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Site Investigation Report for Munitions Response Program Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern

Naval Surface Warfare Center
Crane Division
Crane, Indiana

Contract Task Order F272

August 2010

NAVFAC
Naval Facilities Engineering Command
Midwest
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

TETRA TECH NUS, Inc.

021010/P

FINAL
SITE INSPECTION REPORT
FOR
MUNITIONS RESPONSE PROGRAM SITE INSPECTIONS
AT
MUNITIONS RESPONSE SITES AND AREAS OF CONCERN

Naval Support Activity Crane
Crane, Indiana

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

Submitted by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

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PREPARED UNDER DIRCTION OF:

RICHARD BARRINGER
PROJECT MANAGER
TETRA TECH, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMISSION BY:

JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
TETRA TECH, INC.
KING OF PRUSSIA, PENNSYLVANIA

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ACRONYMS

ºF	Fahrenheit
%R	percent recovery
µg/kg	microgram per kilogram
AOC	Area of Concern
B	Building
BaP	benzo(a)pyrene
bgs	Below ground surface
CAAA	Crane Army Ammunition Activity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COPC	Chemical of potential concern
CSM	Conceptual Site Model
CTO	Contract Task Order
DAF	Dilution-attenuation factor
DERP	Defense Environmental Restoration Program
DI	Deionized
DMM	Discarded Military Munitions
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
EEQ	Ecological effects quotient
EOD	Explosive Ordnance Disposal
EPC	Exposure Point Concentration
ESS	Explosives Safety Submission
FBL	fixed-base laboratory
FOL	Field Operations Leader
FS	Feasibility Study
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HI	Hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient

IDEM	Indiana Department of Environmental Management
IDW	Investigation-derived waste
ILCR	Incremental lifetime cancer risk
ITRC	Interstate Technology and Regulatory Council
IUPPS	Indiana Underground Plant Protection Service
LCS	Laboratory Control Sample
MC	Munitions Constituents
MDL	Method detection limit
MEC	Munitions and Explosives of Concern
mg/kg	milligram per kilogram
MRA/S	Munitions Response Area or Munitions Response Site
MMRP	Military Munitions Response Program
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	Mean sea level
NAD 83	North American Datum of 1983
NAVFAC	Naval Facilities Engineering Command
NFA	No Further Action
NFESC	Naval Facilities Engineering Service Center
NG	Nitroglycerin
NIST	National Institute of Standards and Technology
NOSSA	Naval Ordnance Safety and Security Activity
NSA	Naval Support Activity
NSWC	Naval Surface Warfare Center
PA	Preliminary Assessment
PAH	Polycyclic aromatic hydrocarbon
PAL	Project Action Limit
PPE	Personal Protective Equipment
PQLG	Project Quantitation Limit Goals
PVC	polyvinyl chloride
QA	Quality Assurance
QC	Quality Control
RBSL	Risk-based Screening Levels
RCRA	Resource Conservation and Recovery Act
RDX	cyclo-1,3,5-trimethylene-2,4,6-trinitramine
RI	Remedial Investigation

RPD	Relative Percent Difference
SAR	Small Arms Range
SI	Site Inspection
SOP	Standard Operating Procedure
SSL	Soil Screening Level
TEF	Toxicity equivalency factor
Tetra Tech	Tetra Tech, Inc.
TNT	2,4,6-trinitrotoluene
UFP-SAP	Unified Federal Policy-Sampling and Analysis Plan
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
UXO	Unexploded Ordnance
WAMS	Water Area Munitions Study
WRS	Wilcoxon Rank Sum
XRF	X-ray fluorescence

EXECUTIVE SUMMARY

INTRODUCTION

This Site Inspection (SI) Report for eight Munitions Response Areas or Munitions Response Sites (MRA/Ss) located at Naval Support Activity (NSA) Crane, Crane, Indiana was prepared by Tetra Tech, Inc. (Tetra Tech) for Naval Facilities Engineering Command (NAVFAC) Midwest under the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62472-03-D-0057, Contract Task Order (CTO) F272. This report presents the results of the SI conducted at five of the eight separate MRP sites and/or Areas of Concern (AOCs) of NSA Crane. Figure ES-1 presents a facility location map and Figure ES-2 depicts the location of the eight initially proposed MRP sites to be addressed under this project.

A Preliminary Assessment (PA) Report was completed in 2005 for land-based Munitions Response Program (MRP) sites at NSA Crane by Malcolm Pirnie, Inc. (Malcolm Pirnie, 2005a). That PA Report included three MRP sites requiring further investigation at NSA Crane and those three MRP sites are the Building (B)-143 Drop Test Area - AOC 01; Pyro Area Outside Test Burn Pads - AOC 02; and Test Pads on the Hill Behind B-198 - Unexploded Ordnance (UXO) 06. Munitions-related sites located in water were not addressed under the Navy MRP, so Water Area Munitions Studies (WAMS) were prepared in a format similar to a PA to clearly document the history of these water-based areas in a standard format. A series of WAMS was completed for the water-based sites at NSA Crane and included Lake Oberlin - AOC 04 (Malcolm Pirnie, 2005b); Conservation Dam No. 2845 - UXO 01 (Malcolm Pirnie, 2005c); Dugger Lake Facility - AOC 03 (Malcolm Pirnie, 2005d); and Lake Greenwood Pyro Test Area Near Dam - UXO 03 (Malcolm Pirnie, 2005e). During the planning phase for this SI, the Project Team identified a general similarity in the pyrotechnic (Navy dyes used in water markers and signal smoke) items tested at the four water-based MRP sites at NSA Crane. The Project Team decided to use Lake Oberlin as a test case for evaluating potential Navy dye contamination in test area lake sediment. Lake Oberlin was one of the earliest water areas at NSA Crane and was used for signal and dye testing. Lake Oberlin is small and relatively shallow, so any test residues would tend to be concentrated in the sediments in Lake Oberlin. Since the conceptual site models (CSMs) are similar at the other water test sites and the documented testing activities are similar, no environmental samples were planned for collection at UXO 01, AOC 03, or UXO 03. The results, conclusions, and recommendations for Lake Oberlin in this SI will be similarly applied to these other water testing sites.

A series of historical design drawings, aerial photographs, and environmental reports from the late 1960s to mid-1970s was discovered at NSA Crane. This documentation identified the presence of multiple small arms ranges (SARs) on NSA Crane property that had been used for instructional target training and recreational target shooting for installation and civilian personnel. The range complex included a 500-yard rifle range, a 60-yard pistol range, and shotgun ranges with both trap range and skeet range configurations. Although a PA report had not been prepared to evaluate this MRP site, NAVFAC-Midwest added the West Gate Small Arms Range Complex - AOC 06 to the scope of this SI through a project concurrence letter.

OBJECTIVE

The primary objective of this SI was to determine whether further response actions or remedial investigations (RIs) are appropriate for some of the sites identified in the PA Report, the WAMS Reports, and the recovered historical maps, photographs, and documents regarding the West Gate Small Arms Range Complex, and evaluate the need to restore those sites to an acceptable environmental condition. The SI was based on background information provided in the PA, the WAMS, relevant historical documents, as well as decisions made by the Project Planning Team, which are documented in Worksheet #9 of the UFP-SAP (Tetra Tech, 2009). Supplemental site-specific environmental data are collected during the SI to further characterize the presence/absence of suspected munitions constituents (MC) at these MRP sites and to attempt to delineate the nature and extent of potential MC that may be still be present in soil or lake sediment, based on the SI sampling program.

BACKGROUND AND PHYSICAL SETTING

NSA Crane began operations in 1941 as the Naval Ammunition Depot. Since its inception, NSA Crane has been under four different commands. In 1975, the installation name changed to Naval Weapons Support Center Crane to reflect its true function of weapons support. The Crane Army Ammunition Activity (CAAA) was established in 1977 to conduct loading, assembly, and storage of ammunition at the installation. After merging with the Naval Ordnance Station at Louisville, Kentucky, in 1992, the installation received the name Crane Division, Naval Surface Warfare Center (NSWC). The facility was recently designated NSA Crane and continues to be a recognized leader in highly technical product lines servicing the Navy.

NSA Crane covers nearly 63,000 acres and is in a rural area approximately 37 miles southwest of Bloomington, Indiana, and approximately 70 miles southwest of Indianapolis, Indiana (Figure ES-1). Surrounding towns include Crane Village to the northwest, Burns City to the west, and Bedford to the

east. An 800-acre lake, Lake Greenwood, is located in the north-central portion of the base and serves as the primary water supply for the base (Figure ES-2). Access to NSA Crane is restricted, and the property is surrounded by locked secured gates, with security and a security patrol at all entrances.

The five MRP sites investigated during the SI at NSA Crane are summarized below and in Table ES-1.

Building (B)-143 Drop Test Area – AOC 01

The B-143 Drop Test Area is located in the west-central portion of NSA Crane (Figure ES-2), and encompasses approximately 0.06 acres. The B-143 Drop Test Area sits in a slight depression located at the top of a ridge that slopes to the southeast. The study area was limited to the former concrete drop pad impact area below the top of the drop tower.

The B-143 Drop Test Area was used for testing inert Mk 118 Mod. 0, Rockeye bomblets or submunitions. The quantities of munitions tested at the site are unknown. The munitions used and/or stored at the facility were inert Mk 118 Mod. 0, Rockeye submunitions and the associated chemical constituent in the fuze was lead azide. The munitions items dropped from the tower did not contain high-explosive fillers (Composition B or Octol); therefore, focused sampling on lead from the submunition fuzes would verify the presence/absence of an MC release.

MC contamination was not expected to be present at this site and it was assumed that during the demolition of the former structures at the site (tower, concrete pad, observation building) that some portion of the native soil may have been removed. Therefore, a narrowly focused confirmation sampling plan was proposed to investigate and confirm the presence/absence of lead contamination at the former drop tower and concrete pad.

Eighteen soil samples were collected from the B-143 Drop Test Area. All 18 samples were analyzed for the presence of lead in the field via X-ray fluorescence (XRF). Eight samples were subsequently shipped to the fixed-base laboratory (FBL) for lead analysis with the results compared to human health and ecological screening levels, and applicable background concentrations from the Base-wide Background Soil Investigation Report for NSWC Crane (Tetra Tech, 2001).

The SI results show that lead at this site is not present at concentrations that would cause potential risks to human or ecological receptors. There were a few discrete soil samples with lead concentrations above the applicable Project Action Limit (PAL) background concentration as established in the Basewide Background Soil Investigation Report for the NSWC Crane (Tetra Tech, 2001). However, these

concentrations were eliminated as risks to human receptors because they were all well less than the human health screening level. Additionally, these concentrations were eliminated as ecological risks based on comparisons to screening levels, magnitude and frequency of detections greater than screening levels, and site-use factors.

The maximum detected concentration of lead in soil exceeded the Indiana Department of Environmental Management (IDEM) migration from soil to groundwater value in 1 of the 8 soil samples. This indicates that there is not a large source area of lead contamination at the B-143 Drop Test Area; therefore, concentrations of lead in soil are not expected to adversely impact groundwater. Groundwater from the B-143 Drop Test Area is not used as a source of drinking water.

Based on the SI results, no further action (NFA) at the B-143 Drop Test Area is recommended.

Pyro Area Outside Test Burn Pad – AOC 02

The Pyro Area Outside Test Burn Pads is located in the north-central portion of NSA Crane in the Pyrotechnics Productions Area (Figure ES-2). This area covers approximately 0.002 acres of installation property.

According to installation personnel, the concrete testing basins were used for testing various pyrotechnics devices that were being developed at NSA Crane. The Pyro Area Outside Test Burn Pads consists of two square concrete basins (approximately 6-feet by 6-feet and approximately 30 feet apart), and were reported to have been used from at least 1984 to 1985 to test various types of pyrotechnics that were developed at NSA Crane, such as flares, signals, and screening smokes (Malcolm Pirnie, 2005a). However, historical aerial photographs and historical installation maps indicate that these structures may have been in use as early as the 1950s. The depth of each basin was approximately 4 to 5 feet, with 2 to 3 feet extending bgs. The bottom of each basin appeared to be intact (concrete) and was covered with 3 to 4-inches of residue. The walls of the basins, which extend approximately 2 to 3 feet above the ground surface, are in a poor deteriorating condition.

Two composite samples were collected from the residual material within each of the concrete basins, eight discrete subsurface samples were collected around the sides of each basin, and two discrete samples were collected approximately 30 feet downslope of each basin. All soil samples at the Pyro Area Outside Test Burn Pads were analyzed for explosives, Navy dye compounds, and perchlorate.

The available data indicates there is not a significant source area of explosives in soil at the Pyro Area Outside Test Burn Pads. Explosives in the soil outside the concrete basins are not present at concentrations greater than human health or ecological screening levels. A single detected concentration of cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX), collected from the subsurface soil outside the concrete basin was below the PAL and is not expected to adversely impact groundwater at the site.

Based on the SI results, the concrete basins appear to have intact solid concrete bottoms; therefore, the residual materials within the basins would not have any impact on the area outside of the basins. Because the AOC 02 basins are no longer in use and the condition of the concrete is continuing to degrade with time, as a best management practice, the concrete basins should be scheduled for demolition and removed from the site in the near future. The recommendation for basin is that prior to demolition, the concrete rubble discarded in the basins should be removed and the residual materials contained in the bottom of the concrete basins should be removed for proper disposal.

No dyes were detected in the soil samples collected adjacent to the concrete basins; however, one downslope soil sample contained a detectable level of a single dye compound (Solvent Green 3). There were estimated detections of Solvent Green 3 and Solvent Yellow 3 in the basin residues samples during the SI. The indication from a single estimated detection of one Navy dye compound present in a downhill soil sample collected at AOC 02 is that there is no significant widespread contamination of local soils by Navy dye compoundsand it does not warrant significant follow-on sampling to further characterize this area.

Sampling during the SI demonstrated that AOC 02 indicated insignificant contamination from the historical pyrotechnic testing and burning operations performed at the site. Following the removal of the concrete basins, the basin contents, and completion of standard site restoration activities (e.g., bring subgrade areas up to ground level with clean fill), NFA is proposed for AOC 02.

Test Pads On Hill Behind B-198 – UXO 06

The Test Pads on Hill Behind B-198 are situated in the middle of a cleared woodland area covered with various types of wild grasses and other vegetation in the west-central portion of NSA Crane (Figure ES-2). The Test Pads on Hill Behind B-198 cover approximately 0.6 acres and were used from at least 1983 through 1985 (Malcolm Pirnie, 2005a) for the development and testing of safe disposal methods for various types of dyes. The PA Report identified aerial photographs from 1952 and 1966 that indicated a visible tree-cleared area on the hill behind B-198. However, the tree-cleared area was actually adjacent to the UXO 06 site identified in the PA Report. The UXO 06 site contained tree

vegetation and it did not appear to be active at that time. No installation records or site personnel with knowledge of site operations from that period were able to corroborate the use of the adjacent tree-cleared site for pyrotechnic testing during the 1950s through the 1970s. An aerial photograph dated September 1974 shows the UXO 06 test site was cleared of trees and indicates that area had been modified to support the construction of the test pads in support of the pyrotechnic items testing by the Navy. A recovered document describing a pyrotechnic test procedure dated April 1983 confirms UXO 06 MRP was actively used for pyrotechnic testing in 1983, therefore, it is likely that the pyrotechnic testing at UXO 06 was conducted from the at least the mid-1970s though the mid-1980s. The recovered test procedures indicate that NSA Crane personnel developed and tested an item constructed of a 2.75-inch warhead (colored target markers), and that an M18 Smoke Hand Grenade was also simultaneously tested at UXO 06. The site consisted of two circular sand covered test pads (approximately 21-feet by 21-feet), a polyvinyl chloride (PVC) drainage pipe, and an above ground concrete holding tank.

The site's circular sand test pads, constructed from non-native sand with a reported thickness of approximately 6 inches, were used to test safe disposal methods for various types of dyes. The sand provided a barrier to prevent surface soil penetration of explosives and dyes. A plastic liner and a series of flexible slotted plastic drain pipes were placed beneath the sand pads to intercept infiltrating rainwater and liquids. A concrete holding tank located east of the pads at a lower elevation was used for potential contamination containment.

Four composite surface soil samples were collected from the residual material within the two circular sand test pads. Each composite sample was comprised of five grab samples. Six individual grab samples were collected in the area of the aboveground concrete holding tank. Four of these soil samples were collected around the PVC drainage pipe (two on either side) of the last 10 feet of the pipe before it entered the tank. One soil sample was collected from the saturated material within the concrete holding tank and one sample was collected just downslope of the aboveground concrete holding tank.

Two composite soil samples were collected from the sand mound located northeast of the sand test pads. Each composite sample was comprised of five individual grab samples and to ensure the samples represented all the material within the sand mound, the samples were collected from various depths ranging from 2 feet down to approximately 6 feet. All soil samples at the Test Pads on Hill Behind B-198 were analyzed for explosives and Navy dye compounds.

The Navy dye compound, Solvent Yellow 33, and explosives; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), nitrobenzene, and RDX were the only chemicals detected in the soil samples. The detected concentrations of all chemicals were below the United States Environmental Protection Agency

(USEPA) and IDEM human health direct contact screening criteria; therefore, no chemicals were retained as a direct contact chemical of potential concern (COPC) for soil at the site.

Concentrations of nitrobenzene and RDX exceeded the screening criteria for protection of migration from soil to groundwater; therefore, these chemicals were retained as COPCs.

Solvent Yellow 33 was retained as a COPC for risks to terrestrial plants and invertebrates because an ecological screening level is not available for this dye compound. HMX and RDX were retained as COPCs for risks to mammals and birds because an ecological screening level is not available for these components.

Because there is no available HMX screening value for mammals, risk could not be further evaluated and HMX was retained as an ecological COPC for mammals.

RDX was detected in five of the 12 samples and because there is no available mammal or bird screening value, it was retained as a COPC.

Although no chemicals were retained as human health direct contact COPCs, RDX was retained as a COPC for migration of soil to groundwater. Nitrobenzene, RDX, HMX, and Solvent Yellow 33 were also retained as ecological COPCs. However, the limited low-level estimated detections of residual explosives and a single estimated detection of a Navy dye compound (Solvent Yellow 33) in surface soil samples within or adjacent to the test pads indicate ~~that there is~~ no significant contamination present in the soil at UXO 06. Furthermore, given the relatively small size of the former test pads and adjacent areas and the significantly larger size of the surrounding habitat, it is likely that the limited MC detected at the site pose no significant impact to potential human or ecological receptors. Therefore, UXO 06 is recommended for NFA.

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Lake Oberlin – AOC 04

Lake Oberlin is located in the northwest corner of NSA Crane north of the intersection of Highway 5 and Highway 449 (Figure ES-2). Lake Oberlin covers an estimated 3.0 acres and is approximately 1,000 feet west of Lake Greenwood, the largest water body at NSA Crane. At its deepest point, the lake is approximately 15 feet deep. Lake Oberlin was formed when NSA Crane constructed a 50-meter long

earthen dam (Structure No. 1948) across the unnamed tributary that empties into Furst Creek approximately 1,600 feet south of the lake. The lake is primarily surrounded by woodland.

Historical information concerning Lake Oberlin is limited. The exact dates of use are unknown; however, it is estimated that the site was used in the mid-to-late 1950s. Lake Oberlin was used for testing unknown quantities of submarine flotation flares, surface illumination flares for overboard persons, and fluorescent dye markers. The flares were fired from a signaling pistol and fluorescent dye was released onto the water to identify a person's location. The flare firing point was on the earthen dam and the impact area was the lake water. The fluorescent dye was tested at night so it would be visible during the "man-overboard" training. It is assumed that the dye slicks were observed from the edge of the lake because site personnel did not mention the use of boats or aircraft during interviews.

The float signals tested in Lake Oberlin included the Mk2, Mod. 2 Submarine Float Signal and the Mk2, Marine Illumination Signal. These devices were floated on the water and activated to test signal visibility. The Mk2, Submarine Float Signals were pyrotechnic smoke devices consisting of a cylindrical aluminum tube (3 inches in diameter and 18.6 inches long) equipped with a percussion fuze. Depending on the specific dye formulation for the smoke filler, they had the capability of producing red, black, green, or yellow smoke on the water surface. The Mk2, Marine Illumination Signal, which resembled a 10-gage shotgun shell, was fired from the dam structure by a handheld Mk5 pyrotechnic pistol. After firing, the signal cartridge was propelled from the pistol and a star composition (typically a red, green, or white pyrotechnic signal) burned for a period of about 6 seconds at an altitude of about 200 feet above the launch point.

Four composite sediment samples were collected at a depth of 0 to 6-inches below the water/sediment interface within the southern half of Lake Oberlin and were consistent with the operational area identified in the WAMS (Malcolm Pirnie, 2005b) and the presumed exposure scenarios for potential human or ecological receptors to the lake sediments. Each composite sample was comprised of five discrete sediment samples. The sediment samples collected from Lake Oberlin were analyzed for Navy dye compounds. The receiving basin for Lake Oberlin features mature forests. There has been very little development in this forested area other than the placement of unpaved roads to access the site because the area is used by the Boy Scouts for camping, boating, fishing, and other outdoor recreational activities. Based on the minimal site development and the lack of significant environmental disturbances in the Lake Oberlin drainage basin, it was presumed that annual sedimentation rates would be low in Lake Oberlin.

Navy dye compounds were not detected in the sediment samples collected from Lake Oberlin. Additionally, Lake Oberlin was proposed for use as a representative test site to evaluate the potential

significance of Navy dye compounds to be present in the sediments at three other MRP water test sites used by NSA Crane. Due to the general similarity of the pyrotechnic (dye and signal smoke) items tested in the four water-based MRP sites at NSA Crane, the Project Team decided to use Lake Oberlin as a test case for evaluating potential Navy dye contamination in sediment because it was one of the earliest water areas at NSA Crane used for signal and dye testing and it is small and relatively shallow. Any test residues would tend to be concentrated in the sediments in Lake Oberlin. The documented pyrotechnic testing activities are similar for these water test sites and the general CSMs for these water testing sites are also very similar.

In accordance with the technical planning discussions held with the project planning team, the general results, conclusions, and recommendations developed for Lake Oberlin (AOC 04) based on the environmental data compiled during this SI are to be similarly applied to the other three water testing sites identified in the original scope of work. In accordance with that site management rationale, the sediment (0- to 6-inches below the water/sediment interface) present in the Conservation Dam No. 2845 (UXO 01), former Dugger Lake Facility (AOC 03) and Lake Greenwood Pyro Test Areas (UXO 03) are considered to be free of MC contamination that poses an unacceptable risk to human health or the environment based on the SI conclusions for Lake Oberlin.

Based on the results of the SI, NFA is recommended for Lake Oberlin, and by agreement, this finding also applies to Conservation Dam No. 2845, former Dugger Lake Facility, and Lake Greenwood Pyro Test Areas.

West Gate Small Arms Range Complex – AOC 06

The West Gate Small Arms Range Complex is located south of Highway 5, outside of the western gate of NSA Crane on Navy property (Figure ES-2). This area is currently not being used by NSA Crane. There are no access controls or restrictions in place to limit access to this area. The West Gate Small Arms Range Complex site consists of 4 ranges: 500-yard Rifle Range, 60-yard Pistol Range, Skeet Range, and Trap Range, and covers approximately 34 acres. Because of the overlapping and approximately contiguous site boundaries of these small arms range (SAR) areas, they were combined into one MRP site for this SI.

The West Gate Small Arms Range Complex was used as a recreational small arms range. Based on the information obtained during the data collection process, the West Gate Small Arms Range Complex is believed to have been used exclusively for small arms (rifles, pistols, and shotgun) safety training, target practice, and competition shooting events. The ammunition used at the facility likely included shotgun

ammunition (10-, 12-, 16-, 20-, 28-gauge) and small arms ammunition (.22-, .30-, .45-, .50-caliber and 9-millimeter).

One hundred seventy soil samples (159 discrete and 11 composite) were collected within the West Gate Small Arms Range Complex. All soil samples underwent screening in the field for lead utilizing XRF technology.

Forty discrete samples were submitted to a FBL and analyzed for specific ammunition-related metals (antimony, arsenic, copper, lead, and zinc). Twenty discrete samples were submitted to a FBL and analyzed for polycyclic aromatic hydrocarbons (PAHs); 11 composite samples were submitted to the FBL and analyzed for propellants and explosive compounds. The results of the field XRF lead screening were the basis for determining which samples were shipped to a FBL for select metals analysis. Samples selected for FBL analysis were chosen from samples representing good coverage of the range complex, with the majority of samples having XRF lead concentrations in the range of 250 to 550 mg/kg.

The twenty soil samples shipped to a FBL for PAH analyses were selected from the areas where clay target fallout was expected to occur. Eleven composite soil samples were collected from range firing point areas and these samples were shipped to a FBL for analysis of propellants and explosive compounds.

The PAL for copper, which is 28 mg/kg is based on the ecological soil screening level, was exceeded at three locations (A6SB057 (57.6 “J” mg/kg), A6SB132 (28.8 mg/kg), and A6SB0170 (121 mg/kg)). There were no exceedances of the human health risk screening value (3,100 mg/kg IDEM direct contact in residential soil); therefore, copper concentrations in the soil at the West Gate Small Arms Range were not further evaluated.

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In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the West Gate Small Arms Range Complex. Soil samples were analyzed for PAHs, propellants, explosives, and small arms ammunition-related metals. Lead was initially selected as a COPC; however, the arithmetic mean lead concentration for soil is 130 mg/kg, which is less than the residential COPC selection criterion for lead (400 mg/kg). The USEPA pharmaco-kinetic models used to evaluate concentrations of lead in the environment recommend using the arithmetic mean lead concentration as the lead Exposure Point Concentration (EPC); therefore, lead concentrations in the soil at the West Gate Small Arms Range were not further evaluated in the human health risk screening evaluation.

Arsenic concentrations were within base-wide background levels. The BaP equivalents (from PAH compounds) were exceeded at only one location which was within 75 feet southeast of the trap house, where clay target accumulations are expected. The explosives compounds: HMX, RDX, and 1-Amino, 4,6-Dinitrotoluene, were detected at three locations at either "J" qualified (estimated) values or below the PAL limits; thus, eliminating them as COPCs.

During the XRF field screening operations, two specific areas with elevated lead in soil were identified on the 200-yard firing line/range target on the 500-yard rifle range, and two pistol range bullet stop soil samples were also characterized as having elevated lead concentrations. FBL lead analyses for a limited subset of these soil samples indicated that while multiple soil lead concentrations were present in concentrations greater than the project limit background (27 mg/kg), only soil two samples collected from the hillside behind the pistol range target contained detected concentrations of lead in excess of the human health criteria (400 mg/kg). Several soil samples analyzed for PAHs in locations where skeet fragments were expected and observed to be present contained detectable levels of PAHs from pitch tars used to bind the clay targets. However, calculated benzo(a)pyrene toxicity equivalency factors for those samples were below levels of concern, so the PAH concentrations are not a primary concern for exposures.

When the SI analytical data for AOC 06 are reviewed on a site-wide basis, there is no significant widespread contamination present in surface soil caused by small arms activities at the ranges. There were limited elevated detections of specific constituents in soil samples detected during the SI and the locations for the elevated concentrations were generally consistent with the CSM developed for the site. Areas expected to show accumulations of lead and PAHs from small arms training and competitive events on the ranges were correctly identified in the SAP and confirmed in the field during the SI.

AOC 06 soil samples rarely exceeded project screening criteria for lead. Two soil samples (A6SS056002 and A6SS1700002) collected from the hillside behind the pistol range target contained elevated lead concentrations above the residential COPC selection criteria for lead (400 mg/kg). The arithmetic mean lead concentration for soil is 130 mg/kg, which is less than half of the residential COPC selection criteria for lead (400 mg/kg). The very limited nature of only two discrete lead concentrations above the COPC selection criteria concentration, with the mean lead concentration for the site at less than half of the human health criteria for lead does not appear to warrant significant follow-on activities or a need for additional focused sampling to further characterize AOC 06 soil areas. Consequently, there are no significant exposure risks to SAR MC in the surface soils at the West Gate Small Arms Range Complex (AOC 06) and this site is recommended for NFA.

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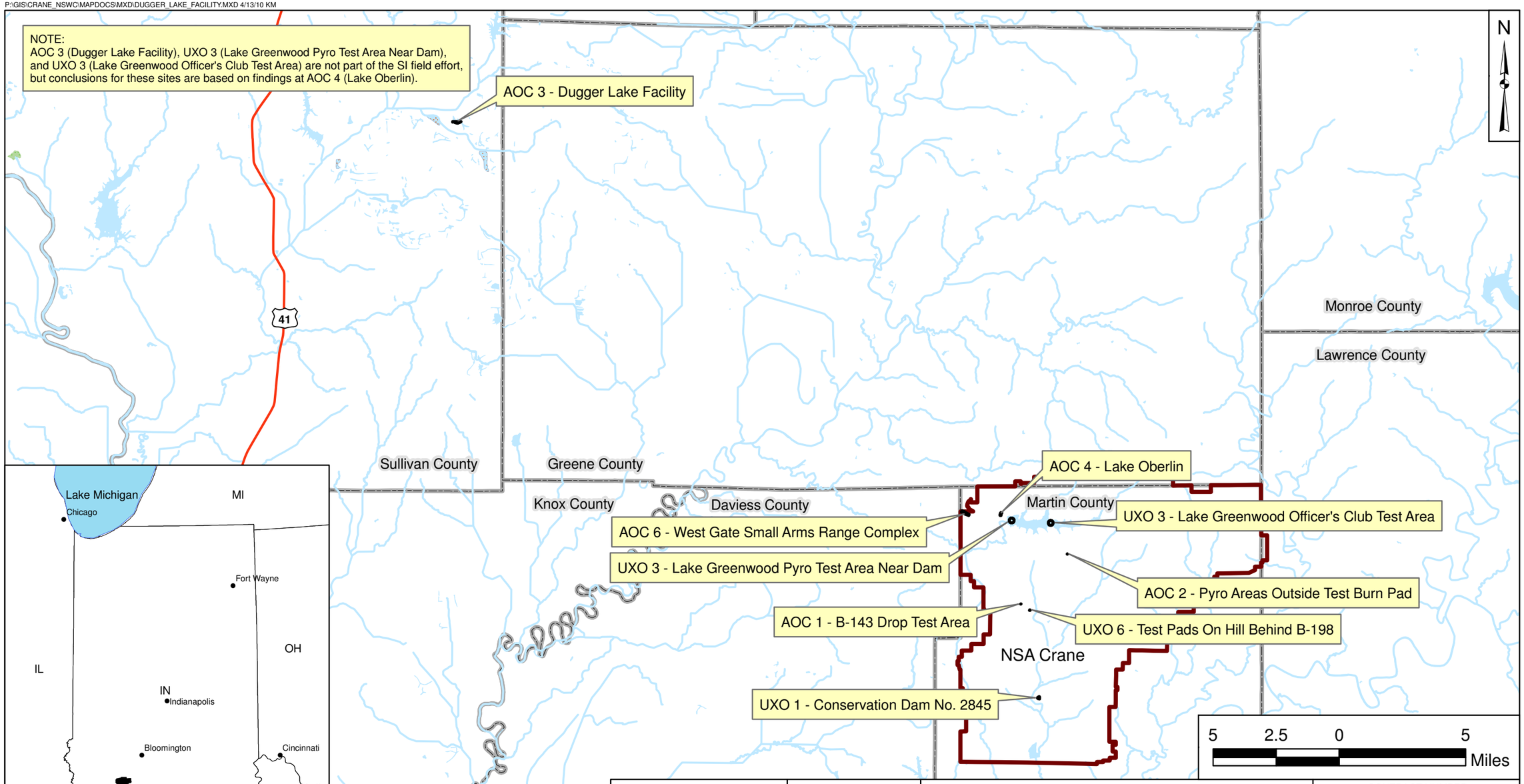

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NAVFAC

GENERAL LOCATION MAP
MRP SI SITES
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
APPROVED BY	DATE
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FIGURE NO.	REV
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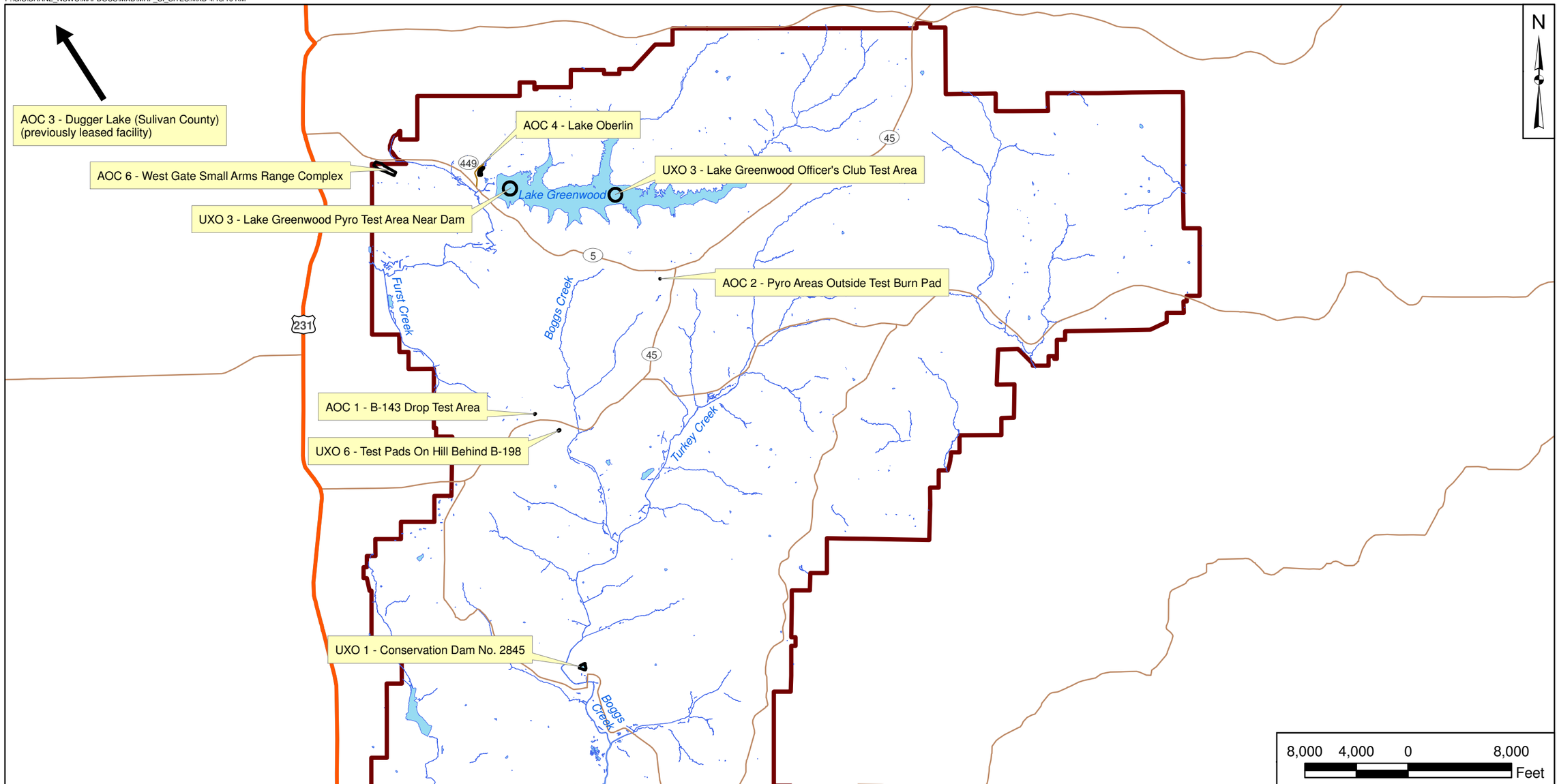

NOTE:
AOC 3 (Dugger Lake Facility), UXO 3 (Lake Greenwood Pyro Test Area Near Dam), and UXO 3 (Lake Greenwood Officer's Club Test Area) are not part of the SI field effort, but conclusions for these sites are based on findings at AOC 4 (Lake Oberlin).

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MRP SI SITE LOCATIONS
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
APPROVED BY	DATE
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1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

This Site Inspection (SI) Report for eight Munitions Response Areas or Munitions Response Sites (MRA/Ss) located at Naval Support Activity (NSA) Crane, Crane, Indiana was prepared by Tetra Tech, Inc. (Tetra Tech) for Naval Facilities Engineering Command (NAVFAC) Midwest under the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62472-03-D-0057, Contract Task Order (CTO) F272.

The Department of Defense (DoD) has established a program to address non-operational (closed, transferring, and transferred) military munitions ranges known as the Military Munitions Response Program (MMRP). Under this program, DoD follows the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process, which is similar to the Resource Conservation and Recovery Act (RCRA) corrective action process. Similar to the CERCLA process, an initial Preliminary Assessment (PA) is prepared to compile historical records and information on the subject range or testing area and determine the presence or potential presence of Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC) at concentrations that may pose a hazard to human health or the environment.

A PA Report was completed in 2005 for land-based Munitions Response Program (MRP) sites at NSA Crane by Malcolm Pirnie, Inc. (Malcolm Pirnie, 2005a). That PA report included three MRP sites requiring further investigation at NSA Crane and those three MRP sites are the Building (B)-143 Drop Test Area - Area of Concern (AOC) 01; Pyro Area Outside Test Burn Pads - AOC 02; and Test Pads on the Hill Behind B-198 - Unexploded Ordnance (UXO) 06. Those three MRP sites are addressed in this SI (the next phase of the CERCLA/MRP process) and are summarized on Table 1-1.

In 2005, by definition, munitions-related sites located in water were not addressed under the Navy MRP, so Water Area Munitions Studies (WAMS) were prepared in a format similar to a PA to clearly document the history of these water-based areas in a standard format. A series of WAMS was completed for the water-based sites at NSA Crane and included Lake Oberlin - AOC 04 (Malcolm Pirnie, 2005b); Conservation Dam No. 2845 - UXO 01 (Malcolm Pirnie, 2005c); Dugger Lake Facility - AOC 03 (Malcolm Pirnie, 2005d) ; and Lake Greenwood Pyro Test Area Near Dam - UXO 03 (Malcolm Pirnie, 2005e), as summarized on Table 1-1. During the planning phase for this SI, the Project Team identified a general similarity in the pyrotechnic (Navy dyes used in water markers and signal smoke) items tested at the four

water-based MRP sites at NSA Crane. The Project Team decided to use Lake Oberlin, as a test case for evaluating potential Navy dye contamination in test area lake sediment. Lake Oberlin was one of the earliest water areas at NSA Crane and was used for signal and dye testing. Lake Oberlin is smaller and relatively shallow, so any test residues would tend to be concentrated in the sediments in Lake Oberlin. Since the conceptual site models (CSMs) are similar at the other water test sites and the documented testing activities are similar, no environmental samples were planned for collection at UXO 01, AOC 03, or UXO 03. The results, conclusions, and recommendations for Lake Oberlin in this SI will be similarly applied to these other water testing sites.

In March 2009, a series of historical design drawings, aerial photographs, and environmental reports from the late 1960s to mid-1970s was discovered at NSA Crane. This documentation identified the presence of multiple small arms ranges (SARs) on NSA Crane property that had been used for instructional target training and recreational target shooting for installation and civilian personnel (see Table 1-1). The range complex included a 500-yard rifle range, a 60-yard pistol range, and shotgun ranges with both trap range and skeet range configurations. Although a PA report had not been prepared to evaluate this MRP site, NAVFAC-Midwest added the West Gate Small Arms Range Complex - AOC 06 to the scope of this SI through a project concurrence letter.

The site-specific and technical information presented in the relevant PA report and WAMS reports (noted above), along with supplemental documentation recovered on the West Gate Small Arms Range Complex were collectively used to develop the SI field program. This SI Report presents the results of the data collected during the SI field program to determine the presence of MC at concentrations that may pose a hazard to human health or the environment in accordance with the Unified Federal Policy–Sampling and Analysis Plan (UFP-SAP) prepared for this project by Tetra Tech (Tetra Tech, 2009), and as required under the Navy MMRP policy.

1.2 SCOPE OF WORK

The SI field program for the five MRP sites included collection of soil and sediment samples to identify chemicals of potential concern (COPCs) (e.g., MCs) that may exist as a result of past testing or training operations at the sites. If contaminants were detected at concentrations exceeding Project Action Limits (PALs), then further investigation may be warranted. The program was designed to evaluate the general nature and extent of potential MC contamination.

SI field activities at the five MRP sites included the following:

B-143 Drop Test Area – AOC 01:

- Collection of discrete surface soil samples [0 to 2 feet below ground surface (bgs)].
- Field analysis for lead utilizing an x-ray fluorescence (XRF) analyzer.
- Selection of a representative number of samples for shipment to a fixed-base laboratory (FBL) for lead analysis.

Pyro Area Outside Test Burn Pads – AOC 02:

- Collection of discrete surface soil samples (0 to 2 feet bgs) and discrete subsurface soil samples (4 to 6 feet bgs).
- Collection of composite soil samples in the concrete basins (0 to 1 feet bgs).
- FBL analysis for Navy dye compounds, perchlorate, and explosives.

Test Pads on Hill Behind B-198 – UXO 06:

- Collection of discrete surface soil samples (0 to 2 feet bgs).
- Collection of composite soil samples in the concrete basins of the former test pads (0 to 1 feet bgs).
- FBL analysis for Navy dye compounds and explosives.

Lake Oberlin – AOC 04:

- Collection of composite sediment samples (0 to 6-inches) at the water/sediment interface.
- FBL analysis for Navy dye compounds.

West Gate Small Arms Range Complex – AOC 06:

- Collection of discrete surface soil samples (0 to 2 feet bgs).
- Collection of composite soil samples along the firing lines (0 to 2 feet bgs).
- Field analysis for lead utilizing an XRF analyzer.
- FBL analysis for select metals, PAHs, and explosives.

1.3 OBJECTIVES

The objective of CTO F272 was to perform SIs for specific areas at the NSA Crane facility with respect to past MEC/MC usage at these MRAs/Ss. Five separate MRP sites are included in the scope field studies

for this SI. Figure ES-1 presents a NSA Crane facility location map and Figure ES-2 depicts the locations of the originally proposed eight MRP sites to be addressed under this project.

The main objective of the SI was to build on the information contained in the PA Report, the WAMS reports, and other relevant historical documentation by gathering site-specific field data to determine whether MCs [e.g., lead, polycyclic aromatic hydrocarbons (PAHs), explosives, propellants, perchlorate, and Navy dye compounds] that may have been released during previous site activities or operations (e.g., fuze testing, pyrotechnic device testing, or small arms target training) are present and potentially contributing to environmental impacts associated with the soil or lake sediment at the subject MRP sites. Based on this information, a determination is made whether further response actions or remedial investigations (RIs) are appropriate for any of the sites and evaluate the need to restore those sites to an acceptable environmental condition.

Other objectives were to use the collected data to refine the site-specific CSMs, to summarize the supplemental information, and to recommend future actions for the MRP sites.

1.4 REPORT ORGANIZATION

This SI Report consists of 9 sections: Section 1.0 is this introduction, which includes the purpose and scope and report organization; Section 2.0 describes the background and physical setting of NSA Crane, including initial SI site surveys; Section 3.0 describes the SI field work design and methodologies; Sections 4.0 through 8.0 discuss the SI of the five MRP sites individually including data results, updated CSMs, and conclusions and recommendations; and Section 9.0 includes the references. The appendices include the following:

- Appendix A – Field Forms
- Appendix B – Site Photos
- Appendix C – Validated Analytical Results
- Appendix D – Data Usability Assessments (including all background information)
- Appendix E – XRF/FBL Correlation Statistical Evaluations
- Appendix F – Human Health Related Information
- Appendix G – Ecological Risk Related Information

TABLE 1-1

SUMMARY OF MRP SITES
SITE INSPECTION REPORT
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Site Name	Site No.	Size (acres)	Historical Use	Dates of Use	Previous MRP Site Documentation
B-143 Drop Test Area	AOC 01	0.06	Testing of Mk 118, Mod 0 Rockeye bomblets	1968-1980	Final Preliminary Assessment, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005a)
Pyro Area Outside Test Burn Pad	AOC 02	0.002	Testing of pyrotechnics (flares, signals, smoke screens)	1984-1985	Final Preliminary Assessment, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005a)
Test Pads On Hill Behind Building 198	UXO 06	0.6	Development and testing of safe disposal methods for various types of dyes	1983-1985	Final Preliminary Assessment, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005a)
Lake Oberlin	AOC 04	3 (water depth of 15-feet)	Testing of submarine floatation flares, surface illumination flares, and fluorescent-dye man-overboard markers	Mid- to late-1950s	Final Water Area Munitions Study – Lake Oberlin, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005b)
Conservation Dam No. 2845	UXO 01	4.1 (water depth of 10-feet)	Limited testing of green and orange life vest floating-type dye markers	1970s	Final Water Area Munitions Study – Conservation Dam No. 2845, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005c)
Dugger Lake Facility	AOC 03	8.5 (water depth of 100-feet)	Testing of marine markers, cable cutters, swimmer recall devices, synchronous equipment clock, explosive capsulated devices and for hydro-acoustic testing	1975-1994	Final Water Area Munitions Study – Dugger Lake Facility, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005d)
Lake Greenwood Pyro Test Area Near Dam	UXO 03	800 (water depth of 35-feet)	Testing of marine markers and underwater illuminating flares	1954-1958	Final Water Area Munitions Study – Lake Greenwood Pyro Test Area Near Dam, Naval Surface Warfare Center, Crane Division, Indiana. (Malcolm Pirnie, 2005e)
West Gate Small Arms Range Complex	AOC 06	approx. 34	500-yard Rifle Range, 60-yard Pistol Range, Skeet Range and Trap Range	Approximately 1966 - 1975	Station Development Plan (1957), Aerial Photographs (1966/1974), Natural Resources Fish & Wildlife Conservation Program Report for Crane Ammunition Depot (1966) and Crane Depot Conservation Club/Gun Club Reports (1970-1975).

2.0 FACILITY BACKGROUND AND PHYSICAL SETTING

2.1 NSA CRANE BACKGROUND AND PHYSICAL SETTING

2.1.1 Regulatory Framework

The regulatory framework for managing Navy MRP sites is guided by federal, state, and local laws, as well as DoD and Navy regulations and guidance, and provides the necessary information for Navy-decision makers. The key legislation, policy, and guidance directing the program includes, but is not limited to, the following:

The Defense Environmental Restoration Program (DERP) established the MMRP in September 2001 to identify and respond to environmental and explosive safety hazards posed by UXO, discarded military munitions (DMM), and MC at closed, transferred, or transferring ranges. MMRP eligible sites include "other than operational" ranges where UXO, DMM, or MC are known or suspected and the release of these materials occurred prior to September 2002. This SI Report addresses eight MRP sites at NSA Crane, as described in Section 1.0, of this SI report.

The National Defense Authorization Act (fiscal year 2002) reinforced the DoD's 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to contain MEC and MC.

The 2001 DERP Management Guidance and the 2002 National Defense Authorization Act, described above, established the MRP. The DoD provides program guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, MEC and MC. The Navy baseline inventory of sites was completed in Fiscal Year 2002 and was used to establish the sites where PAs are needed to further evaluate the potential for MEC and MC. If the findings within the PA Report indicate further investigation of a site is warranted, the SI is initiated to collect site-specific environmental data to determine whether further response actions are necessary to address MC.

The primary goal of the MMRP SI is to collect an appropriate amount of data to ensure a decision for each site can be made regarding whether a RI/Feasibility Study (RI/FS) is required, whether a site requires an immediate response, or whether the site qualifies for no further action (NFA).

2.1.2 History

NSA Crane began operations in 1941 as the Naval Ammunition Depot. Since its inception, NSA Crane has been under four different commands. In 1975, the installation name changed to Naval Weapons Support Center Crane to reflect its true function of weapons support. The Crane Army Ammunition Activity (CAAA) was established in 1977 to conduct loading, assembly, and storage of ammunition at the installation. After merging with the Naval Ordnance Station at Louisville, Kentucky, in 1992, the installation received the name Crane Division, Naval Surface Warfare Center (NSWC). The facility was recently designated NSA Crane and continues to be a recognized leader in highly technical product lines servicing the Navy.

2.1.3 Location and Setting

NSA Crane covers nearly 64,000 acres and is in a rural area approximately 37 miles southwest of Bloomington, Indiana, and approximately 70 miles southwest of Indianapolis, Indiana (Figure ES-1). Surrounding towns include Crane Village to the northwest, Burns City to the west, and Bedford to the east. An 800-acre lake, Lake Greenwood, is located in the north-central portion of the base and serves as the primary water supply for the base (Figure ES-2). Access to NSA Crane is restricted, and the property is surrounded by locked secured gates, with security and a security patrol at all entrances.

2.1.4 Current Land Use and Anticipated Future Land Use

NSA Crane is the third largest U.S. Naval Installation in the world. The base includes over 3,000 buildings and covers more than 98 square miles (64,000 acres). NSA Crane employs approximately 3,400 naval employees and 550 army employees. The installation was originally built to prepare, load, renovate, receive, store, and issue ammunition, including pyrotechnics and illuminating projectiles, and to act as a principal source of supply at a most critical time - the early days of World War II; however, due to its expertise in engineering and electronics, NSA Crane today is a multi-mission, multi-service product center with both fleet support and industrial base missions.

