, signage</td>
<td>YEAR</td>
<td>30</td>
<td>$2,795</td>
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<tr>
<td>4.2 Annual LUC Inspections/Summary Report</td>
<td>YEAR</td>
<td>30</td>
<td>$3,810</td>
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<tr>
<td><strong>5.0 Project Management</strong></td>
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<td>5.1 Project Management</td>
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<tr>
<td><strong>TOTAL COST</strong></td>
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<td>$2,069,136</td>
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</table>

**Revision 9/1/2016**

NSA Mid-South Millington, TN
UXOs 1 and 2 Ranges
Table B-2
Detailed Cost Estimate - NTCRA at UXO 1 and UXO 2
Alternative 3 - Remove Pistol Range Berm, Excavate 19.5 acres to 1-foot; Over excavate 14 areas to 2-feet
NSA Mid-South, Millington TN

Cost Estimate Assumptions
Soil excavation volume (cubic yards) 36,000
  Berm - 4,772 CY; Ranges 19.5 Acres to 1-foot -28,878 CY; 14 10'-squares to 2' - 52 CY
Number of confirmatory soil samples (lead/PAH) 35/95
Volume of backfill (cubic yards) 31,850
Estimated total time for Implementation (see 2.0, below) (weeks) 30

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Planning documents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 HASP</td>
<td>LS</td>
<td>1</td>
<td>$4,680</td>
<td>$4,680</td>
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<tr>
<td>1.2 SAP</td>
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<td>2.1 Mobilization/Demobilization</td>
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<tr>
<td>2.2 Site Preparation, TCLP Sampling</td>
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<td>$9,106</td>
<td>$72,847</td>
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<td>2.3 Tree and Shrub Removal</td>
<td>DAY</td>
<td>20</td>
<td>$10,029</td>
<td>$200,577</td>
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<td>2.4 Excavation and Confirmatory Sampling</td>
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<td>72</td>
<td>$8,092</td>
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<td>2.5 Soil Transportation and Disposal</td>
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<td>54,000</td>
<td>$33</td>
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<td>2.6 Restoration</td>
<td>DAY</td>
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<td>2.7 Analytical/Confirmation Sampling</td>
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<tr>
<td>3.0 Close Out Reporting</td>
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</tbody>
</table>
Table B-3
Detailed Cost Estimate - NTCRA at UXO 1 and UXO 2
Alternative 4 - Fence entire area and LUCs
Access Control for 21 Wooded Acres
NSA Mid-South, Millington TN

Cost Estimate Assumptions
- Linear feet of fence: 5,000
- Number of gates/signs: 4/100
- Estimated total time for Implementation (see 2.0, below) (weeks): 7

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Cost</th>
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<td>1.0 Planning documents</td>
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<td>$4,680</td>
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<td>2.0 Implementation</td>
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<td>2.3 Tree and Shrub Removal</td>
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