No changes in the site's current land use designation are expected in the foreseeable future.

2.2 GENERAL FACILITY PHYSICAL/ENVIRONMENTAL CHARACTERISTICS

2.2.1 Climate

NSA Crane is located in a temperate climate zone with the following characteristics:

- January average minimum and maximum temperatures of 21 degrees Fahrenheit (ºF) and 38ºF, respectively, and average winter humidity range of 60 to 90 percent.

- July average minimum and maximum temperatures of 66ºF and 88ºF, respectively, and average summer humidity range of 40 to 90 percent.

- Average rainfall of 3.7 inches per month, 44.3 inches per year.

- Average wind speed of 8.2 miles per hour generally from the south-southwest.

2.2.2 Topography

NSA Crane is located on the western edge of a rugged, highly vegetated, formerly unglaciated but stream-dissected plateau known as the Crawford Uplands Physiographic Province. The overall terrain at NSA Crane is predominantly rolling with moderately incised stream valleys. Most of the region is covered by deciduous trees and shrubs and few topographically flat areas occur inside the NSA Crane installation perimeter. The elevations across NSA Crane range from about 500 feet above mean seal level (msl) to about 850 feet above msl.

2.2.3 Regional Geology

The sedimentary bedrock beneath NSA Crane dips gently to the west-southwest. The inclination of the strata reflects NSA Crane's location on the eastern flank of the Illinois Basin. This section of the basin is composed of Pennsylvanian and Mississippian strata consisting of shale, sandstone, limestone, and coal (Pennsylvanian) beds. The Pennsylvanian Mansfield Formation (Raccoon Creek Group) rests uncomformably on rocks of the late Mississippian Stephensport and West Baden Groups at the facility. Rocks of Lower Pennsylvanian and Upper Mississippian age underlie the region of Indiana in which NSA Crane is located. With the exception of minor outwash and lacustrine deposits in the northwestern corner of the facility, there are no Pleistocene glacial deposits covering the installation. Surface deposits at NSA Crane consist of Recent (Holocene) and Pleistocene unconsolidated alluvial silt, sand, and gravel and residual soils developed from the underlying rock.

2.2.4 Soil and Vegetation

According to the Soil Survey of Martin County, Indiana, published by the United States Department of Agriculture (USDA), Forest Service, in cooperation with the Indiana Department of Natural Resources,

Soil and Water Conservation Committee (1998), the primary soil types in the area of NSA Crane are various silt loams with a variety of slopes.

The surface soil at the MRP sites is derived from underlying sedimentary rock of the Lower Pennsylvanian Raccoon Creek Group and consists of residual soil and colluvium containing clay, silt, sand, and fragmented and partially weathered bedrock. The most appropriate background soil group as categorized in the Basewide Background Soil Investigation Report is Soil Group 3 - Alluvial, Mississippian, and Pennsylvanian Surface Soil. This background data set includes 15 surface samples that were analyzed for metals constituents (Tetra Tech, 2001).

2.2.5 Hydrology

NSA Crane is located within the Lower East Fork White River watershed, approximately 10 miles northwest of the East Fork White River, which flows approximately 40 miles further southwest before joining the Muscatatuck River, which eventually joins the Ohio River. The surface drainage has formed a dense dendritic pattern throughout the installation. Six creeks in four drainage basins convey surface water from the installation. Drainage from the basin in the extreme eastern part of the installation consists of several small drainages. The northern and northwestern drainage basins eventually empty into Furst Creek, which flows in a westerly direction and crosses the western installation boundary. Rainey Hollow, Sulphur Creek, and Little Sulphur Creek drain the eastern basin. The drainage basin occupying the central portion of the installation is where Boggs Creek and Turkey Creek receive drainage from the industrial area and that portion of the industrial production area located south of Highway 5. Boggs Creek and Furst Creek both eventually empty into Lake Gallimore at the southern boundary of NSA Crane.

2.2.6 Regional Hydrogeology

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

the bedrock or in the overburden. This condition dissipates by percolation into the bedrock and discharge to intermittent or perennial streams. The groundwater associated with the bedrock is stable and probably fluctuates only a minor amount in depth (less than 10 feet) per year. Possibly more than one zone of saturation exists in the bedrock due to the successive beds of sandstone, shale, and limestone.

2.3 REGIONAL ECOLOGY SUMMARY

2.3.1 Endangered and Threatened Species

About 49,000 acres of NSA Crane are forested, and the NSA Crane forest has been important to the re-establishment of deer, turkey, ruffed grouse, and eagles in Indiana. Wildlife research is conducted at NSA Crane by both Purdue University and Indiana University to observe species, number, and overall condition of the wildlife at NSA Crane. The timber at NSA Crane is managed, harvested, and sold, with proceeds going to the installation and associated counties.

Protected species that are known or have the potential to inhabit NSA Crane, according to the NSA Crane Natural Resources Guide information presented in the PA Report (Malcolm Pirnie, 2005a) are listed in Table 2-1. Currently, the only species on the federal endangered species list that has been identified at NSA Crane is the Indiana Bat. Any trees with exfoliating bark have the potential to harbor the Indiana Bat from April to September.

Ecological receptors could come into contact with contamination in soil at the B-143 Drop Test Area, the Test Pads on Hill Behind B-198, and the West Gate Small Arms Range Complex. These receptors, shown in Table 2-1, include wildlife such as deer, rabbits, raccoons, and wild turkeys. Ecological receptors at these three sites could also contact contaminants through the food chain when ingesting vegetation such as grass at the sites. Potential ecological receptors at Lake Oberlin are aquatic flora and fauna that may burrow, forage, or grow in the lake sediment. Fish from Lake Oberlin may be used as a food source by waterfowl. There are no ecological receptors that are expected to be exposed to possible contamination at Pyro Area Outside Test Burn Pads. MC at this site is expected to be contained within approximately 6-foot by 6-foot concrete basins which are currently filled with ash debris and concrete pieces; therefore, it is anticipated that wildlife would not have contact with MC at this site.

2.3.2 Wetlands

No wetlands are known to exist at the four land-based sites, AOC 01, AOC 02, AOC 06, or UXO 06 that are the subject of this SI Report.

2.3.3 Cultural and Archaeological Resources

On a national level, NSA Crane is considered historically significant as the primary ammunition depot for east coast Navy requirements. However, according to the Cultural Resources Survey completed in June 1992 (Northern Division Facilities Engineering Command, 1992), there are no historic resources on the installation, and no buildings or structures or historical or archaeological sites listed in local or state inventories, in the Indiana Register of Historic Sites and Structures (Indiana State Register), or National Register of Historic Places.

2.3.4 Water Resources

An 800-acre lake, Lake Greenwood, is located in the north-central portion of the base and serves as the primary water supply for the base. The facility utilizes surface water from Lake Greenwood for human consumption, process operations, and recreation. Groundwater is used to a limited extent for human consumption and process operations at a few outlying areas, Several soil and water conservation ponds are also present at NSA Crane.

TABLE 2-1

SUMMARY OF KNOWN OR POTENTIAL ECOLOGICAL RECEPTOR SPECIES
SITE INSPECTION REPORT
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Ecological Receptor	Species
Federal Endangered	• Indiana Bat (*Myotis sodalis*).
State Endangered	• Bobcat, osprey, yellow-crowned night heron, timber rattlesnake.
State Species of Special Concern	• Bald Eagle (*Haliaeetus leucocephalus*).
Other Ecological Receptors	• Approximately 20 species of amphibians including bullfrog, spotted salamander, and gray treefrog. • Over 100 species of birds including the wood duck, barn swallow, and marsh hawk. • Approximately 30 species of mammals including white-tailed deer, coyote, raccoon, cottontail rabbit, and wild turkey. • Over 45 species of fish including bluegill, crappie, largemouth bass, and channel catfish. • Approximately 20 species of reptiles including snapping turtle, northern copperhead, and eastern spiny softshell turtle. • Giant Canadian geese. • Ginseng. • Grouse. • Several types of edible mushrooms.

3.0 GENERAL METHODOLOGY

3.1 SITE INSPECTION APPROACH

This section describes the sampling design and methods and documentation utilized during the SI field activities performed at NSA Crane in September 2009 at the B-143 Drop Test Area, Pyro Area Outside Test Burn Pads, Test Pads on Hill Behind B-198, and Lake Oberlin, and in November 2009 at the West Gate Small Arms Range Complex. All SI field work was conducted in accordance with the procedures and methodologies described in the UFP-SAP (Tetra Tech, 2009), which was approved by the U.S. Navy and Indiana Department of Environmental Management (IDEM). The Standard Operating Procedures (SOPs) governing the field work are presented in Appendix B of the approved project-specific UFP-SAP (Tetra Tech, 2009). Sample log sheets, field documentation, site photographs, and other supporting information associated with the SI field investigation for this project are provided in Appendices A and B of this SI Report.

3.1.1 Site Preparation Activities

3.1.1.1 Mobilization/Demobilization

Following approval of the project-specific UFP-SAP, Tetra Tech personnel began initial mobilization activities in September 2009. The field team members reviewed the approved UFP-SAP, associated appendices, and Health and Safety Plan (HASP) prior to the start of project activities. In addition, the Field Operations Leader (FOL) held a field team orientation meeting to ensure that project personnel were familiar with the scope of the field activities.

Prior to collecting any samples at the sites, the FOL and UXO Technician arrived at NSA Crane and began on-site mobilization activities. Mobilization activities included the receipt of all field equipment directly from vendors. Each piece of equipment was checked upon receipt to verify that it was provided in proper working condition. Daily safety meetings were held each morning by the FOL to briefly address the day's planned activities. Upon completion of all SI activities, sample location pin flags were removed from the sites, work areas were thoroughly cleaned, trash was bagged and disposed in the trash dumpster outside the field office, the FOL shipped the equipment back to the third party vendor, and the field crew demobilized from the site. The five MRP sites are included in the Site Summary Table (Table 1-1).

3.1.1.2 Utility Clearance

One week prior to conducting any intrusive investigations, Tetra Tech contacted the Indiana Underground Plant Protection Services (IUPPS), to complete a utility clearance ticket for each of the five MRP sites.

3.1.1.3 Detector-Aided Non-Intrusive Anomaly Avoidance Activities

Because several of the MRP sites were used to test or otherwise demonstrate pyrotechnic devices, it was presumed that there was a slight potential to encounter MEC. Based on this presumption, an Explosives Safety Submission (ESS) Determination Request was submitted to Naval Ordnance Safety and Security Activity (NOSSA) indicating the likelihood of encountering MEC and/or MPPEH during the SI to be low. NOSSA determined that an ESS was not required for sampling activities at any of the MRP sites with the condition that a UXO Technician provides anomaly avoidance support at B-143 Drop Test Area, Pyro Area Outside Test Burn Pads, Test Pads on Hill Behind B-198, and Lake Oberlin. UXO anomaly avoidance procedures were performed in accordance with SOP-01, UXO Detector-Aided Surface Surveys, utilizing a Schoenstedt GA-52Cx magnetic locator. No MEC was detected during the SI at any of these four MRP sites. NOSSA determined that a UXO Technician was not required to support intrusive sampling work at the West Gate Small Arms Range Complex because no MEC were anticipated at that MRP site. The recovered information on the West Gate Small Arms Range Complex indicated it had been used exclusively for small arms training, practice, recreation, and competitive shooting events.

3.1.2 Field Investigation Methods

3.1.2.1 Hand Auger

During this field event, soil samples were collected with hand augers in accordance to SOP-09 (Appendix B of the UFP-SAP).

The hand auger system consisted of a stainless steel bucket bit (i.e. cylinders 6.5-inches long and 2.75-inches in diameter), a 3- or 4-foot extension rod, and a cross handle. A properly decontaminated bucket bit was attached onto a clean extension rod, and then onto the cross handle. The area to be sampled was cleared of any surface debris (i.e., leaves, twigs). The hand auger was turned into the ground and the sample material was removed and placed into a Ziploc® bag until reaching the final desired depth. Larger debris such as twigs, roots, or stones were removed from the sample. The sample ID, date, time, and depth were marked on the bag with an indelible marker. Required information was completed on the Soil Sample Log Sheet and the chain-of-custody form. Excess soil core material was

returned to the hole. The hand auger was decontaminated between discrete sample locations in accordance with SOP-04 and as explained in Section 3.1.7.

3.1.2.2 Ponar Dredge

Sediment samples in Lake Oberlin were collected from 0 to 6 inches below the water/sediment interface using a petite ponar dredge deployed from a motorized boat in accordance with SOP-11 (Sediment Sampling) and SOP-12 (Large Body Water Sediment Sampling). Each sediment sample from Lake Oberlin consisted of five discrete sediment samples collected from subareas measuring less than one-half acre and the samples from each subarea were composited as described in the UFP-SAP.

The Soil and Sediment Sample Log Sheets are included in Appendix A.

3.1.2.3 XRF Analysis

Samples collected at the B-143 Drop Test Area and West Gate Small Arms Range Complex underwent screening in the field utilizing XRF in accordance with SOP-16 (Tetra Tech, 2009).

Prior to analyzing samples, the XRF was standardized in accordance with manufacturer instructions, and three known lead concentrations [National Institute of Standards and Technology (NIST) standards] were analyzed to verify the accuracy of the instrument and to assess the stability and consistency of the results. Sample processing prior to field XRF analysis consisted of homogenizing each soil sample within a large Ziploc® bag, removing rocks and other debris, placing the sample in a small aluminum pan, drying the sample in an electric convection oven, and then using a wooden rolling pin over the bagged sample material to eliminate clods and produce a fine uniform particle size. Each sample was then transferred to a smaller Ziploc® bag from which three separate XRF measurements were made, one from each end and one from the center of the sample bag. The average lead concentration of the three readings was used as the final XRF lead concentration for the sample location.

Additional samples were collected around an original sample location at the West Gate Small Arms Range Complex where XRF lead concentrations were greater than the field action level of 200 milligrams per kilogram (mg/kg). The purpose of these additional samples was to better define any potential area of lead contamination. No more than two additional sample locations were added at each original sample location. Soil XRF lead concentrations less than the field action level of 200 mg/kg are not likely to exceed the FBL lead PAL of 400 mg/kg. After initial screening by XRF, samples were selected for analysis of lead and other select parameters at a FBL. Sample selection for FBL analysis was based on

the field XRF lead concentration with the majority of samples selected having an XRF lead concentration between 250 mg/kg to 550 mg/kg.

A general discussion of the correlation analyses is presented in Section 3.3, and a more detailed site-specific correlation analysis for the B-143 Drop Test Area and West Gate Small Arms Range Complex are discussed in Sections 4.5 and 8.5, respectively, with supporting documentation included in Appendix E.

3.1.3 Site Sampling Operations

The sampling strategy employed a design to target those areas most likely to be contaminated based on the CSMs presented in the UFP-SAP in addition to nearby areas to help to bound any contamination. The data collected under this conservative strategy were expected to represent concentrations greater than those which human or ecological receptors would actually be exposed. The strategy therefore was to ensure that a potential unacceptable human health or ecological risk was not overlooked.

At all sample locations, the sample material was placed in a Ziploc® bag, that was marked with the sample location ID, depth, date, and time. The samples were then thoroughly mixed within the baggie. The homogenized samples from the Pyro Area Outside Test Burn Pads, Test Pad Behind B-198, and Lake Oberlin were then transferred into the appropriate sample container and placed on ice until shipped to the FBL for site-specific analysis. Samples collected from the B-143 Drop Test Area and West Gate Small Arms Range Complex were transferred back to the field office where a portion of every homogenized sample was processed and underwent XRF screening. Unused portions of a collected sample were returned to the sample location where it was collected.

3.1.4 Field Sample Documentation

All field observations including visual observation of lead shot, bullets, pieces of clay targets, flares, etc. were recorded on the sample log sheets and in daily field records. For samples undergoing field XRF analysis, any bullets, bullet fragments, or lead shot observed in a sample were removed prior to analysis because they do not reflect contamination that has migrated to soil. Documentation of lead fragments and shot were important for interpreting spatial contaminant distributions.

The sample numbering scheme was in accordance with SOP-02 (Sample Identification and Nomenclature) of the Tetra Tech UFP-SAP (2009). Sample documentation consisted of the completion of sample log sheets, chain-of-custody forms, field logbooks, and health and safety documentation. Field documentation was completed as per SOP-03. The sample log sheets contain information such as

sample location and sample ID number, container requirements and analyses performed, and sample type, time, and date. Any unusual circumstances encountered during sample collection were noted on the form. Chain-of-custody forms were used to track each sample from collection in the field to receipt and analysis at the FBL. All field log sheets and field forms are included in Appendix A, and site photographs are included as Appendix B.

Sample labeling was in accordance with SOP-01. Soil sample log sheets for the samples collected during this SI are included in Appendix A and contain the following information, as appropriate for each sample:

- Sample location and sample ID
- Name of person(s) collecting the sample
- Sample collection method
- Sample depth, date, and time
- Brief soil description

Sample Handling, Packaging, and Shipping

Sample containers, preservation, packaging, and shipping were in accordance with SOP-11. All sample containers shipped to the FBL were sealed in plastic Ziploc® bags. The sample containers were then placed in a cooler lined with a large plastic garbage bag and covered with ice. A temperature blank was placed in each cooler prior to shipment. The plastic garbage bag was sealed with a knot, and the chain-of-custody form was sealed in a Ziploc® bag and taped to the inside of the cooler lid. A signed and dated custody seal was applied to each end of the cooler and then covered with strapping tape to provide a tamper-evident seal. A Federal Express® airbill was applied to the shipping cooler. Tetra Tech maintained custody of the samples until they were relinquished to Federal Express®. The Federal Express® tracking number (airbill number) was recorded on each chain-of-custody form, and the sender's copy of the airbill was maintained for shipment tracking, if needed. All samples were shipped to the FBL for overnight delivery and were received within sample holding times.

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) were in accordance with Empirical Laboratories, Columbia Analytical Services, and Navy Crane Laboratory SOPs.

3.1.5 Quality Control Samples

Quality assurance/quality control (QA/QC) samples were generated and collected during sampling activities to monitor both field and laboratory procedures, in accordance with the approved UFP-SAP (Tetra Tech, 2009). QA/QC samples included field duplicates, equipment rinsate blanks, and temperature blanks. Field duplicate results are presented in Appendix C of this document. The following types of QA/QC samples were collected during the SI:

- Field Duplicates consisted of a single sample split into two portions. Field duplicates were collected at the rate of 1 in 20 during this field investigation to assess the overall precision of the sampling and analysis program.

- Equipment Rinsate Blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over sample collection equipment after decontamination and before use. Equipment rinsate blanks were analyzed for the same chemical constituents as the associated environmental samples.

- Temperature Blanks were used to determine if samples were adequately cooled during shipment. One temperature blank was submitted to the laboratory in each cooler, and the temperature was checked upon receipt at the laboratory.

3.1.6 GPS

Prior to mobilization for the field effort, all Geographic Information System (GIS) sample coordinates were uploaded into a hand-held Trimble global positioning system (GPS) unit capable of sub-meter accuracy. The GPS was then used in the field to locate all sampling points. The GPS coordinate system was set up so all data points were collected in North American Datum of 1983 (NAD 83) Indiana West State Plane coordinates in US survey feet.

Once all samples at a site were marked and collected, a field team member returned to each individual sample location and updated the GPS coordinates by collecting actual sample location coordinates. GPS coordinates were collected at each location for a minimum of one minute during periods when satellite reception was optimal (i.e., greater than 6 available satellites).

3.1.7 Decontamination Procedures

Reusable (non-dedicated) sampling equipment (e.g., hand augers) was decontaminated prior to beginning sampling and between sample locations in accordance with SOP-08 and per the discussion below:

Two 5-gallon buckets, a scrub brush, and deionized (DI) water were utilized in the decontamination process. Each bucket was filled with approximately 2 to 3 gallons of clean water. One bucket then received a small amount of phosphate-free detergent (Liqui-Nox®) which was mixed into the water. Prior to sample collection, and between sample locations, the auger bit was placed in the water/detergent mix and scrubbed clean. The auger was then transferred to the second bucket for a clean rinse. The auger then received a final rinse with DI water. If the auger was not immediately used it was wrapped in clean aluminum foil.

The ponar dredge used for sediment sample collection at Lake Oberlin was scrubbed clean between each composite sample location.

At the conclusion of SI field activities, the FOL completed a final decontamination of all equipment, which was then shipped back to the appropriate vendor(s).

3.1.8 Investigation-Derived Waste

Investigation-derived waste (IDW) was generated during the SIs. IDW included disposable trowels, personal protective equipment (PPE), excess soil, and decontamination water. Disposable trowels and PPE were properly bagged and placed for disposal in NSA Crane dumpsters. Excess soil from samples was returned to the site from which they were collected. Decontamination water was collected and disposal was performed in accordance with SOP-13.

3.1.9 Record Keeping

SI records including daily activity logs, sample log sheets, and chain-of-custody forms were completed in accordance with SOP-03. Information recorded daily included field activities, weather conditions, identity and arrival and departure times of personnel, management issues, etc. Copies of daily activity records are included in Appendix A.

3.2 ANALYTICAL METHODOLOGY

3.2.1 Data Methods

Chemical analysis for metals, PAHs, and explosives were performed by Empirical Laboratories of Nashville, Tennessee. Chemical analysis for perchlorates was performed by Columbia Analytical Services of Kelso, Washington. Both subcontracted laboratories were Naval Facilities Engineering Service Center (NFESC) approved. Navy dye compounds were analyzed by the Navy Crane Laboratory.

3.2.2 Data Evaluation

3.2.2.1 Data Quality Review

This section describes the data review processes used to determine whether analytical laboratory data were of acceptable technical quality for use in decision making. The review began with data validation, which is a comparison of data quality indicators (DQIs) to prescribed acceptance criteria. The DQIs used are measures to assess the bias and precision of the analytical calibrations and sample analyses. The output of this review was a set of alphabetic flags such as “U,” “J,” “R,” or combinations thereof that may have been assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data. Also evaluated were the measures of data completeness, sensitivity, comparability, and representativeness.

3.2.2.2 Data Validation Process

Limited data validation conducted to evaluate false positives included evaluations of data completeness, holding time compliance, calibrations, field QC and laboratory-generated blanks, field duplicate precision, and detection limits for the data collected during the SI. The data packages provided by the analytical laboratories are expansive enough to allow future complete formal data validation, if necessary.

Assignment of data qualification flags conformed to United States Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Organic Data Review (June, 2008), and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (USEPA, 2004) guidelines to the greatest extent practicable for non-Contract Laboratory Program Data. Data validation specifications require that various data qualifiers be assigned when a deficiency is detected or when a result is less than its detection limit. If no qualifier is assigned to a result that has been validated, the data user is assured that no technical deficiencies were identified during validation. The qualification flags used are defined as follows:

- "U" – Indicates that the chemical was not detected at the numerical detection limit (sample-specific detection limit) noted. Non-detected results from the laboratory are reported in this manner. This qualifier is also added to a positive result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

- "UJ" – Indicates that the chemical was not detected; however, the detection limit (sample-specific detection limit) is considered to be estimated based on problems encountered during laboratory analysis. The associated numerical detection limit is regarded as inaccurate or imprecise.

- "J" – Indicates that the chemical was detected; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is considered to be an estimate of the true concentration.

- "UR" – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies (e.g., holding time missed by two times the specified time limit, severe calibration non-compliance, or extremely low analyte recovery).

- "R" – Indicates that the chemical may or may not be present. The positive analytical result reported by the laboratory is considered to be unreliable and unusable. This qualifier is applied in cases of gross technical deficiencies.

The preceding data qualifiers may be categorized as indicative of major or minor problems. Major problems are defined as issues that result in the rejection of data and qualification with "UR" or "R" qualifiers. These data are considered invalid and are not used for decision-making purposes unless they are used in a qualitative way and their use is justified and documented. Minor problems are defined as issues resulting in the estimation of data and qualification with "U", "J", and "UJ" qualifiers. Estimated analytical results are considered to be suitable for decision-making purposes unless the data use requirements are very stringent and the qualifier indicates a deficiency that is incompatible with the intended data use. A "U" qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the "U" qualifier regardless of whether a quality deficiency has been detected.

3.2.2.3 Data Validation Outputs

After data were validated, a list was developed of non-conformities requiring data qualifier flags used to alert the data user to inaccurate or imprecise data. The reviewer then prepared a technical memorandum presenting qualification of the data, if necessary, and the rationale for making such qualifications (see Appendix D). The net result was a data package that had been carefully reviewed for its adherence to prescribed technical requirements. Pertinent quality estimates are summarized in a more quantitative manner in the following section.

3.2.2.4 Data Quality Review

DQIs are parameters monitored to help establish the quality of data generated during an investigation. Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). During data validation, individual QC results were evaluated. If individual QC results were acceptable, no validation flag was assigned to an analytical result; otherwise, a flag indicating the type of QC deficiency was assigned to the result.

3.2.2.5 Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements that were intended to be generated. For this project, completeness was measured on two different bases:

- Samples collected - measure of the usable samples collected compared to those intended to be collected.

- Laboratory measurements - measure of the amount of usable valid laboratory measurements per matrix for each target analyte.

Usable valid samples (or results) were those judged, after data assessment, to represent the sampling populations and to have not been disqualified for use through data validation or additional data review. Completeness was determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where %C = percent completeness
V = number of samples (or results) determined to be valid
T = total number of planned samples (or results)

3.2.2.6 Sensitivity

Sensitivity is a comparison of the project quantitation limit goals (PQLGs) to the laboratory's method detection limits (MDLs) listed in Worksheet #15 in the UFP-SAP (Tetra Tech, 2009).

3.2.2.7 Accuracy

Accuracy requirements for field measurements are typically ensured through control over sample collection and handling and through routine instrument calibration. Field accuracies were monitored through the use of blanks to detect cross-contamination and by monitoring adherence to procedures that prevent sample contamination or degradation. One equipment rinsate blank was collected during the SI to assess cross-contamination via sample collection equipment. The blank was obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and before use. The rinsate blank was analyzed for the same chemical constituents as the associated environmental samples.

Accuracy in the laboratory was measured through the comparison of a spiked sample or laboratory control sample (LCS) result to a known or calculated value and was expressed as a percent recovery (%R). It was also assessed by monitoring the analytical recovery of select surrogate compounds added to samples that are analyzed by organic chromatographic methods. LCSs were used to assess the accuracy of laboratory operations with minimal sample matrix effects. Matrix spike (MS) and surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. LCS and MS analyses were performed at a frequency of 1 per 20 associated samples of like matrix. Laboratory accuracy was assessed by comparing calculated %R values to accuracy control limits specified by the laboratory using SW-846 methods.

Percent recovery is calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where %R = percent recovery
Ss = result of spiked sample
So = result of non-spiked sample
S = concentration of spiked amount.

3.2.2.8 Precision

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions. Precision for chemical parameters is expressed as a Relative Percent Difference (RPD), which is defined as the ratio of the difference to the mean for the two values being evaluated. RPDs are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference
V1, V2 = two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

3.2.2.9 Comparability

Comparability is defined as the confidence with which one data set can be compared to another (e.g., among sampling points and among sampling events). Comparability was achieved by using standardized sampling and analysis methods and standardized data reporting formats. Comparability of field data was ensured by following the UFP-SAP (Tetra Tech, 2009), and comparability of laboratory measurements was achieved primarily through the use and documentation of standard sampling and analytical methods. Results were reported in units that ensured comparability with previous data and with current state and federal standards and guidelines. Comparability of laboratory measurements was assessed primarily through the use of QC samples and through adherence to the laboratory's QA plans.

3.2.2.10 Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site. The UFP-SAP (Tetra Tech, 2009) and use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would accurately represent actual site conditions. It is believed that all reported data are adequately representative of site conditions.

3.3 CORRELATION BETWEEN XRF AND FIXED-BASE LABORATORY

Correlation Analysis

From samples that were analyzed in the field using XRF and also at the FBL, a regression analysis was conducted to evaluate the correlation between the FBL lead results and XRF lead results. To evaluate the regression analysis, the Pearson Correlation and R-squared value were calculated. The Pearson Correlation is a measure of the strength of the linear relationship between two or more variables with a range of -1 to +1. The value of -1 represents a perfect negative correlation (i.e., as one variable decreases the other increases proportionally); whereas, a value of +1 represents a perfect positive correlation (i.e., as one variable increases the other increases proportionally). A value of 0 represents a lack of correlation.

The correlation analysis results for the B-143 Drop Test Area and West Gate Small Arms Range Complex are presented in Sections 4.5 and 8.5, respectively.

3.4 DATA COMPARISON TO PROJECT ACTION LIMITS

The screening values (PALs) used to evaluate the chemical concentrations detected in site media and to decide whether further site investigation is warranted are listed in Worksheet #15 of the UFP-SAP.

If a soil lead concentration in any sample within the study area boundary of the B-143 Drop Test Area or West Gate Small Arms Range Complex exceeds the lead PAL, the project team will proceed to an RI at this site. The RI plan would be documented in another UFP-SAP. If MC (lead) concentrations in all soil samples are less than the PAL, then the project team will recommend no further investigation of lead at this site.

If individual MC analytes (inorganics, explosives, perchlorate, and Navy dye compounds) are detected in any residual material or soil sample at concentrations that exceed PALs then the project team will

recommend conducting an RI for the site. If MC (inorganics, explosives, perchlorate, and Navy dye compounds) concentrations in all basin residue, sediment, and soil samples do not exceed PALs in all samples, then NFA for MC will be recommended for that particular site.

Detailed discussions regarding site-specific PAL evaluations are presented in Sections 4.0 through 8.0 of this report.

4.0 BUILDING-143 DROP TEST AREA – AOC 01

4.1 SITE BACKGROUND

B-143 Drop Test Area – AOC 01

The B-143 Drop Test Area is located in the west-central portion of NSA Crane (Figure ES-2), and encompasses approximately 0.06 acres. The B-143 Drop Test Area sits in a slight depression located at the top of a ridge that slopes to the southeast. The elevation of the site is approximately 650 feet above msl, and the elevation at the base of the ridge is approximately 600 feet above msl.

The size of the test area was estimated during the PA site visit and was based on a visual survey of the site. The described site size for AOC 01 of 0.06 acres differs from the 0.08-acres identified in the Navy Range Inventory, but the stated 0.06 acre area was considered to be more accurate because it was field verified during the PA. The B-143 Drop Test Area is located south of B-143, which is currently used for small ordnance component testing.

The B-143 Drop Test Area is separated from B-143 by approximately 50 feet of grass and 50 feet of pavement. An unnamed tributary to Boggs Creek is located at the base of the ridge, which receives surface water runoff from the B-143 Drop Test Area. The B-143 Drop Test Area is located in the central drainage basin at NSA Crane.

Following the completion of the testing activities in 1980, the 40-foot drop tower, the small (15-foot by 15-foot) control building, and the concrete drop pad were removed from the site as early as 1982. At the time of the 2003 PA site visit, the only evidence that remained of the former test area was a slight depression located in a clearing at the center of a lightly wooded area with young trees and sparse undergrowth. During the April 2009 Tetra Tech site visit, the former drop tower location was overgrown with vegetation and covered with leaf litter. Although the B-143 Drop Test Area is inside the installation fenceline for NSA Crane, there are no additional access controls or restrictions that limit access to the site. Once personnel are cleared by gate security personnel to enter the installation, Navy personnel, contractors, and authorized visitors are not specifically restricted from accessing the B-143 Drop Test Area.

4.1.1 Historical Munitions Usage Information

The B-143 Drop Test Area covers approximately 0.06 acres and was used for testing inert Mk 118 Mod 0, Rockeye bomblets or submunitions. Submunitions are defined as any ordnance dispensed from a larger carrier such as a projectile, rocket warhead, or dispenser dropped from aircraft. According to interviews with site personnel, during the 1968 to 1980 period of use, the B-143 Drop Test Area consisted of a 40-foot drop tower, a concrete drop pad, and a test building. These structures have since been removed from the site. During testing activities, the pre-armed inert Mk 118 Mod 0, Rockeye submunitions were released from the top of the drop tower and impacted the concrete drop pad area on the ground surface. The quantities of munitions tested at the site are unknown. There is no evidence that any submunitions missed the concrete pad or penetrated the adjacent soil, and Navy policy at the time of site use required that ordnance be removed after testing. It has been presumed that only inert submunitions with live fuzes were tested at the B-143 Drop Test Area. This presumption is based on the following: (1) the close proximity of the area to Buildings 143, 99, 100, 186, and 2870 (within approximately 115 feet); (2) the use of a concrete pad as an impact area; and (3) interviews with site personnel. It is assumed that any remaining ordnance would have been disposed at the time the drop tower and concrete drop pad were removed; however, no ordnance removal records have been located.

4.1.2 Munitions Constituents

The munitions used and/or stored at the facility were inert Mk 118 Mod 0, Rockeye submunitions and the associated chemical constituent in the fuze was lead azide. The PA Report for this site indicated that MEC were not suspected and no MEC were observed on the surface at the site. During the planning phase of the UFP-SAP, the decision was made to focus on detecting potential MC in area soil. Soil MC analyses were limited to lead (lead azide in Rockeye submunition fuze assembly). The munitions items dropped from the tower did not contain high-explosive fillers (Composition B or Octol), so focused sampling on lead from the submunition fuzes would verify the presence/absence of an MC release.

MC contamination was not expected to be present at this site and it was assumed that during the demolition of the former structures at the site (tower, concrete pad, observation building) that some portion of the native soil may also have been removed. Therefore, a very focused confirmation sampling plan was proposed to investigate and confirm the presence/absence of lead contamination at the former drop tower and concrete pad.

4.1.3 Current Land Use and Anticipated Future Land Use

The immediate area around the B-143 Drop Test Area is lightly wooded and currently not in use. There are no access controls or restrictions in place to limit access to the B-143 Drop Test Area, and upon access to the installation, Navy personnel, contractors, and visitors are not specifically restricted from the former drop test area. No change in land use of the adjacent areas is anticipated.

4.2 SITE FIELDWORK

4.2.1 Site Field Activities

Soil sampling at the B-143 Drop Test Area was limited to surface soil (0- to 2-feet bgs) because that interval is the established surface soil depth as NSA Crane and because lead typically has limited mobility in soil and would be expected to remain in the surface soil. All samples were analyzed for lead in the field using XRF and eight of the 18 samples were submitted to the FBL for definitive lead analysis.

Soil sample locations were selected based on a bias towards areas that had the greatest potential to have been impacted by past site operations. See Figure 4-1 for all sample locations. Prior to initiating sample collection, all sample locations were marked by colored pin flags bearing the sample location ID. Proposed sample locations identified in the approved UFP-SAP were located by GPS and by measurements from stationary objects (e.g.: roadways, existing buildings). Upon collection of the samples at the B-143 Drop Test Area, a field team member utilized the handheld GPS unit to collect actual sample location coordinates in order to map the sampling locations. These data were measured to sub-meter accuracy using the horizontal datum: NAD 83 Indiana State Plane Coordinate System West. All proposed sample locations were collected as planned in the approved UFP-SAP.

Photographs associated with the sampling activities at the B-143 Drop Test Area are presented in Appendix B.1.

The B-143 Drop Test Area was lightly wooded with sparse undergrowth; therefore, limited vegetation clearance was required. Only small underbrush around the sampling points was removed to facilitate sampling.

4.2.2 Work Plan Deviations

There were no deviations from the UFP-SAP for the B-143 Drop Test Area.

4.2.3 Field Data Collection

Eighteen soil samples, A1SS001G0002 through A1SS018G0002, were collected within a grid system at the B-143 Drop Test Area by hand auger. All samples were analyzed in the field using XRF and eight of the 18 samples were submitted to the FBL for definitive lead analysis. Six of those samples (A1SS001G0002, 004, 006, 013, 015, and 018) were pre-determined in the UFP-SAP (Tetra Tech, 2009) for FBL lead analysis, and the other two samples (A1SS003G0002 and 010) were selected from the remaining 12 due to having the highest average XRF lead concentrations of 63 and 307 mg/kg, respectively.

All samples were placed in large Ziploc® bags and thoroughly homogenized prior to processing a portion for XRF analysis and prior to placing a portion of the remaining sample in the appropriate sample jar and shipped to the respective FBL for lead analyses. Table 4-1 provides a summary of the samples collected and their respective analysis at the B-143 Drop Test Area, and Figure 4-1 shows all sampling locations. Soil sample log sheets are included in Appendix A.1 of this document.

4.3 SITE INSPECTION DATA COLLECTION RESULTS

4.3.1 MC Sampling Results

Eighteen soil samples were collected from the B-143 Drop Test Area. All 18 samples were analyzed for the presence of lead in the field via XRF, and eight samples were shipped to the FBL for lead analysis (SW-846 6010B).

Soil samples collected at the B-143 Drop Test Area were compared to human health and ecological screening levels, and applicable background concentration from the Base-wide Background Soil Investigation Report for Naval Surface Warfare Center Crane (Tetra Tech, 2001). The complete MC analytical results are presented in Appendix C and the data validation reports are presented in Appendix D.1.

Table 4-2 summarizes the XRF and FBL lead results at the B-143 Drop Test Area. The lead screening level (PAL) for the FBL analyses was 27 mg/kg, and was based on the applicable background concentration from the Base-wide Background Soil Investigation Report (Tetra Tech, 2001). The PAL for the field XRF analyses was 200 mg/kg, which was selected as a conservative measure and is one-half of the human health direct contact for lead in residential soil. Soil samples A1SS003G0002 and A1SS010G0002, both located in the central area of the B-143 Drop Test Area, contained FBL lead

concentrations of 56 and 164 mg/kg, respectively, which exceeded the 27 mg/kg PAL for the FBL lead in soil. Only soil sample A1SS010G0002, with an average XRF lead concentration of 307 mg/kg, exceeded the field XRF lead PAL of 200 mg/kg. However, all lead concentrations were below the human health direct contact residential soil lead PAL of 400 mg/kg.

Figure 4-2 presents the XRF and FBL lead detections in soil at the B-143 Drop Test Area.

The Human Health Risk Screening Evaluation summary is discussed in Section 4.6, with supporting documentation presented in Appendix F.1.

The Ecological Risk Screening Evaluation summary is discussed in Section 4.7, with supporting documentation presented in Appendix G.1.

4.4 DATA PRESENTATION AND USABILITY

4.4.1 Data Validation Process

All of the results from analytical FBL samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October, 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October, 2004) guidelines.

No data collected for the B-143 Drop Test Area were qualified or rejected. All data for the B-143 Drop Test Area are considered valid for their intended purpose.

4.4.1.1 Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Appendix D.1.

4.4.1.2 Completeness

The sample collection and FBL analytical completeness for the B-143 Drop Test Area were 100 percent.

4.4.1.3 Sensitivity

The PQLGs are listed in Worksheet #15 of the UFP-SAP (Tetra Tech, 2009). Analytical sensitivity for data at the B-143 Drop Test Area was satisfactory to meet DQOs presented in the UFP-SAP.

All results for lead were positive so there are no instances where the non-detected sample results exceed the PQLGs either because of the FBLs inability to meet the PQLG or because of elevated detection limits because of blank contamination.

4.4.1.4 Field and Laboratory Accuracy

There was no quality control deficiencies noted for field or FBL accuracy for the B-143 Drop Test Area data.

4.4.1.5 Field and Laboratory Precision

There was no quality control deficiencies noted for field or FBL precision for the B-143 Drop Test Area data.

4.4.1.6 Comparability

No comparability issues were noted during the data validation process for the B-143 Drop Test Area data.

4.4.1.7 Representativeness

The UFP-SAP (Tetra Tech, 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and FBL audits, all reported data are adequately representative of site conditions and intended populations for the B-143 Drop Test Area.

4.5 CORRELATION BETWEEN XRF AND FIXED-BASE LABORATORY

From the samples that were analyzed in the field using XRF and also at the FBL, a regression analysis was conducted to evaluate the correlation between the FBL lead results and XRF lead results. To evaluate the regression analysis, the Pearson Correlation and the R-squared value were calculated. The

Pearson Correlation is a measure of the strength of the linear relationship between two or more variables with a range of -1 to +1. The value of -1 represents a perfect negative correlation (as one variable decreases the other increases proportionally); whereas, a value of +1 represents a perfect positive correlation (as one variable increases the other increases proportionally). A value of 0 represents a lack of correlation. The correlation between the FBL lead concentrations and the field XRF average lead concentrations at the B-143 Drop Test Area was 0.99, indicating a very strong correlation.

The R-squared value represents the percent of variation in the FBL lead results that can be explained by the XRF lead results. The R-squared value for the B-143 Drop Test Area was 0.98. An R-Squared value greater than 80 percent is considered to indicate a very strong relationship between the two measurement methods; the maximum possible value is 100 percent. The regression analysis is included in Appendix E.1.

4.6 HUMAN HEALTH RISK SCREENING EVALUATION SUMMARY

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from MC present at the B-143 Drop Test Area. Soil samples were only analyzed for lead. The detected concentrations of lead in all samples were less than the USEPA and IDEM direct contact screening criteria; therefore, lead was not retained as a direct contact COPC in soil at the B-143 Drop Test Area.

Tetra Tech compared the maximum concentration of lead in soil to the risk-based screening level (RBSL) based on direct contact exposures to soil and protection of groundwater. If the maximum concentration of lead exceeded the direct contact exposure criteria then lead would be retained as a COPC and cancer risks and hazard indices would be estimated. The potential for lead to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration to the screening criteria for the protection of groundwater.

Concentrations of lead in soil samples exceeded the USEPA SSL for migration from soil to groundwater based on a Dilution Attenuation Factor (DAF) of 1 in 5 of 8 samples, but were less than the EPA SSL based on a DAF of 20 in all samples. The maximum detected concentration of lead in soil also exceeded the IDEM migration from soil to groundwater value in one sample. This indicates that there is not a large source area of lead contamination at the B-143 Drop Test Area and therefore concentrations of lead in soil are not expected to adversely impact groundwater. Groundwater from the B-143 Drop Test Area is not currently used as a source of drinking water, so the pathway is currently incomplete.

4.7 ECOLOGICAL RISK SCREENING SUMMARY

The goal of the ecological risk screening is to determine whether adverse ecological impacts are present at the site as a result of exposure to chemicals released to the environment through historical site activities. The risk screening allows conclusions to be made as to whether ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks at the site.

Lead was not selected as a COPC for terrestrial invertebrates because the maximum concentration was less than the applicable screening level. However, lead was initially selected as a COPC for terrestrial plants, mammals, and birds based on exceedances of their applicable screening levels. When a chemical is initially retained as an ecological COPC, it then goes through refinement to better define those chemicals and to identify and eliminate any chemicals from further consideration that were retained because of very conservative exposure scenarios.

Lead was initially selected as a COPC for terrestrial plants because the maximum concentration of 164 mg/kg, at location A1SB010, exceeded its screening level of 120 mg/kg. All remaining lead concentrations at the site were well below the screening level. The slight exceedance in one sample is not likely to cause a significant impact to plants at the site; therefore, lead was subsequently eliminated as a COPC for terrestrial plants at the site.

Lead was also initially selected as a COPC for mammals and birds based on the maximum lead concentration in food-chain modeling. Risks were then recalculated using the average lead concentration throughout the site. Based on the average lead concentration and the fact the site is very small (0.06 acres), lead was also eliminated as a COPC for mammals and birds at the site.

4.8 UPDATED CSM

Only MC associated with the B-143 Drop Test Area was considered in the CSM exposure pathway analysis (Figure 4-3). A general description of the CSM exposure pathway analysis as presented in the UFP-SAP (Tetra Tech, 2009) is summarized below:

If MC (lead) remains at the site, it would be primarily retained in surface soil (0 to 2 feet bgs). Soils present at this site are well to moderately drained, and contaminants could infiltrate into subsurface soil and ultimately leach from soil into groundwater. Additional, although unlikely, migration pathways would include storm water runoff that could transport contaminated surface soil, affecting nearby soil and

possibly the unnamed Boggs Creek tributary at the bottom of the ridge. Contaminant dilution would occur during overland transport.

Current human receptors at the B-143 Drop Test Area that could come into contact with MC contamination in soil include military and civilian personnel, contractors, trespassers, and hunters. Hunters could also contact contaminants through the food chain because MC contaminants may bioaccumulate in animals. Ecological receptors that could come into contact with MC contamination in surface soil include wildlife such as deer, rabbits, raccoons, and wild turkeys. Ecological receptors could also contact contaminants through the food chain when ingesting vegetation such as grass at the site.

CSM Summary

The updated CSM for the B-143 Drop test Area is shown on Figure 4-4 and details the potential exposure sources, pathways, and receptors. The exposure source is limited to the former drop tower and concrete pad, due to the low-lying location of this site. One pathway is runoff from precipitation. Leaching from soil into groundwater has been eliminated as a pathway, since groundwater is not used at the site. Receptors would be trespassers and ecological receptors by ingestion, dermal contact, and inhalation of the surface soil. Exposure pathways have been eliminated for both human and ecological receptors under both current and hypothetical future land uses.

4.9 CONCLUSIONS

Focused confirmation sampling was performed to investigate and confirm the presence/absence of potential lead contamination from the testing of inert but fuzed Mk 118 Mod 0, Rockeye submunitions at the former B-143 Drop Test Area tower and concrete pad site. MEC contamination was not expected to be present at this site and the primary MC was the lead azide in the fuze of the tested inert submunitions. All facility structures at the former B-143 Drop Test Area had been demolished and removed from the site.

The SI results show that lead at this site is not present at concentrations that would cause potential risks to human or ecological receptors. There were a few discrete soil samples with lead concentrations above the applicable PAL background concentration from the Basewide Background Soil Investigation Report for the Naval Surface Warfare Center Crane (Tetra Tech, 2001) in the surface soil. However, these concentrations were eliminated as risks to human receptors since they were all well below the human health screening level. They were also eliminated as ecological risks based on comparisons to screening levels, magnitude and frequency of detections greater than screening levels, and site-use factors.

The maximum detected concentration of lead in soil exceeded the IDEM migration from soil to groundwater value in 1 of the 18 soil samples. This indicates that there is not a large source area of lead contamination at the B-143 Drop Test Area; therefore, concentrations of lead in soil are not expected to adversely impact groundwater. Groundwater from the B-143 Drop Test Area is not used as a source of drinking water, so the pathway is currently incomplete.

4.10 RECOMMENDATIONS

Based on the SI results, NFA at the B-143 Drop Test Area is recommended.

TABLE 4-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
B-143 DROP TEST AREA - AOC 01
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	ANALYSIS	
					XRF (LEAD)	FBL (SW 846-6010B)
A1SB001	A1SS001G0002	9/12/2009	HA	0-2	X	X
A1SB002	A1SS002G0002	9/12/2009	HA	0-2	X	
A1SB003	A1SS003G0002	9/12/2009	HA	0-2	X	X
A1SB004	A1SS004G0002	9/12/2009	HA	0-2	X	X
A1SB005	A1SS005G0002	9/12/2009	HA	0-2	X	
A1SB006	A1SS006G0002	9/12/2009	HA	0-2	X	X
A1SB007	A1SS007G0002	9/12/2009	HA	0-2	X	
A1SB008	A1SS008G0002	9/12/2009	HA	0-2	X	
A1SB009	A1SS009G0002	9/12/2009	HA	0-2	X	
A1SB010	A1SS010G0002	9/12/2009	HA	0-2	X	X
A1SB011	A1SS011G0002	9/12/2009	HA	0-2	X	
A1SB012	A1SS012G0002	9/12/2009	HA	0-2	X	
A1SB013	A1SS013G0002	9/12/2009	HA	0-2	X	X
A1SB014	A1SS014G0002	9/12/2009	HA	0-2	X	
A1SB015	A1SS015G0002	9/12/2009	HA	0-2	X	X
A1SB016	A1SS016G0002	9/12/2009	HA	0-2	X	
A1SB017	A1SS017G0002	9/12/2009	HA	0-2	X	
A1SB018	A1SS018G0002	9/12/2009	HA	0-2	X	X

X = Indicates sample was collected and analyzed as proposed in the UFP-SAP (Tetra Tech, 2009)
bgs = below ground surface
FBL = Fixed-base laboratory
HA = Hand auger
XRF = X-ray fluorescence

TABLE 4-2

XRF AND FBL SURFACE SOIL MC LEAD DETECTIONS
B-143 DROP TEST AREA - AOC 01
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	A1SB001		A1SB002		A1SB003		A1SB004		A1SB005		A1SB006		A1SB007		A1SB008		A1SB009		A1SB010	
Sample ID		A1SS001G0002		A1SS002G0002		A1SS003G0002		A1SS004G0002		A1SS005G0002		A1SS006G0002		A1SS007G0002		A1SS008G0002		A1SS009G0002		A1SS010G0002	
Sample Date		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Inorganics (mg/kg)																					
LEAD	27	15.1				**56**		23.2				11.9								**164**	
Field XRF (mg/kg)																					
LEAD	200	28		24		63		28		28		24		25		30		60		**307**	

Sample Location	PAL (mg/kg)	A1SB011		A1SB012		A1SB013		A1SB013		A1SB013		A1SB014		A1SB015		A1SB016		A1SB017		A1SB018	
Sample ID		A1SS011G0002		A1SS012G0002		A1SS013G0002		A1SS013G0002-AVG		A1SS013G0002-D		A1SS014G0002		A1SS015G0002		A1SS016G0002		A1SS017G0002		A1SS018G0002	
Sample Date		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912		20090912	
Sample Type		NORMAL		NORMAL		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Inorganics (mg/kg)																					
LEAD	27					15.6		15		14.4				12.3						13.4	
Field XRF (mg/kg)																					
LEAD	200	41		31		21						19		30		15		16		20	

mg/kg = milligram per kilogram
PAL = Project action limit
XRF = X-ray fluorescence

Shading indicates an exceedence of the PAL.

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DRAWN BY K. MOORE	DATE 7/10/09	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY J. GOERDT	DATE 4/13/10	B-143 DROP TEST AREA - AOC 1 MC SAMPLING LOCATIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 4-1 / REV 0

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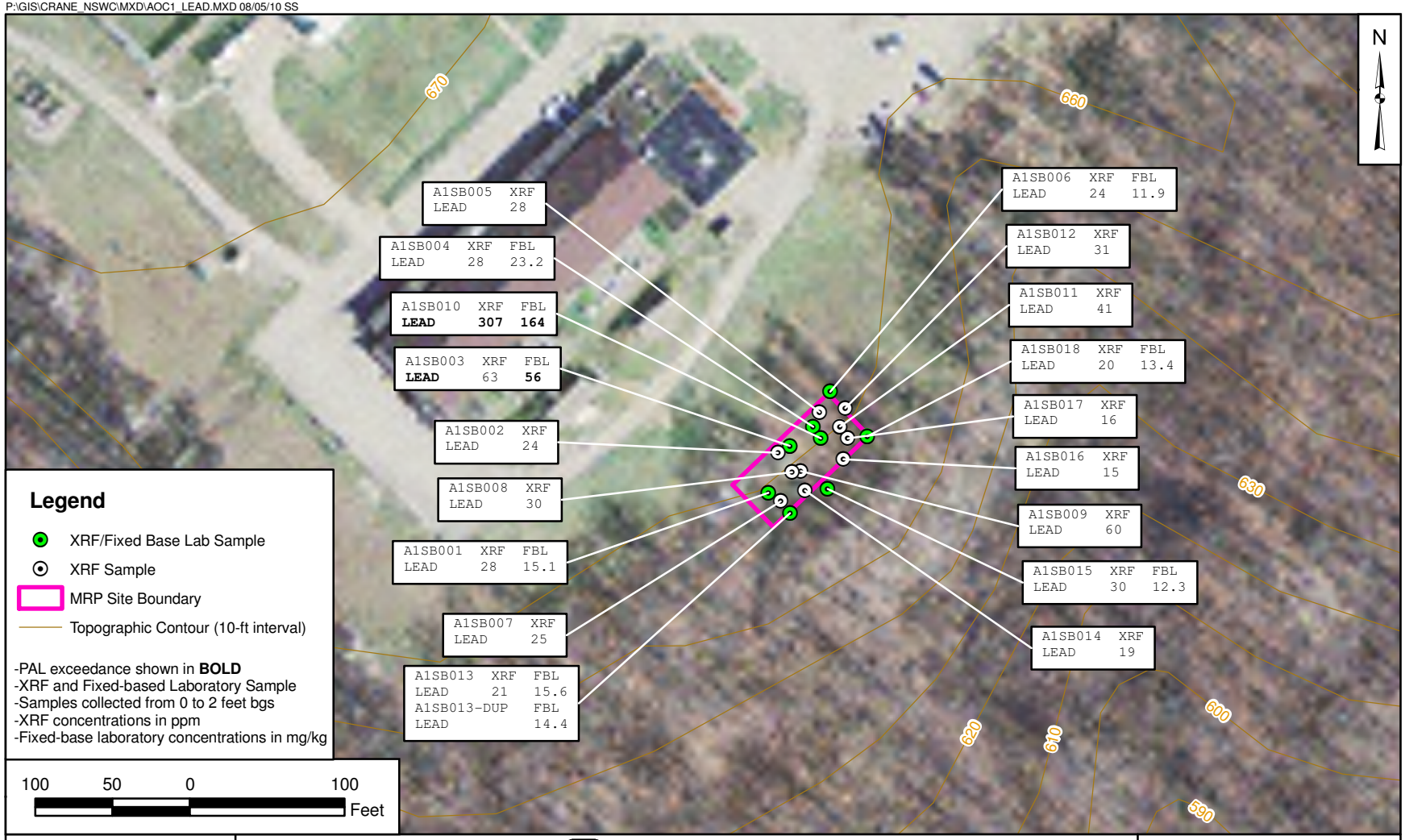
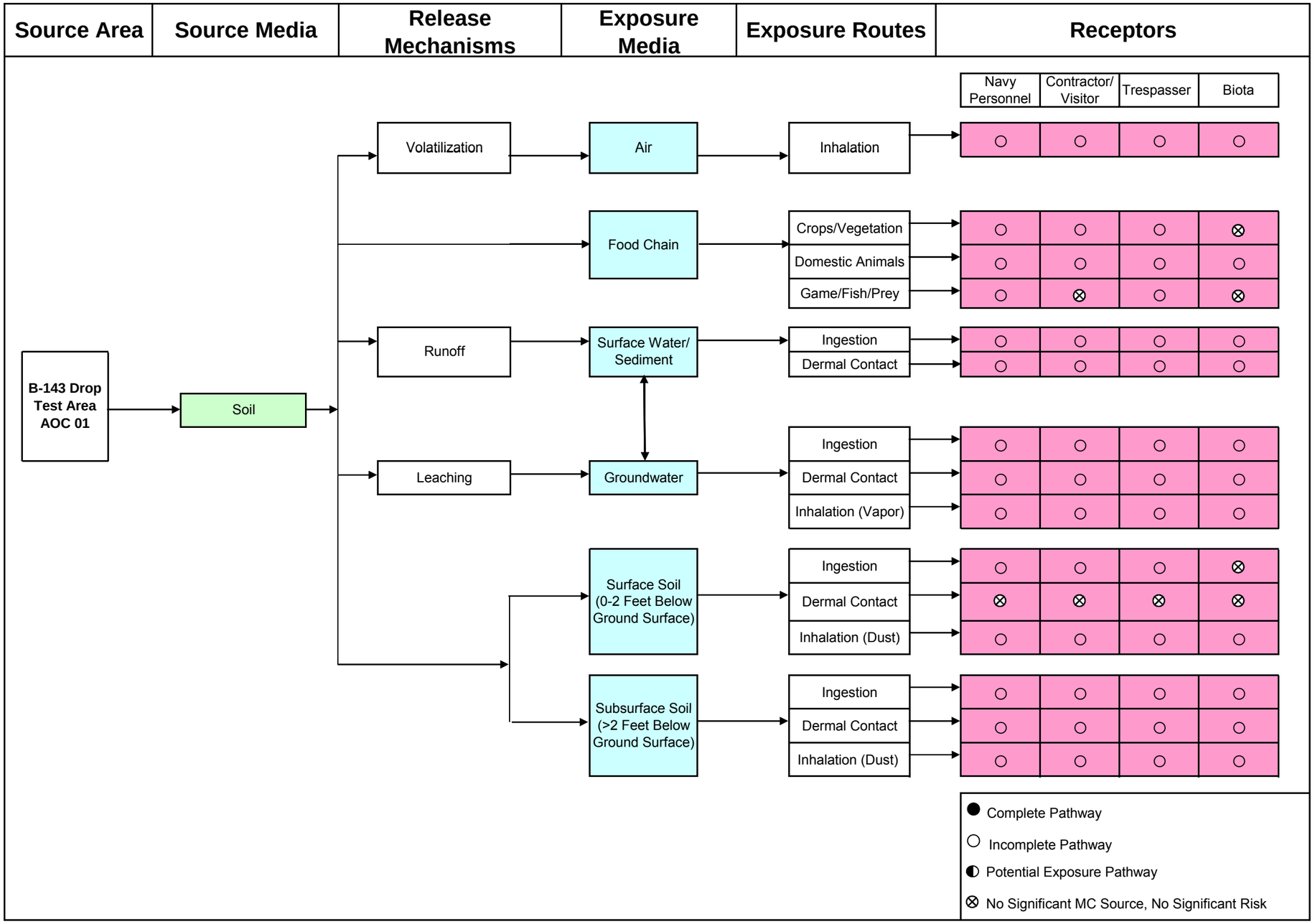


DRAWN BY T. WHEATON	DATE 02/05/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY R. BARRINGER	DATE 08/05/10	B-143 DROP TEST AREA - AOC 1 SURFACE SOIL LEAD DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 4-2 / REV 0

FIGURE 4-3
MC EXPOSURE PATHWAY ANALYSIS
B-143 DROP TEST AREA - AOC 01
NSA CRANE, CRANE, INDIANA



LEGEND

SHRUBS

TREE/VEGETATION

RUNOFF

INFILTRATION

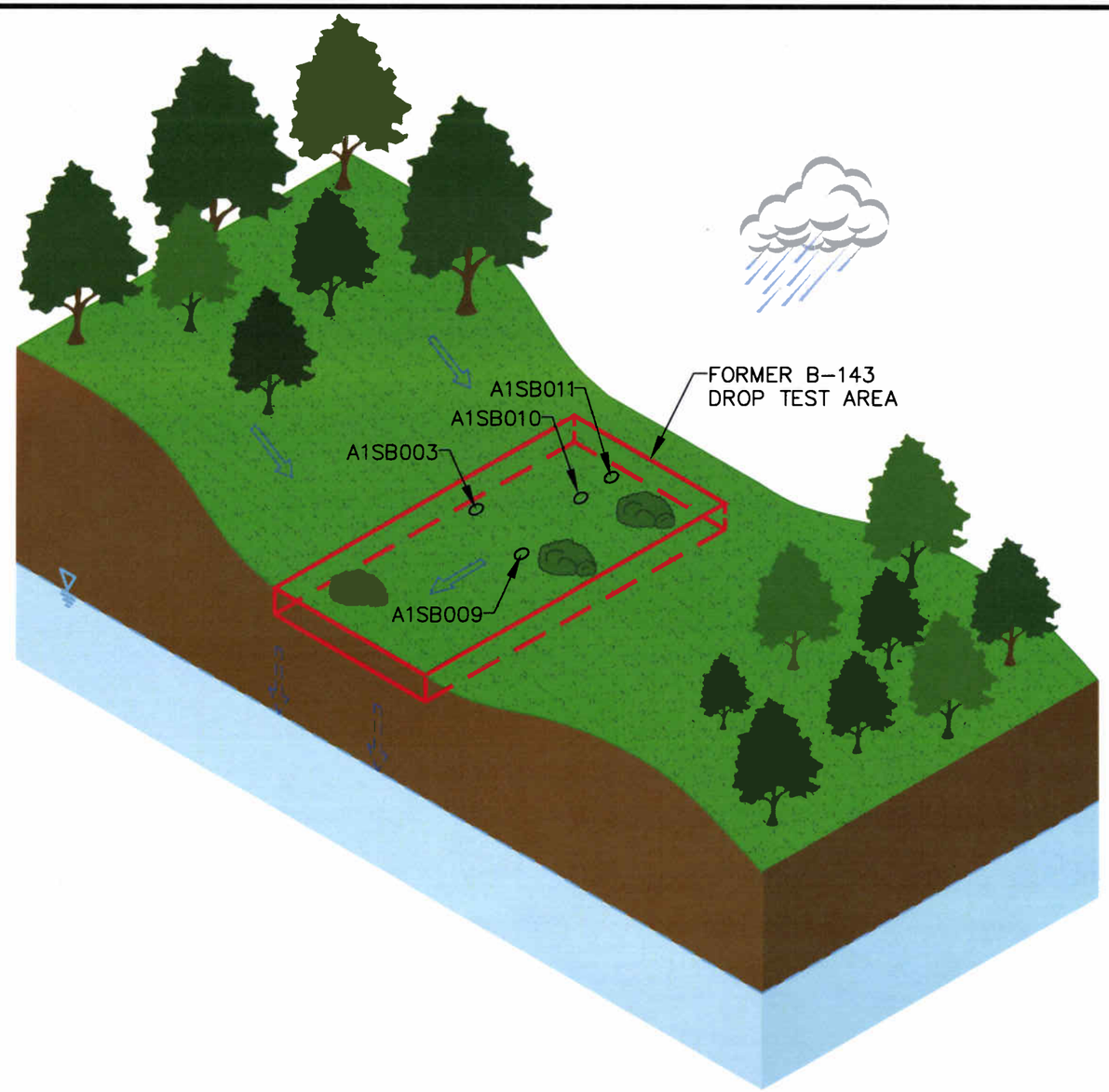
MRP SITE BOUNDARY

WATER TABLE (ESTIMATED)

HIGHEST SOIL LEAD CONCENTRATIONS OBSERVED IN SURFACE SOIL SAMPLES FROM AOC 01		
SAMPLE NAME	XRF READING (mg/kg)	LAB CONC. (mg/kg)
A1SB010	307	164
A1SB003	63	56
A1SB009	60	NA
A1SB011	41	NA

NOTE:
HIGHEST LAB CONCENTRATIONS NOTED ABOVE WERE ABOVE 27 mg/kg BASEWIDE BACKGROUND LEVEL BUT WERE BELOW THE 400 mg/kg REGIONAL RESIDENTIAL SCREENING LEVEL FOR LEAD IN SOIL. OTHER SAMPLES CONSISTENT WITH BACKGROUND LEVELS.

CURRENT AND FUTURE RECEPTORS FOR AOC 01
HUMAN: –MILITARY/CIVILIAN PERSONNEL –CONTRACTORS –TRESPASSERS
ECOLOGICAL: –PLANTS –INVERTEBRATES –BIRDS –MAMMALS



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CHECKED BY	DATE
REVISED BY	DATE
SCALE NOT TO SCALE	

NAVFAC

B–143 DROP TEST AREA–AOC 01
CONCEPTUAL SITE MODEL
NSA
CRANE, INDIANA

CONTRACT NO. 1621	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 4–4	REV. 0

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5.0 PYRO AREA OUTSIDE TEST BURN PADS – AOC 02

5.1 SITE BACKGROUND

Pyro Area Outside Test Burn Pads – AOC 02

The Pyro Area Outside Test Burn Pads is located in the north-central portion of NSA Crane in the Pyrotechnics Productions Area (Figure ES-2). This area covers approximately 0.002 acres of installation property that gently slopes to the southwest from an elevation of approximately 775 feet above msl. The Pyro Area Outside Test Burn Pads is located south of Highway 5 and 300 feet west of B-126 (which houses a flare and illuminant assembly operation) in the Pyrotechnic Area of NSA Crane. A storage area and an area of grass and pavement are located between the site and B-126. Several other buildings associated with pyrotechnics production are located in the immediate area of this site. A fence surrounds the entire area of the pyrotechnics testing and assembly area in which the Pyro Area Outside Test Burn Pads is located. The fencing limits access to the pyrotechnics construction buildings and prohibits access to the area.

According to installation personnel, the concrete testing basins were used for testing various pyrotechnics devices that were being developed at NSA Crane. Historical aerial photographs and installation maps indicate that these concrete basins may have been in use as early as the 1950s. The Pyro Area Outside Test Burn Pads consists of two square concrete basins (approximately 6-feet by 6-feet and approximately 30 feet apart), located west of B-126, and the basins were described in the PA (Malcolm Pirnie, 2005a) as reportedly used from 1984 to 1985 to test various types of pyrotechnics that were developed at NSA Crane, such as flares, signals, and screening smokes. The depth of each basin was approximately 4 to 5 feet, with 2 to 3 feet extending bgs. The bottom of each basin appeared to be intact (concrete) and was covered with 3 to 4-inches of soil. The walls of the basins, which extend approximately 2 to 3 feet above the ground surface, are in a poor deteriorating condition. During the PA and Tetra Tech site visits, no munitions-related debris was observed either within the basins or along the ground surface in the immediate area surrounding the basins. As observed during the 2009 Tetra Tech site visit, the basins contained large chunks of concrete debris, presumably from a nearby demolition project. The general poor condition of the tops of the concrete basin walls appears to confirm that these basins are likely over 25 years old and may actually be closer to 50 or 60 years old.

Testing at the site was conducted inside the concrete basins. Kick outs, which result when munitions items are not consumed during operations but are ejected by detonation forces, are not expected to have

lead to direct soil contamination outside the basins because the testing occurred inside the basins and the test items were pyrotechnic devices, not explosives. It is likely that burning pyrotechnics produced combustion products in smoke that had been released and deposited on the area surface soil surrounding the basins during the period that the site was used for testing. However, it is suspected that the pyrotechnic residues released in the surrounding soils would have been at much lower concentrations than the pyrotechnic residues contained in the basins, due to the airborne dispersal over wide areas.

Access to the basin bottoms was difficult due to the large chunks of concrete inside each one; however, an approximate 6 inch by 6 inch area was cleared in each basin bottom and it was determined the bottoms were concrete. A metal rod was also used to poke down around the large chunks of concrete in various locations of the basins and each time a hard flat surface was encountered on the bottom. Based on these findings, the pyrotechnics are not expected to have penetrated the soil beneath the basins. There is a manhole in the area of the concrete testing basins indicating that underground utilities are present in the northern area of the site, but those are not related to the pyrotechnic testing activities and are most likely associated with a sanitary or storm water sewer line.

The Zanesville-Udorthents complex is present with 2 to 6 percent slopes at the Pyro Area Outside Test Burn Pads. These are shallow to deep, well-drained and moderately well-drained soils. The complex consists of about 48 percent Zanesville soil and 42 percent Udorthents that occur as areas so intricately mixed that mapping them separately is not practical. Zanesville soil has a moderate available water capacity and Udorthents soil has moderate permeability and available water capacity.

5.1.1 Historical Munitions Testing Information

From the mid-1940s through today various types of pyrotechnics have been developed at NSA Crane, including flares, signals, and screening smokes. The munitions tested or used at this site included a variety of military pyrotechnic devices (illumination markers, flares, signals, and screening smokes) which contained perchlorate, minor amounts of explosives (used as pyrotechnic initiators) and Navy dye compounds for screening smoke and colored flares and signals. It is likely that pyrotechnic testing was performed in the AOC 02 concrete basins beginning as early as the 1950s (based on aerial photographs) through 1985 to support the pyrotechnic production operations in Building 126 and other related pyrotechnic research and development activities.

5.1.2 Munitions Constituents

The residual material inside the two square concrete basins could be contaminated with MC. Based on past site operations, suspected MC at the Pyro Area Outside Test Burn Pads would include perchlorate, explosives, and Navy dye compounds.

5.1.3 Current Land Use and Anticipated Future Land Use

Several other buildings associated with pyrotechnics production are located in the immediate area of this site. Currently, the area around Pyro Area Outside Test Burn Pads is not used and the immediate surrounding areas are used for storage. The land use for the site and surrounding areas is not anticipated to change for the foreseeable future.

5.2 SITE FIELDWORK

5.2.1 Site Field Activities

The residual material (3 to 4 inches) inside the concrete basins could be contaminated with MC, which would include perchlorate, explosives, and Navy dye compounds. Subsurface soil (4 to 6 feet bgs) outside of the concrete basins may also be contaminated. Although the procedures used at the site during testing and the results of the visual survey make it unlikely that MEC are present in the residual material in the concrete basins, A UXO Technician was present during the MC investigation to confirm the absence of MEC. Safety and hazard anomaly avoidance practices were followed at this site during MC sampling.

The horizontal boundary for the MC investigation included the area around the concrete test basins at the Pyro Area Outside Test Burn Pads as shown on Figure 5-1. The horizontal boundary for this investigation extended to the surface area surrounding and downgradient of the basins to a distance of approximately 30 feet where surface runoff may have moved contaminants.

The vertical boundary for the Pyro Area Outside Test Burn Pads was limited to the residual material contained within the basins and the select soil locations and intervals outside the basins that are most likely to be contaminated. The interval of interest for the surface soil was 0- to 2-feet bgs. Data collected from this interval of surface soil will indicate the presence of contamination that could have been deposited there from the air column during testing activities and subsequent surface migration. The subsurface soil outside of the basins extended approximately two feet into the soil starting at the depth of the basin floor or bottom of basin walls. Although the bottoms of each basin are presumed to be intact

concrete, subsurface soil data from below the basins would represent any contamination that may have migrated from the basins into subsurface soil.

Soil sample locations were selected based on a bias towards areas that had the greatest likelihood to have been impacted by past site operations. See Figure 5-1 for all sample locations. Prior to initiating sample collection, all sample locations outside of the concrete basins were marked by colored pin flags bearing the sample location ID number. Proposed sample locations identified in the approved UFP-SAP were located by GPS. Sample locations from the bottom of each concrete basin were dependent on accessible locations through the large concrete chunks. Sample material within the basins was collected from five separate areas for a thorough representation of the material within the basins. Upon collection of the samples at the Pyro Area Outside Test Burn Pads, a field team member utilized the handheld GPS unit to collect actual sample location coordinates in order to map the sampling locations. These data were measured to sub-meter accuracy using the horizontal datum: NAD 83 Indiana State Plane Coordinate System West. All sample locations were as proposed in the approved UFP-SAP.

Photographs associated with the sampling activities at the Pyro Area Outside Test Burn Pads are presented in Appendix B.2.

The Pyro Area Outside Test Burn Pads site is routinely mowed; therefore, no vegetation clearance was required at the site.

5.2.2 Work Plan Deviations

There were no deviations from the UFP-SAP for the Pyro Area Outside Test Burn Pads.

5.2.3 Field Data Collection

Two composite samples, A2SS001C0001 and A2SS002C0001, each comprised of five grab samples from the residual material within each of the two concrete basins were collected to characterize the chemical nature of the materials remaining in the basins. Composite samples provide greater spatial coverage than individual grab samples and thus increase the potential for detecting contamination. To determine the exact depth of each basin prior to sampling, the FOL directed digging down alongside an exterior wall until the base of the basin was encountered. It was determined that the basins extend below ground approximately 2 to 3 feet; therefore, the goal of the composite sample within each basin was to collect material that is representative of the entire depth of the basin. The composite samples collected

from the residue within the concrete basins, were collected via a clean stainless steel hand trowel at 0 to 0.5 feet bgs.

Four grab subsurface soil samples were collected from each side of the exterior of the two basins by hand auger for a total of eight subsurface samples. Samples A2SB003G0406 through A2SB010G0406, were collected from 4 to 6 feet bgs, the depth that was determined to be just beneath the bottom of the basin floor. The interval of these samples began at the depth of the basin floor (4 feet) and extended 2 feet below that depth (6 feet).

Two individual surface soil samples, A2SB011G0002 and A2SB012G0002, were collected by hand auger in a downslope location from each of the two basins and in an area where surface runoff from the basin area would flow, as determined in the field by the local topography. The surface soil interval of interest for these downslope samples was 0- to 2-feet bgs.

All 12 samples were placed in large Ziploc® bags and thoroughly homogenized prior to placing a portion of the sample in the appropriate sample jar and shipped to the respective FBL for explosives, perchlorate, and Navy dye analyses. Table 5-1 provides a summary of the samples collected at the Pyro Area Outside Test Burn Pads, and Figure 5-1 shows all sampling locations. Soil sample log sheets are included in Appendix A.2 of this document.

5.3 SITE INSPECTION DATA COLLECTION RESULTS

5.3.1 MC Sampling Results

Twelve soil samples were analyzed for the presence of MC (explosives, SW-846 Method 8330A; perchlorate, SW-846 6850; and Navy dye compounds, CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001). Limitations were considered when evaluating and interpreting the Navy dye data. Limitations on data use were in accord with the data usability assessment description provided on Worksheet #37 of the UFP-SAP.

Soil samples collected at the Pyro Area Outside Test Burn Pads were compared to human health screening levels. The complete MC analytical results are presented in Appendix C and the data validation reports are presented in Appendix D.2.

Table 5-2 summarizes the MC explosives analytical results. There were no explosive compound PAL exceedances. There were detections associated with "J" qualifiers, meaning the chemical was present; however, the associated reported concentration should be regarded as an estimate and not regarded as a precise representation of the concentration that may be present in the sample. The FBL reported concentration is an estimate of the true concentration. The following explosive constituents had "J"-qualified detections: 2-Nitrotoluene at A2SS001C0001; 2-Amino-4, 6-Dinitrotoluene, Nitrobenzene, and Nitroglycerin at A2SS002C0001; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) at A2SB005G0406 and A2SB010G0406; and cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX) at A2SB008G0406.

Table 5-3 summarizes the MC perchlorate analytical results. There were no perchlorate PAL exceedances in the Pyro Area Outside Test Burn Pads samples. All the Pyro Area Outside Test Burn Pads soil samples had perchlorate detections and several of those were estimated or "J" qualified. However, the PAL for perchlorate is 55,000 micrograms per kilogram (µg/kg), and the highest sample detection was 5.5 µg/kg, which is 1/10,000 the PAL.

Table 5-4 summarizes the MC Navy dye analytical results. Three of the 12 samples had exceedances of the Navy dye PALs; however, all detections were estimated or "J"-qualified. The following Navy dye parameters had "J"-qualified detections: Solvent Green 3 at A2SS001C0001, A2SS002C0001, and A2SS012G0002; and Solvent Yellow 3 at A2SS002C0001. No other Navy dye compounds were detected at the Pyro Area Outside Test Burn Pads.

The entire analytical data set for the Pyro Area Outside Test Burn Pads samples is presented in Appendix C.

Figure 5-2 shows the Pyro Area Outside Test Burn Pads sample locations exhibiting explosive compound detections.

Figure 5-3 shows the Pyro Area Outside Test Burn Pads sample locations exhibiting perchlorate detections.

Figure 5-4 shows the Pyro Area Outside Test Burn Pads sample locations exhibiting Navy dye compound detections.

The Human Health Risk Screening Evaluation summary is discussed in Section 5.5, with supporting documentation presented in Appendix F.2.

The Ecological Risk Screening Evaluation summary is discussed in Section 5.6, with supporting documentation presented in Appendix G.2.

5.4 DATA PRESENTATION AND USABILITY

5.4.1 Data Validation Process

All of the results from analytical FBL samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (USEPA, 2004) guidelines.

5.4.1.1 Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Appendix D.2**.** Rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections are also presented in Appendix D.2. Rejected data are not acceptable for performing risk assessments.

5.4.1.2 Completeness

The explosives fraction had 8 out of 195 results rejected because of percent difference between columns greater than 100 percent. The results are likely false positives because the compounds cannot be confirmed using a second column. The FBL measurement completeness was 95.9 percent, which meets the 90 percent completeness goal. The sample collection completeness was 100 percent.

5.4.1.3 Sensitivity

The PQLGs are listed in Worksheet #15 of the UFP-SAP (Tetra Tech, 2009). Analytical sensitivity for data at the Pyro Area Outside Test Burn Pads was satisfactory to meet data quality objectives (DQOs) presented in the UFP-SAP.

There were no instances where the non-detected sample results exceed the PQLGs either because of the FBLs inability to meet the PQLG or because of elevated detection limits due to blank contamination.

5.4.1.4 Field and Laboratory Accuracy

There were several results qualified due to surrogate recovery in the explosive and dye analyses for the Pyro Area Outside Test Burn Pads. However, the qualifications do not point to any trends showing a systematic problem with extraction efficiency. There were no quality control deficiencies noted for field accuracy.

5.4.1.5 Field and Laboratory Precision

There were no quality control deficiencies noted for field or FBL precision at the Pyro Outside Test Burn Pads.

5.4.1.6 Comparability

No comparability issues were noted during the data validation process for the Pyro Outside Test Burn Pads.

5.4.1.7 Representativeness

The UFP-SAP (Tetra Tech, 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and FBL audits all reported data are adequately representative of site conditions and intended populations at the Pyro Outside Test Burn Pads.

5.5 HUMAN HEALTH RISK SCREENING EVALUATION SUMMARY

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from MC present at the Pyro Area Outside Test Burn Pads. Tetra Tech evaluated soil sampling data for the Pyro Area Outside Test Burn Pads as well as for soil samples collected within the concrete basins. Soil samples were analyzed for explosives, Navy dye compounds, and perchlorate. Two composite soil samples (A2SS001C0001 and A2SS002C0001) were collected from within concrete basins and are more representative of material disposed of in the basins than in surrounding soil.

For residues within the concrete basins, only Solvent Green 3 and Solvent Yellow 3 were detected at concentrations exceeding the USEPA and Indiana Department of Environmental Management (IDEM) direct contact risk-based COPC screening levels and were retained as COPCs.

For soil from outside the concrete basins, only Solvent Green 3 was detected at concentrations exceeding the USEPA and IDEM direct contact risk-based COPC screening levels and was retained as a COPC.

Hazard Indices (HIs) for residential and industrial exposures to soil outside of the concrete basins were less than or equal to unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions. There are no carcinogenic toxicity criteria available for the identified COPCs in soil from outside the concrete basins; therefore, Incremental Lifetime Cancer Risks (ILCRs) could not be calculated.

The HI for residential exposures to residues inside of the concrete basins exceeds the acceptable level of 1. Solvent Green 3 was the major contributor to the HI for residential exposures. The HI for industrial exposures to residue inside of the concrete basins was less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for industrial exposures under the defined exposure conditions. The ILCR for residential exposures to residue (soil) inside of the concrete basins exceeded the USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}. Solvent Yellow 3 was the major contributor to the ILCR for residential exposures. The ILCR for industrial exposures to soil inside of the concrete basins was within USEPA's and IDEM's target risk range. It is very unlikely that future residents would be exposed to residue collected from within the concrete basins. In the future if the site was developed for residential use then the concrete basins would be removed. It is also unlikely that industrial workers would have prolonged contact with the residue in the concrete basins. Therefore, the ILCRs and HIs calculated for

potential exposures to residue in the concrete basins are very conservative and are presented to aid in risk management decisions.

RDX was the only chemical detected in soil from outside the concrete basins at a concentration exceeding the screening criteria for the protection of migration from soil to groundwater; therefore, RDX was retained as a COPC for the migration from soil to groundwater at the Pyro Area Outside Test Burn Pads. RDX was only detected in a single soil sample (A2SB008G0406) with an RDX concentration of 0.076 "J" mg/kg. The detected concentration exceeded the USEPA soil screening levels (SSLs) based on dilution-attenuation factors (DAFs) of 1 (0.00023 mg/kg) and 20 (0.0046 mg/kg), (Appendix F, Table F-2.7). The available data indicates there is not a significant source area of RDX in soils at the Pyro Area Outside Test Burn Pads; therefore, the single detected concentration of RDX is not expected to adversely impact groundwater at the Pyro Area Outside Test Burn Pads. Groundwater from the Pyro Area Outside Test Burn Pads is not currently used as a source of drinking water, so the pathway is currently incomplete.

The explosive compounds 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, nitrobenzene, and nitroglycerin were detected in residue from inside the concrete basins at concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs. These detections in sample A2SB0001 and A2SB0021 were at very low and estimated concentrations, but still above the DAF risk screening levels presented in Appendix F, Table F-2.8.

A single estimated nitrobenzene detection of 0.044 J in the composite residue sample (A2SS002C) from the southern basin exceeded the USEPA SSLs based on DAFs of 1 (0.000079 mg/kg) and 20 (0.00158 mg/kg), (Appendix F, Table F-2.8) and the IDEM migration from soil to groundwater criteria (0.028 mg/kg). The composite residue sample (A2SS002C) from the southern basin also contained and estimated concentration of 2-amino-4,6-dinitrotoluene (0.071 J mg/kg) that exceeded the USEPA SSL based on a DAF of 1 (0.056 mg/kg), but were less than the SSL based on a DAF of 20 (1.12 mg/kg). Similar estimated detections of 2-nitrotoluene (0.067 J mg/kg) and nitroglycerin (0.013 J mg/kg) in the basin residue composite samples exceeded the USEPA SSLs based on DAFs of 1 and 20 (Appendix F, Table F-2.8).

The data indicate there is no significant source area of 2-NT and NG at the site. Groundwater is not used at the site as a source of drinking water; therefore, the exposure pathway for human receptors is incomplete.

5.6 ECOLOGICAL RISK SCREENING SUMMARY

The goal of the ecological risk screening is to determine whether adverse ecological impacts are present at the site as a result of exposure to chemicals released to the environment through historical site activities. The risk screening allows conclusions to be made as to whether ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks at the site.

The ecological risk screening for the Pyro Area Outside Test Burn Pads only took into consideration the two downslope samples (A2SS011G0002 and A2SS012G0002). The two composite residue samples A2SS001C0001 and A2SS002C0001 were collected within the concrete basins, and since the concrete bottoms are believed to be intact and there is no ecological habitat in the basins, these samples were not evaluated in the ecological risk screening. The eight samples (A2SS003G0406 through A2SS010G04046) collected outside the bottoms of the two concrete basins were at depths of 4 to 6 feet bgs where there is very limited ecological exposure; therefore, those samples were not evaluated in the ecological risk screening.

Solvent Green 3 and perchlorate were initially retained as COPCs for risks to terrestrial plants, invertebrates, mammals, and birds because screening levels are not available. When a chemical is initially retained as an ecological COPC, it then goes through refinement to better define those chemicals and to identify and eliminate any chemicals from further consideration that were retained because of very conservative exposure scenarios.

Upon refinement, Solvent Green 3 continued to be retained as a COPC for plants and invertebrates since no screening values are available and it could not be further evaluated. Based on low ecological effects quotient (EEQs) from the less conservative terrestrial food chain modeling for mammals, Solvent Green 3 was not retained as a COPC for mammals. Although screening values are not available for birds, Solvent Green 3 is not likely to impact birds based on the low EEQs for mammals and the fact that the site is only 0.02 acres, and birds would only obtain a very small portion of their food from this site, Solvent Green 3 was not retained as a COPC for birds.

Perchlorate was detected at low concentrations (0.00098 and 0.001 mg/kg) in both downslope soil samples. Limited data indicates that perchlorate does not have an effect on plants and earthworms at low concentrations (< 10 mg/kg) (Yoo, et al, undated). Based on a study by the USEPA in 2002, a screening benchmark of 4 mg/kg for plants and 1 mg/kg for earthworms was calculated, and since both perchlorate detections at the Pyro Area Outside Test Burn Pads were well below these concentrations, perchlorate was not retained as a COPC.

5.7 UPDATED CSM

Only MC associated with the Pyro Area Outside Test Burn Pads is considered in the CSM exposure pathway analysis (Figure 5-5). A general description of the CSM exposure pathway analysis as presented in the UFP-SAP (Tetra Tech, 2009) is summarized below:

As a result of past practices, MEC or MC could be present in the residual material located within the concrete basins; however, it appears as though the concrete floors within the basins are intact, thus preventing leaching of contaminants into the surrounding subsurface soil.

Current human receptors at this site that could come into contact with MC contamination in soil include military and civilian personnel, contractors, and visitors. MC is typically contained in residue within the concrete basins and separated from subsurface soil and groundwater; therefore, it is anticipated that wildlife would not have contact with MC at this site.

CSM Summary

The updated CSM for the Pyro Area Outside Test Burn Pads is shown on Figure 5-6 and details the potential exposure sources, pathways, and receptors. The exposure sources appear to be limited to residual material within the basins. Leaching from soil into groundwater has been eliminated as a pathway, since groundwater is not used at the site. No potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. However, if the basins were to be removed, the residual material within the basins should be properly disposed of.

5.8 CONCLUSIONS

Soil samples at the Pyro Area Outside Test Burn Pads were analyzed for explosives, Navy dye compounds, and perchlorate. Composite samples were collected from the residual material within two concrete basins, eight discrete subsurface samples were collected around the sides of each basin, and two discrete samples were collected approximately 30 feet downslope of each basin.

The available data indicates there is not a significant source area of explosives in soils at the Pyro Area Outside Test Burn Pads. Explosives in soils outside the concrete basins are not present at concentrations that are greater than human health or ecological screening levels. The single detected concentration of RDX, collected from the subsurface soil along the outside of a concrete basin and below

the PAL, is not expected to adversely impact groundwater at the site. Groundwater from the Pyro Area Outside Test Burn Pads is not currently used as a source of drinking water, so the pathway is incomplete.

The explosive compounds 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, nitrobenzene, and nitroglycerin were detected in residue from inside the concrete basins at concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs at the Pyro Area Outside Test Burn Pads. The concrete basins appear to be intact with solid concrete bottoms; therefore, the residual materials within the basins would not have any impact on the area outside of the basins. Furthermore, the groundwater from the Pyro Area Outside Test Burn Pads is not currently used as a source of drinking water, so the pathway is incomplete.

All perchlorate detections were below the PAL for human health, and the detections at the two downslope soil samples were deemed negligible to cause any adverse ecological effects.

The Navy dye compound, Solvent Green 3 was retained as an ecological COPC since there are no available screening values and it could not be further evaluated.

5.9 RECOMMENDATIONS

Based on the SI results, the concrete basins appear to be intact with solid concrete bottoms; therefore, the residual materials within the basins would not have any impact on the area outside of the basins. A reasonable best management practice for this MRP site should include the demolition and removal of the concrete basin structures. Prior to basin demolition, the residual material in the bottom of the concrete basins should first be removed and properly disposed.

No dyes were detected in the vicinity of the concrete basins and although one downslope soil sample contained a detectable level of a single dye compound, it does not appear that this single estimated dye compound detection in surface soil warrants further evaluation to support future site closure.

Following completion of the concrete basin removals, AOC 02 is recommended for NFA.

TABLE 5-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
PYRO AREA OUTSIDE TEST BURN PAD - AOC 02
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	FBL ANALYSIS		
					Explosives (SW-846 8330A)	Perchlorate (SW-846 6850)	Navy Dye Compounds[1]
A2SB001	A2SS001C0001	9/9/2009	HA	0-1	X	X	X
A2SB002	A2SS002C0001	9/9/2009	HA	0-1	X	X	X
A2SB003	A2SB003G0406	9/9/2009	HA	4-6	X	X	X
A2SB004	A2SB004G0406	9/9/2009	HA	4-6	X	X	X
A2SB005	A2SB005G0406	9/9/2009	HA	4-6	X	X	X
A2SB006	A2SB006G0406	9/9/2009	HA	4-6	X	X	X
A2SB007	A2SB007G0406	9/9/2009	HA	4-6	X	X	X
A2SB008	A2SB008G0406	9/9/2009	HA	4-6	X	X	X
A2SB009	A2SB009G0406	9/9/2009	HA	4-6	X	X	X
A2SB010	A2SB010G0406	9/9/2009	HA	4-6	X	X	X
A2SB011	A2SS011G0002	9/9/2009	HA	0-2	X	X	X
A2SB012	A2SS012G0002	9/9/2009	HA	0-2	X	X	X

1 = CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001

X = Indicates sample was collected and analyzed as proposed in the UFP-SAP (Tetra Tech, 2009)
bgs = below ground surface
FBL = Fixed-base laboratory
HA = Hand auger

TABLE 5-2

SURFACE SOIL MC EXPLOSIVES DETECTIONS
PYRO AREA OUTSIDE TEST BURN PAD - AOC 02
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	A2SB001		A2SB001		A2SB001		A2SB002		A2SB003		A2SB004		A2SB005		A2SB006		A2SB007	
Sample ID		A2SS001C0001		A2SS001C0001-AVG		A2SS001C0001-D		A2SS002C0001		A2SB003G0406		A2SB004G0406		A2SB005G0406		A2SB006G0406		A2SB007G0406	
Sample Date		20090909		20090909		20090909		20090909		20090909		20090909		20090909		20090909		20090909	
Sample Type		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)																			
2-AMINO-4,6-DINITROTOLUENE	15	0.062	U	0.062	UJ	0.062	UJ	0.071	J	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U
2-NITROTOLUENE	2.9	0.067	J	0.067	J	0.78	R	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U
HMX	380	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.059	J	0.062	U	0.062	U
NITROBENZENE	4.4	0.062	U	0.062	UJ	0.062	UJ	0.044	J	0.062	U	0.062	U	0.062	U	0.029	R	0.062	U
NITROGLYCERIN	6.1	0.21	UJ	0.21	UJ	0.21	UJ	0.13	J	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ
RDX	5.5	0.062	U	0.062	U	0.062	U	0.062	U	0.024	R	0.028	R	0.062	U	0.033	R	0.029	R

Sample Location	PAL (mg/kg)	A2SB008		A2SB009		A2SB010		A2SB011		A2SB012	
Sample ID		A2SB008G0406		A2SB009G0406		A2SB010G0406		A2SS011G0002		A2SS012G0002	
Sample Date		20090909		20090909		20090909		20090909		20090909	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)											
2-AMINO-4,6-DINITROTOLUENE	15	0.062	U	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ
2-NITROTOLUENE	2.9	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U
HMX	380	0.062	U	0.062	U	0.038	J	0.062	U	0.062	U
NITROBENZENE	4.4	0.062	U	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ
NITROGLYCERIN	6.1	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ	0.21	UJ
RDX	5.5	0.076	J	0.062	U	0.062	U	0.062	U	0.062	U

mg/kg = milligram per kilogram
PAL = Project action limit

Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.
R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

TABLE 5-3

SURFACE SOIL MC PERCHLORATE DETECTIONS
PYRO AREA OUTSIDE TEST BURN PAD - AOC 02
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A2SB001		A2SB001		A2SB001		A2SB002		A2SB003		A2SB004		A2SB005		A2SB006	
Sample ID		A2SS001C0001		A2SS001C0001-AVG		A2SS001C0001-D		A2SS002C0001		A2SB003G0406		A2SB004G0406		A2SB005G0406		A2SB006G0406	
Sample Date		20090909		20090909		20090909		20090909		20090909		20090909		20090909		20090909	
Sample Type		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Miscellaneous (µg/kg)																	
PERCHLORATE	55000	5		5.25		5.5		3.2		0.51	J	0.25	J	1.3	J	1.3	J

Sample Location	PAL (µg/kg)	A2SB007		A2SB008		A2SB009		A2SB010		A2SB011		A2SB012	
Sample ID		A2SB007G0406		A2SB008G0406		A2SB009G0406		A2SB010G0406		A2SS011G0002		A2SS012G0002	
Sample Date		20090909		20090909		20090909		20090909		20090909		20090909	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Miscellaneous (µg/kg)													
PERCHLORATE	55000	4.9		5.5		1.5	J	4.5		1	J	0.98	J

µg/kg = microgram per kilogram
PAL = Project action limit

Notes:

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

TABLE 5-4

SURFACE SOIL MC NAVY DYE DETECTIONS
PYRO AREA OUTSIDE TEST BURN PAD - AOC 02
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A2SB001		A2SB001		A2SB001		A2SB002		A2SB003		A2SB004		A2SB005		A2SB006		A2SB007	
Sample ID		A2SS001C0001		A2SS001C0001-AVG		A2SS001C0001-D		A2SS002C0001		A2SB003G0406		A2SB004G0406		A2SB005G0406		A2SB006G0406		A2SB007G0406	
Sample Date		20090909		20090909		20090909		20090909		20090909		20090909		20090909		20090909		20090909	
Sample Type		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Dyes (µg/kg)																			
SOLVENT GREEN 3	125000	**305027**	**J**	**602971**	**J**	**900915**	**J**	**402177**	**J**	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ
SOLVENT YELLOW 3	130	973	U	973	UJ	973	UJ	**40446**	**J**	973	U	973	U	973	U	973	UJ	973	UJ

Sample Location	PAL (µg/kg)	A2SB008		A2SB009		A2SB010		A2SB011		A2SB012	
Sample ID		A2SB008G0406		A2SB009G0406		A2SB010G0406		A2SS011G0002		A2SS012G0002	
Sample Date		20090909		20090909		20090909		20090909		20090909	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Dyes (µg/kg)											
SOLVENT GREEN 3	125000	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ	**176035**	**J**
SOLVENT YELLOW 3	130	973	UJ	973	UJ	973	UJ	973	UJ	973	UJ

µg/kg = microgram per kilogram
PAL = Project action limit

Shading indicates an exceedence of the PAL.

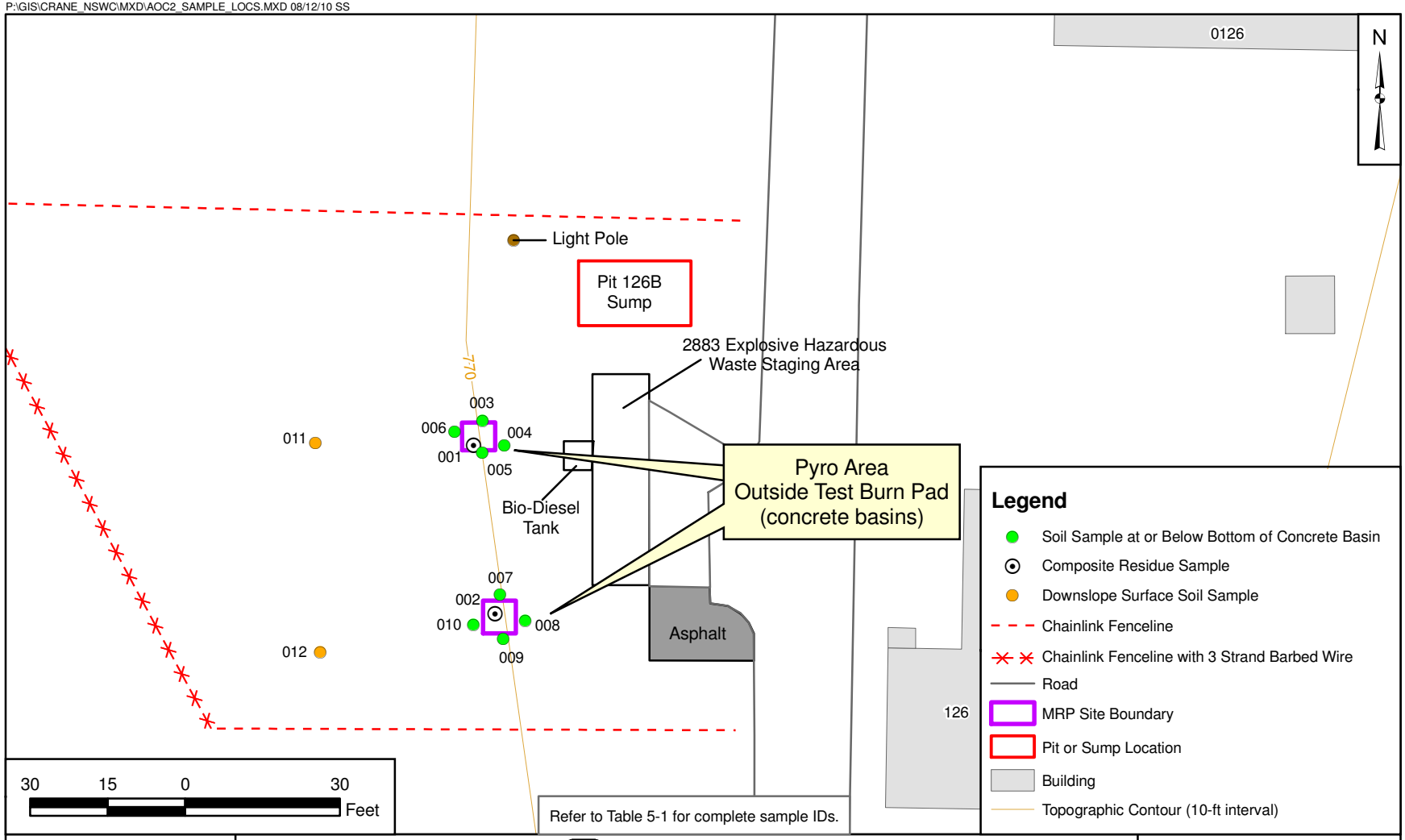
Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

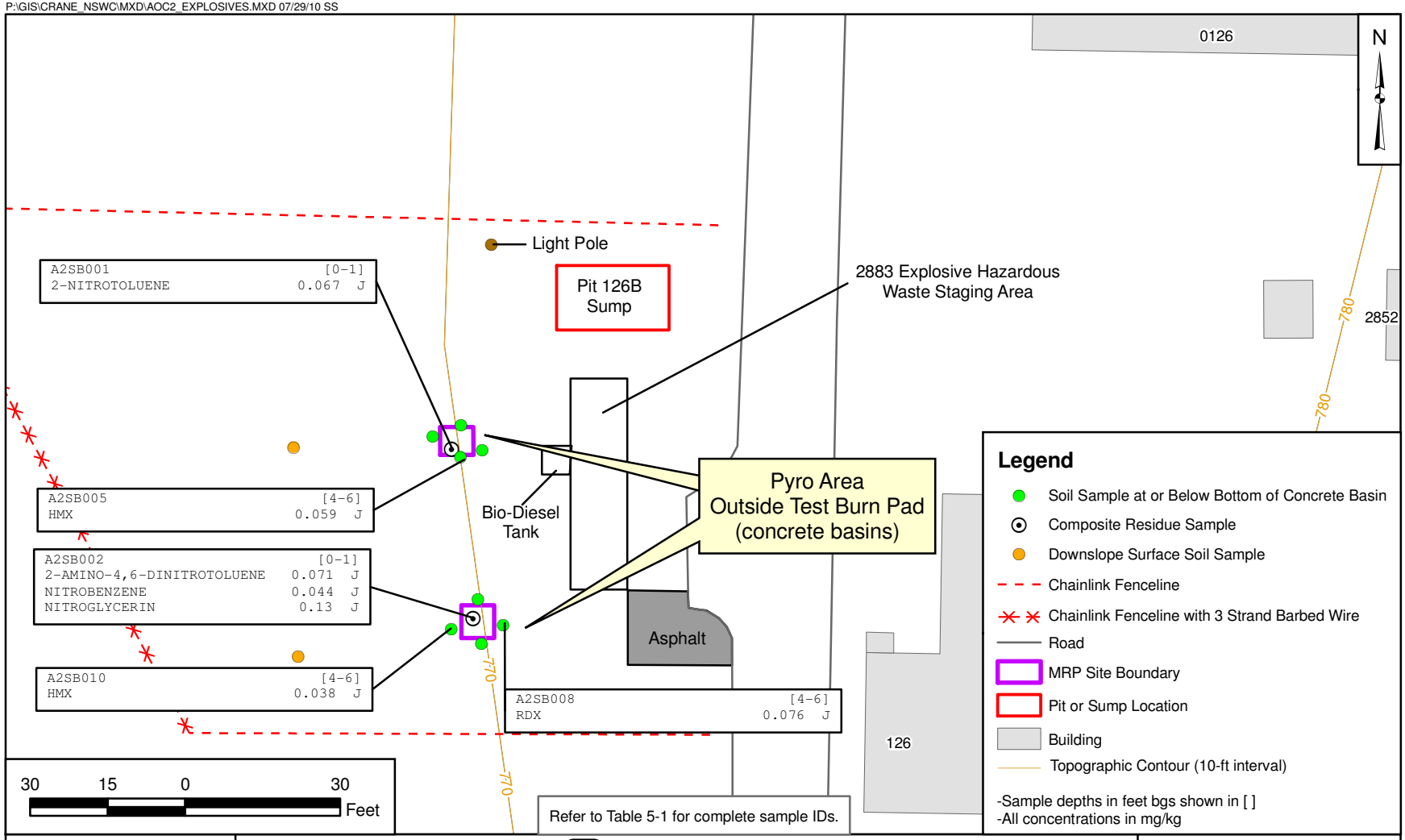
J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

P:\GIS\CRANE_NSWC\MXD\AOC2_SAMPLE_LOCS.MXD 08/12/10 SS



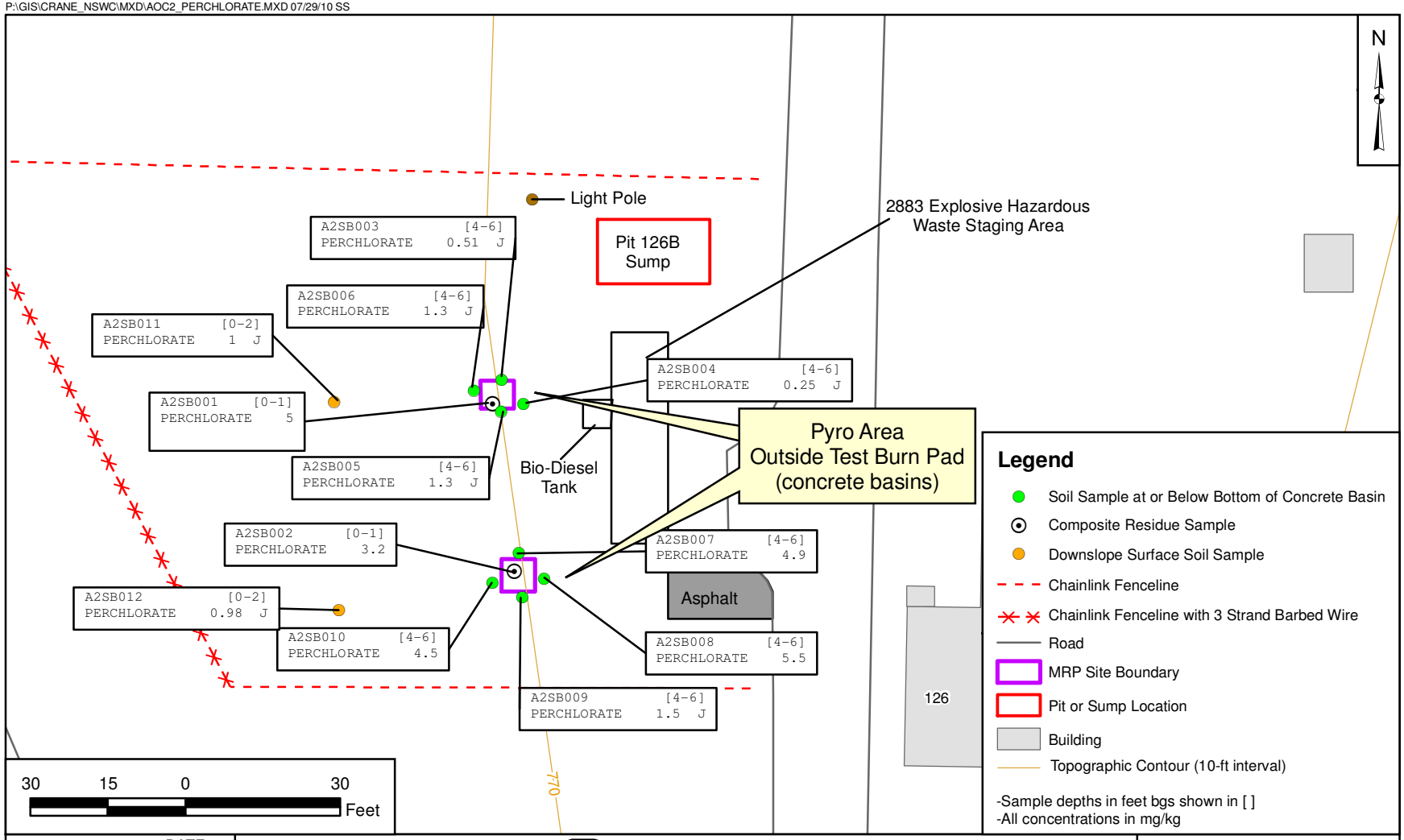
DRAWN BY S. STROZ	DATE 07/22/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER CTO F272
CHECKED BY R. BARRINGER	DATE 08/12/10	PYRO AREA OUTSIDE TEST BURN PAD - AOC 2 MC SAMPLING LOCATIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 5-1 / REV 0

P:\GIS\CRANE_NSWC\MXD\AOC2_EXPLOSIVES.MXD 07/29/10 SS



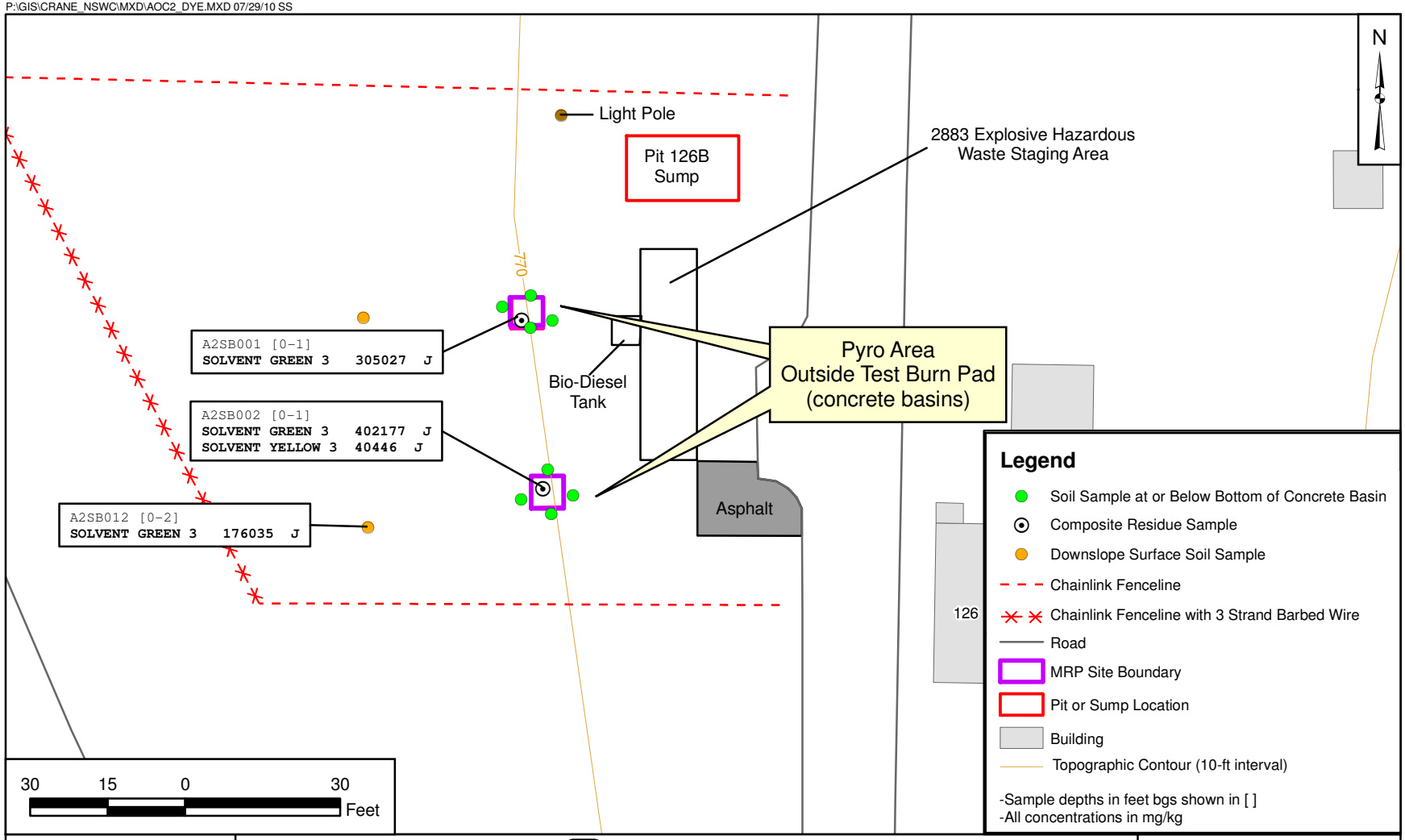
DRAWN BY T. WHEATON	DATE 02/05/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY R. BARRINGER	DATE 07/29/10	PYRO AREA OUTSIDE TEST BURN PAD - AOC 2 BASIN RESIDUE AND SOIL SAMPLE EXPLOSIVES COMPOUND DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 5-2 / REV 0

P:\GIS\CRANE_NSWC\MXD\AOC2_PERCHLORATE.MXD 07/29/10 SS



DRAWN BY T. WHEATON	DATE 02/05/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY R. BARRINGER	DATE 07/29/10	PYRO AREA OUTSIDE TEST BURN PAD - AOC 2 BASIN RESIDUE AND SOIL SAMPLE PERCHLORATE DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 5-3 / REV 0

P:\GIS\CRANE_NSWC\MXD\AOC2_DYE.MXD 07/29/10 SS



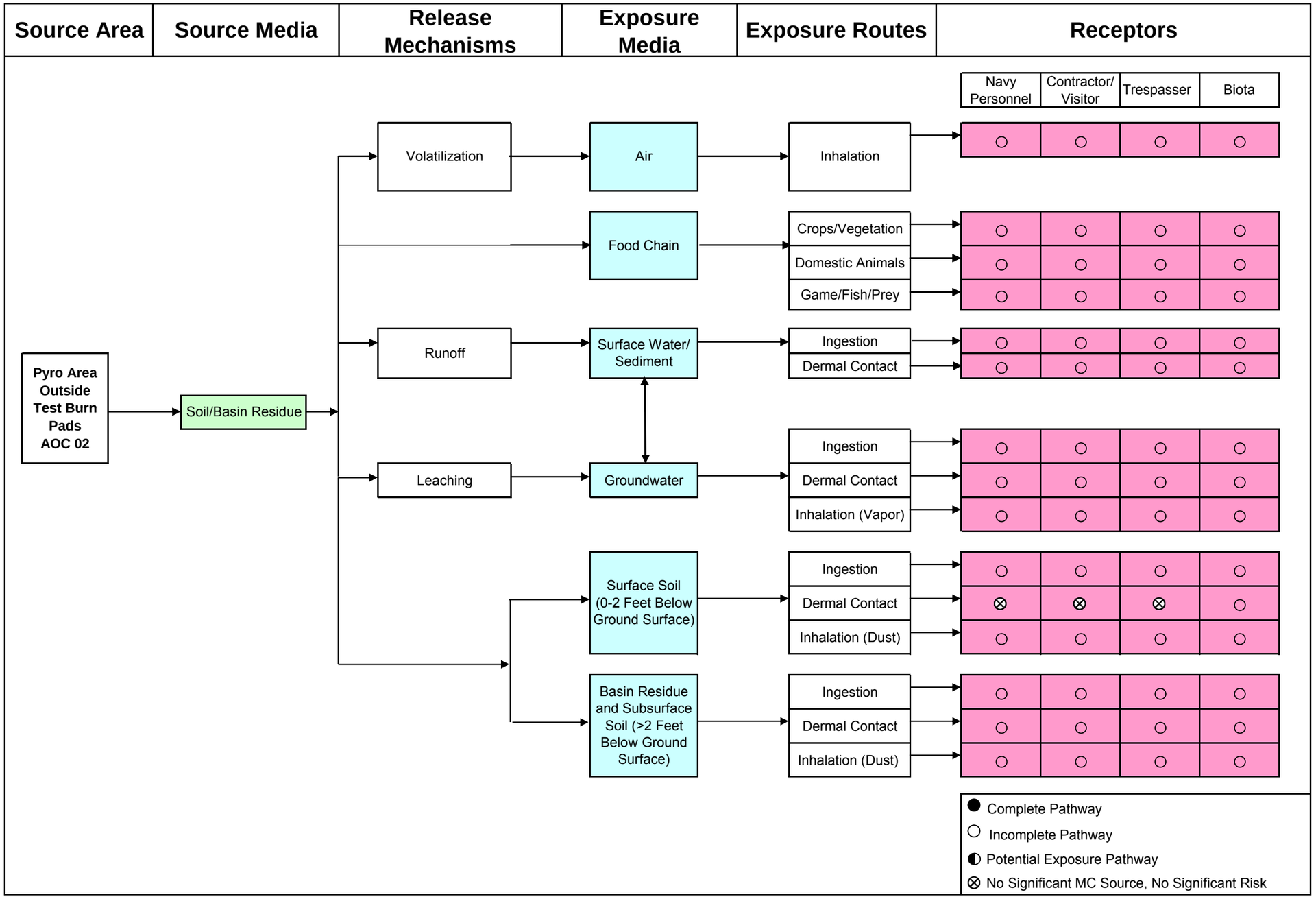
DRAWN BY T. WHEATON	DATE 02/05/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY R. BARRINGER	DATE 07/29/10	PYRO AREA OUTSIDE TEST BURN PAD - AOC 2 BASIN RESIDUE AND SOIL SAMPLE NAVY DYE COMPOUND DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 5-4 / REV 0

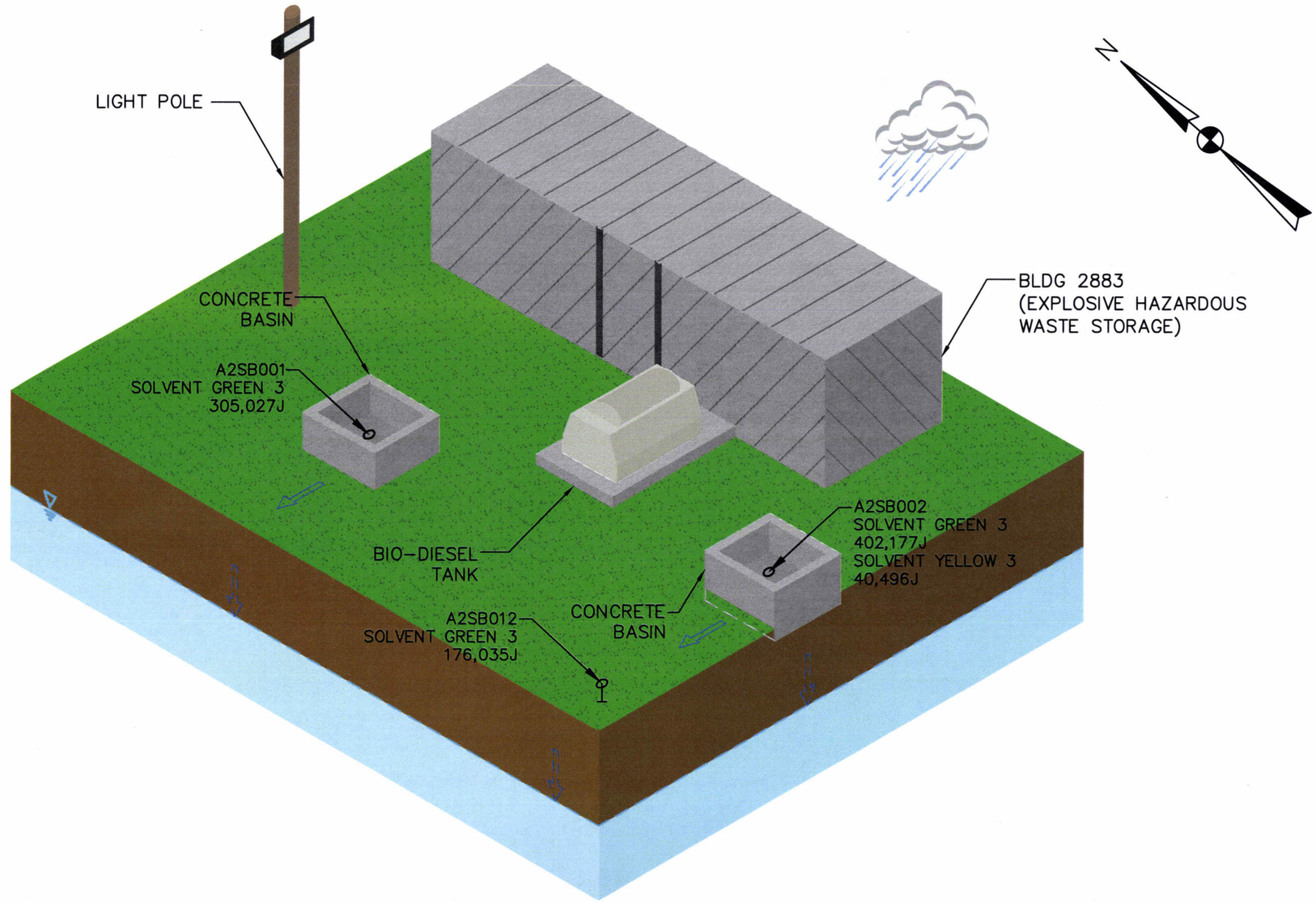
FIGURE 5-5

MC EXPOSURE PATHWAY ANALYSIS

PYRO AREA OUTSIDE TEST BURN PADS - AOC 02

NSA CRANE, CRANE, INDIANA





LEGEND

RUNOFF

INFILTRATION

WATER TABLE (ESTIMATED)

NOTE:
PRIMARY DYE COMPOUND DETECTIONS IDENTIFIED IN BASIN RESIDUE SAMPLES. NO SIGNIFICANT DETECTIONS OF PERCHLORATE OR EXPLOSIVES. ONLY ONE DYE DETECTION DOWN SLOPE SOIL SAMPLE (A2SB012), AND THERE WERE DETECTIONS OF UP TO TWO DYE COMPOUNDS IN THE BASIN RESIDUE SAMPLES.CONCENTRATIONS ARE IN ug/kg.

CURRENT AND FUTURE RECEPTORS FOR AOC 02
HUMAN: -MILITARY/CIVILIAN PERSONNEL -CONTRACTORS -TRESPASSERS

DRAWN BY CK DATE 3/30/10	NAVFAC	PYRO AREA OUTSIDE TEST BURN PAD – AOC 02 CONCEPTUAL SITE MODEL NSA CRANE, INDIANA	CONTRACT NO. 1621
CHECKED BY DATE			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 5-6 / REV. 0

R:\1621\CSM\1621CSM02.dwg PIT NICHOLE.DILLA 4/13/2010 9:13:52 AM

6.0 TEST PADS ON HILL BEHIND B-198 – UXO 06

6.1 SITE BACKGROUND

Test Pads on Hill Behind B-198 – UXO 06

The Test Pads on Hill Behind B-198 are situated in the middle of a cleared woodland area covered with various types of wild grasses and other vegetation in the west-central portion of NSA Crane (Figure ES-2). The site is a relatively flat area that slopes significantly to the northeast, and is at an elevation of approximately 660 feet above msl. The Test Pads on Hill Behind B-198 are separated from B-198 (which is currently used for research and development) by approximately 2,000 feet of grass and woodlands.

The site acreage estimate contained in the range inventory was 0.01-acre and was determined to be inaccurate and differs from the area calculated during the SI site visit by Tetra Tech. The Test Pads on Hill behind B-198 cover approximately 0.6 acres and were reported in the PA as used from 1983 through 1985 for the development and testing of safe disposal methods for various types of dyes (Malcolm Pirnie, 2005a). A review of historical aerial photographs of the general area behind B-198 was included in the PA and indicated that there were some visible tree-cleared areas in the hill behind B-198 during 1952 and 1966. Those tree-cleared areas are adjacent to the UXO 06 area. The physical area associated with the UXO 06 Test Pads does not appear to be fully cleared of trees until approximately 1974. In the 1974 aerial photograph there are no visible indications that the UXO 06 test pads had been constructed or were in use at that time. It is likely that the test pads were installed soon after the 1974 photograph was recorded and the overall site operations may have extended from the mid-1970s to the mid-1980s (approximately ten year duration).

Personnel at NSA Crane developed and tested an item constructed of a 2.75-inch warhead (colored target markers); the M18 Smoke Hand Grenade was also simultaneously tested at this site. The site consisted of two circular test pads (approximately 21-feet by 21-feet and covered with sand), a polyvinyl chloride (PVC) drainage pipe, and an aboveground concrete holding tank.

The site's circular sand test pads, constructed from non-native sand with a reported approximate thickness of 6 inches, were used to develop and test safe disposal methods for various types of dyes. The sand provided a barrier to prevent surface soil penetration of explosives and dyes. A plastic liner and a series of flexible slotted plastic drain pipes were placed beneath the sand pads to intercept infiltrating

rainwater and liquids. The aboveground concrete holding tank with an estimated capacity of approximately 1,000 gallons is located east of the pads at a lower elevation and the test pad piping system conveyed potential liquid contaminants and rainwater from the sand pads to the tank. When the test pads were in use, Navy Special Job Procedures required that all testing materials and associated debris, including "wasted sand," were to be removed from the testing area after testing; however, there is no documentation to indicate that these recommended procedures were followed.

During the PA site visit (2003), items observed within the perimeter of the site included the above-ground concrete holding tank, remnants of the PVC pipe used for drainage to the holding tank, and a rusted metal barrier piece reportedly used as a shield for protection during testing operations. Additional Navy buildings with utilities are located around B-198. A fire hydrant observed near the concrete holding tank indicates that an underground water line exists at the site to the north and east of the site.

Silt loam soil located in the area are nearly level or gently sloping, deep, well-drained, moderately permeable soils where surface runoff is rapid and erosion is a concern and includes the Zanesville silt loam located at the Test Pads on Hill Behind B-198. Even though silt loams contain fine-grained materials and the frost line is approximately 2.5-feet bgs, actual frost heaving may not be a significant concern because the soil is very-well drained.

Surface water runoff from the site drains south into an unnamed tributary which flows southwest into Boggs Creek. The Test Pads on Hill Behind B-198 are located in the central drainage basin at NSA Crane.

During the 2009 Tetra Tech site visit, features observed included plastic sheeting and slotted drainage piping exposed at the ground surface. Most of the sand material that formerly comprised the test pad areas appeared to have been scraped and pushed into a mound located immediately north of the test pad site. This sand mound contained visible metallic debris which may have been related to the testing of 2.75-inch warheads. No MEC were encountered. An enclosed gun tub in the area may have been used as a safe observation point for the test pads.

6.1.1 Historical Munitions Testing Information

The Test Pads on Hill behind B-198 were used from approximately 1975 through 1985 for the development and testing of safe disposal methods for various types of dyes. Personnel at NSA Crane developed and tested an item constructed of a 2.75-inch warhead (colored target markers); the M18 Smoke Hand Grenade was also simultaneously tested at this site.

Safe disposal methods were developed and tested for the following types of dyes at the site:

- 2.75-inch warheads that functioned by using a blasting cap to detonate a C-4 booster, which then detonated a Baratol imploding charge. "Special Job Procedure for Testing of 2.75-Inch Warhead at Test Site Behind Building 198," indicates that these were 2.75-inch colored target markers. (Naval Weapons Support Center, 1983).

- M18 Smoke Hand Grenades that emitted red, yellow, violet, or green smoke for 50 to 90 seconds when ignited.

6.1.2 Munitions Constituents

MC associated with the types of munitions known to have been used at the site include 2,4,6-trinitrotoluene (TNT), baratol, and C-4 [composed of more than 90 percent RDX, less than 2 percent motor oil, and less than 8 percent plasticizers by weight], as well as other non-explosive materials such as fluorescent dye, Solvent Yellow 33 dye, and methyl-amino-anthraquinone.

6.1.3 Current Land Use and Anticipated Future Land Use

Hunting is not permitted in the UXO 06 site area. Beyond that land use restriction, there are no other known zoning/land use restrictions for the Test Pads on Hill Behind B-198. The land use of the site and surrounding areas are not anticipated to change for the foreseeable future. Although access to NSA Crane is restricted; there are no controls or restrictions in place to limit specific access to the Test Pads on Hill Behind B-198. Because B-198 is a research and development building, individuals within the area are required to check in with personnel located inside B-198.

6.2 SITE FIELDWORK

6.2.1 Site Field Activities

During a 2009 site visit, it was observed that the sand material may have been scraped off the test pads and pushed into a mound located immediately north of the test pad site. This sand mound contained visible metallic debris at the time of the site visit. As a result of testing activities, surface soil (0- to 2-feet bgs) associated with the sand test pads, the sand mound, and drain system could be contaminated with MC (explosives and Navy dye compounds). This medium was investigated during the SI to determine if

MC are present at concentrations that indicate the presence of a potential unacceptable human health and ecological risk and if an RI of the site is required. Additionally, there is the potential that MEC is present within the sand mound; therefore, a UXO Technician was present during the MC investigation to confirm the absence/presence of MEC within the sand mound and safety and hazard anomaly avoidance practices were followed at this site during MC sampling.

The horizontal boundary of the MC investigation included the area of the Test Pads on Hill Behind B-198, the drain system, and the sand mound area, as shown on Figure 6-1.

The vertical boundary for the Test Pads on Hill Behind B-198 was limited to the top two feet of surface soil. The pyrotechnic flares, signals, and screening smokes tested at the Test Pads on Hill Behind B-198 would most likely have impacted the immediate area inside the sand test pad area and the area associated with the drain system.

Chemical data were used to determine the presence of MC (explosives and Navy dye compounds) in surface soil at the Test Pads on Hill Behind B-198. Soil samples were analyzed for MC of concern: explosives (SW-846 Method 8330A) and Navy dye compounds (CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001).

Soil sample locations were selected based on a bias towards areas that had the greatest likelihood to have been impacted by past site operations. See Figure 6-1 for all sample locations. Prior to initiating sample collection, all sample locations were marked by colored pin flags bearing the sample location ID. Proposed sample locations identified in the approved UFP-SAP were located by GPS. Upon collection of the samples at the Test Pads on Hill Behind B-198, a field team member utilized the handheld GPS unit to collect actual sample location coordinates in order to map the sampling locations. These data were measured to sub-meter accuracy using the horizontal datum: NAD 83 Indiana State Plane Coordinate System West. All proposed sample locations were collected as planned in the approved UFP-SAP.

Photographs associated with the sampling activities at the Test Pads on Hill Behind B-198 are presented in Appendix B.3.

The test pad area consisted mainly of high grasses which were knocked down by hand in the immediate areas of the sample locations.

6.2.2 Work Plan Deviations

There were no deviations from the UFP-SAP for the Test Pads on Hill Behind B-198.

6.2.3 Field Data Collection

Four composite surface soil samples, X6SS001C0002 through X6SS004C0002, were collected from the residual material within the two circular sand test pads. Each composite sample was comprised of five grab samples. Composite samples provide greater spatial coverage than individual grab samples and thus increase the potential for detecting contamination. The sand overlain on the plastic liner varied in depth from only a few inches to approximately 6-inches. Due to the shallow soil depth, these samples were collected with clean stainless steel hand trowels.

Six individual grab samples were collected in the area of the above ground concrete holding tank. Four of these samples, X6SS005G0002 through X6SS008G0002, were collected around the PVC drainage pipe (two on either side) of the last 10 feet of the pipe before it entered the tank. One sample, X6SS009G0002, was collected from the saturated material within the concrete holding tank, and one sample, X6SS010G0002, was collected just down gradient of the above ground concrete holding tank. All six samples were collected via hand auger.

Two composite soil samples (X6SS0011C0002 and X6SS0012C0002) were collected from the sand mound located northeast of the sand test pads. Each composite sample was comprised of five individual grab samples and to ensure the samples represented all the material within the sand mound, the samples were collected from various depths ranging from 2 feet down to approximately 6 feet. These two composite samples were collected via hand auger.

All samples were placed in large Ziploc® bags and thoroughly homogenized prior to placing a portion of the sample in the appropriate sample jar and shipped to the respective FBL for explosives and Navy dye compound analyses. Table 6-1 provides a summary of the samples collected at the Test Pads on Hill Behind B-198. Soil sample log sheets are included in Appendix A.3 of this document.

6.3 SITE INSPECTION DATA COLLECTION RESULTS

6.3.1 MC Sampling Results

Twelve soil samples collected from the Test Pads on Hill Behind B-198 were analyzed for the presence of MC (explosives, SW-846 Method 8330A and Navy dye compounds, CR4052-PD-2500, Rev.1—

Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001). Limitations were considered when evaluating and interpreting the Navy dye data. Limitations on data use were in accord with the data usability assessment description provided on Worksheet #37 of the UFP-SAP.

Soil samples collected at the Test Pads on Hill Behind B-198 were compared to human health and ecological screening levels (PALs). The complete MC analytical results are presented in Appendix C and the data validation reports are presented in Appendix D.3.

Table 6-2 summarizes the MC explosives analytical results at the Test Pads on Hill Behind B-198. Only one sample had a detection that exceeded an explosive compound PAL. Sample X6SS0006G0002 had a Nitrobenzene concentration of 0.094 mg/kg which exceeded the PAL of 0.028 mg/kg. However, this detection was associated with a "J" qualifier, meaning the chemical was present; however, the associated reported concentration should be regarded as an estimate and not as a precise representation of the concentration that may be present in the sample.

Table 6-3 summarizes the MC Navy dye analytical results at the Test Pads on Hill Behind B-198. There were no detections of Navy dye compounds that exceeded the PALs.

Figure 6-2 presents the explosives detections in soil at the Test Pads on Hill Behind B-198, and Figure 6-3 presents the Navy dye detections in soil at the Test Pads on Hill behind B-198.

The Human Health Risk Screening Evaluation summary is discussed in Section 6.6, with supporting documentation presented in Appendix F.3.

The Ecological Risk Screening Evaluation summary is discussed in Section 6.7, with supporting documentation presented in Appendix G.3.

6.4 DATA PRESENTATION AND USABILITY

6.4.1 Data Validation Process

All of the results from analytical FBL samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (USEPA, 2004) guidelines.

No data collected for the Test Pads on Hill Behind B-198 were qualified or rejected. All data for the Test Pads on Hill Behind B-198 are considered valid for their intended purpose.

6.4.1.2 Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Appendix D.3**.** Rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections are also presented in Appendix D.3. Rejected data are not acceptable for performing risk assessments.

6.4.1.3 Completeness

The explosives fraction had 2 out of 195 results rejected because of percent difference between columns greater than 100 percent. The results are likely false positives because the compounds cannot be confirmed using a second column. The FBL measurement completeness was 99 percent, which meets the 90 percent completeness goal. The sample collection completeness was 100 percent.

6.4.1.4 Sensitivity

The PQLGs are listed in Worksheet #15 of the UFP-SAP (Tetra Tech, 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the UFP-SAP.

There are no instances where the non-detected sample results exceed the PQLGs either because of the FBLs inability to meet the PQLG or because of elevated detection limits due to blank contamination.

6.4.1.5 Field and Laboratory Accuracy

There were several results qualified due to surrogate recovery in the explosive and dye analyses. However, the qualifications do not point to any trends showing a systematic problem with extraction efficiency. There were no quality control deficiencies noted for field accuracy.

6.4.1.6 Field and Laboratory Precision

Two RDX results for one sample duplicate pair were qualified due to field duplicate imprecision in the explosives fraction. The lack of homogeneity in soil samples is common and the precision results do not indicate a site wide problem with the soil matrix.

6.4.1.7 Comparability

No comparability issues were noted during the data validation process.

6.4.1.8 Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The UFP-SAP (Tetra Tech, 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and FBL audits all reported data are adequately representative of site conditions and intended populations.

6.5 HUMAN HEALTH RISK SCREENING EVALUATION SUMMARY

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from MC present at the Test Pads on Hill Behind B-198. Tetra Tech evaluated soil sampling data for the Test Pads on Hill Behind B-198. Soil samples were analyzed for explosives and Navy dye compounds. The Navy dye compound, Solvent Yellow 33, and the explosives; HMX, nitrobenzene, and RDX were the only chemicals detected in the soil samples.

The detected concentrations of Solvent Yellow 33, HMX, and RDX were all less than the USEPA and IDEM direct contact screening criteria; therefore, not retained as a direct contact COPC for soil at the Test Pads on Hill Behind B-198. Nitrobenzene slightly exceeded the PAL; however, the detection was associated with a “J” qualifier indicating the associated reported concentration should be regarded as an estimate and not regarded as a precise representation of the concentration that may be present in the sample.

Concentrations of nitrobenzene and RDX exceeded the screening criteria for protection of migration from soil to groundwater; therefore, these chemicals were retained as COPCs. Nitrobenzene was only detected at a low estimated concentration in one sample (X6SS006, see Figure 6-2) and the detected concentration exceeded the USEPA SSLs based on DAFs of 1 and 20 and the IDEM migration from soil to groundwater criteria (Appendix F, Table F-3.2). While the detected concentration of nitrobenzene exceeded the screening criteria for migration from soil to groundwater, the available data indicates there is not a significant source area of nitrobenzene contamination at the site. Consequently, the single detected concentration of nitrobenzene in soil is not expected to adversely impact groundwater. Concentrations of RDX exceeded the USEPA SSLs based on DAFs of 1 and 20 in all samples in which it was detected. However, it should be noted that RDX was only detected in five samples at relatively low (estimated) concentrations. Although these RDX detections exceeded the DAFs of 1 and 20 (soil to groundwater migration), it appears from the data that there is not a significant source area of contamination (Appendix F, Table F-3.2). Groundwater from the Test Pads on Hill Behind B-198 is currently not used as a source of drinking water, so the pathway is currently incomplete.

6.6 ECOLOGICAL RISK SCREENING SUMMARY

The goal of the ecological risk screening is to determine whether adverse ecological impacts are present at the site as a result of exposure to chemicals released to the environment through historical site activities. The risk screening allows conclusions to be made as to whether ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks at the site.

Soil samples were analyzed for explosives and Navy dye compounds. The Navy dye compound, Solvent Yellow 33, and the explosives; HMX, nitrobenzene, and RDX were the only chemicals detected in the soil samples. Solvent Yellow 33 was initially retained as COPC for risks to terrestrial plants, invertebrates, mammals, and birds because an ecological screening level is not available. HMX and RDX were retained as COPCs for risks to mammals and birds because an ecological screening level is not available. When a chemical is initially retained as an ecological COPC, it then goes through refinement to better define those chemicals and to identify and eliminate any chemicals from further consideration that were retained because of very conservative exposure scenarios.

Solvent Yellow 33 was detected in only one of 12 samples (X6SS003C0001). The EEQs from the food chain modeling were less than 1.0; therefore, it was not retained as a COPC for mammals. Since the EEQ for Solvent Yellow 33 was less than 1.0 for mammals, it is not likely to impact birds. The fact that it was only detected in one of the 12 samples, and that the entire site is only 0.6 acres in size, Solvent Yellow 33 was not retained as a COPC for birds.

HMX was also only detected in one of the 12 samples. A subchronic study indicated no adverse effects to birds from HMX exposures as high as 10,000 mg/kg in feed, suggesting that HMX is largely not available for absorption (USACHPPM, 2001). Therefore, HMX was eliminated as a COPC for birds. Since there is no available HMX screening value for mammals, risk could not be further evaluated and HMX was retained as a COPC for mammals.

RDX was detected in five of the 12 samples and since there is no available mammal or bird screening value, it was retained as a COPC.

6.7 UPDATED CSM

Only MC associated with the Test Pads on Hill Behind B-198 is considered in the CSM exposure pathway analysis (Figure 6-4). A general description of the CSM exposure pathway analysis as presented in the UFP-SAP (Tetra Tech, 2009) is summarized below:

MC, if present, may migrate through the remnants of the broken drain system and discharge to the surface soil near the former collection tank. Potential contaminants could infiltrate into subsurface soil and ultimately leach from the soil into the groundwater. If an underground water line exists at the site (which may be indicated by the fire hydrant observed during the PA site visit), this could provide another conduit for MC migration. An additional migration pathway may be storm water run-off that could have transported contaminated surface soil to a location downgradient of the sand pads and the sand mound which could affect nearby soil and groundwater and possibly the unnamed tributary which discharges into Boggs Creek. Contaminant dilution would occur during overland transport.

Current human receptors at this site that could come into contact with MC contamination in soil include military and civilian personnel, contractors, trespassers, and hunters. Hunters could also contact MC contaminants through the food chain because hunting is permitted at NSA Crane and contaminants may bioaccumulate in animals. Ecological receptors that could come into contact with MC contamination in surface soil include wildlife such as deer, rabbits, raccoons, and wild turkeys. Ecological receptors could also contact contaminants through the food chain when ingesting vegetation such as grass at the site.

CSM Summary

The updated CSM for the Test Pads on Hill Behind B-198 is shown on Figure 6-5 and details the potential exposure sources, pathways, and receptors. The exposure sources appear to be limited to the circular

sand test pads, sand mound, and area around the concrete holding tank. One pathway is runoff from precipitation. Leaching from soil into groundwater has been eliminated as a pathway, since groundwater is not used as the site. Receptors would be trespassers and ecological receptors by ingestion, dermal contact, and inhalation of the surface soil. Potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses.

6.8 CONCLUSIONS

Soil samples at the Test Pads on Hill Behind B-198 were analyzed for Navy dyes and explosives. The Navy dye compound, Solvent Yellow 33, and explosives; HMX, nitrobenzene, and RDX were the only chemicals detected in the soil samples. The detected concentrations of all chemicals were less than the USEPA and IDEM human health direct contact screening criteria; therefore, no chemical was retained as a direct contact COPC for soil at the site.

Concentrations of nitrobenzene and RDX exceeded the screening criteria for protection of migration from soil to groundwater; therefore, these chemicals were retained as COPCs.

Solvent Yellow 33 was retained as a COPC for risks to terrestrial plants and invertebrates because an ecological screening level is not available. HMX and RDX were retained as COPCs for risks to mammals and birds because an ecological screening level is not available.

Since there is no available HMX screening value for mammals, risk could not be further evaluated and HMX was retained as an ecological COPC for mammals.

RDX was detected in five of the 12 samples and since there is no available mammal or bird screening value, it was retained as a COPC.

6.9 RECOMMENDATIONS

Although no chemicals were retained as human health direct contact COPCs, RDX was retained as a COPC for migration of soil to groundwater. The compounds Nitrobenzene, RDX, HMX, and Solvent Yellow 33 were detected in one or more of the surface soil samples and were retained as COPCs for limited ecological receptors. The limited low-level estimated detections of residual explosives and a single estimated detection of a Navy dye compound (Solvent Yellow 33) in surface soil samples within or adjacent to the test pads indicate that there is no significant contamination present in the UXO 06 soil. Furthermore, given the relatively small size of the former test pads and adjacent areas and the

significantly larger size of the surrounding habitat, it is likely that the MC detected at the site pose no significant impact to potential human or ecological receptors. Therefore UXO 06 is recommended for no further action.

TABLE 6-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
TEST PADS ON HILL BEHIND B-198 - UXO 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	FBL ANALYSIS	
					Explosives (SW-846 8330A)	Navy Dye Compounds[1]
X6SB001	X6SS001C0001	9/11/2009	HA	0-1	X	X
X6SB002	X6SS002C0001	9/11/2009	HA	0-1	X	X
X6SB003	X6SS003C0001	9/11/2009	HA	0-1	X	X
X6SB004	X6SS004C0001	9/11/2009	HA	0-1	X	X
X6SB005	X6SS005G0002	9/11/2009	HA	0-2	X	X
X6SB006	X6SS006G0002	9/11/2009	HA	0-2	X	X
X6SB007	X6SS007G0002	9/11/2009	HA	0-2	X	X
X6SB008	X6SS008G0002	9/11/2009	HA	0-2	X	X
X6SB009	X6SS009G0001	9/11/2009	HA	0-1	X	X
X6SB010	X6SS010G0002	9/11/2009	HA	0-2	X	X
X6SB011	X6SS011C0002	9/11/2009	HA	0-2	X	X
X6SB012	X6SS012C0002	9/11/2009	HA	0-2	X	X

1 = CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001

X = Indicates sample was collected and analyzed as proposed in the UFP-SAP (Tetra Tech, 2009)
bgs = below ground surface
FBL = Fixed-base laboratory
HA = Hand auger

TABLE 6-2

SURFACE SOIL MC EXPLOSIVES DETECTIONS
TEST PADS BEHIND B-198 - UXO 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	X6SB001		X6SB002		X6SB003		X6SB003		X6SB003		X6SB004		X6SB005		X6SB006		X6SB007		X6SB008		X6SB009	
Sample ID		X6SS001C0001		X6SS002C0001		X6SS003C0001		X6SS003C0001-AVG		X6SS003C0001-D		X6SS004C0001		X6SS005G0002		X6SS006G0002		X6SS007G0002		X6SS008G0002		X6SS009G0001	
Sample Date		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911	
Sample Type		NORMAL		NORMAL		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)																							
HMX	3800	0.062	U	0.062	U	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ	0.062	UJ	0.04	J	0.062	UJ
NITROBENZENE	0.028	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	0.062	U	**0.094**	**J**	0.062	U	0.066	R	0.062	U
RDX	5.5	0.049	R	0.062	U	0.16	J	0.0955	J	0.062	UJ	0.1	J	0.062	U	0.089	J	0.062	U	0.13	J	0.062	U

Sample Location	PAL (mg/kg)	X6SB010		X6SB011		X6SB012	
Sample ID		X6SS010G0002		X6SS011C0002		X6SS012C0002	
Sample Date		20090911		20090911		20090911	
Sample Type		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)							
HMX	3800	0.062	UJ	0.062	UJ	0.062	UJ
NITROBENZENE	0.028	0.062	U	0.062	U	0.062	U
RDX	5.5	0.062	U	0.062	U	0.14	J

mg/kg = milligram per kilogram
PAL = Project action limit

Shading indicates an exceedence of the PAL.

Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

TABLE 6-3

SURFACE SOIL MC NAVY DYE DETECTIONS
TEST PADS BEHIND B-198 - UXO 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	X6SB001		X6SB002		X6SB003		X6SB004		X6SB005		X6SB006		X6SB007		X6SB008		X6SB008		X6SB008	
Sample ID		X6SS001C0001		X6SS002C0001		X6SS003C0001		X6SS004C0001		X6SS005G0002		X6SS006G0002		X6SS007G0002		X6SS008G0002		X6SS008G0002-AVG		X6SS008G0002-D	
Sample Date		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911		20090911	
Sample Type		NORMAL		NORMAL		ORIG		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		AVG		DUP	
Dyes (µg/kg)																					
SOLVENT YELLOW 33	3100000	687.5	UJ	687.5	UJ	122929	J	687.5	UJ	687.5	UJ	687.5	UJ	687.5	UJ	687.5	UJ	687.5	UJ	687.5	U

Sample Location	PAL (µg/kg)	X6SB009		X6SB010		X6SB011		X6SB012	
Sample ID		X6SS009G0001		X6SS010G0002		X6SS011C0002		X6SS012C0002	
Sample Date		20090911		20090911		20090911		20090911	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL	
Dyes (µg/kg)									
SOLVENT YELLOW 33	3100000	687.5	UJ	687.5	UJ	687.5	UJ	687.5	U

µg/kg = microgram per kilogram
PAL = Project action limit

Notes:

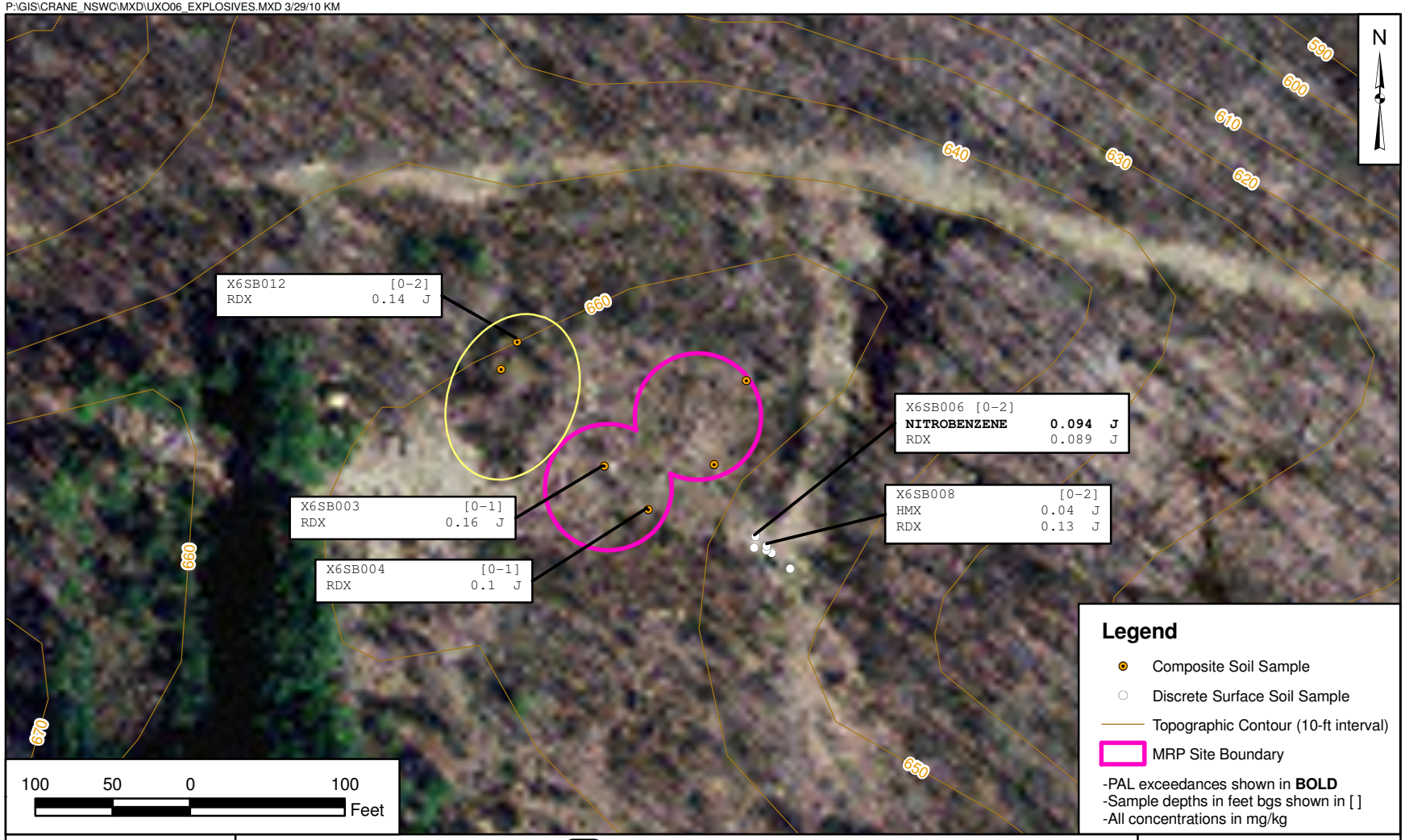
UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

P:\GIS\CRANE_NSWC\MXD\UXO06_SAMPLES.MXD 3/29/10 KM

DRAWN BY K. MOORE	DATE 07/10/09	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY J. GOERDT	DATE 3/29/10	TEST PADS BEHIND BUILDING 198 - UXO 6 MC SAMPLING LOCATIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 6-1 / REV 0

P:\GIS\CRANE_NSWC\MXD\UXO06_EXPLOSIVES.MXD 3/29/10 KM



DRAWN BY T. WHEATON	DATE 02/08/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY J. GOERDT	DATE 3/29/10	TEST PADS BEHIND BUILDING 198 - UXO 6 SOIL EXPLOSIVES DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 6-2 / REV 0

P:\GIS\CRANE_NSWC\MXD\UXO06_DYE.MXD 3/29/10 KM

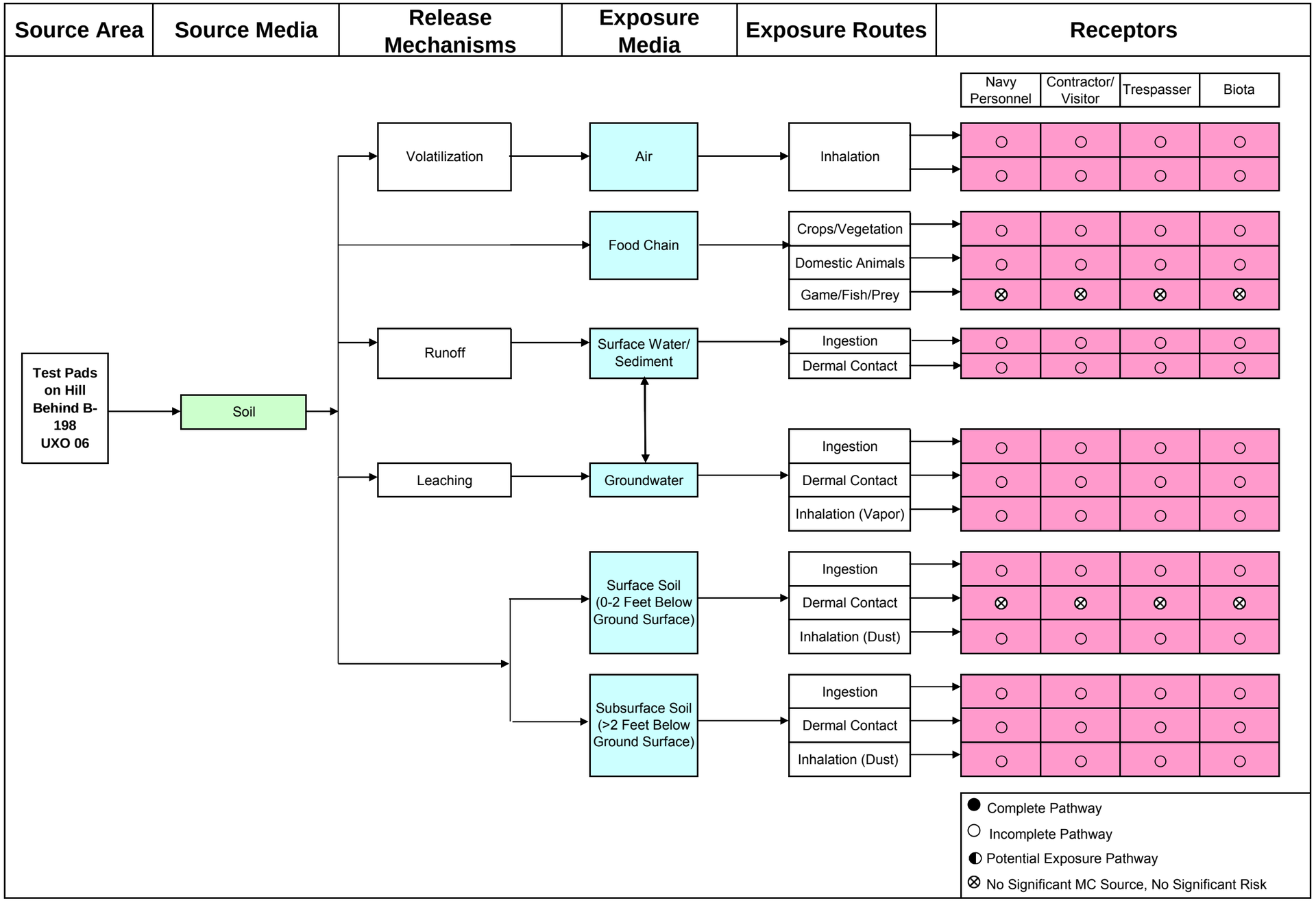
DRAWN BY T. WHEATON	DATE 02/09/10	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY J. GOERDT	DATE 3/29/10	TEST PADS BEHIND BUILDING 198 - UXO 6 SOIL NAVY DYE COMPOUND DETECTIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 6-3 / REV 0

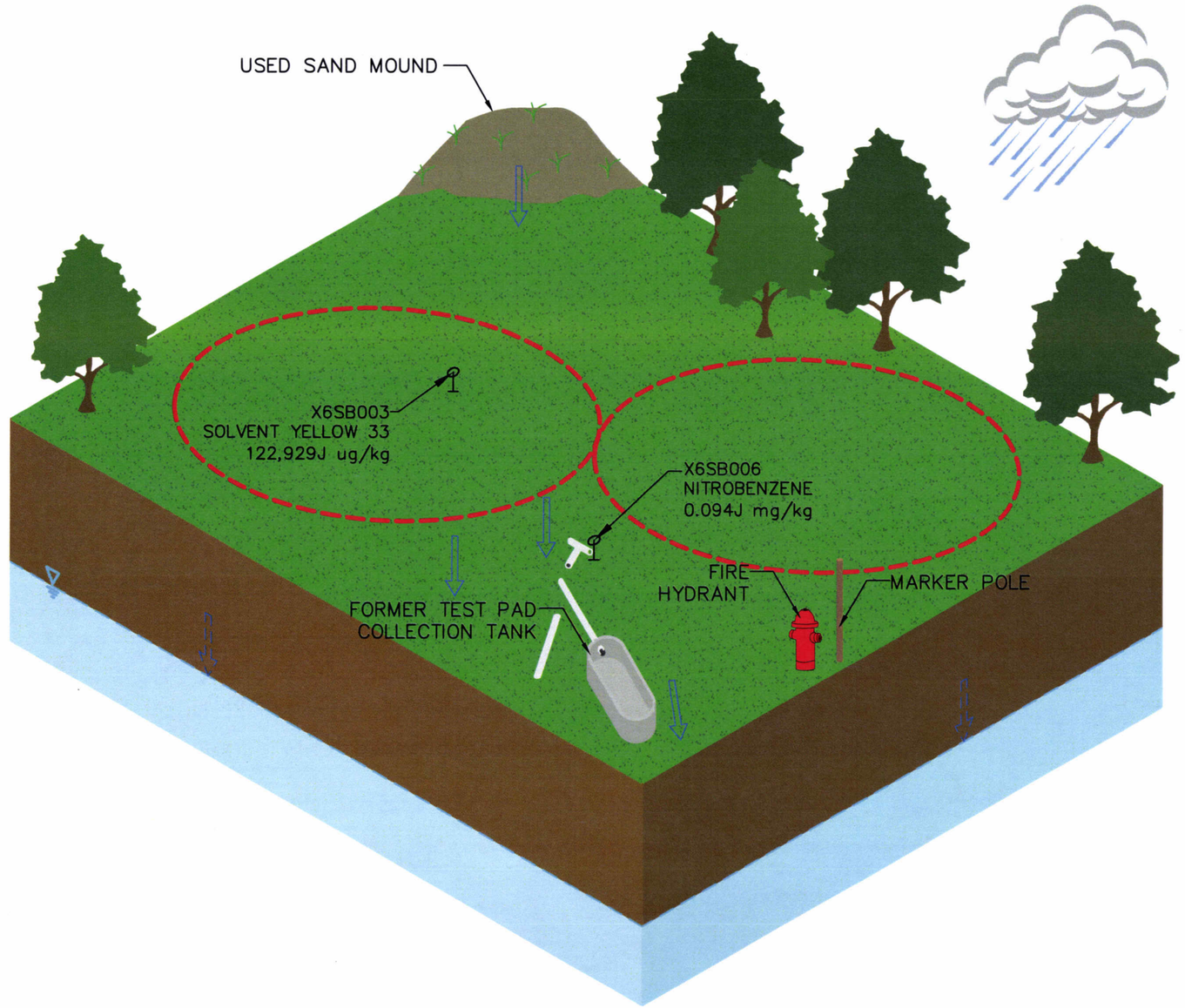
FIGURE 6-4

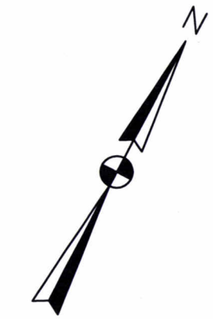
MC EXPOSURE PATHWAY ANALYSIS

TEST PADS ON HILL BEHIND B-198

NSA CRANE, CRANE, INDIANA







LEGEND

- TREE/VEGETATION
- FORMER TEST PAD AREA
- WATER TABLE (ESTIMATED)
- RUNOFF
- INFILTRATION

CURRENT AND FUTURE RECEPTORS FOR UXO 06
HUMAN: –MILITARY/CIVILIAN PERSONNEL –CONTRACTORS –TRESPASSERS
ECOLOGICAL: –PLANTS –INVERTEBRATES –BIRDS –MAMMALS

DRAWN BY CK	DATE 2/23/10	
CHECKED BY	DATE	
REVISED BY	DATE	
SCALE NOT TO SCALE		

NAVFAC

TEST PADS ON THE HILL BEHIND
B–198–UXO 06
CONCEPTUAL SITE MODEL
NSA
CRANE, INDIANA

CONTRACT NO. 1621	
OWNER NO.	
APPROVED BY	DATE
DRAWING NO. FIGURE 6–5	REV. 0

R:\1621\CSM\1621CSM04.dwg PIT NICHOLE.DILLA 4/13/2010 9:14:33 AM

7.0 LAKE OBERLIN - AOC 04

7.1 SITE BACKGROUND

Lake Oberlin – AOC 04

Lake Oberlin is located in the northwest corner of NSA Crane, north of the intersection of Highway 5 and Highway 449 (Figure ES-2). Lake Oberlin covers an estimated 3.0 acres and is approximately 1,000 feet west of Lake Greenwood, the largest water body at NSA Crane. At its deepest point, the lake is approximately 15 feet deep. Lake Oberlin was formed when NSA Crane constructed a 50-meter long earthen dam (Structure No. 1948) across the unnamed tributary that empties into Furst Creek approximately 1,600 feet south of the lake. The soil composition of the dam is unknown. Lake Oberlin is in the northern drainage basin. Surface runoff, intermittent streams, and unnamed tributaries supply Lake Oberlin. The dam is located along the southern edge of the lake and is covered with grass. The lake is primarily surrounded by woodland. No records were available detailing the sediments of Lake Oberlin.

The elevation of Lake Oberlin is approximately 565 feet above msl. The area east of the lake gently slopes upward and the area immediately west of the lake is primarily flat. The only structure observed at Lake Oberlin by the SI Project Team in 2008 and 2009 was a small fishing dock. There are no major structures surrounding Lake Oberlin; however, numerous storage magazines are located within 1 mile of the lake.

The Haymond silt loam, indentified within the area southwest of Lake Oberlin, is characterized by frequent flooding of its poorly-drained soil. It has a high water capacity, moderate permeability, and slow surface runoff. Frost heave may be associated with this type of soil because it is silty fine-grained and drains poorly. Areas prone to frost heave provide conditions that may allow MEC to work its way into the soil over time. There are several other soil types in the areas that surround Lake Oberlin: the Wellston-Gilpin complex which is present to the east of the lake, is characterized by well drained soils with a high water capacity, moderate permeability, and medium surface runoff; Negley silt loam to the west of the lake, is characterized by well drained soils with a high water capacity, moderate to moderately rapid permeability, and rapid surface runoff; and Burnside loam to the north of the lake is well drained with a low water capacity, moderate permeability, and slow surface runoff.

7.1.1 Historical Munitions Testing Information

Historical information concerning Lake Oberlin is limited. The exact dates of use are unknown; however, it is estimated that the site was used in the mid-to-late 1950s. Lake Oberlin was used for testing unknown quantities of submarine flotation flares, surface illumination flares for overboard persons, and fluorescent dye markers. The flares were fired from a signaling pistol and fluorescent dye was released onto the water to identify a person's location. The flare firing point was on the earthen dam and the impact area was the lake water. The fluorescent dye was tested at night so it would be visible during the "man-overboard" training. It is assumed that the dye slicks were observed from the edge of the lake because site personnel did not mention the use of boats or aircraft during interviews

It was Navy policy at the time of testing to recover all munitions debris, fragments, and residues associated with testing of the pyrotechnic signal devices, smoke and dye markers, and other munitions devices. A record of this policy was not found during the PA data collection effort, but NSA Crane personnel corroborated the policy. It is assumed that all retrievable fragments were recovered; however, it is possible that small fragments, and partially consumed flares and their associated components may have settled to the bottom sediment and were unrecoverable. It is also assumed that only the dam area was cleared of testing debris because there are no records of recovering debris from the lake. There are also no records of Explosive Ordnance Disposal (EOD) responses for testing at Lake Oberlin. No munitions-related debris was observed along the dam or on the land surrounding the lake during the WAMS survey team visit in 2003, or by the SI Project Team in 2008 and 2009. Lake Oberlin is identified on numerous historic maps, but its use as a range is not indicated on the maps, and it was not identified as a range in the Navy Range Inventory.

7.1.2 Munitions Constituents

The float signals tested in Lake Oberlin included the MK2, Mod. 2 Submarine Float Signal and the MK2, Marine Illumination Signal. These devices were floated on the water and activated to test signal visibility. The MK2, Submarine Float Signals were pyrotechnic smoke devices consisting of a cylindrical aluminum tube (3 inches in diameter and 18.6 inches long) equipped with a percussion fuze. Depending on the specific dye formulation for the smoke filler, they had the capability of producing red, black, green, or yellow smoke on the water surface. The MK2, Marine Illumination Signal, which resembled a 10-gage shotgun shell, was fired from the dam structure by a handheld MK5 pyrotechnic pistol. After firing, the signal cartridge was propelled from the pistol and a star composition (typically a red, green, or white pyrotechnic signal) burned for a period of about 6 seconds at an altitude of about 200 feet above the launch point. There is minimal probability that MEC are present in the Lake Oberlin sediment as a result

of partially consumed flares and their associated components settling to the bottom of the lake. It is not anticipated that the ordnance tested at Lake Oberlin would have penetrated the sediments or subsurface soils during testing.

Although it was Navy policy to recover all fragments and residues associated with testing, it is possible that partially consumed flares and their associated components (including Navy dye compounds) have settled to the bottom sediment at Lake Oberlin. MC associated with the items suspected to have been used at the site include a combination of various chemicals that are contained in burning-type and explosive-type colored smoke munitions. Some chemicals used in typical smoke compositions would have included metals and perchlorate. Perchlorate, however, is very soluble in water, and is therefore not expected to be present in the sediment (DoD, 2007).

7.1.3 Current Land Use and Anticipated Future Land Use

Lake Oberlin is currently used by the Boy Scouts and possibly others for recreational boating and fishing. The use of the land for recreation is not anticipated to change during the foreseeable future. There are no known zoning/land use restrictions for Lake Oberlin.

7.2 SITE FIELDWORK

7.2.1 Site Field Activities

The lake covers approximately 3 acres, has a water depth typically less than 15 feet, and the presumed main testing area measured about 1 acre in size. The smaller size of the Lake Oberlin test area for the pyrotechnic devices and dye markers provides an increased likelihood to encounter potential MC (Navy dye compounds) in the lake sediment based on higher sediment concentrations for a given mass of contaminants released to the lake.

Due to past testing activities, sediment (0- to 6-inches below the water/sediment interface) at Lake Oberlin may be contaminated with MC (Navy dye compounds). Therefore, this media was investigated during the SI to determine if MC is present at concentrations that indicate the presence of a potential unacceptable risk to human health or the environment. The potential for encountering MEC in the Lake Oberlin sediment is remote. No munitions-related debris was observed along the dam or on the land surrounding the lake during the PA survey team site visit in 2003. However, a UXO Technician was part of the MC sampling team to ensure that no MEC were present in the lake bottom sediment collected for sampling and analysis.

Sediment sample locations were selected based on a bias towards areas that were believed to be most likely contaminated by past operations at the site. The target area (from the PA Report) was reported to be in the southern half of Lake Oberlin. See Figure 7-1 for all sample locations. Sample locations as identified in the approved UFP-SAP (Tetra Tech, 2009) were located utilizing GPS. All proposed sample locations were collected as planned in the approved UFP-SAP.

Photographs associated with the sampling activities at Lake Oberlin are presented in Appendix B.4.

No vegetation clearing was required for the sampling activities at Lake Oberlin.

7.2.2 Work Plan Deviations

There were no deviations from the UFP-SAP for Lake Oberlin.

7.2.3 Field Data Collection

Four composite sediment samples (A4SD001C0006 through A4SD004C0006) were collected at a depth of 0 to 6-inches below the water/sediment interface within the southern half of Lake Oberlin. Each composite sample was comprised of five discrete samples. A grid-type pattern was laid out over the southern half of Lake Oberlin and then broken down into four distinct areas to identify grab sample locations.

The sediment samples were collected from a motorized boat. Sample locations were navigated to by following a handheld GPS unit. Upon reaching the desired sample location, the boat anchor was lowered to the lake bottom to keep the boat in the area of the sample location. A petite ponar dredge, attached to a rope, was allowed to descend to the lake bottom. A sharp pull on the rope activated the spring-loaded clamp on the dredge which then closed around the sediment material. The dredge was pulled up alongside the boat above the water surface allowing excess water to drain off. The dredge was then brought into the boat where it was opened allowing the material to fall into a one-gallon Ziploc® bag. All discrete samples were placed in individual Ziploc® bags and marked with sample ID, location, and time. The sample bags were thoroughly homogenized.

Although no UXO surveys were proposed for this water body, a UXO Technician was onboard the sampling boat to assist with the sediment sampling effort and to visually examine the recovered material from the lake bed to ensure the material did not contain any MEC.

Upon returning to the NSA Crane field office, the four composite samples were obtained by emptying the sample material from the five sample-specific bags into a large Ziploc® bag which was then thoroughly homogenized. A portion of that sample material was then placed into the appropriate sample jar and taken to the Crane FBL for Navy dye compound analyses. Table 7-1 provides a summary of the samples collected at Lake Oberlin, and Figure 7-1 shows all sampling locations. Soil sample log sheets are included in Appendix A.4 of this document.

7.3 SITE INSPECTION DATA COLLECTION RESULTS

7.3.1 MC Sampling Results

Four sediment samples collected within Lake Oberlin were analyzed for the presence of MC (Navy dye compounds, CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001). Limitations were considered when evaluating and interpreting the Navy dye data. Limitations on data use were in accord with the data usability assessment description provided on Worksheet #37 of the UFP-SAP.

The sediment samples collected from within Lake Oberlin were compared to their respective PALs. The complete MC analytical results are presented in Appendix C and the data validation reports are presented in Appendix D.5.

Table 7-2 summarizes the results as compared to the PALs for Navy dye compounds. There were no detections of Navy dye compounds in any of the four composite sediment samples collected from Lake Oberlin.

Since there were no Navy dye compound detections, it was not necessary to perform a Human Health Risk Screening Evaluation or an Ecological Risk Screening Evaluation.

7.4 DATA PRESENTATION AND USABILITY

7.4.1 Data Validation Process

All of the results from analytical FBL samples were validated according to multiple specifications. Sample data validation generally followed USEPA Contract Laboratory Program National Functional Guidelines

for Organic Data Review (USEPA, 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (USEPA, 2004) guidelines.

No data collected for Lake Oberlin were qualified or rejected. All data for Lake Oberlin are considered valid for their intended purpose.

7.4.1.1 Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Appendix D.4.

7.4.1.2 Completeness

The sample collection and FBL analytical completeness for Lake Oberlin were 100 percent.

7.4.1.3 Sensitivity

The PQLGs are listed in Worksheet #15 in the UFP-SAP (Tetra Tech, 2009). Analytical sensitivity for data at Lake Oberlin was satisfactory to meet DQOs presented in the UFP-SAP.

There were no instances where the non-detected sample results exceed the PQLGs either because of the FBLs inability to meet the PQLG or because of elevated detection limits due to blank contamination.

7.4.1.4 Field and Laboratory Accuracy

There was no QC deficiencies noted for field or FBL accuracy for the Lake Oberlin data.

7.4.1.5 Field and Laboratory Precision

There was no QC deficiencies noted for field or FBL precision for the Lake Oberlin data.

7.4.1.6 Comparability

No comparability issues were noted during the data validation process for the Lake Oberlin data.

7.4.1.7 Representativeness

The UFP-SAP (Tetra Tech, 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and FBL audits, all reported data are adequately representative of site conditions and intended populations for Lake Oberlin.

7.5 UPDATED CSM

The WAMS Report for Lake Oberlin indicates that although there are no exposure pathways to MEC in the subsurface for human or ecological receptors, there are potentially complete pathways for MC to impact human and ecological receptors through dermal contact and ingestion. Recreational fishing at Lake Oberlin could also expose human receptors to potential MC accumulation in fish and could similarly impact the food chain for ecological receptors at Lake Oberlin (see Figure 7-3).

Only MC associated with Lake Oberlin was considered in the CSM exposure pathway analysis. A general description of the CSM exposure pathway analysis as presented in the UFP-SAP (Tetra Tech, 2009) is summarized below:

As a result of past testing activities, there was a very low probability that lake bottom sediment at Lake Oberlin might be contaminated by Navy dye compounds. Lake sediment sampling completed at Lake Oberlin during the SI did not detect any Navy dye compounds and confirmed that the lake sediment was not impacted by the dye compounds used in the pyrotechnic devices tested on the lake surface.

Lake Oberlin is used for fishing, boating, and other recreational uses. Potential human receptors are military and civilian recreational boaters and fishermen (Boy Scouts), visitors, and trespassers.

There is the potential that if contaminants were present in Lake Oberlin sediment that they could potentially migrate within the sediment to underlying groundwater or possibly transported by surface water. However, because the Navy Dye compounds were not detected in the composite sediment

samples collected at Lake Oberlin there are no complete exposure pathways for the AOC 04 Lake Oberlin MRP site.

CSM Summary

The updated CSM for Lake Oberlin is shown on Figure 7-4. No complete exposure pathways exist for either human or ecological receptors under both current and hypothetical future land uses.

7.6 CONCLUSIONS

Due to past testing activities, sediment (0- to 6-inches below the water/sediment interface) at Lake Oberlin was investigated during the SI to determine if Navy dye (MC) compounds were detectable at concentrations that pose a potential unacceptable risk to human health or the environment. Navy dye compounds were not detected in the sediment samples collected from Lake Oberlin.

Additionally, Lake Oberlin was proposed for use as a representative test site to evaluate the potential significance of Navy dye compounds to be present in the sediments at three other MRP water test sites used by NSA Crane that included the Conservation Dam No. 2845 (UXO 01), the Dugger Lake Facility (AOC 03), and the Lake Greenwood Pyro Test Area Near Dam and the Officer's Club Test Area (UXO 03). Due to the general similarity of the pyrotechnic (dye and signal smoke) items tested in the four water-based MRP sites at NSA Crane, the Project Team decided to use Lake Oberlin as a test case for evaluating potential Navy dye contamination in sediment. Lake Oberlin was one of the earliest water areas at NSA Crane used for signal and dye testing and the lake is small and relatively shallow. Any test residues would tend to be concentrated in the sediments in Lake Oberlin. The documented pyrotechnic testing activities are similar for these water test sites and the general CSMs for these water testing sites are also very similar.

In accordance with the technical planning discussions held with the project planning team, the general results, conclusions, and recommendations developed for Lake Oberlin based on the environmental data compiled during this SI are to be similarly applied to the other three water testing sites identified in the original scope of work. Based on that site management rationale, the sediment (0- to 6-inches below the water/sediment interface) present in the Conservation Dam 2845, former Dugger Lake Facility, and Lake Greenwood Pyro Test Areas are considered to be free of MC contamination that could pose an unacceptable risk to human health or the environment based on the SI conclusions for Lake Oberlin.

7.7 RECOMMENDATIONS

Based on the results of the SI, NFA is recommended for Lake Oberlin (AOC 04), and by agreement, this finding also applies to the Conservation Dam No. 2845 (UXO 01), the former Dugger Lake Facility (AOC 03) in Sullivan County, Indiana, and both of the Lake Greenwood Pyro Test Areas (UXO 03).

TABLE 7-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
LAKE OBERLIN - AOC 04
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (water/sediment interface)	FBL ANALYSIS
					Navy Dye Compounds[1]
A4SD001	A4SD001C0006	9/10/2009	PD	0-0.5	X
A4SD002	A4SD002C0006	9/10/2009	PD	0-0.5	X
A4SD003	A4SD003C0006	9/10/2009	PD	0-0.5	X
A4SD004	A4SD004C0006	9/10/2009	PD	0-0.5	X

1 = CR4052-PD-2500, Rev.1—Determination of Organic Colorants in Environmental Matrices by High-Performance Liquid Chromatography, Explosives Sciences Branch, NSWC Crane, May 9, 2001

X = Indicates sample was collected and analyzed as proposed in the UFP-SAP (Tetra Tech, 2009)
FBL = Fixed-base laboratory
PD = Ponar dredge

TABLE 7-2

SEDIMENT MC NAVY DYE DETECTIONS
LAKE OBERLIN - AOC 04
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A4SD001		A4SD001		A4SD001		A4SD002		A4SD003		A4SD004	
Sample ID		A4SD001C0006		A4SD001C0006-AVG		A4SD001C0006-D		A4SD002C0006		A4SD003C0006		A4SD004C0006	
Sample Date		20090910		20090910		20090910		20090910		20090910		20090910	
Sample Type		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL	
Dyes (µg/kg)													
1-AMINOANTHRAQUINONE	14700	1212.5	U	1212.5	U	1212.5	U	1212.5	U	1212.5	U	1212.5	U
2-AMINOANTHRAQUINONE	14700	1150	U	1150	U	1150	U	1150	U	1150	U	1150	U
ACID BLUE 1	10000	2617	UJ	2617	UJ	2617	U	2617	U	2617	U	2617	U
ACID BLUE 45	380000000	2037.5	UJ	2037.5	UJ	2037.5	U	2037.5	U	2037.5	U	2037.5	U
ACID BLUE 9	1630000	447.5	U	447.5	U	447.5	U	447.5	U	447.5	U	447.5	U
ACID ORANGE 10	6460	1310	U	1310	U	1310	U	1310	U	1310	U	1310	U
ACID RED 64	NA	1629	U	1629	U	1629	U	1629	U	1629	U	1629	U
ACID YELLOW 23	49000000	2564	UJ	2564	UJ	2564	U	2564	U	2564	U	2564	U
ACID YELLOW 3	3100000	10147.5	UJ	10147.5	UJ	10147.5	U	10147.5	U	10147.5	U	10147.5	U
ACID YELLOW 73	950000	845	U	845	U	845	U	845	U	845	U	845	U
BASIC VIOLET 10	12000	730	U	730	U	730	U	730	U	730	U	730	U
BASIC YELLOW 2	1300	6670.5	UJ	6670.5	UJ	6670.5	UJ	6670.5	UJ	6670.5	UJ	6670.5	UJ
DISPERSE BLUE 14	610000	1954.5	U	1954.5	U	1954.5	U	1954.5	U	1954.5	U	1954.5	U
DISPERSE RED 9	610000	883.5	U	883.5	U	883.5	U	883.5	U	883.5	U	883.5	U
DISPERSE VIOLET 1	610000	4750.5	U	4750.5	U	4750.5	U	4750.5	U	4750.5	U	4750.5	U
SOLVENT GREEN 3	125000	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ	3489.5	UJ
SOLVENT ORANGE 3	129000	283.5	U	283.5	U	283.5	U	283.5	U	283.5	U	283.5	U
SOLVENT ORANGE 7	52000	881	U	881	U	881	U	881	U	881	U	881	U
SOLVENT RED 1	1200000	11478	UJ	11478	UJ	11478	U	11478	U	11478	U	11478	U
SOLVENT RED 24	1200000	4260	UJ	4260	UJ	4260	UJ	4260	UJ	4260	UJ	4260	UJ
SOLVENT YELLOW 14	3230	473.5	U	473.5	U	473.5	U	473.5	U	473.5	U	473.5	U
SOLVENT YELLOW 2	26000	1105	U	1105	U	1105	U	1105	U	1105	U	1105	U
SOLVENT YELLOW 3	130	973	UJ	973	UJ	973	U	973	U	973	U	973	U
SOLVENT YELLOW 33	3100000	687.5	U	687.5	U	687.5	U	687.5	U	687.5	U	687.5	U

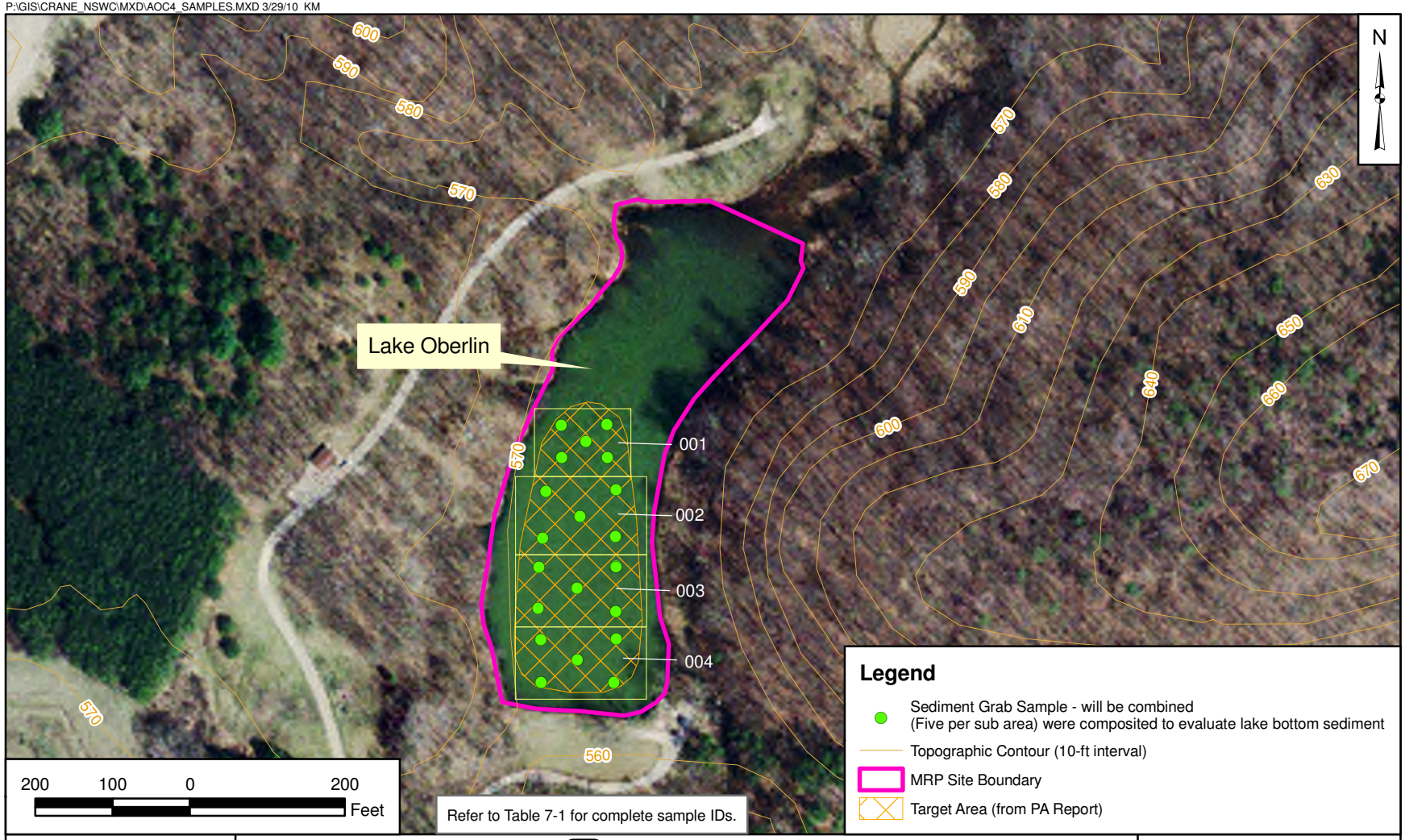
µg/kg = microgram per kilogram
PAL = Project action limit

Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

P:\GIS\CRANE_NSWC\MXD\AOC4_SAMPLES.MXD 3/29/10 KM



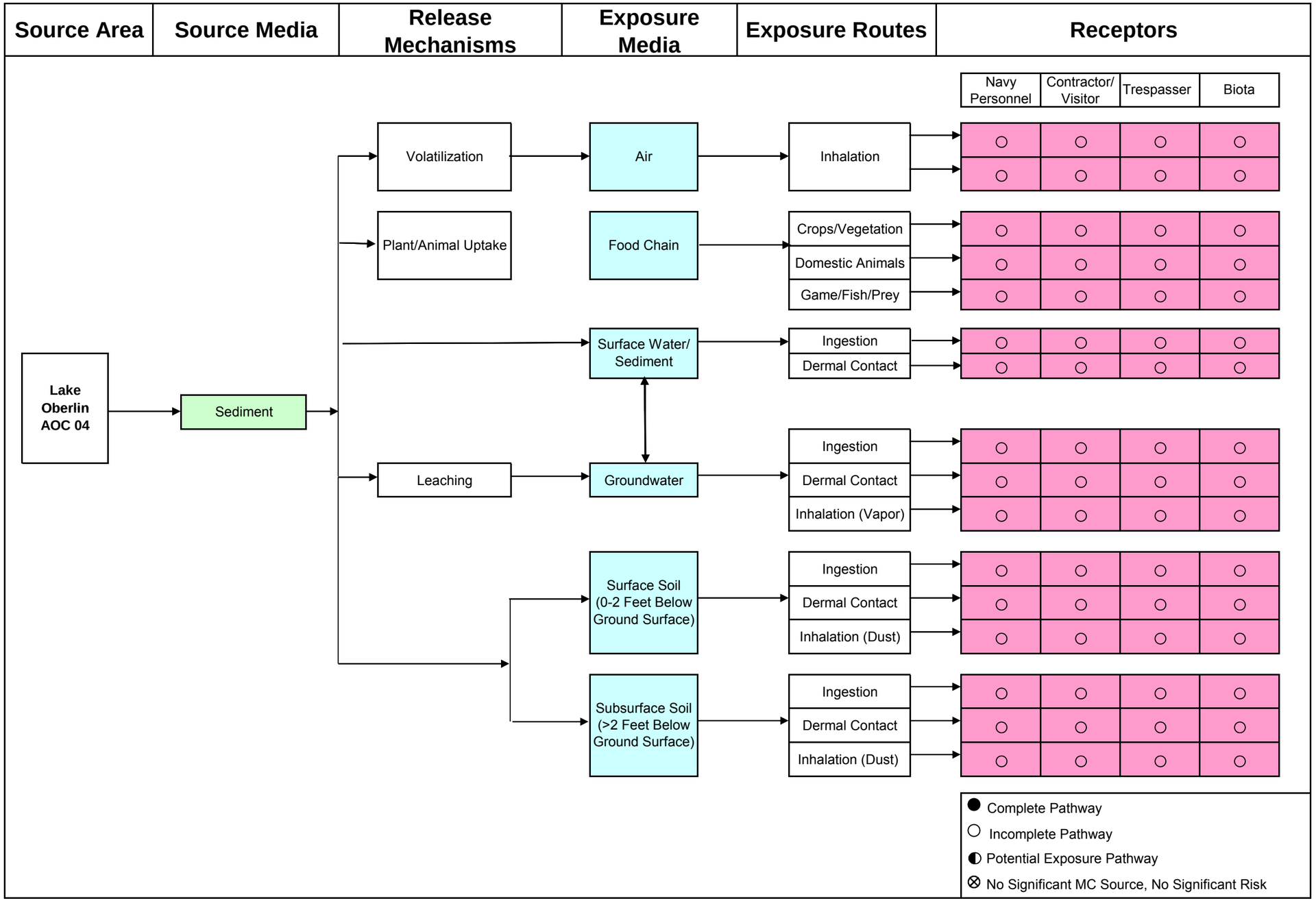
DRAWN BY K. MOORE	DATE 07/10/09	Tetra Tech NUS, Inc.	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY J. GOERDT	DATE 3/29/10	LAKE OBERLIN - AOC 4 MC SAMPLING LOCATIONS NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
COST/SCHEDULE AREA			APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 7-1 / REV 0

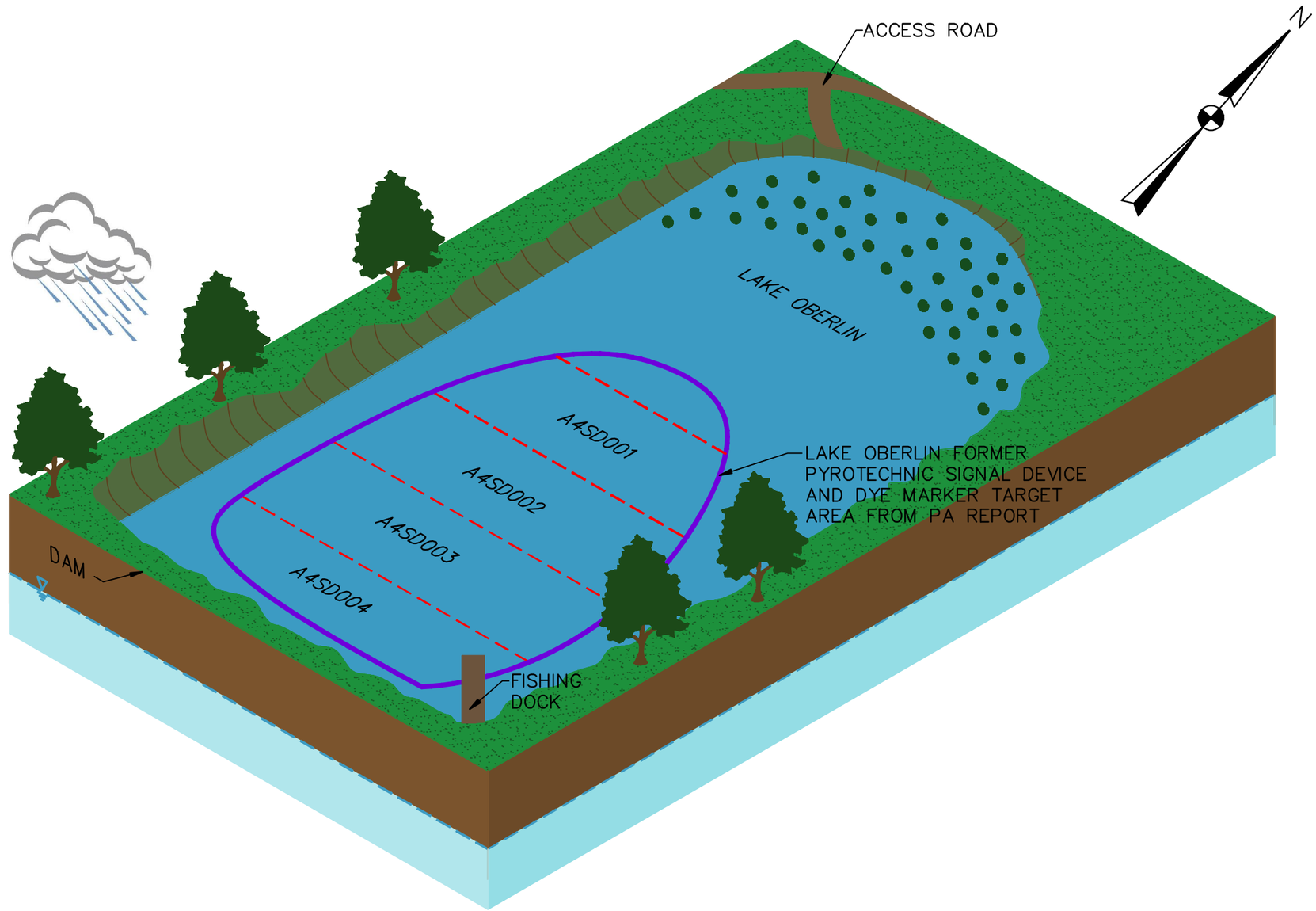
FIGURE 7-2

MC EXPOSURE PATHWAY ANALYSIS

LAKE OBERLIN AOC - 04

NSA CRANE, CRANE, INDIANA





LEGEND

- LILY PAD
- TREE/VEGETATION
- SAMPLING GRID
- WATER TABLE (ESTIMATED)

NOTE:
NAVY DYE COMPOUNDS WERE NOT DETECTED IN THE SEDIMENT SAMPLES FROM LAKE OBERLIN. THEREFORE, NAVY DYE COMPOUNDS ARE NOT EXPECTED TO BE PRESENT IN THE LAKE SEDIMENTS IN UXO 01 CONSERVATION DAM NO. 2845, AOC 03 DUGGER LAKE FACILITY, OR UXO 03 LAKE GREENWOOD PYRO TEST AREA NEAR DAM.

CURRENT AND FUTURE RECEPTORS FOR AOC 04
HUMAN: –MILITARY/CIVILIAN PERSONNEL –CONTRACTORS –RECREATIONAL USERS (BOY SCOUTS, FISHERMAN, BOATERS, SWIMMERS)

DRAWN BY CK	DATE 2/23/10	LAKE OBERLIN–AOC 04 CONCEPTUAL SITE MODEL NSA CRANE, INDIANA	CONTRACT NO. 1621
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 7–3 / REV. 0

NAVFAC

R:\1621\CSM\1621CSM03.dwg PIT CARLY.KRAMER 4/19/2010 10:42:51 AM

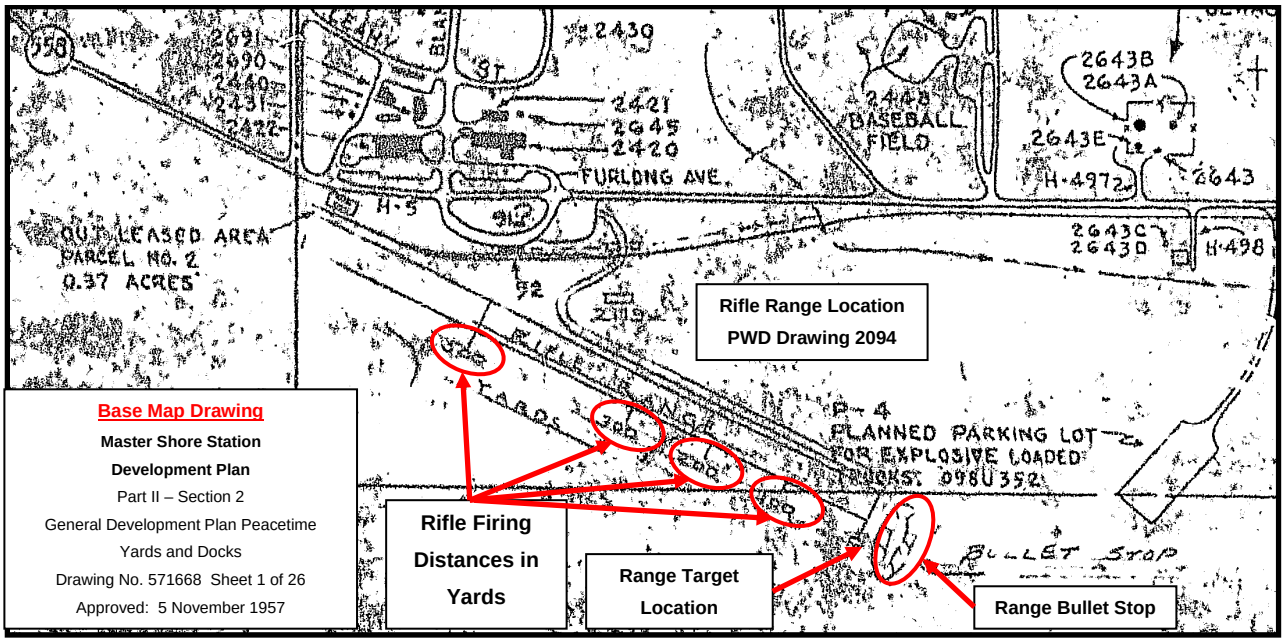
8.0 WEST GATE SMALL ARMS RANGE COMPLEX – AOC 06

8.1 SITE BACKGROUND

West Gate Small Arms Range Complex – AOC 06

The West Gate Small Arms Range Complex is located south of Highway 5, outside of the western gate of NSA Crane on Navy property (Figure ES-2). This area is currently not being used by NSA Crane. There are no access controls or restrictions in place to limit access to this area. The West Gate Small Arms Range Complex site consists of 4 ranges: 500-yard Rifle Range, 60-yard Pistol Range, Skeet Range, and Trap Range, and covers approximately 34 acres. Because of the overlapping and approximately contiguous site boundaries of these ranges, they were combined into one MRP site for this SI.

The 500-yard Rifle Range covers 12 acres; was constructed, graded, and seeded in 1966; and was opened in 1967. The range had 100-, 200-, 300-, and 500-yard firing lines. Historical aerial photographs and site layout drawings indicate that a 400-yard firing line was not installed, but a line of metal posts near the trap house where it would have been located may have supported Rifle Range targets fired upon from the 500-yard firing line (see below). The date of the original construction of the Skeet Range is unknown; however, it was reportedly rebuilt in 1974.



Historical documents recovered from NSA Crane files indicate that range improvements completed at the West Gate Small Arms Range Complex during 1971 included construction of semi-permanent target posts at 50 feet, 25 yards (75 feet), 100 feet, 45 yards (135 feet), and 50 yards (150 feet); construction of universal target carriers mounted on the target posts (by bolts) to accommodate regulation small bore, rim and center fire pistol and slug gun targets; and construction of firing lane markers which also served as accessory tables for pistol shooting. Additional recovered documents confirmed that competitive pistol shooting events were performed at the pistol range 1971 through 1973. Range improvements for the skeet range in 1974 impacted the general area of the pistol range. A 1975 design drawing for pistol range improvements (approved 24 April 1975) illustrated the range layout as having 16 firing lanes (two groups of eight lanes) with firing lines constructed at 7 yards (21 feet), 15 yards (45 feet), 25 yards (75 feet), and 50 yards (150 feet). A final range line was constructed at a distance of 60 yards (180 feet) from the targets. No information on the West Gate Small Arms Range Complex for the period after 1975 was recovered, and it is believed that these recreational firing ranges may have been closed at that time.

The location of the Trap Range was identified based on the position of the former trap house structure, and also faced south toward the natural hillside. An observed drainage channel in front of the trap house that flows east past the Skeet Range contained skeet fragments and plastic shotgun wads. In the portion of the site where the Trap Range and Skeet Range overlap, expended shotgun wads, clay pigeon fragments, larger missed clay pigeons, and areas of expended shotfall containing accumulated lead shot were observed. The shotfall areas for the Trap Range and the Skeet Range also overlap the general target area hillside for the Pistol Range. The Skeet Range shotfall area also overlaps the 500-yard Rifle Range between the 300-yard and the 200-yard firing lines.

There are no major structures associated with this site. However, the remains of the old trap house, foundations for the skeet range high house and low house, and related structures in the former range firing areas and range target locations are still present within the site boundaries, and guided the field sampling program at this site. The Trap Range and the Skeet Range faced to the south and used the contours of the natural hillside to help contain expended shot and clay pigeons. The remnants of the Skeet Range (foundations from the high house, low house, and concrete pads for firing stations) were identified in the northern part of the site during the Tetra Tech site visit. Multiple expended shotgun shells were observed on the ground surface in this area. Wooden target frames and welded metal bases for target frames and lane barricades were observed in the field on the former pistol range and confirmed the general firing positions and range target locations.

8.1.1 Historical Munitions Information

The West Gate Small Arms Range Complex was used as a recreational small arms range. Based on the information obtained during the data collection process, the West Gate Small Arms Range Complex is believed to have been used exclusively for small arms (rifles, pistols, and shotgun), safety training, target practice, and competition shooting events. There is no reason to suspect that anything other than small arms ammunition was ever used in this area. The ammunition used at the facility likely included the following:

- Shotgun Ammunition
  - 10-gauge shotgun shells
  - 12-gauge shotgun shells
  - 16-gauge shotgun shells
  - 20-gauge shotgun shells
  - 28-gauge shotgun shells

- Small Arms Ammunition
  - .22-caliber shells
  - .30-caliber shells
  - .45-caliber shells
  - .50-caliber shells
  - 9-mm shells

Other materials used on the ranges included bulk smokeless powder and ammunition for muzzle loading rifles. The rifle range and pistol range typically used paper targets for the competitive shooting events. The discovery of multiple metal targets on the rifle range during the SI site walk in the form of animal silhouettes confirms that there were competitive shooting events that used scaled sheet-metal cutouts representing animals (chickens, pigs, turkeys, and rams) as targets. The trap and skeet ranges used the standard clay skeet targets, as evidenced by the remains of the trap house and the skeet fragments observed on the range floor.

8.1.2 Munitions Constituents

Based on the historical use of the site, MC may be present in the surface soil throughout this area. For small arms ranges, the Interstate Technology and Regulatory Council (ITRC) has prepared a document titled Characterization and Remediation of Soils at Closed Small Arms Firing Ranges, dated

January 2003, to provide information on the general layout of small arms ranges, as well as information on areas that may be impacted with MC and/or MEC as a result of range use and the characteristics of the munitions used. According to the ITRC guidance, the penetration depth of small arms ammunition on the range floor is typically 1 foot or less. The document states that rounds that impact the range floor typically had a flat trajectory that fell short of or missed the target, or resulted from ricochet, and these fragments are usually found within the top 6 inches of soil. It is expected that the maximum soil depth which the munitions would have penetrated the soil at the West gate Small Arms Range Complex is approximately 1 foot bgs.

In addition, the drainage channel leading away from the ranges may contain accumulated contamination from storm water runoff and erosion. It is also likely that MC is present at the impact areas (targets) and other bullet stop areas, and on the natural hillside. MC associated with small arms ranges includes metals such as lead, antimony, arsenic, copper, tin, and zinc. Lead is the primary metal of concern because it is the primary constituent in the munitions used at these ranges, and because of its documented toxicity to human and ecological receptors. It is anticipated that the other metals were spatially correlated with the lead. Other MC in the surface soil on the Skeet and Trap Ranges and on the natural hillside includes PAH compounds in the pitch tar used to manufacture the clay skeet targets. Nitroglycerin (NG) residue may be present in the soil at the various range firing lines associated with firing small arms ammunition on the these ranges.

8.1.3 Current Land Use and Anticipated Future Land Use

The West Gate Small Arms Range Complex is currently not being used by NSA Crane. The area is located on Navy property outside the western NSA Crane security gate, and there are no access controls or restrictions in place to limit access to this area. The land use of the site and surrounding area is not anticipated to change for the foreseeable future. The site could potentially be used for hunting.

8.2 SITE FIELDWORK

8.2.1 Site Field Activities

Soil sampling at the West Gate Small Arms Range Complex was limited to surface soil (0- to 2-feet bgs) because that interval is the established surface soil depth as NSA Crane and because lead is relatively immobile in soil and would be expected to remain in surface soil. Samples were analyzed in the field for lead using XRF with a subset of those samples subsequently selected for submittal to the FBL for select metals analysis. Samples collected within the clay target fall out zones for the skeet and trap ranges

were selected for PAH analysis at the FBL, and samples collected at the firing areas for the rifle range, pistol range, trap range, and skeet range were selected for NG analysis at the FBL.

Soil sample locations were selected based on a bias towards areas that had the greatest likelihood to have been impacted by past site operations. See Figure 8-1 for all sample locations. Prior to marking sample locations, the field team completed a site walkover to determine if the proposed sample locations completely encompassed the former ranges. During the site walk of the Pistol Range, wooden shooting stations were observed in the area near the base of the Pistol Range impact hillside just west of the Rifle Range 300-yard firing line. Proposed sample locations in this area were limited so the proposed sample locations on the Pistol Range impact hillside were adjusted slightly (spread out) to include this area.

Prior to initiating sample collection, all sample locations were marked by colored pin flags bearing the sample location ID. Proposed sample locations identified in the approved UFP-SAP were located by GPS. While marking sample locations for the Trap and Skeet Ranges, sample location A6SB065 was determined to be co-located on a previous sample location (A6SB1120) collected for the Pistol Range; therefore, sample A6SS0650002 was not collected. Upon collection of the samples at the West Gate Small Arms Range Complex, a field team member utilized the handheld GPS unit to collect actual sample location coordinates in order to map the sampling locations. These data were measured to sub-meter accuracy using the horizontal datum: NAD 83 Indiana State Plane Coordinate System West.

Photographs associated with the sampling activities at the West Gate Small Arms Range Complex are presented in Appendix B.5.

Due to extremely dense understory growth in September 2009 at the West Gate Small Arms Range Complex, the Project Team made the decision to delay sampling activities at this location until later in the year (after the initial seasonal frost events had reduced the vegetative cover). Field crew members remobilized in November 2009 and the understory growth was considerably less dense and vegetation removal was limited to clearing small paths to the more remote sampling locations at the former skeet and trap range. However, more extensive vegetation clearing, using hand tools, was required at each of the firing and target berms at the former rifle range which were thickly covered in briars. No trees having a trunk diameter greater than 3-inches were disturbed.

8.2.2 Work Plan Deviations

As discussed above, the sample at location A6SB065 was not collected as proposed. There were no other deviations from the UFP-SAP for the West Gate Small Arms Range Complex.

8.2.3 Field Data Collection

One hundred seventy soil samples (159 discrete and 11 composite) were collected within the West Gate Small Arms Range Complex via hand auger in accordance with SOP-09. See Figure 8-1 for all sample locations. All samples were collected at a depth of 0 to 2 feet bgs except one sample (A6SS1480001), which was collected at 0 to 1 foot bgs due to refusal in that area with the hand auger. All samples underwent screening in the field for lead utilizing XRF in accordance with UFP-SAP SOP-16. A discussion on XRF procedures is presented later in this section.

Forty discrete samples were submitted to the respective FBL and analyzed for specific metals, including antimony, arsenic, copper, lead, and zinc. Twenty discrete samples were submitted to the respective FBL and analyzed for PAHs, and 11 composite samples were submitted to the respective FBL and analyzed for explosives.

The sampling design took into account each of the individual ranges as described below:

500-Yard Rifle Range

- A composite surface soil sample, each comprised of 10 discrete samples, was collected from the downrange side of each of the 500-, 300-, 200-, and 100-yard firing berms. Each composite sample was submitted to the FBL for explosives analysis. The assumed shooters position at each of the firing berms was along the top of the berm; therefore, the grab samples were evenly spaced in a zigzag pattern along the top of each 100-foot long firing berm to maximize the potential to detect contamination.

- Because it was suspected that firing range targets were eventually stationed on the 300-, 200-, and 100-yard firing berms to support the metallic animal silhouette competitions requiring multiple target firing distances from a single firing line (based on the bullet-impacted timbers and the targets observed in the field), 10 discrete surface soil samples were collected from each of these points and all underwent field analysis for lead with the XRF. Each set of 10 samples were evenly spaced in a zigzag pattern along the upper northwest (uprange) face of each of the sampled target location berms. This sampling location distribution was designed to maximize the spatial coverage in an attempt to maximize the potential for detecting contamination.

- Seven discrete surface soil samples were collected within the area of the former target positions near the main bullet stop. These samples were also evenly spaced in a zigzag pattern over an area of approximately 100 feet. These seven samples also underwent field analysis for lead with the XRF in an attempt to establish the spatial distribution of lead.

- Fourteen discrete surface soil samples were collected at the hillside (bullet stop) behind the main target area. These samples were collected along two 150-foot long transect lines with seven samples per line. The lower transect line was located in the area of the hillside where bullets passing through or next to the targets would have impacted the hillside. The second transect line was located approximately 5-feet higher on the hill from the first line in an area where any bullets passing above the intended targets would impact the hillside. Each of these samples underwent field XRF analysis for lead to establish the spatial distribution of lead.

Trap Range and Skeet Range

- Because the footprint of the Trap Range falls within the area of the Skeet Range, a single sampling design encompasses both ranges.

- One composite surface soil sample, comprised of 10 individual grab samples, was collected from each of the firing areas at the Skeet Range and the Trap Range. Each of these composite samples was submitted to the FBL for explosives (nitroglycerin) analysis. This design was intended to maximize the potential to detect explosives with a minimum number of samples where it was most likely to be present.

- Seventy-eight discrete surface soil samples were collected in the area encompassing both the Trap Range and the Skeet Range. Samples were spaced approximately 50- to 75-feet apart along nine transect lines starting at the shooters' positions at the Skeet Range. The Trap and Skeet Ranges consists of an open field as well as heavily forested areas. The area also rises in elevation as you move from the shooters position to the area of outfall (north to south). All samples underwent field analysis for lead with the XRF to establish the spatial lead distribution.

Pistol Range

- Five composite surface soil samples, each comprised of 10 individual grab samples, were collected from the five firing lines at the Pistol Range. These firing points were located 50-, 75-, 100-, 135-, and 150-feet from the target area. Each of these composite samples was submitted to the FBL for

- Twenty-six discrete surface soil samples were collected at the Pistol Range target area and at the hillside (bullet stop) behind the target area. These samples were collected along three transect lines. Seven samples were collected along the lower 200-foot transect line which were placed in the area of the former target locations. Nine samples were collected along the middle 225-foot transect line which were placed approximately 5 to 8 feet above the first transect line, in the area where bullets passing through or next to the targets would have impacted the hillside. Ten samples were along the upper 250-foot transect line which were placed approximately 5 feet above the middle transect line, in the area where bullets passing over the intended targets would have impacted the hillside. All 26 samples underwent field analysis for lead with the XRF to establish the spatial distribution of lead.

XRF

As stated above, all 170 soil samples collected at the West Gate Small Arms Range Complex underwent field screening for lead via XRF. Prior to analyzing samples, the XRF was standardized and samples were processed as described in Section 3.1.2.3.

The results of the field XRF lead analyses were the basis for determining which samples were sent to the FBL for select metals analysis. The FOL selected samples representing the range of concentrations observed in the field with the majority of samples in the 250 to 550 mg/kg range. Sample locations, methods, and FBL analyses are presented on Table 8-1. All XRF lead concentrations and respective FBL lead concentrations, if applicable, are included on Table 8-2. The correlation analyses for the XRF versus FBL lead analysis is discussed in Section 8.5.

8.3 SITE INSPECTION DATA COLLECTION RESULTS

8.3.1 MC Sampling Results

One hundred seventy surface soil samples were collected at the West Gate Small Arms Range Complex. All 170 samples were analyzed for the presence of lead in the field via XRF. Forty samples were shipped to a FBL for select metals analysis, 20 were shipped to a FBL for PAH analysis, and 11 were shipped to a FBL for explosives analysis.

Soil samples collected at the West Gate Small Arms Range Complex were compared to human health and ecological screening criteria, and the applicable background concentration from the Base-wide Background Soil Investigation Report for Naval Surface Warfare Center Crane (Tetra Tech, 2001). The MC analytical results are presented in Appendix C and the data validation reports are presented in Appendix D.5.

Metals

Table 8-3 summarizes the results as compared to the calculated screening values for metals. The PAL selected for each metal is consistent to what was established in the UFP-SAP (Tetra Tech, 2009) and was typically the 95 percent upper tolerance limit (UTL) as presented in the Basewide Background Soil Investigation Report for the Crane facility (Tetra Tech, 2001). On Table 8-3, if a parameter exceeded the PAL at any sampling point, the parameter was highlighted. Forty discrete soil samples were analyzed for the MC select metals: antimony, arsenic, copper, lead, and zinc. The PALs for antimony, arsenic, and zinc were not exceeded at any of the sampling points. The PAL for copper which is 28 mg/kg is based on the ecological soil screening level and this concentration was exceeded at three locations at the West Gate Small Arms Range Complex. These exceedances of the copper PAL included samples at locations A6SB057 (57.6 "J" mg/kg), A6SB132 (28.8 mg/kg), and A6SB0170 (121 mg/kg). No soil samples exceeded the human health risk screening value of 3,100 mg/kg for copper for direct contact in residential soil. The PAL for lead, 27 mg/kg, was exceeded in 27 of the 40 soil samples submitted to the FBL. Two soil samples exceeded the human health risk screening value of 400 mg/kg for lead for direct contact in residential soil. Soil sample location A6SB057 had an FBL lead concentration of 901 mg/kg, and sample location A6SB170 had an FBL lead concentration of 1,240 mg/kg. Only one sample location (A6SB134) had an XRF lead concentration (483 mg/kg) greater than the 400 mg/kg human health PAL, with no associated FBL result. Figure 8-2 illustrates XRF lead detections and PAL exceedances in soil at the West Gate Small Arms Range Complex. Figure 8-3 illustrates the FBL inorganic detections and PAL exceedances in soil at the West Gate Small Arms Range Complex.

Propellants/Explosives

Table 8-4 summarizes the analytical results and any exceedances as compared to the calculated screening values for explosives. The PAL was the reference limit, unless the screening calculations exceeded this value. In Table 8-4, if a parameter exceeded the PAL at any sampling point, the parameter was highlighted. Eleven composite soil samples were analyzed for explosives. NG was not detected at any sampling location. HMX, RDX, and 2-Amino-4,6-Dinitrotoluene were detected at three sampling locations; however, all three concentrations were estimated ("J" qualifier). There were no PAL

exceedances for HMX, RDX, or 2-Amino-4,6-Dinitrotoluene at any of the sampling locations. Figure 8-4 illustrates the explosives detections in soil at the West Gate Small Arms Range Complex. Appendix C includes the full analytical results for the explosives analyzed.

PAHs

Table 8-5 summarizes the analytical results and any exceedance as compared to the calculated screening values for PAHs. The PAL was the reference limit, unless the screening calculations exceeded this value. In Table 8-5, if a parameter exceeded the PAL at any sampling point, the parameter was highlighted. PAH analysis was limited to samples collected in areas where clay pigeon fragments from skeet and trap range activities were expected or visibly present. Twenty soil samples were sent to the FBL for PAH analysis. At six of the sampling locations, the PALs for PAHs were exceeded for one or more parameters.

The PAHs are believed to be associated with the fragments of the clay pigeons used as targets on the skeet and trap ranges. A pitch tar containing PAHs was used in the manufacture of the clay pigeons to help bind the clay particles. Table 8-5 also presents the PAH results and the calculated benzo(a)pyrene (BaP) equivalents. The calculated screening value is 1,500 µg/kg. A description of the BaP equivalents follow:

The USEPA has identified seven PAHs as potentially carcinogenic: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)-pyrene. Of these PAHs, benzo(a)pyrene has been subjected to the most toxicological study and the USEPA has used the toxicological data to establish quantitative toxicological parameters (cancer slope factors and inhalation unit risks) for benzo(a)pyrene. All seven of these PAHs have a similar chemical structure and similar chemical properties. For example, these PAHs have relatively low solubilities in water, have low potential to volatilize into the air and have a propensity for adsorbing to soil rather than dissolving in water once they are in the environment. Laboratory studies suggest that these chemicals act similarly from the perspective of carcinogenicity and that the carcinogenic potency of the individual PAHs can be evaluated with reference to the carcinogenic potency of benzo(a)pyrene. Therefore, USEPA has developed a toxicity equivalency factor (TEF) for each potentially carcinogenic PAH that can be used to convert the concentration of that PAH to an equivalent concentration of benzo(a)pyrene. Since benzo(a)pyrene is often abbreviated BaP, this process is known as determining the BaP equivalent concentration.

The TEFs for the seven potentially carcinogenic PAHs are given in the table below:

PAH	TEF
Benzo(a)pyrene	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-c,d)pyrene	0.1

The BaP equivalent concentration was calculated for each sample using the following four step process:

First, for any potentially carcinogenic PAH that was not detected, half the reporting limit was used as the concentration for that PAH. Second, the concentration of each potentially carcinogenic PAH was multiplied by its TEF to give its BaP equivalent concentration. Third, the BaP equivalent concentrations for all potentially carcinogenic PAHs were summed to give the total BaP equivalent concentration. Fourth, if no potentially carcinogenic PAHs were detected in a sample, the reporting limit for benzo(a)pyrene was used as the total BaP equivalent concentration.

Table 8-5 presents the concentrations of potentially carcinogenic PAHs in each discrete surface soil sample submitted for analysis of PAHs. This table also provides the TEFs and the resulting total BaP equivalent concentration for each sample. In Table 8-5, the total BaP equivalent concentrations are compared to risk-based screening levels (RBSLs) for BaP for direct contact exposures to soil (i.e., incidental ingestion, dermal contact, and inhalation of constituents emitted from soil to the air). The RBSL for residential exposures to BaP in soil is 15 µg/kg, as discussed in Appendix F. This value comes from the USEPA Regional Screening Level tables and corresponds to a risk level of 10^{-6}. As discussed in Appendix F, a risk level of 10^{-4} is used as the point of departure for evaluating total cancer risks in this assessment. Consequently, a RBSL corresponding to a risk level of 10^{-4}, 1,500 µg/kg, was used to evaluate the total BaP equivalent concentrations in Table 8-5. None of the 20 soil samples had total BaP equivalent concentrations that exceeded the RBSL of 1,500 µg/kg. Sample A6SS0610002 had the highest BaP equivalent for originally collected (as opposed to duplicate) samples with a calculated concentration of 626 mg/kg. To evaluate future nonresidential uses of the site, Table 8-5 presents a comparison of the total BaP equivalent concentrations to the non-residential RBSL of 21,000 µg/kg (corresponding to a risk level of 10^{-4}). No soil samples had total BaP equivalent concentrations that exceeded the non-residential RBSL of 21,000 µg/kg. The BAP equivalents are illustrated on Figure 8-5.

Any observance of clay target remnants were noted in the sample log sheets. Appendix C includes the full analytical results for the PAHs analyzed.

The Human Health Risk Screening Evaluation summary for the West Gate Small Arms Range Complex is discussed in Section 8.6, with supporting documentation presented in Appendix F.5.

The Ecological Risk Screening Evaluation summary for the West Gate Small Arms Range is discussed in Section 8.7, with supporting documentation presented in Appendix G.5.

8.4 DATA PRESENTATION AND USABILITY

8.4.1 Data Validation Process

All of the results from analytical FBL samples were validated according to multiple specifications. Sample data validation generally followed USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA, 1999), and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (USEPA, 2004) guidelines.

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Appendix D.5**.** Rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections are also presented in Appendix D.5. Rejected data are not acceptable for performing risk assessments.

8.4.1.1 Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of FBL samples (e.g., laboratory duplicates). Individually, field and FBL DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 8-3.

8.4.1.2 Completeness

The explosives fraction had 4 out of 180 results rejected because of percent difference between columns greater than 100 percent. The results are likely false positives because the compounds cannot be confirmed using a second column. The laboratory measurement completeness was 97.8 percent, which meets the 90 percent completeness goal. The sample collection completeness was 100 percent.

8.4.1.3 Sensitivity

The PQLGs are listed in Worksheet #15 in the UFP-SAP (Tetra Tech, 2009). Analytical sensitivity for data at the West Gate Small Arms Range Complex was satisfactory to meet DQOs presented in the UFP-SAP.

There are no instances where the non-detected sample results exceed the PQLGs either because of the FBLs inability to meet the PQLG or because of elevated detection limits due to blank contamination.

8.4.1.4 Field and Laboratory Accuracy

There were several results qualified due to matrix spike and LCS recoveries in the explosive and metals fractions at the West gate Small Arms Range Complex. Only one explosive compound result was qualified due to an LCS recovery greater than the laboratory quality control limit and one explosive compound result was qualified due to a matrix spike recovery less than the laboratory quality control limit. The explosive results qualified because of LCS or matrix spike recoveries do not indicate any bias with the data. Copper, lead, and zinc results were qualified due to a matrix spike recovery greater than the laboratory quality control limit. There may be a slight high bias for these results. All antimony results were qualified due to matrix spike recoveries less than the laboratory quality control limits indicating a low bias for antimony results. An impact on data quality is not expected because the spike recoveries were all greater than 30 percent and considered useable for risk assessment. There was no quality control deficiencies noted for field accuracy.

8.4.1.5 Field and Laboratory Precision

There were several results qualified due to field or laboratory duplicate imprecision in the explosives, PAH, and metals fractions at the West Gate Small Arms Range Complex. The lack of homogeneity in soil samples is common and the precision results do not indicate a site wide problem with the soil matrix.

8.4.1.6 Comparability

No comparability issues were noted during the data validation process for the West Gate Small Arms Range Complex.

8.4.1.7 Representativeness

The UFP-SAP (Tetra Tech, 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

8.5 CORRELATION BETWEEN XRF AND FIXED-BASE LABORATORY

From the samples that were analyzed in the field using XRF and also at the FBL, a regression analysis was conducted to evaluate the correlation between the FBL lead results and XRF lead results. To evaluate the regression analysis, the Pearson Correlation and the R-squared value were calculated. The Pearson Correlation is a measure of the strength of the linear relationship between two or more variables with a range of -1 to +1. The value of -1 represents a perfect negative correlation (as one variable decreases the other increases proportionally); whereas, a value of +1 represents a perfect positive correlation (as one variable increases the other increases proportionally). A value of 0 represents a lack of correlation. The regression analysis was calculated for two data sets at the West Gate Small Arms Range Complex. The first regression analysis was calculated for XRF lead concentrations less than 400 mg/kg and their respective FBL lead concentration. The correlation for this sample group was 0.69, indicating a moderate relationship trend. It should be noted that there were only three samples not included in this initial regression analysis (i.e.: samples exhibiting an XRF lead concentration greater than 400 mg/kg). The second regression analysis was calculated for all XRF lead samples at the West Gate Small Arms Range Complex with their respective FBL lead concentrations. The correlation for this sample group was 0.59, also indicating a moderate relationship trend.

The R-squared value represents the percent of variation in the FBL lead results that can be explained by the XRF lead results. The R-squared value for the first regression analysis at the West Gate Small Arms Range Complex (less than 400 mg/kg) was 0.48. The R-squared value for the second regression analysis at the West Gate Small Arms Range Complex (all samples) was 0.35. The regression analysis is included in Appendix E.2.

8.6 HUMAN HEALTH RISK SCREENING EVALUATION SUMMARY

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from MC present at the West Gate Small Arms Range Complex. Tetra Tech evaluated soil sampling data for the West Gate Small Arms Range Complex. Soil samples were analyzed for inorganics, explosives, and PAHs. Maximum concentrations of each chemical in soil were compared to RBSLs based on direct contact exposure to soil and protection of groundwater. Any chemical exceeding their respective RSBL was then retained as a COPC. The potential for chemicals to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration of each chemical to screening criteria for the protection of groundwater. Nineteen PAHs, three explosives, and five inorganics were detected in the soils at the West Gate Small Arms Range Complex. The following chemicals exceeded the USEPA and IDEM direct contact RBSLs and were retained as COPCs:

- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene equivalents]
- Inorganics [arsenic and lead]

Concentrations for arsenic were within basewide background levels and therefore subsequently eliminated as a COPC.

HIs for residential and industrial exposures are less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions. ILCRs for residential and industrial exposures were within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}.

Lead was selected as a COPC; however, the arithmetic mean lead concentration for soil is 130 mg/kg which is less than the residential COPC selection criterion for lead (400 mg/kg). The USEPA pharmaco-kinetic models used to evaluate concentrations of lead in the environment recommend using the arithmetic mean lead concentration as the lead EPC; therefore, lead concentrations in these soils were not further evaluated in this human health risk screening evaluation.

The following chemicals were detected in soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for soil at the West Gate Small Arms Range Complex:

- PAHs [1-methylnaphathalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, and benzo(a)pyrene equivalents]
- Explosives [2-amino-4,6-dinitrotoluene and RDX]
- Inorganics [arsenic, copper, and lead]

Only arsenic and lead were present in soil at concentrations above the IDEM migration from soil to groundwater criteria. Concentrations of 1-methylnaphthalene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, 2-amino-4,6-dinitrotoluene, and copper exceeded the USEPA SSL based on a DAF of 1, but were less than the USEPA SSL based on a DAF of 20. Arsenic concentrations were within base-wide background levels. All PAHs have relatively low solubility in water, but the more soluble PAHs that are COPCs (i.e., naphthalene) are readily biodegradable, so if these PAHs leach from soil into groundwater, there is a good chance that some or all of these chemicals will degrade in groundwater. The PAHs with very low solubility in water have much higher affinity for soil solids over soil water. It could take a long time (years to decades) for these PAHs to leach through the soil and reach groundwater. The PAHs with very low solubility are also susceptible to biodegradation and even a low rate of biodegradation could remove the chemicals from the leachate before it reaches the groundwater. Groundwater from the West Gate Small Arms Range Complex is not currently used as a source of drinking water, so the pathway is currently incomplete.

8.7 ECOLOGICAL RISK SCREENING SUMMARY

The goal of the ecological risk screening is to determine whether adverse ecological impacts are present at the site as a result of exposure to chemicals released to the environment through historical site activities. The risk screening allows conclusions to be made as to whether ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks at the site.

Tetra Tech evaluated soil sampling data for the West Gate Small Arms Range Complex. Soil samples were analyzed for inorganics, propellants/explosives, and PAHs.

One PAH (pyrene), one explosive (2-Amino-4,6-dinitrotoluene), and four metals (antimony, copper, lead, zinc) were initially selected as COPCs for mammals and birds because they were detected at concentrations exceeding their respective screening levels. Two additional explosives (HMX, RDX) were initially selected as COPCs for mammals and birds because they did not have screening levels.

When a chemical is initially retained as an ecological COPC, it then goes through refinement to better define those chemicals and to identify and eliminate any chemicals from further consideration that were retained because of very conservative exposure scenarios.

Copper was initially selected as a COPC for terrestrial plants due to an exceedance of its screening level. However, copper was only detected in one of 40 samples and its location was in the middle of the skeet range and it was surrounded by other samples with low copper concentrations. Therefore, risks to plants from copper are not significant and it was subsequently eliminated as a COPC for plants.

Concentrations of lead exceeded its screening level of 120 mg/kg in 10 samples of 40 samples. Four of the concentrations just slightly exceeded the screening level, while four had concentrations between 200 and 320 mg/kg, and two had concentrations between 900 and 1250 mg/kg. The greatest concentrations of lead were found in the middle of the skeet range. Therefore, although potential impacts to plants are limited to a few areas, because the site is heavily wooded, and because the bioavailability of the lead from the shot pellets is not known, there is uncertainty in whether plants are actually being impacted at the site.

The EEQs from the terrestrial food chain modeling were greater than 1.0 for several chemicals using maximum chemical concentrations and conservative exposure assumptions (see Appendix G.5). Therefore, as part of the Step 3a refinement, risks for this pathway were recalculated using average chemical concentrations in surface soil and sediment and less conservative exposure assumptions (i.e., average ingestion rates, average body weights) (see Appendix G.5).

Based on the calculation of average chemical concentrations, copper had an EEQ less than 1.0 using the NOAEL as the TRV. Therefore, copper was eliminated as a COPC. Lead has an EEQ for the robin slightly greater than 1.0 using the NOAEL as the TRV (EEQ = 1.1); however, none of the receptors have EEQs greater than 1.0 using the LOAEL as the TRV. Lead was present in greatest concentrations in the middle of the skeet range. However, because the EEQ based on the NOAEL and was only slightly greater than 1.0, it is unlikely that lead will significantly impact birds at the site. For that reason, lead was eliminated as a COPC for birds.

2-Amino-4,6-dinitrotoluene has an EEQ for the robin slightly greater than 1.0 using the NOAEL as the TRV (EEQ = 1.6); however, none of the receptors have EEQs greater than 1.0 using the LOAEL as the TRV. This explosive was only detected in 1 of 11 samples. Its only detection was in one of the five composite samples from the pistol range, which is less than 0.5 acres in size. Therefore, assuming that a

robin would only obtain 50 percent of its food from the pistol range, then the EEQ would be less than 1.0. For that reason, 2-Amino-4,6-dinitrotoluene was eliminated as a COPC from the site.

Although avian TRVs were not available for HMX, it is not likely to impact birds because a subchronic study confirms no adverse effects to birds from exposures as high as 10,000 ppm HMX in feed, suggesting that HMX is largely not available for absorption (USACHPPM, 2001). Therefore, HMX was eliminated as a COPC for birds.

No chemicals were retained as COPCs for terrestrial invertebrates or wildlife.

Lead was the only chemical retained as a COPC for potential risks to plants.

8.8 UPDATED CSM

Only MC associated with the West Gate Small Arms Range Complex was considered in the CSM exposure pathway analysis (Figure 8-6). A general description of the CSM exposure pathway analysis as presented in the UFP-SAP (Tetra Tech, 2009) is summarized below:

MC (select metals, PAHs, and propellants/explosives) in surface soil could infiltrate into the subsurface soil and ultimately leach from the soil into the groundwater. An additional migration pathway may be storm water runoff that could have transported contaminated surface soil through drainage channels to a downgradient location which could contaminate nearby soil and groundwater. Contaminant dilution would occur during overland transport.

Human receptors at this site that could come into contact with MC contamination in surface soil are military and civilian personnel, contractors, trespassers, and hunters. Human receptors (hunters) could also contact contaminants through the food chain because hunting is permitted at NSA Crane, and contaminants may bioaccumulate in animals. Ecological receptors that could come into contact with MC contamination in surface soil include wildlife such as deer, rabbits, raccoons, and wild turkeys. Ecological receptors could also contact contaminants through the food chain when ingesting vegetation such as grass at the site.

CSM Summary

The updated CSM is shown on Figure 8-7 and details the potential exposure sources, pathways, and receptors. The exposure sources appear to be limited to the areas of lead shot and small arms bullet

accumulation and the range areas containing clay target fragments. One pathway is runoff from precipitation. Leaching from soil into groundwater has been eliminated as a pathway, since groundwater is not used at the site. Receptors would be trespassers and ecological receptors by ingestion, dermal contact, and inhalation of surface soil, soil, and sediment. Potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses.

8.9 CONCLUSIONS

In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the West Gate Small Arms Range Complex. Soil samples were analyzed for PAHs, explosives/propellants, and inorganics. Lead was initially selected as a COPC; however, the arithmetic mean lead concentration for soil is 130 mg/kg which is less than the residential COPC selection criterion for lead (400 mg/kg). The USEPA pharmaco-kinetic models used to evaluate concentrations of lead in the environment recommend using the arithmetic mean lead concentration as the lead EPC; therefore, lead concentrations in the soil at the West Gate Small Arms Range were not further evaluated in the human health risk screening evaluation.

Arsenic concentrations were within base-wide background levels. The calculated BaP equivalents for the original PAH soil samples did not exceed the BaP half-equivalents screening criteria of 1,500 µg/kg. The explosives: HMX, RDX, and 1-Amino, 4,6-Dinitrotoluene, were detected in only three of the composited firing line soil samples at either estimated “J” values or below the PAL limits.

MC detections were present in range soil samples, but the detected concentrations did not appear to be significant in terms of MC exposures to human or ecological receptors.

8.10 RECOMMENDATIONS

MC analytes were detected in a limited number of surface soils at concentrations equal to or greater than the PALs established for those compounds. Two specific areas with elevated XRF readings for lead in soil (above 200 mg/kg for XRF screening purposes) were identified within AOC 06. One area at the 200-yard firing line/range target on the 500-yard rifle range had three sample locations (A6SS131, A6SS132, and A6SS134) with field-measured lead concentrations above the XRF screening level. The other area with elevated XRF readings was identified along the pistol range bullet stop hillside and had four sample locations (A6SS093, A6SS097, A6SS169 and A6SS171) with field-measured lead concentrations above the XRF screening level (see Figure 8-2). Four of these seven of these soil samples were submitted for FBL analysis of lead and the laboratory data from these locations generally

confirmed that actual lead concentrations for these samples were below the 400 mg/kg PAL established for human health lead exposure.

Several soil samples analyzed for PAHs in locations where skeet fragments were expected and observed to be present contained detectable levels of PAHs from pitch tars used to bind the clay targets. However, the calculated BaP equivalents were below the screening level established for that compound. NFA is therefore recommended for PAH detections (and calculated BaP levels) in soil at the West Gate Small Arms Range Complex (AOC 06).

The highest laboratory soil sample lead concentrations were detected at location A6SS170 (1,240 mg/kg) and location A6SS057 (901 mg/kg) on the bullet stop hillside behind the pistol range. These points constituted the only individual soil samples with lead concentrations above the established residential COPC selection criterion for lead (400 mg/kg) for human health lead exposure. The risk evaluations for human health and ecological receptors indicated that the detected lead concentrations were not a significant concern. The arithmetic mean for lead in AOC 06 soil samples was 130 mg/kg, which is less than 50 percent of the 400 mg/kg human health lead exposure criterion. Consequently, there are no significant exposure risks to SAR MC in the surface soil at AOC 06 and the West Gate Small Arms Range Complex is recommended for NFA.

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
500-YARD FIRING LINE								
A6SB001	A6SS001C0002	11/16/2009	HA	0-2	X			X
300-YARD FIRING LINE								
A6SB002	A6SS002C0002	11/15/2009	HA	0-2	X			X
200-YARD FIRING LINE								
A6SB003	A6SS003C0002	11/11/2009	HA	0-2	X			X
100-YARD FIRING LINE								
A6SB004	A6SS004C0002	11/12/2009	HA	0-2	X			X
TRAP RANGE FIRING POINTS								
A6SB005	A6SS005C0002	11/16/2009	HA	0-2	X			X
SKEET RANGE FIRING POINTS								
A6SB006	A6SS006C0002	11/16/2009	HA	0-2	X			X
PISTOL RANGE FIRING POINT								
A6SB007	A6SS007C0002	11/14/2009	HA	0-2	X			X
A6SB008	A6SS008C0002	11/14/2009	HA	0-2	X			X
A6SB009	A6SS009C0002	11/14/2009	HA	0-2	X			X
A6SB010	A6SS010C0002	11/14/2009	HA	0-2	X			X
A6SB011	A6SS011C0002	11/14/2009	HA	0-2	X			X
TRAP AND SKEEET RANGE								
A6SB0012	A6SS012G0002	11/11/2009	HA	0-2	X			
A6SB0013	A6SS013G0002	11/11/2009	HA	0-2	X			
A6SB0014	A6SS014G0002	11/11/2009	HA	0-2	X			
A6SB0015	A6SS015G0002	11/11/2009	HA	0-2	X	X		
A6SB0016	A6SS016G0002	11/11/2009	HA	0-2	X			
A6SB0017	A6SS017G0002	11/11/2009	HA	0-2	X			
A6SB0018	A6SS018G0002	11/11/2009	HA	0-2	X			
A6SB0019	A6SS019G0002	11/11/2009	HA	0-2	X			
A6SB0020	A6SS020G0002	11/11/2009	HA	0-2	X		X	
A6SB0021	A6SS021G0002	11/11/2009	HA	0-2	X		X	

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB0022	A6SS022G0002	11/11/2009	HA	0-2	X	X		
A6SB0023	A6SS023G0002	11/11/2009	HA	0-2	X			
A6SB0024	A6SS024G0002	11/11/2009	HA	0-2	X			
A6SB0025	A6SS025G0002	11/11/2009	HA	0-2	X	X		
A6SB0026	A6SS026G0002	11/11/2009	HA	0-2	X			
A6SB0027	A6SS027G0002	11/11/2009	HA	0-2	X			
A6SB0028	A6SS028G0002	11/13/2009	HA	0-2	X			
A6SB0029	A6SS029G0002	11/13/2009	HA	0-2	X			
A6SB0030	A6SS030G0002	11/13/2009	HA	0-2	X		X	
A6SB0031	A6SS031G0002	11/11/2009	HA	0-2	X	X		
A6SB0032	A6SS032G0002	11/11/2009	HA	0-2	X	X		
A6SB0033	A6SS033G0002	11/11/2009	HA	0-2	X			
A6SB0034	A6SS034G0002	11/11/2009	HA	0-2	X			
A6SB0035	A6SS035G0002	11/13/2009	HA	0-2	X		X	
A6SB0036	A6SS036G0002	11/13/2009	HA	0-2	X		X	
A6SB0037	A6SS037G0002	11/13/2009	HA	0-2	X	X	X	
A6SB0038	A6SS038G0002	11/15/2009	HA	0-2	X			
A6SB0039	A6SS039G0002	11/15/2009	HA	0-2	X	X		
A6SB0040	A6SS040G0002	11/13/2009	HA	0-2	X			
A6SB0041	A6SS041G0002	11/13/2009	HA	0-2	X			
A6SB0042	A6SS042G0002	11/13/2009	HA	0-2	X			
A6SB0043	A6SS043G0002	11/15/2009	HA	0-2	X			
A6SB0044	A6SS044G0002	11/15/2009	HA	0-2	X			
A6SB0045	A6SS045G0002	11/13/2009	HA	0-2	X	X		
A6SB0046	A6SS046G0002	11/13/2009	HA	0-2	X			
A6SB0047	A6SS047G0002	11/13/2009	HA	0-2	X			
A6SB0048	A6SS048G0002	11/15/2009	HA	0-2	X		X	
A6SB0049	A6SS049G0002	11/15/2009	HA	0-2	X		X	
A6SB0050	A6SS050G0002	11/15/2009	HA	0-2	X		X	

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB0051	A6SS051G0002	11/15/2009	HA	0-2	X			
A6SB0052	A6SS052G0002	11/15/2009	HA	0-2	X			
A6SB0053	A6SS053G0002	11/13/2009	HA	0-2	X	X		
A6SB0054	A6SS054G0002	11/13/2009	HA	0-2	X			
A6SB0055	A6SS055G0002	11/13/2009	HA	0-2	X			
A6SB0056	A6SS056G0002	11/15/2009	HA	0-2	X		X	
A6SB0057	A6SS057G0002	11/13/2009	HA	0-2	X	X		
A6SB0058	A6SS058G0002	11/13/2009	HA	0-2	X			
A6SB0059	A6SS059G0002	11/13/2009	HA	0-2	X			
A6SB0060	A6SS060G0002	11/13/2009	HA	0-2	X			
A6SB0061	A6SS061G0002	11/15/2009	HA	0-2	X		X	
A6SB0062	A6SS062G0002	11/15/2009	HA	0-2	X		X	
A6SB0063	A6SS063G0002	11/13/2009	HA	0-2	X	X	X	
A6SB0064	A6SS064G0002	11/13/2009	HA	0-2	X			
A6SB0065	**Sample Not Collected[1]**							
A6SB0066	A6SS066G0002	11/13/2009	HA	0-2	X			
A6SB0067	A6SS067G0002	11/13/2009	HA	0-2	X	X		
A6SB0068	A6SS068G0002	11/13/2009	HA	0-2	X			
A6SB0069	A6SS069G0002	11/14/2009	HA	0-2	X		X	
A6SB0070	A6SS070G0002	11/14/2009	HA	0-2	X		X	
A6SB0071	A6SS071G0002	11/14/2009	HA	0-2	X		X	
A6SB0072	A6SS072G0002	11/13/2009	HA	0-2	X	X	X	
A6SB0073	A6SS073G0002	11/13/2009	HA	0-2	X			
A6SB0074	A6SS074G0002	11/13/2009	HA	0-2	X			
A6SB0075	A6SS075G0002	11/15/2009	HA	0-2	X			
A6SB0076	A6SS076G0002	11/13/2009	HA	0-2	X			
A6SB0077	A6SS077G0002	11/13/2009	HA	0-2	X		X	
A6SB0078	A6SS078G0002	11/13/2009	HA	0-2	X	X		
A6SB0079	A6SS079G0002	11/13/2009	HA	0-2	X	X		

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB0080	A6SS080G0002	11/13/2009	HA	0-2	X			
A6SB0081	A6SS081G0002	11/13/2009	HA	0-2	X			
A6SB0082	A6SS082G0002	11/13/2009	HA	0-2	X			
A6SB0083	A6SS083G0002	11/15/2009	HA	0-2	X		X	
A6SB0084	A6SS084G0002	11/15/2009	HA	0-2	X		X	
A6SB0085	A6SS085G0002	11/13/2009	HA	0-2	X	X		
A6SB0086	A6SS086G0002	11/13/2009	HA	0-2	X			
A6SB0087	A6SS087G0002	11/13/2009	HA	0-2	X			
A6SB0088	A6SS088G0002	11/13/2009	HA	0-2	X			
A6SB0089	A6SS089G0002	11/13/2009	HA	0-2	X			
A6SB0090	A6SS090G0002	11/13/2009	HA	0-2	X			
PISTOL RANGE								
A6SB091	A6SS091G0002	11/14/2009	HA	0-2	X			
A6SB092	A6SS092G0002	11/14/2009	HA	0-2	X			
A6SB093	A6SS093G0002	11/14/2009	HA	0-2	X	X		
A6SB094	A6SS094G0002	11/14/2009	HA	0-2	X	X		
A6SB095	A6SS095G0002	11/14/2009	HA	0-2	X			
A6SB096	A6SS096G0002	11/14/2009	HA	0-2	X			
A6SB097	A6SS097G0002	11/14/2009	HA	0-2	X	X		
A6SB098	A6SS098G0002	11/14/2009	HA	0-2	X			
A6SB099	A6SS099G0002	11/14/2009	HA	0-2	X			
A6SB100	A6SS100G0002	11/14/2009	HA	0-2	X	X		
A6SB101	A6SS101G0002	11/14/2009	HA	0-2	X			
A6SB102	A6SS102G0002	11/14/2009	HA	0-2	X			
A6SB103	A6SS103G0002	11/14/2009	HA	0-2	X	X		
A6SB104	A6SS104G0002	11/14/2009	HA	0-2	X			
A6SB105	A6SS105G0002	11/14/2009	HA	0-2	X			
A6SB106	A6SS106G0002	11/14/2009	HA	0-2	X			
A6SB107	A6SS107G0002	11/14/2009	HA	0-2	X	X		

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB108	A6SS108G0002	11/14/2009	HA	0-2	X	X		
A6SB109	A6SS109G0002	11/14/2009	HA	0-2	X			
A6SB110	A6SS110G0002	11/14/2009	HA	0-2	X			
A6SB111	A6SS111G0002	11/14/2009	HA	0-2	X	X		
A6SB112	A6SS112G0002	11/14/2009	HA	0-2	X			
A6SB113	A6SS113G0002	11/14/2009	HA	0-2	X			
A6SB114	A6SS114G0002	11/14/2009	HA	0-2	X	X		
A6SB115	**Sample Not Collected[2]**							
A6SB116	A6SS116G0002	11/14/2009	HA	0-2	X	X		
300-YARD FIRING LINE								
A6SB117	A6SS117G0002	11/13/2009	HA	0-2	X			
A6SB118	A6SS118G0002	11/13/2009	HA	0-2	X			
A6SB119	A6SS119G0002	11/13/2009	HA	0-2	X	X		
A6SB120	A6SS120G0002	11/13/2009	HA	0-2	X			
A6SB121	A6SS121G0002	11/13/2009	HA	0-2	X			
A6SB122	A6SS122G0002	11/13/2009	HA	0-2	X			
A6SB123	A6SS123G0002	11/13/2009	HA	0-2	X	X		
A6SB124	A6SS124G0002	11/13/2009	HA	0-2	X			
A6SB125	A6SS125G0002	11/13/2009	HA	0-2	X			
A6SB126	A6SS126G0002	11/13/2009	HA	0-2	X			
200-YARD FIRING LINE								
A6SB127	A6SS127G0002	11/11/2009	HA	0-2	X			
A6SB128	A6SS128G0002	11/11/2009	HA	0-2	X			
A6SB129	A6SS129G0002	11/11/2009	HA	0-2	X	X		
A6SB130	A6SS130G0002	11/11/2009	HA	0-2	X			
A6SB131	A6SS131G0002	11/11/2009	HA	0-2	X			
A6SB132	A6SS132G0002	11/11/2009	HA	0-2	X	X		
A6SB133	A6SS133G0002	11/11/2009	HA	0-2	X			
A6SB134	A6SS134G0002	11/11/2009	HA	0-2	X			

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB135	A6SS135G0002	11/11/2009	HA	0-2	X			
A6SB136	A6SS136G0002	11/11/2009	HA	0-2	X			
100-YARD FIRING LINE								
A6SB137	A6SS137G0002	11/12/2009	HA	0-2	X	X		
A6SB138	A6SS138G0002	11/12/2009	HA	0-2	X			
A6SB139	A6SS139G0002	11/12/2009	HA	0-2	X			
A6SB140	A6SS140G0002	11/12/2009	HA	0-2	X			
A6SB141	A6SS141G0002	11/12/2009	HA	0-2	X			
A6SB142	A6SS142G0002	11/12/2009	HA	0-2	X			
A6SB143	A6SS143G0002	11/12/2009	HA	0-2	X			
A6SB144	A6SS144G0002	11/12/2009	HA	0-2	X	X		
A6SB145	A6SS145G0002	11/12/2009	HA	0-2	X			
A6SB146	A6SS146G0002	11/12/2009	HA	0-2	X			
MAIN TARGET AREA								
A6SB147	A6SS147G0002	11/12/2009	HA	0-2	X			
A6SB148	A6SS1480001	11/12/2009	HA	0-2	X	X		
A6SB149	A6SS149G0002	11/12/2009	HA	0-2	X			
A6SB150	A6SS150G0002	11/12/2009	HA	0-2	X	X		
A6SB151	A6SS151G0002	11/12/2009	HA	0-2	X			
A6SB152	A6SS152G0002	11/12/2009	HA	0-2	X			
A6SB153	A6SS153G0002	11/12/2009	HA	0-2	X			
MAIN BULLET STOP								
A6SB154	A6SS154G0002	11/12/2009	HA	0-2	X			
A6SB155	A6SS155G0002	11/12/2009	HA	0-2	X			
A6SB156	A6SS156G0002	11/12/2009	HA	0-2	X	X		
A6SB157	A6SS157G0002	11/12/2009	HA	0-2	X			
A6SB158	A6SS158G0002	11/12/2009	HA	0-2	X			
A6SB159	A6SS159G0002	11/12/2009	HA	0-2	X			
A6SB160	A6SS160G0002	11/12/2009	HA	0-2	X	X		

TABLE 8-1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE LOCATION	SAMPLE ID	SAMPLE DATE	SAMPLE METHOD	SAMPLE DEPTH (feet bgs)	XRF (LEAD)	FBL ANALYSIS		
						Select Metals (SW 846-3050B/6010B/6020)	PAH (SW-846 8270)	NG (SW-846 8330A)
A6SB161	A6SS161G0002	11/12/2009	HA	0-2	X			
A6SB162	A6SS162G0002	11/12/2009	HA	0-2	X			
A6SB163	A6SS163G0002	11/12/2009	HA	0-2	X	X		
A6SB164	A6SS164G0002	11/12/2009	HA	0-2	X			
A6SB165	A6SS165G0002	11/12/2009	HA	0-2	X			
A6SB166	A6SS166G0002	11/12/2009	HA	0-2	X	X		
A6SB167	A6SS167G0002	11/12/2009	HA	0-2	X			
PISTOL RANGE								
A6SB168	A6SS168G0002	11/14/2009	HA	0-2	X	X		
A6SB169	A6SS169G0002	11/14/2009	HA	0-2	X			
A6SB170	A6SS170G0002	11/14/2009	HA	0-2	X	X		
A6SB171	A6SS171G0002	11/14/2009	HA	0-2	X			

1 = Sample was not collected at location A6SB065 due to its location falling directly on top of another sample from the Pistol Range firing line.
2 = XRF sample data was not collected at location A6SB115

X = Indicates sample was collected and analyzed as proposed in the UFP-SAP (Tetra Tech, 2009)
bgs = below ground surface
FBL = Fixed-base laboratory
HA = Hand auger
NG = Nitroglycerin
PAH = Polycyclic aromatic hydrocarbon

TABLE 8-2

XRF AND FBL SURFACE SOIL MC LEAD DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	XRF ANALYSIS					FBL ANALYSIS
			DATE	1st[1] (ppm)	2nd[1] (ppm)	3rd[1] (ppm)	AVG[2] (ppm)	LEAD[3] (mg/kg)
500-YARD FIRING LINE								
A6SB001C0002	11/16/2009	930	11/17/2009	19	24	19	21	
300-YARD FIRING LINE								
A6SB002C0002	11/15/2009	1030	11/17/2009	40	42	ND	27	
200-YARD FIRING LINE								
A6SB003C0002	11/11/2009	900	11/17/2009	43	43	39	42	
100-YARD FIRING LINE								
A6SB004C0002	11/12/2009	1700	11/17/2009	21	25	25	24	
TRAP RANGE FIRING POINTS								
A6SB005C0002	11/16/2009	1130	11/17/2009	18	19	17	18	
SKEET RANGE FIRING POINTS								
A6SB006C0002	11/16/2009	1050	11/17/2009	26	21	25	24	
PISTOL RANGE FIRING POINT								
A6SB007C0002	11/14/2009	940	11/17/2009	17	17	18	17	
PISTOL RANGE FIRING POINT								
A6SB008C0002	11/14/2009	1000	11/17/2009	27	29	26	27	
PISTOL RANGE FIRING POINT								
A6SB009C0002	11/14/2009	1100	11/17/2009	29	55	30	38	
PISTOL RANGE FIRING POINT								
A6SB010C0002	11/14/2009	1045	11/17/2009	150	76	68	98	
PISTOL RANGE FIRING POINT								
A6SB011C0002	11/14/2009	1120	11/17/2009	45	54	57	52	
TRAP AND SKEEET RANGE								
A6SS0120002	11/11/2009	1000	11/15/2009	18	24	14	19	
A6SS0130002	11/11/2009	0935	11/15/2009	20	27	16	21	
A6SS0140002	11/11/2009	0950	11/15/2009	45	36	37	39	
A6SS0150002	11/11/2009	1010	11/15/2009	69	61	68	66	53.2
A6SS0160002	11/11/2009	1030	11/15/2009	18	19	19	19	
A6SS0170002	11/11/2009	1030	11/15/2009	40	40	33	38	
A6SS0180002	11/11/2009	1130	11/15/2009	25	24	24	24	
A6SS0190002	11/11/2009	1130	11/15/2009	26	19	24	23	
A6SS0200002	11/11/2009	0955	11/15/2009	20	20	17	19	
A6SS0210002	11/11/2009	0935	11/15/2009	23	17	20	20	
A6SS0220002	11/11/2009	0945	11/15/2009	106	76	105	96	113
A6SS0230002	11/11/2009	1420	11/15/2009	44	39	37	40	
A6SS0240002	11/11/2009	1420	11/15/2009	50	60	57	56	
A6SS0250002	11/11/2009	1430	11/15/2009	26	32	33	30	15.5
A6SS0260002	11/11/2009	1435	11/15/2009	26	27	27	27	
A6SS0270002	11/11/2009	1440	11/15/2009	23	12	23	19	
A6SS0280002	11/13/2009	0955	11/15/2009	25	26	22	24	
A6SS0290002	11/13/2009	0955	11/15/2009	18	20	17	18	
A6SS0300002	11/13/2009	0930	11/15/2009	25	30	22	26	
A6SS0310002	11/11/2009	1535	11/15/2009	80	114	91	95	127
A6SS0320002	11/11/2009	1445	11/15/2009	111	93	121	108	31.0
A6SS0330002	11/11/2009	1455	11/15/2009	20	24	27	24	
A6SS0340002	11/11/2009	1635	11/15/2009	22	23	24	23	
A6SS0350002	11/13/2009	1018	11/15/2009	29	24	31	28	
A6SS0360002	11/13/2009	955	11/15/2009	20	18	21	20	
A6SS0370002	11/13/2009	943	11/15/2009	50	56	43	50	23.5
A6SS0380002	11/15/2009	915	11/17/2009	51	55	51	52	
A6SS0390002	11/15/2009	935	11/17/2009	84	73	75	77	29.0
A6SS0400002	11/13/2009	1405	11/15/2009	51	59	64	58	
A6SS0410002	11/13/2009	1350	11/15/2009	14	19	14	16	

TABLE 8-2

XRF AND FBL SURFACE SOIL MC LEAD DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	XRF ANALYSIS					FBL ANALYSIS
			DATE	1st[1] (ppm)	2nd[1] (ppm)	3rd[1] (ppm)	AVG[2] (ppm)	LEAD[3] (mg/kg)
A6SS0420002	11/13/2009	1340	11/15/2009	17	16	18	17	
A6SS0430002	11/15/2009	855	11/17/2009	20	25	31	25	
A6SS0440002	11/15/2009	950	11/17/2009	137	122	100	120	
A6SS0450002	11/13/2009	1335	11/17/2009	77	94	61	77	113
A6SS0460002	11/13/2009	1345	11/15/2009	18	20	17	18	
A6SS0470002	11/13/2009	1405	11/15/2009	19	16	23	19	
A6SS0480002	11/15/2009	1100	11/17/2009	25	19	22	22	
A6SS0490002	11/15/2009	1040	11/17/2009	19	16	17	17	
A6SS0500002	11/15/2009	1020	11/17/2009	23	26	20	23	
A6SS0510002	11/15/2009	1000	11/17/2009	24	11	19	18	
A6SS0520002	11/15/2009	1005	11/17/2009	ND	15	23	13	
A6SS0530002	11/13/2009	1450	11/17/2009	79	78	122	93	46.8
A6SS0540002	11/13/2009	1435	11/17/2009	19	16	21	19	
A6SS0550002	11/13/2009	1425	11/17/2009	17	20	16	18	
A6SS0560002	11/15/2009	1010	11/17/2009	15	16	17	16	
A6SS0570002	11/13/2009	1555	11/17/2009	165	171	122	153	901
A6SS0580002	11/13/2009	1440	11/17/2009	23	25	23	24	
A6SS0590002	11/13/2009	1455	11/17/2009	20	18	19	19	
A6SS0600002	11/13/2009	1425	11/17/2009	21	21	20	21	
A6SS0610002	11/15/2009	1145	11/17/2009	33	26	33	31	
A6SS0620002	11/15/2009	1120	11/17/2009	16	12	19	16	
A6SS0630002	11/13/2009	1100	11/17/2009	27	23	20	23	12.8
A6SS0640002	11/13/2009	1110	11/17/2009	20	19	21	20	
A6SS065	**SAMPLE NOT COLLECTED[4]**							
A6SS0660002	11/13/2009	1600	11/15/2009	30	27	33	30	
A6SS0670002	11/13/2009	1545	11/15/2009	28	37	43	36	44.6
A6SS0680002	11/13/2009	1530	11/16/2009	12	21	22	18	
A6SS0690002	11/14/2009	1640	11/17/2009	22	25	22	23	
A6SS0700002	11/14/2009	1625	11/17/2009	35	36	29	33	
A6SS0710002	11/14/2009	1610	11/17/2009	18	16	22	19	
A6SS0720002	11/13/2009	1030	11/17/2009	29	41	18	29	20.9
A6SS0730002	11/13/2009	1530	11/15/2009	22	21	23	22	
A6SS0740002	11/13/2009	1555	11/16/2009	14	22	17	18	
A6SS0750002	11/15/2009	1115	11/17/2009	19	15	15	16	
A6SS0760002	11/13/2009	1640	11/16/2009	21	20	22	21	
A6SS0770002	11/13/2009	1635	11/16/2009	29	35	30	31	
A6SS0780002	11/13/2009	1640	11/16/2009	63	88	120	90	130
A6SS0790002	11/13/2009	1435	11/16/2009	99	158	130	129	17.1
A6SS0800002	11/13/2009	1620	11/16/2009	44	39	36	40	
A6SS0810002	11/13/2009	1620	11/17/2009	19	23	20	21	
A6SS0820002	11/13/2009	1620	11/17/2009	15	15	18	16	
A6SS0830002	11/15/2009	1100	11/17/2009	18	15	19	17	
A6SS0840002	11/15/2009	1045	11/17/2009	29	22	25	25	
A6SS0850002	11/13/2009	1700	11/17/2009	27	29	22	26	14.0
A6SS0860002	11/13/2009	1700	11/17/2009	38	28	22	29	
A6SS0870002	11/13/2009	1450	11/17/2009	21	23	ND	15	
A6SS0880002	11/13/2009	1710	11/17/2009	22	14	21	19	
A6SS0890002	11/13/2009	1715	11/17/2009	26	20	23	23	
A6SS0900002	11/13/2009	1700	11/17/2009	19	13	15	16	
PISTOL RANGE								
A6SS0910002	11/14/2009	1425	11/17/2009	72	64	70	69	
A6SS0920002	11/14/2009	1435	11/17/2009	49	53	74	59	
A6SS0930002	11/14/2009	1450	11/17/2009	**368**	**286**	**295**	**316**	321

TABLE 8-2

XRF AND FBL SURFACE SOIL MC LEAD DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	XRF ANALYSIS					FBL ANALYSIS
			DATE	1st[1] (ppm)	2nd[1] (ppm)	3rd[1] (ppm)	AVG[2] (ppm)	LEAD[3] (mg/kg)
A6SS0940002	11/14/2009	1500	11/17/2009	134	103	77	105	21.0
A6SS0950002	11/14/2009	1510	11/17/2009	56	74	86	72	
A6SS0960002	11/14/2009	1530	11/17/2009	10	15	16	14	
A6SS0970002	11/14/2009	1540	11/17/2009	**1120**	**956**	**474**	**850**	258
A6SS0980002	11/14/2009	1435	11/17/2009	66	61	54	60	
A6SS0990002	11/14/2009	1425	11/17/2009	19	21	13	18	
A6SS1000002	11/14/2009	1450	11/17/2009	114	141	89	115	41.0
A6SS1010002	11/14/2009	1455	11/17/2009	29	26	20	25	
A6SS1020002	11/14/2009	1510	11/17/2009	18	19	20	19	
A6SS1030002	11/14/2009	1520	11/17/2009	**237**	77	85	133	75.3
A6SS1040002	11/14/2009	1530	11/17/2009	173	70	113	119	
A6SS1050002	11/14/2009	1550	11/17/2009	11	9	25	15	
A6SS1060002	11/14/2009	1605	11/17/2009	14	13	15	14	
A6SS1070002	11/14/2009	1420	11/17/2009	99	159	121	126	116
A6SS1080002	11/14/2009	1430	11/17/2009	193	130	**261**	195	166
A6SS1090002	11/14/2009	1440	11/17/2009	27	32	36	32	
A6SS1100002	11/14/2009	1445	11/17/2009	51	39	48	46	
A6SS1110002	11/14/2009	1455	11/17/2009	85	107	132	108	74.8
A6SS1120002	11/14/2009	1500	11/15/2009	82	78	101	87	
A6SS1130002	11/14/2009	1545	11/15/2009	58	43	44	48	
A6SS1140002	11/14/2009	1510	11/17/2009	159	152	142	151	285
A6SS1150002	**SAMPLE NOT COLLECTED[5]**							
A6SS1160002	11/14/2009	1520	11/17/2009	87	92	92	90	48.9
A6SS1680002	11/14/2009	1515	11/17/2009	26	35	37	33	25.7
A6SS1690002	11/14/2009	1500	11/17/2009	**269**	**236**	**202**	**236**	
A6SS1700002	11/14/2009	1555	11/17/2009	**580**	**782**	**365**	**576**	**1240**
A6SS1710002	11/14/2009	1600	11/17/2009	76	66	50	64	
300-YARD FIRING LINE								
A6SS1170002	11/13/2009	1040	11/15/2009	40	61	50	50	
A6SS1180002	11/13/2009	1050	11/15/2009	50	44	40	45	
A6SS1190002	11/13/2009	1100	11/15/2009	34	37	40	37	19.9
A6SS1200002	11/13/2009	1110	11/15/2009	74	66	70	70	
A6SS1210002	11/13/2009	1120	11/15/2009	86	78	59	74	
A6SS1220002	11/13/2009	1130	11/15/2009	38	30	38	35	
A6SS1230002	11/13/2009	1140	11/15/2009	44	68	56	56	30.5
A6SS1240002	11/13/2009	1145	11/15/2009	36	35	34	35	
A6SS1250002	11/13/2009	1150	11/15/2009	14	17	19	17	
A6SS1260002	11/13/2009	1135	11/15/2009	31	40	38	36	
200-YARD FIRING LINE								
A6SS1270002	11/11/2009	1620	11/18/2009	136	201	154	164	
A6SS1280002	11/11/2009	1620	11/18/2009	152	87	147	129	

TABLE 8-2

XRF AND FBL SURFACE SOIL MC LEAD DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	XRF ANALYSIS					FBL ANALYSIS
			DATE	1st[1] (ppm)	2nd[1] (ppm)	3rd[1] (ppm)	AVG[2] (ppm)	LEAD[3] (mg/kg)
A6SS1290002	11/11/2009	1625	11/18/2009	70	93	66	76	205
A6SS1300002	11/11/2009	1625	11/18/2009	64	49	176	96	
A6SS1310002	11/11/2009	1630	11/18/2009	**359**	**266**	**305**	**310**	
A6SS1320002	11/11/2009	1630	11/18/2009	**257**	**405**	171	**278**	174
A6SS1330002	11/11/2009	1635	11/18/2009	102	85	105	97	
A6SS1340002	11/11/2009	1635	11/18/2009	**475**	**580**	**393**	**483**	
A6SS1350002	11/11/2009	1640	11/18/2009	31	28	22	27	
A6SS1360002	11/11/2009	1640	11/18/2009	39	37	65	47	
100-YARD FIRING LINE								
A6SS1370002	11/12/2009	1535	11/15/2009	16	16	16	16	
A6SS1380002	11/12/2009	1545	11/15/2009	28	24	27	26	19.1
A6SS1390002	11/12/2009	1545	11/15/2009	20	22	23	22	
A6SS1400002	11/12/2009	1535	11/15/2009	36	39	45	40	
A6SS1410002	11/12/2009	1530	11/15/2009	82	100	85	89	
A6SS1420002	11/12/2009	1520	11/15/2009	13	18	21	17	
A6SS1430002	11/12/2009	1525	11/15/2009	49	48	47	48	
A6SS1440002	11/12/2009	1530	11/15/2009	64	86	61	70	111
A6SS1450002	11/12/2009	1530	11/15/2009	62	50	40	51	
A6SS1460002	11/12/2009	1520	11/15/2009	67	57	66	63	
MAIN TARGET AREA								
A6SS1470002	11/12/2009	1045	11/15/2009	12	18	16	15	
A6SS1480001	11/12/2009	1050	11/15/2009	31	43	37	37	31.8
A6SS1490002	11/12/2009	1050	11/15/2009	31	38	34	34	
A6SS1500002	11/12/2009	1100	11/15/2009	59	84	64	69	85.7
A6SS1510002	11/12/2009	1055	11/15/2009	38	43	43	41	
A6SS1520002	11/12/2009	1100	11/15/2009	15	15	17	16	
A6SS1530002	11/12/2009	1105	11/15/2009	70	68	67	68	
MAIN BULLET STOP		1120						
A6SS1540002	11/12/2009		11/15/2009	21	19	25	22	
A6SS1550002	11/12/2009	1130	11/17/2009	18	18	18	18	
A6SS1560002	11/12/2009	1142	11/17/2009	93	123	112	109	27.5
A6SS1570002	11/12/2009	1150	11/17/2009	27	20	20	22	
A6SS1580002	11/12/2009	1200	11/17/2009	58	66	52	59	
A6SS1590002	11/12/2009	1215	11/17/2009	23	26	26	25	
A6SS1600002	11/12/2009	1230	11/17/2009	24	23	22	23	11.4
A6SS1610002	11/12/2009	1120	11/17/2009	19	22	27	23	
A6SS1620002	11/12/2009	1125	11/17/2009	21	17	22	20	
A6SS1630002	11/12/2009	1135	11/17/2009	62	58	44	55	36.1
A6SS1640002	11/12/2009	1140	11/17/2009	196	**214**	188	199	
A6SS1650002	11/12/2009	1145	11/17/2009	168	95	112	125	
A6SS1660002	11/12/2009	1150	11/17/2009	31	35	44	37	26.2
A6SS1670002	11/12/2009	1205	11/17/2009	17	19	12	16	

FBL = Fixed-base laboratory
mg/kg = milligram per kilogram
ppm = parts per million
XRF = X-ray flourescence

1 - Bold font indicates individual XRF lead concentration greater than the field XRF lead PAL of 200 ppm.
2 - Shaded cell indicates average XRF lead concentration greater than the field XRF lead PAL of 200 ppm.
3 - Shaded cell indicates FBL lead concentration greater than the human health lead PAL of 400 ppm.
4 - Sample was eliminated due to its field location falling in same location as another sample.
5 - Sample was not collected at this location for XRF analysis.

TABLE 8-3

XRF AND FBL SURFACE SOIL MC METALS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	A6SB001	A6SB002	A6SB003	A6SB004	A6SB005	A6SB006	A6SB007	A6SB008	A6SB009	A6SB010	A6SB011	A6SB012
Sample ID		A6SS001C0002	A6SS002C0002	A6SS003C0002	A6SS004C0002	A6SS005C0002	A6SS006C0002	A6SS007C0002	A6SS008C0002	A6SS009C0002	A6SS010C0002	A6SS011C0002	A6SS012G0002
Sample Date		20091116	20091115	20091111	20091112	20091116	20091116	20091114	20091114	20091114	20091114	20091114	20091111
Sample Type		ORIG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9												
ARSENIC	11.83												
COPPER	28												
LEAD	27												
ZINC	65.6												
XRF (mg/kg)													
LEAD	200	21	27	42	24	18	24	17	27	38	98	52	19

Sample Location	PAL (mg/kg)	A6SB013	A6SB014	A6SB015	A6SB016	A6SB017	A6SB018	A6SB019	A6SB020	A6SB021	A6SB022	A6SB023	A6SB024
Sample ID		A6SS013G0002	A6SS014G0002	A6SS015G0002	A6SS016G0002	A6SS017G0002	A6SS018G0002	A6SS019G0002	A6SS020G0002	A6SS021G0002	A6SS022G0002	A6SS023G0002	A6SS024G0002
Sample Date		20091111	20091111	20091111	20091111	20091111	20091111	20091111	20091111	20091111	20091111	20091111	20091111
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9			0.313 UJ							0.308 UJ		
ARSENIC	11.83			3.69							7.87		
COPPER	28			5.07 J							11.3 J		
LEAD	27			**53.2 J [E]**							**113 J [E]**		
ZINC	65.6			25.6 J							51.6 J		
XRF (mg/kg)													
LEAD	200	21	39	66	19	38	24	23	19	20	96	40	56

Sample Location	PAL (mg/kg)	A6SB025	A6SB026	A6SB027	A6SB028	A6SB029	A6SB030	A6SB031	A6SB032	A6SB033	A6SB034	A6SB035	A6SB036
Sample ID		A6SS025G0002	A6SS026G0002	A6SS027G0002	A6SS028G0002	A6SS029G0002	A6SS030G0002	A6SS031G0002	A6SS032G0002	A6SS033G0002	A6SS034G0002	A6SS035G0002	A6SS036G0002
Sample Date		20091111	20091111	20091111	20091113	20091113	20091113	20091111	20091111	20091111	20091111	20091113	20091113
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.293 UJ						0.302 UJ	0.301 UJ				
ARSENIC	11.83	11						5.44	6.56				
COPPER	28	14.3 J						6.92 J	8.81 J				
LEAD	27	15.5 J						**127 J [E]**	**31.0 J [E]**				
ZINC	65.6	61.3 J						32.6 J	29.7 J				
XRF (mg/kg)													
LEAD	200	30	27	19	24	18	26	95	108	24	23	28	33

Sample Location	PAL (mg/kg)	A6SB037	A6SB038	A6SB039	A6SB040	A6SB041	A6SB042	A6SB043	A6SB044	A6SB045	A6SB046	A6SB047	A6SB048
Sample ID		A6SS037G0002	A6SS038G0002	A6SS039G0002	A6SS040G0002	A6SS041G0002	A6SS042G0002	A6SS043G0002	A6SS044G0002	A6SS045G0002	A6SS046G0002	A6SS047G0002	A6SS048G0002
Sample Date		20091113	20091115	20091115	20091113	20091113	20091113	20091115	20091115	20091113	20091113	20091113	20091115
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.306 UJ		0.296 UJ						0.305 UJ			
ARSENIC	11.83	6.47		8.3						4.23			
COPPER	28	9.04 J		13.1 J						5.97 J			
LEAD	27	23.5 J		**29.0 J [E]**						**113 J [E]**			
ZINC	65.6	48.0 J		49.3 J						32.9 J			
XRF (mg/kg)													
LEAD	200	50	52	77	58	16	17	25	120	77	18	19	22

Sample Location	PAL (mg/kg)	A6SB049	A6SB050	A6SB051	A6SB052	A6SB053	A6SB054	A6SB055	A6SB056	A6SB057	A6SB058	A6SB059	A6SB060
Sample ID		A6SS049G0002	A6SS050G0002	A6SS051G0002	A6SS052G0002	A6SS053G0002	A6SS054G0002	A6SS055G0002	A6SS056G0002	A6SS057G0002	A6SS058G0002	A6SS059G0002	A6SS060G0002
Sample Date		20091115	20091115	20091115	20091115	20091113	20091113	20091113	20091115	20091113	20091113	20091113	20091113
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9					0.313 UJ				0.303 UJ			
ARSENIC	11.83					9.16				4.12			

TABLE 8-3

XRF AND FBL SURFACE SOIL MC METALS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

COPPER	28					7.45 J				**57.6 J [E]**			
LEAD	27					**46.8 J [E]**				**901 J [E]**			
ZINC	65.6					30.8 J				31.2 J			
XRF (mg/kg)													
LEAD	200	17	23	18	13	93	19	18	16	153	24	19	21

Sample Location	**PAL (mg/kg)**	**A6SB061**	**A6SB062**	**A6SB063**	**A6SB064**	**A6SB066**	**A6SB067**	**A6SB068**	**A6SB069**	**A6SB070**	**A6SB071**	**A6SB072**	**A6SB073**
Sample ID		A6SS061G0002	A6SS062G0002	A6SS063G0002	A6SS064G0002	A6SS066G0002	A6SS067G0002	A6SS068G0002	A6SS069G0002	A6SS070G0002	A6SS071G0002	A6SS072G0002	A6SS073G0002
Sample Date		20091115	20091115	20091113	20091113	20091113	20091113	20091113	20091114	20091114	20091114	20091113	20091113
Sample Type		ORIG	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9			0.295 UJ			0.299 UJ					0.293 UJ	
ARSENIC	11.83			7.85			6.48					6.94	
COPPER	28			11.9 J			7.63 J					9.85 J	
LEAD	27			12.8 J			**44.6 J [E]**					20.9 J	
ZINC	65.6			39.3 J			31.3 J					33.3 J	
XRF (mg/kg)													
LEAD	200	31	16	23	20	30	36	18	23	33	19	29	22

Sample Location	**PAL (mg/kg)**	**A6SB074**	**A6SB075**	**A6SB076**	**A6SB077**	**A6SB078**	**A6SB079**	**A6SB080**	**A6SB081**	**A6SB082**	**A6SB083**	**A6SB084**	**A6SB085**
Sample ID		A6SS074G0002	A6SS075G0002	A6SS076G0002	A6SS077G0002	A6SS078G0002	A6SS079G0002	A6SS080G0002	A6SS081G0002	A6SS082G0002	A6SS083G0002	A6SS084G0002	A6SS085G0002
Sample Date		20091113	20091115	20091113	20091113	20091113	20091113	20091113	20091113	20091113	20091115	20091115	20091113
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9					0.329 UJ	0.304 UJ						0.304 UJ
ARSENIC	11.83					5.81	5.17						6.07
COPPER	28					7.24 J	7.42 J						9.60 J
LEAD	27					**130 J [E]**	17.1 J						14.0 J
ZINC	65.6					37.2 J	20.1 J						36.7 J
XRF (mg/kg)													
LEAD	200	18	16	21	31	90	129	40	21	16	17	25	26

Sample Location	**PAL (mg/kg)**	**A6SB086**	**A6SB087**	**A6SB088**	**A6SB089**	**A6SB090**	**A6SB091**	**A6SB092**	**A6SB093**	**A6SB094**	**A6SB095**	**A6SB096**	**A6SB097**
Sample ID		A6SS086G0002	A6SS087G0002	A6SS088G0002	A6SS089G0002	A6SS090G0002	A6SS091G0002	A6SS092G0002	A6SS093G0002	A6SS094G0002	A6SS095G0002	A6SS096G0002	A6SS097G0002
Sample Date		20091113	20091113	20091113	20091113	20091113	20091114	20091114	20091114	20091114	20091114	20091114	20091114
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG
Inorganics (mg/kg)													
ANTIMONY	6.9								0.295 UJ	0.586 UJ			0.295 UJ
ARSENIC	11.83								9.04	8.13			4.42
COPPER	28								8.95 J	9.75 J			16.7 J
LEAD	27								**321 J [E]**	20.9 J			**258 J [E]**
ZINC	65.6								29.1 J	38.3 J			25.9 J
XRF (mg/kg)													
LEAD	200	29	15	19	23	16	69	59	**216 [E]**	105	72	14	**850 [E]**

Sample Location	**PAL (mg/kg)**	**A6SB097**	**A6SB097**	**A6SB098**	**A6SB099**	**A6SB100**	**A6SB101**	**A6SB102**	**A6SB103**	**A6SB104**	**A6SB105**	**A6SB106**	**A6SB107**
Sample ID		6SS097G0002-AV	A6SS097G0002-D	A6SS098G0002	A6SS099G0002	A6SS100G0002	A6SS101G0002	A6SS102G0002	A6SS103G0002	A6SS104G0002	A6SS105G0002	A6SS106G0002	A6SS107G0002
Sample Date		20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114
Sample Type		AVG	DUP	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.294 UJ	0.293 UJ			0.579 UJ			0.287 UJ				0.304 UJ
ARSENIC	11.83	5.28	6.14			7.48			4.79				6.78
COPPER	28	15.4 J	14.1			10.6 J			6.66				9.74
LEAD	27	**286 J [E]**	**314 [E]**			**41.4 J [E]**			**75.3 [E]**				**116 [E]**
ZINC	65.6	28.85 J	31.8 J			24.4 J			21.6 J				36.2 J
XRF (mg/kg)													
LEAD	200			60	18	115	25	18	133	119	15	14	126

TABLE 8-3

XRF AND FBL SURFACE SOIL MC METALS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	A6SB108	A6SB109	A6SB110	A6SB111	A6SB112	A6SB113	A6SB114	A6SB115	A6SB116	A6SB117	A6SB118	A6SB119
Sample ID		A6SS108G0002	A6SS109G0002	A6SS110G0002	A6SS111G0002	A6SS112G0002	A6SS113G0002	A6SS114G0002	A6SS115G0002	A6SS116G0002	A6SS117G0002	A6SS118G0002	A6SS119G0002
Sample Date		20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091114	20091113	20091113	20091113
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.307 UJ			0.302 UJ			0.305 UJ		0.308 UJ			0.303 UJ
ARSENIC	11.83	6.7			5.86			5.8		5.9			8.84
COPPER	28	8.65			11			8.49		9.52			11.2
LEAD	27	**166 [E]**			**74.8 [E]**			**285 [E]**		**48.9 [E]**			19.9
ZINC	65.6	28.6 J			28.7 J			32.8 J		30.3 J			51.4 J
XRF (mg/kg)													
LEAD	200	195	32	46	108	87	48	151	0 U	90	50	45	37

Sample Location	PAL (mg/kg)	A6SB120	A6SB121	A6SB122	A6SB123	A6SB124	A6SB125	A6SB126	A6SB127	A6SB128	A6SB129	A6SB130	A6SB131
Sample ID		A6SS120G0002	A6SS121G0002	A6SS122G0002	A6SS123G0002	A6SS124G0002	A6SS125G0002	A6SS126G0002	A6SS127G0002	A6SS128G0002	A6SS129G0002	A6SS130G0002	A6SS131G0002
Sample Date		20091113	20091113	20091113	20091113	20091113	20091113	20091113	20091111	20091111	20091111	20091111	20091111
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9				0.320 UJ						0.310 UJ		
ARSENIC	11.83				10.5						8.84		
COPPER	28				16.9						21.3		
LEAD	27				**30.5 [E]**						**205 [E]**		
ZINC	65.6				57.2 J						37.6 J		
XRF (mg/kg)													
LEAD	200	70	74	35	56	35	17	36	164	129	76	96	**310 [E]**

Sample Location	PAL (mg/kg)	A6SB132	A6SB133	A6SB134	A6SB135	A6SB136	A6SB137	A6SB138	A6SB139	A6SB140	A6SB141	A6SB142	A6SB143
Sample ID		A6SS132G0002	A6SS133G0002	A6SS134G0002	A6SS135G0002	A6SS136G0002	A6SS137G0002	A6SS138G0002	A6SS139G0002	A6SS140G0002	A6SS141G0002	A6SS142G0002	A6SS143G0002
Sample Date		20091111	20091111	20091111	20091111	20091111	20091112	20091112	20091112	20091112	20091112	20091112	20091112
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.319 UJ						0.305 UJ					
ARSENIC	11.83	6.75						5.28					
COPPER	28	**28.8 [E]**						7.33					
LEAD	27	**174 [E]**						19.1					
ZINC	65.6	37.7 J						33.0 J					
XRF (mg/kg)													
LEAD	200	**278 [E]**	97	**483 [E]**	27	47	16	26	22	40	89	17	48

Sample Location	PAL (mg/kg)	A6SB144	A6SB145	A6SB146	A6SB147	A6SB148	A6SB149	A6SB150	A6SB151	A6SB152	A6SB153	A6SB154	A6SB155
Sample ID		A6SS144G0002	A6SS145G0002	A6SS146G0002	A6SS147G0002	A6SS148G0002	A6SS149G0002	A6SS150G0002	A6SS151G0002	A6SS152G0002	A6SS153G0002	A6SS154G0002	A6SS155G0002
Sample Date		20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.299 UJ				0.332 UJ		0.345 UJ					
ARSENIC	11.83	6.13				4.35		3.33					
COPPER	28	12.4				7.01		19					
LEAD	27	**111 [E]**				**31.8 [E]**		**85.7 [E]**					
ZINC	65.6	31.0 J				23.7 J		21.0 J					
XRF (mg/kg)													
LEAD	200	70	51	63	15	37	34	69	41	16	68	22	18

TABLE 8-3

XRF AND FBL SURFACE SOIL MC METALS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	**PAL (mg/kg)**	**A6SB156**	**A6SB156**	**A6SB156**	**A6SB157**	**A6SB158**	**A6SB159**	**A6SB160**	**A6SB161**	**A6SB162**	**A6SB163**	**A6SB164**	**A6SB165**
Sample ID		A6SS156G0002	6SS156G0002-AV	A6SS156G0002-D	A6SS157G0002	A6SS158G0002	A6SS159G0002	A6SS160G0002	A6SS161G0002	A6SS162G0002	A6SS163G0002	A6SS164G0002	A6SS165G0002
Sample Date		20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112	20091112
Sample Type		ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)													
ANTIMONY	6.9	0.299 UJ	0.295 UJ	0.291 UJ				0.309 UJ			0.318 UJ		
ARSENIC	11.83	4.03	5.24	6.45				7.64			5.31		
COPPER	28	9.29	12.845	16.4				12.4			17.7		
LEAD	27	**27.5 [E]**	**48.9 [E]**	**70.3 [E]**				11.4			**36.1 [E]**		
ZINC	65.6	25.3 J	30.75 J	36.2 J				38.0 J			27.0 J		
XRF (mg/kg)													
LEAD	200	109			22	59	25	23	23	20	55	199	125

Sample Location	**PAL (mg/kg)**	**A6SB166**	**A6SB167**	**A6SB168**	**A6SB169**	**A6SB170**	**A6SB171**
Sample ID		A6SS166G0002	A6SS167G0002	A6SS168G0002	A6SS169G0002	A6SS170G0002	A6SS171G0002
Sample Date		20091112	20091112	20091114	20091114	20091114	20091114
Sample Type		NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
Inorganics (mg/kg)							
ANTIMONY	6.9	0.312 UJ		0.295 UJ		0.471 J	
ARSENIC	11.83	8.3		6.06		7.75	
COPPER	28	13.5		9.44		**121 [E]**	
LEAD	27	26.2		25.7		**1240 [E]**	
ZINC	65.6	43.9 J		31.4 J		42.4 J	
XRF (mg/kg)							
LEAD	200	37	16	33	**236 [E]**	**576 [E]**	64

mg/kg = milligram per kilogram
PAL = Project action limit

Shading indicates an exceedence of the PAL.

Notes:

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

TABLE 8-4

SURFACE SOIL MC EXPLOSIVES DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (mg/kg)	A6SB001		A6SB001		A6SB001		A6SB002		A6SB003		A6SB004		A6SB005		A6SB006		A6SB007	
Sample ID		A6SS001C0002		A6SS001C0002-AVG		A6SS001C0002-D		A6SS002C0002		A6SS003C0002		A6SS004C0002		A6SS005C0002		A6SS006C0002		A6SS007C0002	
Sample Date		20091116		20091116		20091116		20091115		20091111		20091112		20091116		20091116		20091114	
Sample Type		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)																			
2-AMINO-4,6-DINITROTOLUENE	15	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ	0.06	UJ
HMX	380	0.05	R	0.06	U	0.06	U	0.06	U	0.06	U	0.24	J	0.06	U	0.06	U	0.06	U
RDX	5.5	0.34	J	0.185	J	0.06	UJ	0.06	U	0.06	U	0.34		0.06	U	0.06	U	0.06	U

Sample Location	PAL (mg/kg)	A6SB008		A6SB009		A6SB010		A6SB011	
Sample ID		A6SS008C0002		A6SS009C0002		A6SS010C0002		A6SS011C0002	
Sample Date		20091114		20091114		20091114		20091114	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL	
Explosives (mg/kg)									
2-AMINO-4,6-DINITROTOLUENE	15	0.06	UJ	0.16	J	0.06	UJ	0.06	UJ
HMX	380	0.06	U	0.13	J	0.06	UJ	0.06	U
RDX	5.5	0.06	U	0.06	J	0.06	U	0.06	U

mg/kg = milligram per kilogram
PAL = Project action limit

Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration i an estimate of the true concentration.

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

There were no positive detections for nitroglycerin in the composite soil samples collected from the range firing areas.

TABLE 8-5

SURFACE SOIL MC PAH/BaP EQUIVALENTS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A6SB020		A6SB021		A6SB030		A6SB035		A6SB036		A6SB037		A6SB048		A6SB049	
Sample ID		A6SS020G0002		A6SS021G0002		A6SS030G0002		A6SS035G0002		A6SS036G0002		A6SS037G0002		A6SS048G0002		A6SS049G0002	
Sample Date		20091111		20091111		20091113		20091113		20091113		20091113		20091115		20091115	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
PAHs (µg/kg)																	
1-METHYLNAPHTHALENE	22000	1.6	U	1.6	U	1.6	U	1.7	U	2.8	J	1.6	U	1.6	U	2.3	J
2-METHYLNAPHTHALENE	310000	1.6	U	1.6	U	1.6	U	1.7	U	3.4	J	1.6	U	1.6	U	4.5	J
ACENAPHTHENE	29000	2.5	J	1.6	U	1.6	U	60		1.7	U	1.6	U	1.9	J	1.6	U
ACENAPHTHYLENE	3400000	1.6	U	1.6	U	1.6	U	1.7	U	1.7	J	1.6	U	1.6	U	1.6	U
ANTHRACENE	29000	5.5	J	1.6	U	1.6	U	1.7	U	1.7	U	2.2	J	2.2	J	1.6	U
BAP EQUIVALENT-HALFND	15	**135.85**		6.2358		2.0088		1.7	U	2.19935		14.094		**58.899**		1.6	U
BAP EQUIVALENT-POS	15	**135.85**		5.355		0.24		1.7	U	0.32		14.094		**58.899**		1.6	U
BENZO(A)ANTHRACENE	150	97		1.6	U	1.6	U	1.7	U	1.7	U	3.6	J	37	J	1.6	U
BENZO(A)PYRENE	15	**89**		4.2	J	1.6	U	1.7	U	1.7	U	6.5	J	**39**		1.6	U
BENZO(B)FLUORANTHENE	150	94		7.5	J	2.4	J	1.7	U	3.2	J	19	J	44	J	1.6	U
BENZO(G,H,I)PERYLENE	1100	76		1.6	U	1.6	U	1.7	U	1.7	U	12	J	35	J	1.6	U
BENZO(K)FLUORANTHENE	1100	31	J	2.5	J	1.6	U	1.7	U	1.7	U	5.8	J	15	J	1.6	U
CHRYSENE	1100	140		1.6	U	1.6	U	1.7	U	1.7	U	16	J	49		1.6	U
DIBENZO(A,H)ANTHRACENE	15	**21**		1.6	U	1.6	U	1.7	U	1.7	U	4.3	J	8.6	J	1.6	U
FLUORANTHENE	29000	86		4.4	J	1.9	J	2000		3.4	J	2.5	J	46	J	1.6	U
FLUORENE	29000	1.6	U	1.6	U	1.6	U	1.7	U	1.7	J	1.6	U	1.6	U	1.6	U
INDENO(1,2,3-CD)PYRENE	150	63		3.8	J	1.6	U	1.7	U	1.7	U	9.6	J	30	J	1.6	U
NAPHTHALENE	3900	1.6	U	1.6	U	1.6	U	1.7	U	2.9	J	1.6	U	1.6	U	9.3	J
PHENANTHRENE	1100	23	J	1.8	J	1.6	U	470		2.5	J	1.6	U	12	J	1.6	U
PYRENE	1100	91		5.3	J	2.1	J	**2100**		4.4	J	4.7	J	49	J	1.6	U

Comparison to Residential Screening Level of 1,500 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)	135.85		6.2358		2.0088		1.7	U	2.19935		14.094		58.899		1.6	U

Comparison to Non-Residential Screening Level of 21,000 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)	135.85		6.2358		2.0088		1.7	U	2.19935		14.094		58.899		1.6	U

TABLE 8-5

SURFACE SOIL MC PAH/BaP EQUIVALENTS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A6SB050		A6SB056		A6SB061		A6SB061		A6SB061		A6SB062		A6SB063		A6SB069	
Sample ID		A6SS050G0002		A6SS056G0002		A6SS061G0002		A6SS061G0002-AVG		A6SS061G0002-D		A6SS062G0002		A6SS063G0002		A6SS069G0002	
Sample Date		20091115		20091115		20091115		20091115		20091115		20091115		20091113		20091114	
Sample Type		NORMAL		NORMAL		ORIG		AVG		DUP		NORMAL		NORMAL		NORMAL	
PAHs (µg/kg)																	
1-METHYLNAPHTHALENE	22000	2.7	J	3.2	J	6.7	J	58.35	J	110	J	6.5	J	5	J	16	J
2-METHYLNAPHTHALENE	310000	5.1	J	6.5	J	12	J	111	J	210	J	13	J	10	J	31	J
ACENAPHTHENE	29000	1.6	U	1.6	U	12	J	42.5	J	73	J	1.6	U	1.6	U	8.6	J
ACENAPHTHYLENE	3400000	1.6	U	1.6	U	1.6	U	1.6	UJ	1.6	UJ	1.6	U	1.6	U	1.8	U
ANTHRACENE	29000	1.6	U	1.6	U	18	J	59	J	100	J	1.6	U	1.6	U	12	J
BAP EQUIVALENT-HALFND	15	1.6	U	1.6	U	**626.35**		**2149.425**		**3672.5**		1.6	U	1.6	U	**395.48**	
BAP EQUIVALENT-POS	15	1.6	U	1.6	U	**625.55**		**2149.425**		**3672.5**		1.6	U	1.6	U	**394.58**	
BENZO(A)ANTHRACENE	150	1.6	U	1.6	U	**550**	**J**	**1525**	**J**	**2500**	**J**	1.6	U	1.6	U	**320**	
BENZO(A)PYRENE	15	1.6	U	1.6	U	**480**	**J**	**1490**	**J**	**2500**	**J**	1.6	U	1.6	U	**310**	
BENZO(B)FLUORANTHENE	150	1.6	U	1.6	U	**580**	**J**	**1640**	**J**	**2700**	**J**	1.6	U	1.6	U	**340**	
BENZO(G,H,I)PERYLENE	1100	1.6	U	1.6	U	350	J	975	J	**1600**	**J**	1.6	U	1.6	U	200	
BENZO(K)FLUORANTHENE	1100	1.6	U	1.6	U	170	J	540	J	910	J	1.6	U	1.6	U	110	
CHRYSENE	1100	1.6	U	1.6	U	850	J	**2125**	**J**	**3400**	**J**	1.6	U	1.6	U	480	
DIBENZO(A,H)ANTHRACENE	15	1.6	U	1.6	U	1.6	UJ	**230.4**	**J**	**460**	**J**	1.6	U	1.6	U	1.8	U
FLUORANTHENE	29000	1.6	U	1.6	U	520	J	1460	J	2400	J	1.6	U	1.6	U	290	
FLUORENE	29000	1.6	U	1.6	U	4.1	J	12.55	J	21	J	1.6	U	1.6	U	3.1	J
INDENO(1,2,3-CD)PYRENE	150	1.6	U	1.6	U	**300**	**J**	**1050**	**J**	**1800**	**J**	1.6	U	1.6	U	**170**	
NAPHTHALENE	3900	10	J	5.7	J	14	J	72	J	130	J	12	J	14	J	37	J
PHENANTHRENE	1100	1.6	U	1.6	U	120	J	355	J	590	J	1.6	U	1.6	U	69	
PYRENE	1100	1.8	J	1.6	U	560	J	**1580**	**J**	**2600**	**J**	1.6	U	1.6	U	320	

Comparison to Residential Screening Level of 1,500 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)		1.6	U	1.6	U	626.35		**2149.425**		**3672.5**		1.6	U	1.6	U	395.48	

Comparison to Non-Residential Screening Level of 21,000 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)		1.6	U	1.6	U	626.35		2149.425		3672.5		1.6	U	1.6	U	395.48	

TABLE 8-5

SURFACE SOIL MC PAH/BaP EQUIVALENTS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Sample Location	PAL (µg/kg)	A6SB070	A6SB070	A6SB071	A6SB071	A6SB072		A6SB077		A6SB083		A6SB084	
Sample ID		6SS070G000	070G0002-6	SS071G000	071G0002-0	A6SS072G0002		A6SS077G0002		A6SS083G0002		A6SS084G0002	
Sample Date		20091114		20091114		20091113		20091113		20091115		20091115	
Sample Type		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
PAHs (µg/kg)													
1-METHYLNAPHTHALENE	22000	18	J	20	J	1.6	U	16	J	65		51	
2-METHYLNAPHTHALENE	310000	37	J	42	J	1.6	U	32	J	120		98	
ACENAPHTHENE	29000	1.6	U	1.5	U	1.6	U	1.7	U	1.7	J	1.7	U
ACENAPHTHYLENE	3400000	1.6	U	1.5	U	1.6	U	1.7	U	1.6	U	1.7	U
ANTHRACENE	29000	2.9	J	1.5	U	1.6	U	1.7	U	2.4	J	1.7	U
BAP EQUIVALENT-HALFND	15	**29.324**		1.5	U	1.6	U	1.7	U	8.8419		10.5687	
BAP EQUIVALENT-POS	15	**28.524**		1.5	U	1.6	U	1.7	U	8.8419		9.7187	
BENZO(A)ANTHRACENE	150	18	J	1.5	U	1.6	U	1.7	U	5.1	J	5.9	J
BENZO(A)PYRENE	15	**22**		1.5	U	1.6	U	1.7	U	4.2	J	7.5	J
BENZO(B)FLUORANTHENE	150	27	J	1.5	U	1.6	U	1.7	U	5.9	J	10	J
BENZO(G,H,I)PERYLENE	1100	17	J	1.5	U	1.6	U	1.7	U	4	J	5.9	J
BENZO(K)FLUORANTHENE	1100	10	J	1.5	U	1.6	U	1.7	U	3.6	J	4	J
CHRYSENE	1100	24	J	1.5	U	1.6	U	1.7	U	5.9	J	8.7	J
DIBENZO(A,H)ANTHRACENE	15	1.6	U	1.5	U	1.6	U	1.7	U	3.1	J	1.7	U
FLUORANTHENE	29000	27	J	1.5	U	1.6	U	1.7	U	6.5	J	6	J
FLUORENE	29000	1.6	U	1.5	U	1.6	U	1.7	U	2	J	1.7	U
INDENO(1,2,3-CD)PYRENE	150	19	J	1.5	U	1.6	U	1.7	U	4	J	5.8	J
NAPHTHALENE	3900	36	J	31	J	1.6	U	36	J	82		69	
PHENANTHRENE	1100	11	J	1.5	U	1.6	U	2.4	J	4.2	J	2.6	J
PYRENE	1100	25	J	1.5	U	1.6	U	1.7	U	5.9	J	6.3	J

Comparison to Residential Screening Level of 1,500 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)	29.324		1.5	U	1.6	U	1.7	U	8.8419		10.5687	

Comparison to Non-Residential Screening Level of 21,000 µg/kg

BAP EQUIVALENT-HALFND (µg/kg)	29.324		1.5	U	1.6	U	1.7	U	8.8419		10.5687	

TABLE 8-5

SURFACE SOIL MC PAH/BaP EQUIVALENTS DETECTIONS
WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06
SITE INSPECTION REPORT
NSA CRANE
CRANE, INDIANA

Toxicity Equivalency Factors (TEFs) for PAHs

PAH	TEF
BENZO(A)ANTHRACENE	0.1
BENZO(A)PYRENE	1
BENZO(B)FLUORANTHENE	0.1
BENZO(K)FLUORANTHENE	0.01
CHRYSENE	0.001
DIBENZO(A,H)ANTHRACENE	1
INDENO(1,2,3-CD)PYRENE	0.1

BaP Screening Levels

Risk Level	1E-06
Res screening level for BaP (µg/kg)	15
Non-res screening level for BaP (µg/kg)	210

µg/kg = microgram per kilogram
BaP = Benzo(A)Pyrene
PAH = Polycyclic aromatic hydrocarbon
PAL = Project action limit

Shading indicates an exceedence of the PAL.

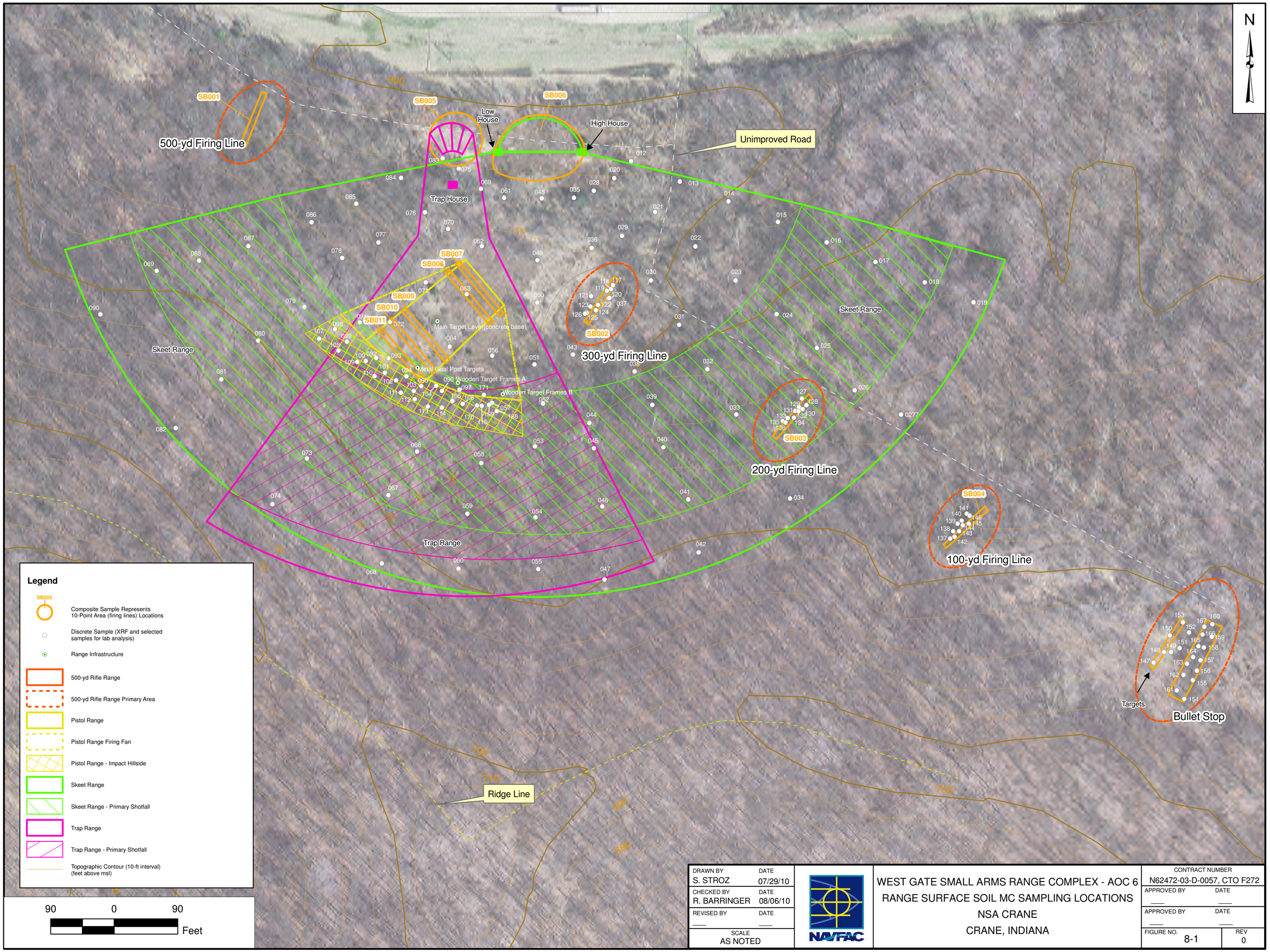
Notes:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

P:\GIS\CRANE_NSWC\MAPDOCS\MXD\WEST_GATE_SMALL_ARMS_SAMPLES_C_SIZE.MXD 08/06/10 SS



DRAWN BY S. STROZ	DATE 07/29/10	WEST GATE SMALL ARMS RANGE COMPLEX - AOC 6 RANGE SURFACE SOIL MC SAMPLING LOCATIONS NSA CRANE CRANE, INDIANA	CONTRACT NUMBER N62472-03-D-0057, CTO F272
CHECKED BY R. BARRINGER	DATE 08/06/10		APPROVED BY ___ DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. 8-1 REV 0

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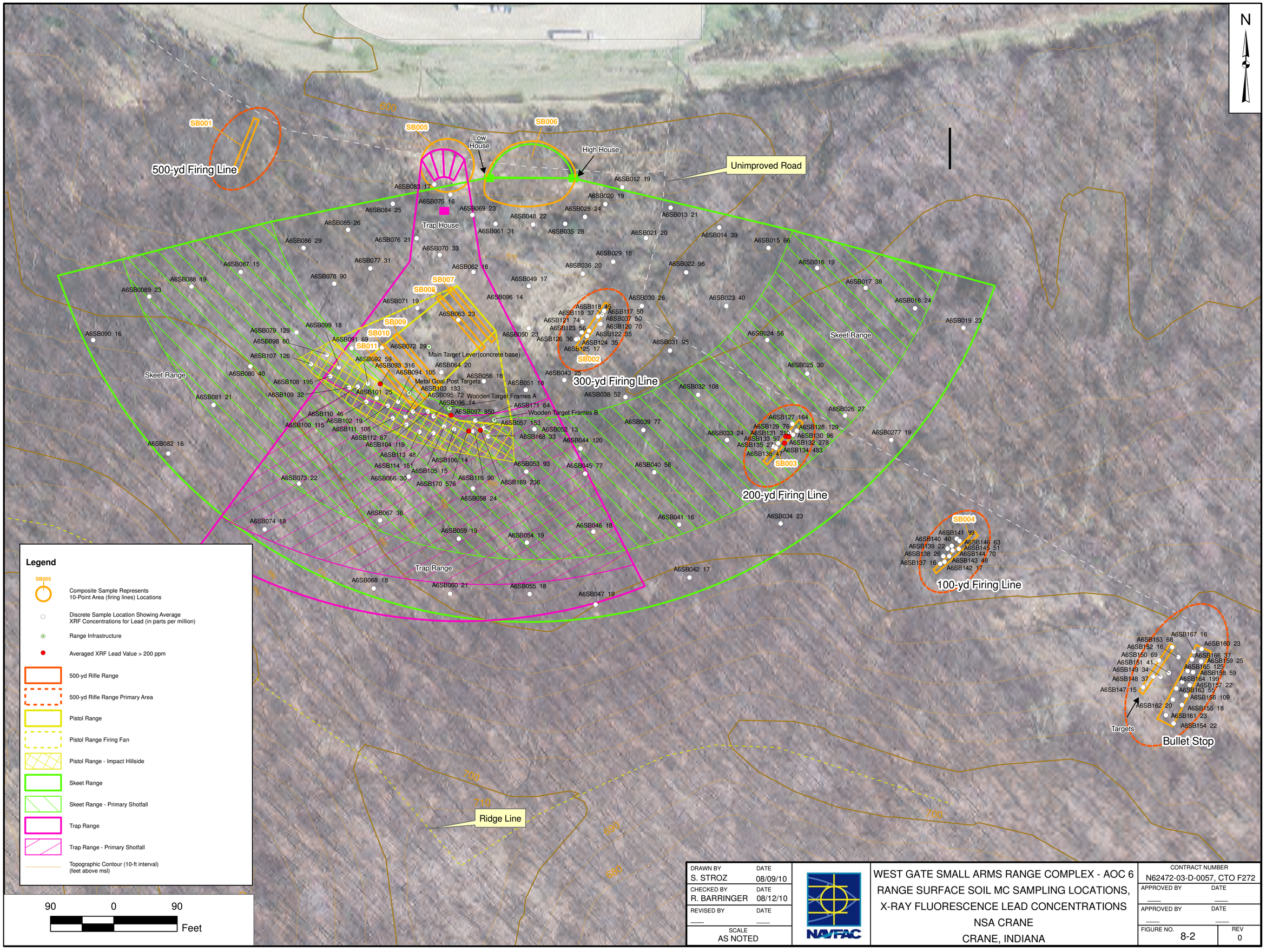

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S. STROZ	08/09/10
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R. BARRINGER	08/12/10
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SCALE	
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NAVFAC

WEST GATE SMALL ARMS RANGE COMPLEX - AOC 6
RANGE SURFACE SOIL MC SAMPLING LOCATIONS,
X-RAY FLUORESCENCE LEAD CONCENTRATIONS
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
APPROVED BY	DATE
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APPROVED BY	DATE
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FIGURE NO. 8-2	REV 0

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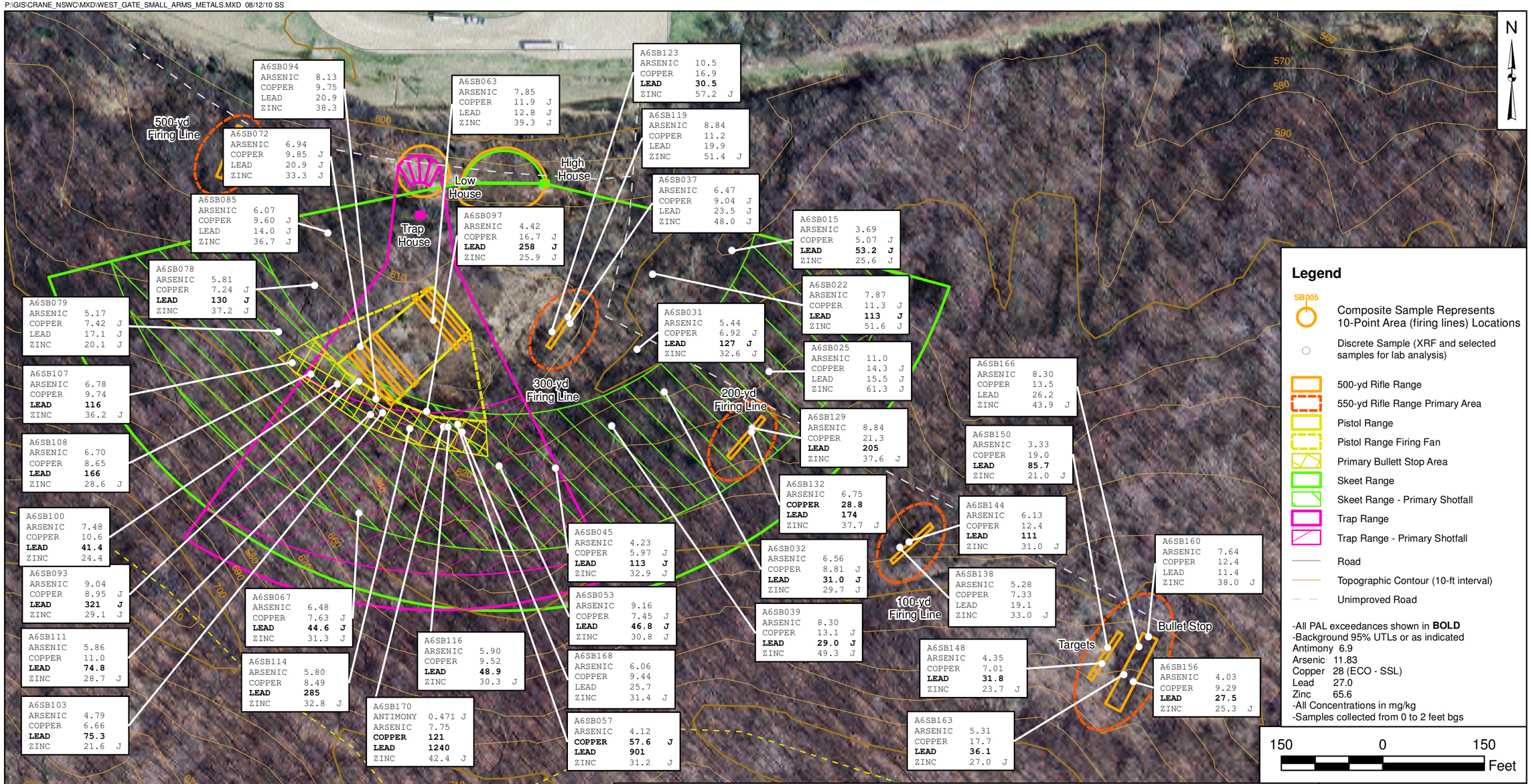

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T. WHEATON	02/08/10
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R. BARRINGER	08/12/10
REVISED BY	DATE
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SCALE	
AS NOTED	

NAVFAC

WEST GATE SMALL ARMS RANGE COMPLEX - AOC 6
RANGE SURFACE SOIL FBL METALS DETECTIONS
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
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FIGURE NO. 8-3	REV 0

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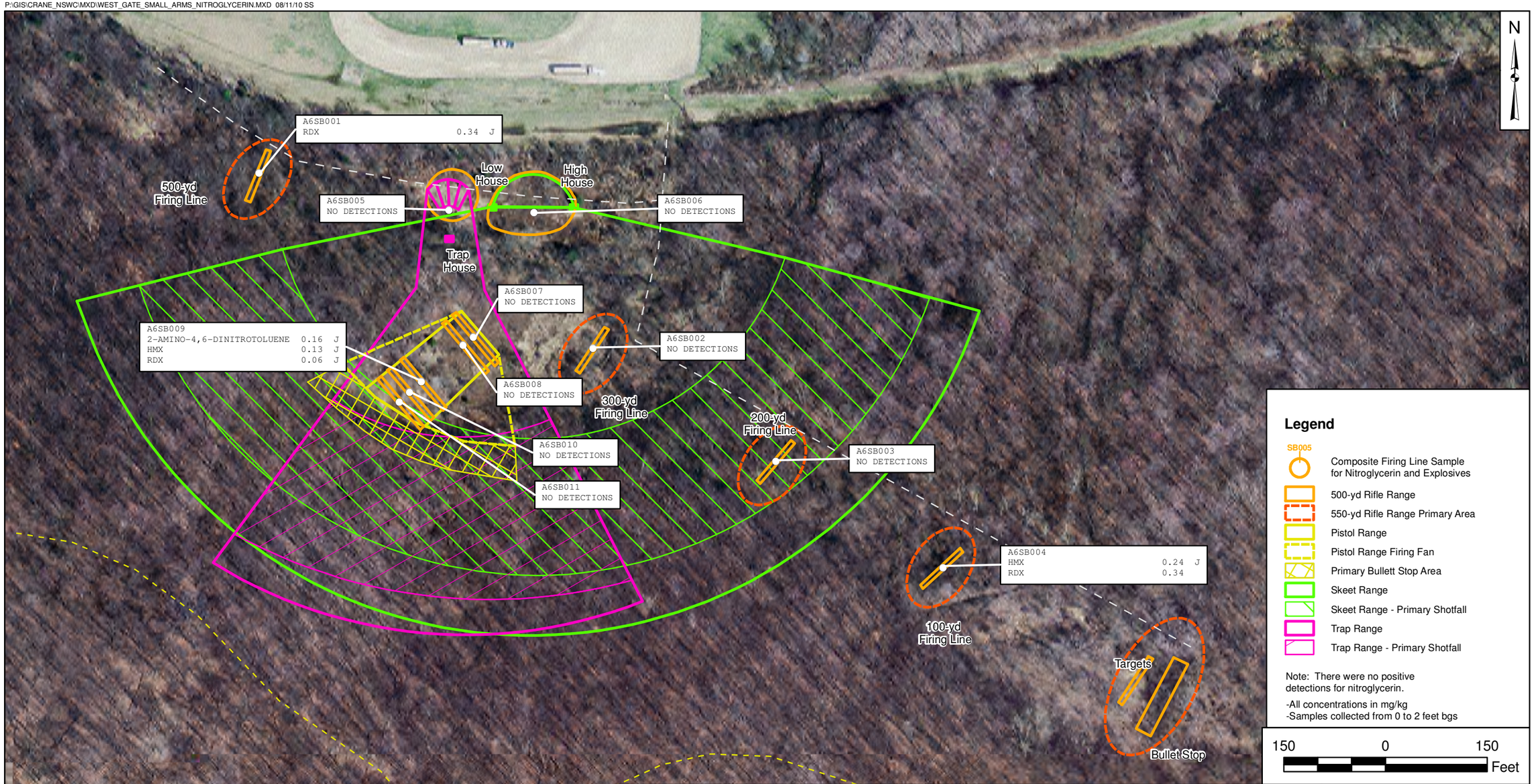

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T. WHEATON	02/08/10
CHECKED BY	DATE
R. BARRINGER	08/11/10
REVISED BY	DATE
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SCALE	
AS NOTED	

NAVFAC

WEST GATE SMALL ARMS RANGE COMPLEX - AOC 6
RANGE FIRING LINE SURFACE SOIL EXPLOSIVES
INCLUDING NITROGLYCERIN DETECTIONS
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
APPROVED BY	DATE
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APPROVED BY	DATE
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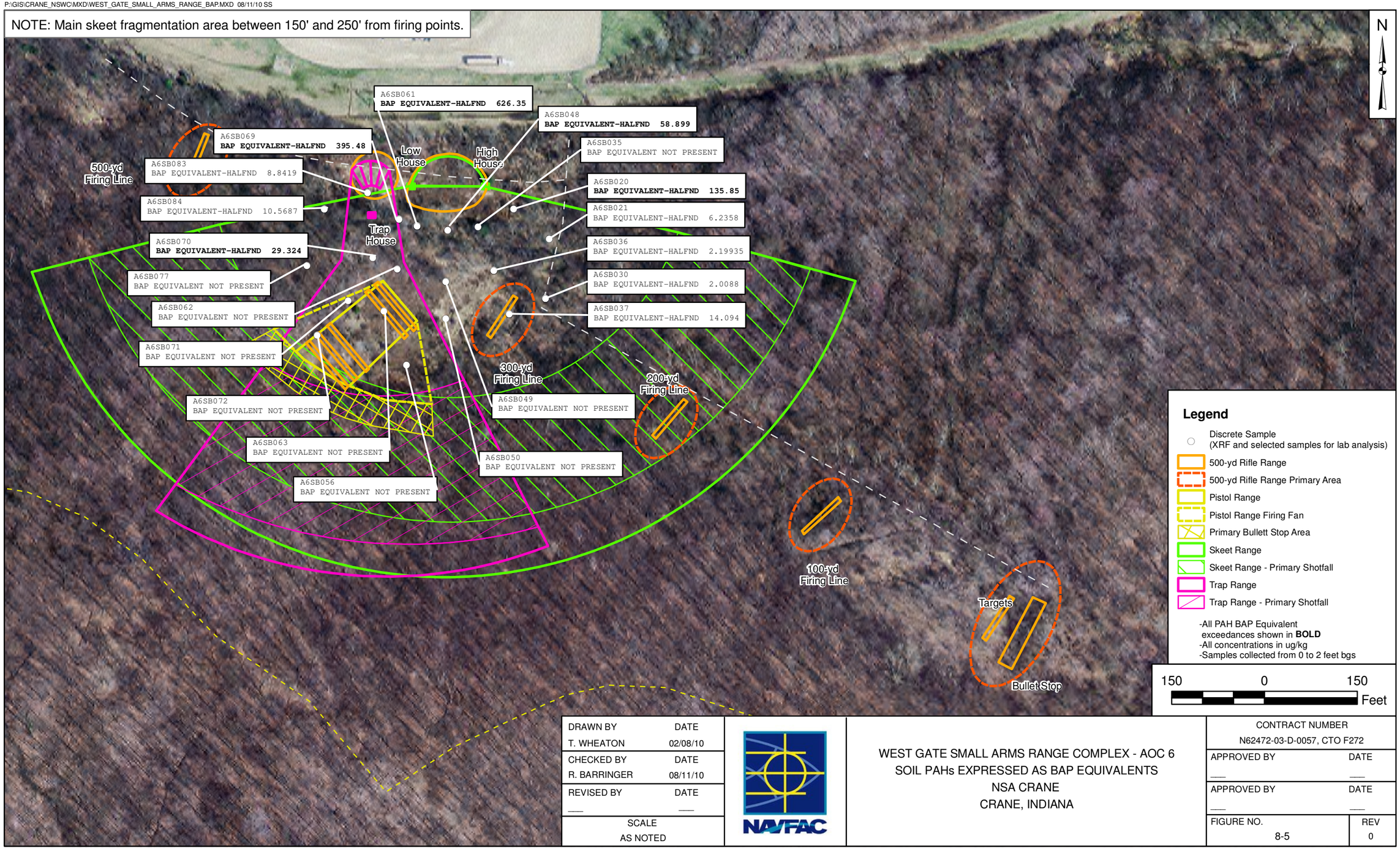
FIGURE NO. 8-4	REV 0

P:\GIS\CRANE_NSWC\MXD\WEST_GATE_SMALL_ARMS_RANGE_BAP.MXD 08/11/10 SS



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T. WHEATON	02/08/10
CHECKED BY	DATE
R. BARRINGER	08/11/10
REVISED BY	DATE
___	___
SCALE	
AS NOTED	

NAVFAC

WEST GATE SMALL ARMS RANGE COMPLEX - AOC 6
SOIL PAHs EXPRESSED AS BAP EQUIVALENTS
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
N62472-03-D-0057, CTO F272	
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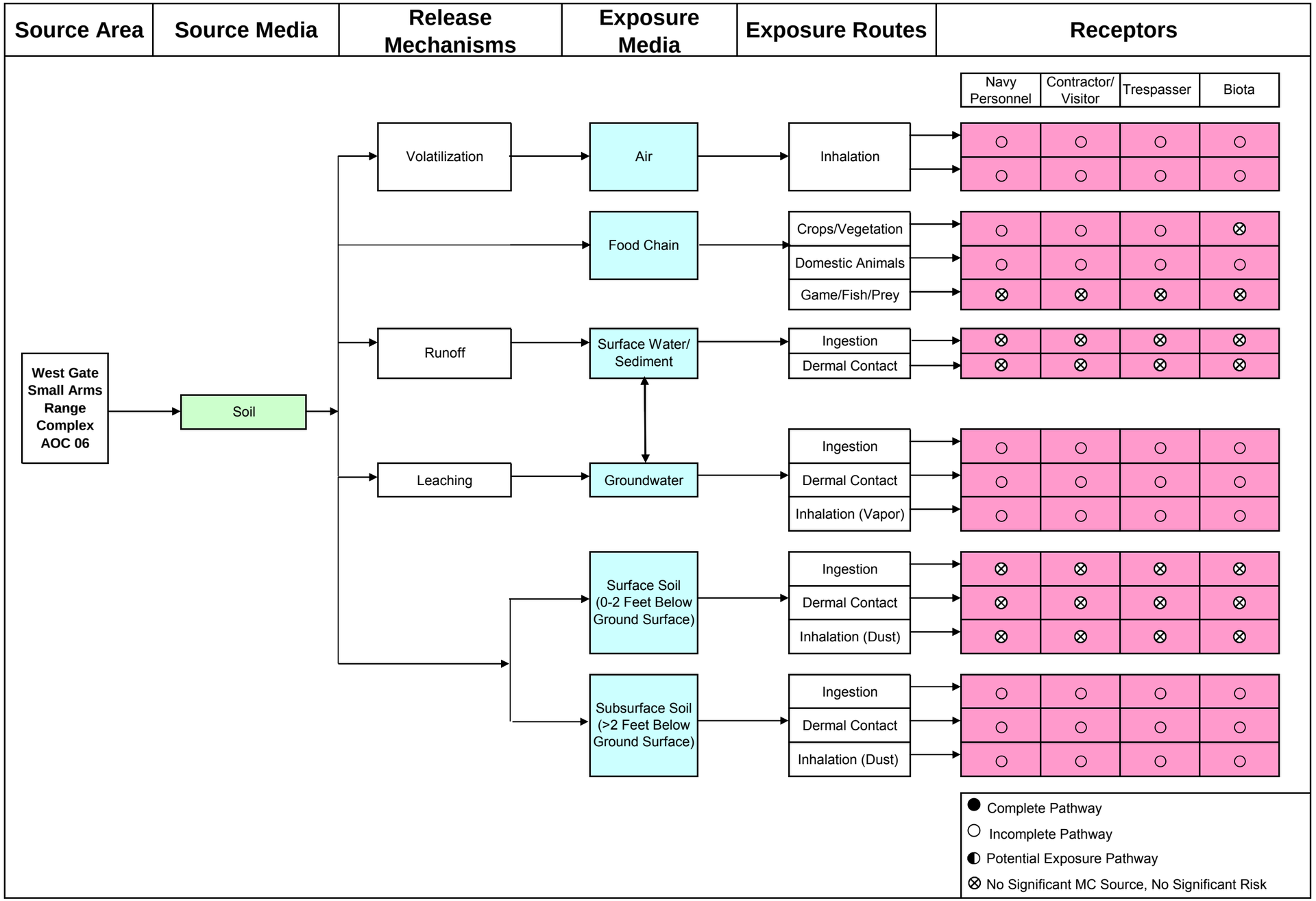
FIGURE NO.	REV
8-5	0

FIGURE 8-6

MC EXPOSURE PATHWAY ANALYSIS

WEST GATE SMALL ARMS RANGE COMPLEX - AOC 06

NSA CRANE, CRANE, INDIANA



LEGEND

500-YD RIFLE RANGE FIRING LINE

FIRING LINE/TARGET LOCATIONS

PISTOL RANGE

PISTOL RANGE IMPACT HILLSIDE

TRAP RANGE

TRAP RANGE IMPACT HILLSIDE

SKEET RANGE

SKEET RANGE PRIMARY SHOT FALL

TREE/VEGETATION

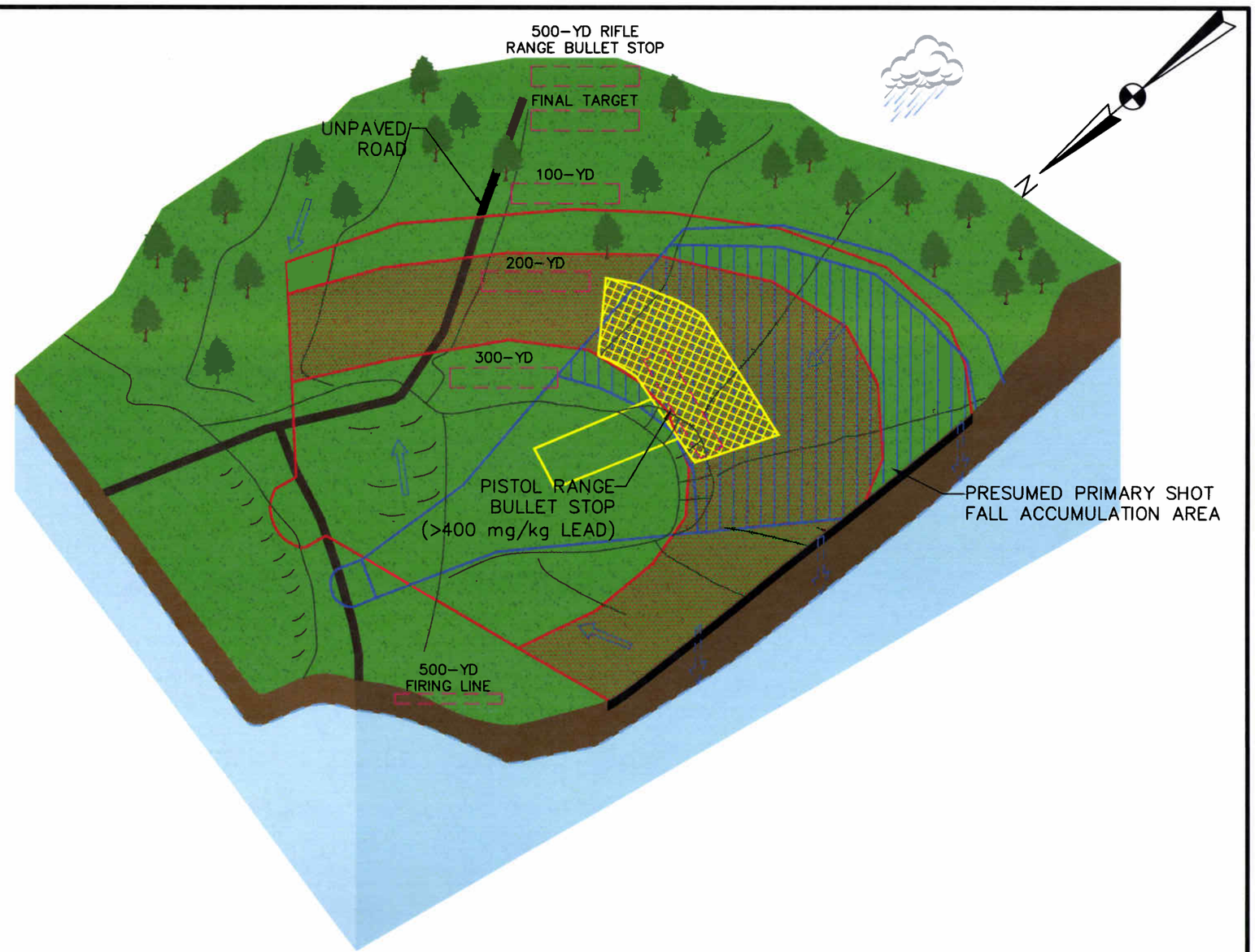
WATER TABLE

RUNOFF

INFILTRATION

NOTE:
GOOD CORRELATION BETWEEN PEAK XRF READINGS (PISTOL RANGE BULLET STOP AND 200-YD FIRING LINE/TARGET AREA) AND FIXED-BASE LAB (FBL) CONCENTRATIONS. FBL PEAK SOIL LEAD CONCENTRATIONS (>400mg/kg) OBSERVED IN TWO SOIL SAMPLES FROM PISTOL RANGE BULLET STOP (IMPACT HILLSIDE). ABOVE BACKGROUND METALS (LEAD AND COPPER) CONCENTRATIONS MATCHED PRESUMED SHOT FALL AND BULLET STOP/IMPACT LOCATIONS. PAH CONCENTRATIONS WERE DETECTED IN SOIL SAMPLES DOWNRANGE OF THE SKEET AND TRAP RANGE FIRING AREAS AS EXPECTED IN THE CSM.

CURRENT AND FUTURE RECEPTORS FOR AOC 06
HUMAN: -MILITARY/CIVILIAN PERSONNEL -CONTRACTORS -TRESPASSERS
ECOLOGICAL: -PLANTS -INVERTEBRATES -BIRDS -MAMMALS



DRAWN BY CK DATE 2/25/10	NAVFAC	WEST GATE SMALL ARMS RANGE COMPLEX-AOC 06 CONCEPTUAL SITE MODEL NSA CRANE, INDIANA	CONTRACT NO. 1621
CHECKED BY DATE			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 8-7 / REV. 0

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APPENDIX A

GENERAL FIELD FORMS

APPENDIX A.1

Field Logbook

AOC 04 748

TITLE NSA Crane MRP Sites **PROJECT NO.** 112G0162111

BOOK 2644

Work continued from Page —

9-8-09

Travel to NSA Crane.

9-9-09

AM: PC low 60's
PM: PC mid 80's

Morning was spent collecting confirmation samples at SWMU 13.

1115 - Visiting MRP sites along w/ FMT.

1130 - Arrived at B-198 test pads. Checked inside for area supervisor & was informed he was currently unavailable.

1145 - Looked over area at B-143. Again no one around to talk to.

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Work continued to Page 2

SIGNATURE [signature] DATE 9-9-09

TITLE NSA Crane MRP Sites PROJECT NO. 112G01621
BOOK 2644

Work continued from Page 1

1150 - Stopped by Pyro Test Area which is behind a fenced-in area. Returning to field office at B-3245.

1215 - At B-3245 preparing to sample at Pyro Test Area.

1315 - Arrived at Pyro Test Area and met w/ area Supervisor (Kenny). Informed him of our intent to collect soil samples within the concrete basins. Was given approval to proceed.

1400 - Collecting samples at Pyro Test Area. Basins do have a hard bottom. Seemed like concrete, but looked black like asphalt. Each basin had approximately 3 inches of soil. Each basin had large chunks of concrete (possibly old basin covers) inside. Samples collected

Work continued to Page 3

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SIGNATURE DATE 9-9-09

TITLE NSA Crane MRP Sites PROJECT NO. 112G01621
BOOK 2644

Work continued from Page 2

around inside walls. No sample collected from center.

Bottoms of each basin were approximately 3½ feet bags, so samples on exterior sides were collected at 4-6 feet bgs.

FD0909090101 collected from sample location A2SS001C0001. Dyes, Explosives, and Perchlorate MS/MSD collected at sample location A2SB009G0406.

1615 - Stopped back at SWMU 13 to collect GPS coordinates.

1635 - Returned to B3245 to unload samples & equipment.

1640 - Drove out to Lake Oberlin to assess boat launching areas.

1715 - Returned to B-3245

Work continued to Page 4

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SIGNATURE DATE 9-9-09

Work continued from Page 3

to begin processing samples. Samples transferred to appropriate sample jars & placed in refrigerator.

1945 - Left Crane enroute to gas station & hotel.

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SIGNATURE

WITNESS

DATE 9/9/09

DATE

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9-10-09

AM: PC low 60's
PM: MS low 80's

0800 - Arrived at Crane pass office to get visitor pass. Pass was not ready on 9-9-09

0820 - B-3245. FM on site. Loaded equipment into vehicle & preparing to collect samples at Lake Oberlin.

0845 - Contacted Bill Sudduth w/ Noble Engineering. He said they were still about an hour from Crane. Asked him to contact me when he reached the Crane gate & we would meet him at the site. I worked on COCs & daily notes.

0950 - Recieved call from Bill Sudduth indicating he was at the pass office. Told him to

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WITNESS

DATE 9/10/09

DATE

TITLE NSA Crane PROJECT NO. [illegible]
MRP Sites BOOK 2644

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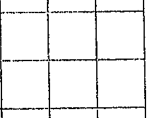
meet us at Hwy 5 & 449.

1010 - Met w/ Bill Sullivan & Colleague & proceeded back to Lake Oberlin. They were towing a 12-foot Jon boat w/ an electric trolling motor.

1030 - Discussed sampling techniques & safety concerns. Life jackets were on the boat. Put the boat in on the south shore. The 4 of us fit quite comfortably on the boat. Began collecting samples at location 004. Samples making up the composite sample were collected in a pattern similar to a 5 on a dice.



ID	Time	
004 -	1100	MS/MSD
003 -	1130	
002 -	1200	
001 -	1220	FD 09100901

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SIGNATURE [signature] DATE 9/10/09
WITNESS DATE

TITLE MRP BOOK 2644

Work continued from Page 6

1245 - All sampling complete at Lake Oberlin. Samples were collected by trolling to specific location, anchor dropped, and Wildco clamshell sampler was lowered to the bottom. Pin on sampler was released & given time to close. Sampler was then pulled back up to the boat by its rope, allowed to drain for a minute & then contents emptied into a 1-gallon Ziploc baggies which was labeled w/ sample ID, date and time. All samples were fairly uniform in that they were all very black & fine w/ a strong organic odor.

1322 - Returned to B3245. Fin processing samples while I begin COCs & labels.

1510 ~~1445~~ - Dropped off samples at

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SIGNATURE [signature] DATE 9/10/09
WITNESS DATE

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the Crane laboratory. Steve Mellle.

1525 - Stopped at B198 to talk to Supervisor about sampling the test pads behind the building. Supervisor (Gary Norris) was not available, but would be back first thing in the morning.

1540 - Returned to B3245 to finish processing samples.

1830
1700 - Left Crane enroute to Fed Ex.

Work continued to Page —

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SIGNATURE
WITNESS
DATE 9-10-09
DATE

Work continued from Page —

9-11-09

AM: PC low 60's
PM: PC ~80°

0800 - Arrived at B3245. FM on site. Stopped over a B3260 and picked up the shovel. Prepped vehicle for soil sampling.

0855 - Arrived a B198 to talk w/ Gary Norris. He was on the phone.

0920 - Informed Mr. Norris of our intent to sample the former test pads behind the building. He had no objections.

0930 - Drove vehicle up onto the former test pad area. Grass was about 4 feet high & fairly thick. GPS was used to mark out sample locations.

The soil material w/in the

Work continued to Page 10

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WITNESS
DATE 9-11-09
DATE

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concrete basin was approximately 8-inches deep & very wet. A sample (010) was collected about 8 feet downgradient of the tank. Samples collected on either side of the drain pipe leading into the tank. Composite samples collected at test pads and on sand hill. The black plastic under the test pads was visible & not completely intact in all places.

1210 - Completed sample collection at the former test pads.

1230 - B3245 to begin the processing of samples.

Rinsate blank (RB09110901) was collected from hand auger for Navy Dye analysis. Lab supplied water B815219

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SIGNATURE [signature] DATE 9-11-09

WITNESS DATE

Work continued from Page 10

Field dup sample (FD09110901) collected at location 008 (Dyes). MS/MSD sample collected at location (005) for explosives & dyes.

FD09110901 collected at location 003 for explosives.

1445 - Dropped off final sample (Dye) at Crane laboratory.

1455 - At Lake Oberlin to take a few more photos.

1515 - Stopped at B3260 to pick up XRF equipment that was shipped in. Returned to B3245.

1630 - Stopped by Lowes to see if they rented equipment, but they do not. Looking for a brush cutter to clear sample locations at B143 & Small Arms Range.

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WITNESS DATE

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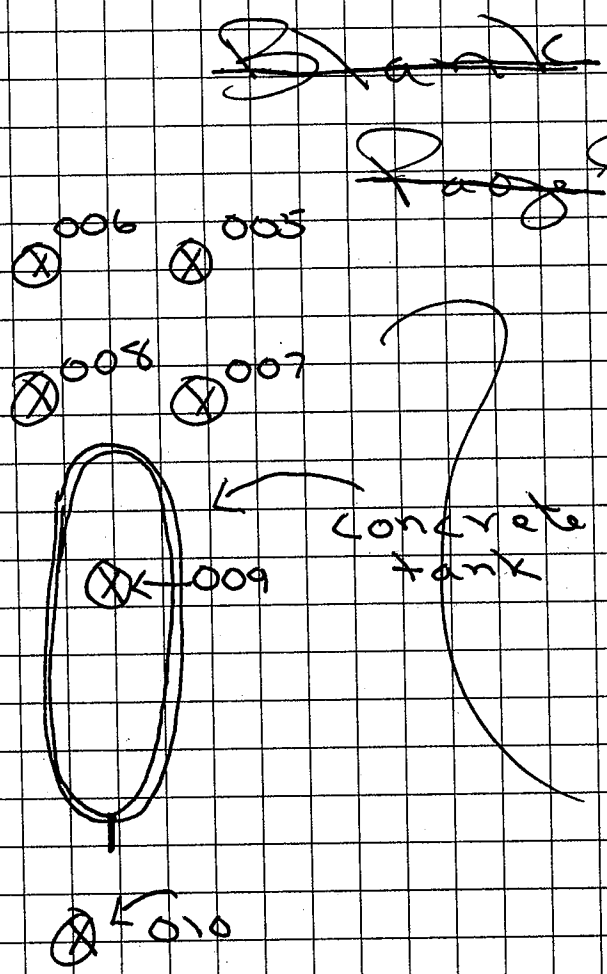

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SIGNATURE
WITNESS
DATE 9-11-09
DATE

Work continued from Page —

9-12-09

AM: Clear, upper 50's
PM: Clear, low 80's

0730 - Enroute from Bedford to Bloomington to pick up brush cutter from Master Rental Co.

0920 - Arrived at B3245. Preparing to sample at B143. Unable to use GPS to locate samples due to thick tree canopy. Made measurement from roadway. The area is basically along bowl-shaped oval. Samples were adjusted to fit inside this area. A former gravel road came down into the Drop Test Area. This made it difficult to hand auger down to 2 feet. Many samples in this area were collected at 12-16".

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DATE 9-12-09
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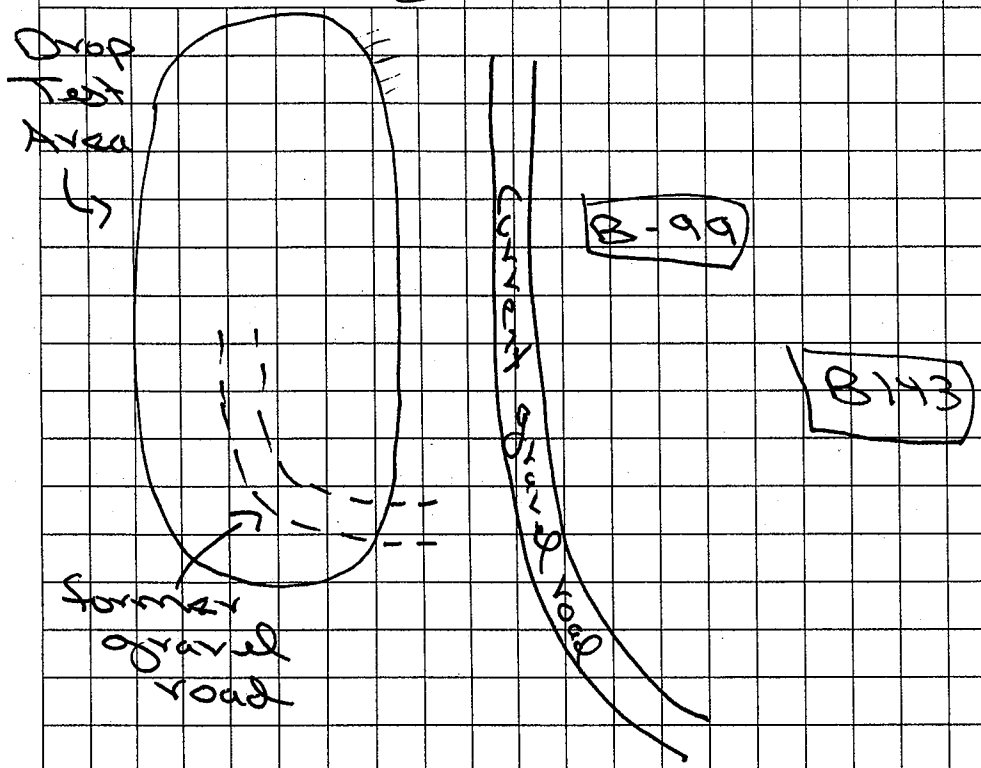

1330 - Finished collecting samples at B143. Returned to B3245 to process samples & place in fridge.

1430 - Went to the Small Arms Range to look over the site. Area is extremely thick

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SIGNATURE [signature] DATE 9-12-09

WITNESS DATE

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w/ vegetation & contains difficult terrain. Will take several days to clear sampling locations.

1515 - Teleconference w/ R. Baisinger & R. Barringer regarding sampling at the Small Arms Range. Informed them of the current site conditions & recommended that sampling of the site be delayed until late October or early November. After a frost or freeze or two, vegetation will start to die back allowing for easier sample location & collection. Both agreed to this recommendation.

Phoned FM & told him to demob the following day.

1620 - Arrived back at Small Arms Range to take photos.

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WITNESS DATE

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DATE

WITNESS

DATE

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9-13-09

0830 - At Wal Mart to purchase aluminum pans used to dry samples in oven for XRF analysis.

0940 - Arrived at Crane B32 Began preparing for XRF analysis.

1000 - 1430 - Ran XRF on the 18 samples collected at the B193 Drop Test Area. Majority of samples had fairly low lead concentrations (<65 ppm). One sample (SS010) had an average XRF lead concentration of 307 ppm. Upon closer examination of sample material was able to find two small pieces of metal in the soil. XRF of each piece revealed lead levels around 100 ppm, but metals were very high.

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SIGNATURE

DATE 9/13/09

WITNESS

DATE

Work continued from Page 17

1445 - Began printing out labels & placing samples in jars.

1500 - Completing COCs.

1530 - Labeling samples & placing in cooler of ice.

1630 - General clean up of field office, & then left the site.

Work continued to Page

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SIGNATURE

WITNESS

DATE 9/13/09

DATE

Work continued from Page —

9-14-09

0845 - Arrived at Fed Ex, but not open until 0900. Proceeded to Master Rental Center & dropped off brush cutter.

0855 - Returned to Fed Ex & shipped out one cooler of samples to Empirical Labs & shipped Schonstedt back to Pita Environmental.

Remainder of day spent traveling back to PGH.

Field Environmental picked up equipment on 9-15-09 ~ 1330

Hand augers (2)
GPS
XRF w/ stand

Work continued to Page —

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SIGNATURE

WITNESS

DATE 9/14/09

DATE

Work continued from Page —

11-10-09 →

Sampling at the West Gate Small Arms Range.

JG - Jim Goerdt FOL
JF - John Floyd Sampler
LF - Lauren Foster Sampler
CR - Chris Rumer Sampler

Work continued to Page

SCIENTIFICBINDERY88YRS.COM

SIGNATURE DATE

WITNESS DATE

Work continued from Page —

11-10-09

AM: PC mid 50's
PM: PC mid 60's

0825 - Arrived at Crane Pass Office w/ LF.

0835 - Arrived at Field Trailer. JF on site. Held a brief Health & Safety meeting to discuss the field effort & what to expect in the field. Heavy brush, lots of trip hazards.

1000 - Stopped by DRMO to inquire about unused equipment left at Field trailer. Met w/ rep who checked out the equipment & began process of having it removed from the trailer.

1045 - Back at field trailer to

Work continued to Page 22

SCIENTIFICBINDERY88YRS.COM

SIGNATURE DATE 11-10-09

WITNESS DATE

Work continued from Page 21

prepare for sampling at the West Gate Small Arms Range (SAR).

1250 - Arrived at SAR & began clearing & marking sample locations. Utilizing GPS to locate samples. Understory is very thick w/ thorn bushes. Began by locating high/low house locations as a base. Located several locations in the initial area of the trap & skeet ranges.

1610 - Returned to field trailer to unload equipment. Met w/ Chris Hughes, the electrician working w/ the trailer.

1700 - Enroute to Sam's Club & Menards for field supplies.

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SIGNATURE [signature] DATE 11-10-09
WITNESS DATE

Work continued from Page —

11-11-09

AM: Clear mid 40's
PM: Clear upper 50's

0700 - Wal Mart for field supplies.

0800 - Arrived at field trailer. Loaded vehicles w/ sampling equipment, decon water, etc.

0910 - Arrived at SAR w/ JF & LF. While LF began marking additional sample locations w/ GPS, JF & myself began collecting samples via hand auger. Collected samples from locations 012-022 at the skeet range.

1200 - Returned to the field trailer to drop off samples, re-stock equipment & lunch.

1330 - Arrived back at the

Work continued to Page 24

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SIGNATURE [signature] DATE 11-11-09
WITNESS DATE

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SAR. Again LF marking locations w/ GPS while JF & myself collected samples. Finished collecting samples 023-027, 031-034, 127-136.

1725 - All returned to field trailer to unload samples & field equipment. Organizing samples in trailer by location.

1810 - End of day. Leaving Crane.

During the course of the day it was determined that current field staff would not be adequate to finish sampling by the 18th. Contacted Pittsburgh office & requested additional help. Chris Rumer to travel tomorrow to Indiana.

Individual Samples Collected: 31

XRF = 0

Work continued to Page

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SIGNATURE [signature] DATE 11-11-09
WITNESS DATE

Work continued from Page 11-12-09

AM: Clear, upper 30's
PM: Clear, upper 50's

0720 - Arrived at Crane field trailer. Loaded equipment & decon water into vehicles.

0755 - Enroute to SAR. LF marking locations w/ GPS. JF & myself collecting sampl via hand auger. Collected samples 147-167 from main target area and main bullet stop at the Rifle Range. Several of the larger "sheep" sit metal targets were located in a fairly straight line giving us a confident feeling of the target location area. There was refusal at 6" at sample location SB148. The 1st line of samples was placed approx. 5-6 feet in front of those target the western-most location

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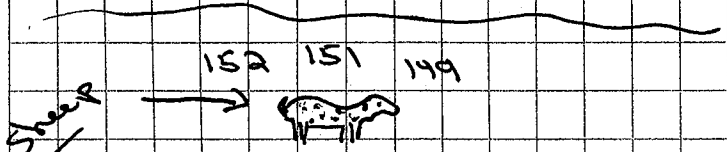
SIGNATURE [signature] DATE 11-12-09
WITNESS DATE

Work continued from Page 25

was placed approx. 25 feet west of the last observed target on the line. The eastern sample was placed approx. 10 feet east of the first target location. The 2nd line of samples was placed approx. 10 feet behind the target line. The 1st line of samples on the bullet stop were placed approx. 3-5 feet from base of berm, which was in line w/ the tops of the upright targets. The 2nd line of samples on the bullet stop were placed approx. 15 feet higher than the 1st line, which was about 4-5 feet from the top of the berm.

154 - 160
161 - 167



Work continued to Page 27

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SIGNATURE [signature] DATE 11-12-09
WITNESS DATE

Work continued from Page 26

The sample locations on the main bullet stop (berm) were spaced so the outer locations were just beyond the outer sample locations at the target area.

1300 - Completed morning sampling & returned to field trailer to drop off sample & eat lunch.

1325 - Tom Brand stopped over w/ XRF equipment. Dumped decon water & refilled buckets. Put together a couple of percussion (slide hammer) drills to possibly use for sample collection.

1435 - Arrived back at SAR & continued w/ sample marking & collection. Tried using the percussion drill & it worked fine for the initial 6",

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SIGNATURE [signature] DATE 11-12-09
WITNESS DATE

Work continued from Page 27

but for deeper depths it proved difficult to drive deeper & even more difficult to remove from the boring. Use of the percussion drill was quickly abandoned. Collected samples 004c (10 aliquots) & 137-146.

1745 - Returned to field trailer to drop off samples & sampling equipment.

1745 - End of day - left Crane.

Individual Samples Collected: 41

XRF = 0

Work continued to Page —

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SIGNATURE [signature] DATE 11-12-09
WITNESS DATE

Work continued from Page —

11-13-09 ~~12-11-09~~

AM: Clear mid 30's
PM: Clear low 60's

0810 - Arrived at the Crane Visitor Center w/ Chris Rumen (CR) to obtain a pass for Chris. No pass available for Chris, but was able to obtain a one-day pass.

0830 - Arrived at field trailer & loaded sampling equipment & decon water.

0930 - Arrived at the SAR. LF marking sample locations while Mr. CR. & myself begin collecting samples via hand auger. Collected samples 028-030, 035-037, 063, 064, 072, 117-126 (19 samples)

1210 - Returned to the field trailer to unload samples, begin drying

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SIGNATURE [signature] DATE 11-13-09
WITNESS DATE

TITLE MRP Sites BOOK 2644

AOC-6

Work continued from Page 29

of samples, & lunch. Charging the GPS.

1315 - Returned to the SAR. JF is working on getting electricity hooked up at the field trailer. CR & LF collecting samples while I mark sample locations w/ GPS.

1530 - JF at SAR to help collect samples. Electricity is on at the trailer.

1730 - Finish sampling at the SAR. Collected samples at 040-042, 045-047, 053-055, 057-060, 066-068, 073-074, 076-082, 085-090.

1800 - Arrived back at field trailer. Unloaded equipment & samples. Continued drying some of the samples.

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Work continued to Page 31

SIGNATURE

WITNESS

DATE 11-13-09

DATE

TITLE MRP Sites BOOK 2644

AOC-6

Work continued from Page 30

1930 - Left Crane, enroute to Wal-Mart for additional field supplies.

Note: Sample location SB065 on the Pistol Range was not collected since its location was practically on top of another sample location that was added.

Samples collected = 50

XRF = 0

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Work continued to Page —

SIGNATURE

WITNESS

DATE 11-13-09

DATE

TITLE NSA Crane MRP Sites PROJECT NO. 112G00162 BOOK 2644

AOC-6

Work continued from Page –

11-14-09

AM: Clear, low 40's
PM: Clear, low 60's

0800 - Arrived at Crane ~~Visitor~~ Gate. Security Gate. CR was not allowed on base w/o pass. Officer at gate would not allow a one day pass. I contacted JF & LF to tell them we would meet them at the SAR.

0895 - JF & LF arrive at the SAR. Began clearing & marking & collecting samples at the Pistol Range. While laying out the Pistol Range firing lines, they seemed to be too far to the NW which placed them outside the boundaries of the range. Re alligned them in the field. Distance between firing line 007 & 008 was approx. 25 feet.

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SIGNATURE [signature] DATE 11/14/09
WITNESS DATE

TITLE NSA Crane MRP Sites

AOC-6

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0950 - Contacted Tom Brent regarding access issue for CR. Tom will make a few phone calls & get back to me.

1030 - Tom Brent called back & informed me he recieved OK for CR to access the Base per Karl Hays. Any trouble we are to call 812-854-5623. If that doesn't work, call 3300.

1230 - Recieved one-day pass for CR & proceeded to field trailer to drop off samples & eat lunch. During the morning we collected samples at 007c - 011c. Each of these composite samples were comprised of 10 aliquots for a total of 50 samples collected. Each firing line was approx. 100-125 feet long.

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SIGNATURE [signature] DATE 11/14/09
WITNESS DATE

TITLE NSA Crane PROJECT NO. 11AG0162

MRP Sites BOOK 2644

AOC-6

Work continued from Page 33

1400 - Returned to the SAP. While laying out samples at the Pistol Range berm it was noticed that the location of the range on the UFP-SAP Figure 17-5 was not in line w/ former target stations at the site. The range was located too far west. Adjusted sample locations on the berm so they covered the area reaching all the way east to the 300-yd firing berm. The entire range floor is covered under sampling locations from the shed to trap ranges.

1730 - Finished sampling for the day. Collected samples at 33 locations. Includes 069-071, 091-116, & newly added samples 168-171. Returned to field trailer to

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SIGNATURE [signature] DATE 11/14/09

WITNESS DATE

TITLE NSA Crane PROJECT NO. 11AG0162

MRP Sites BOOK 2644

AOC-6

Work continued from Page

unload samples & equipment.

1930: End of Day. Leaving Crane.

Samples collected: 83

XRF = 0

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Work continued to Page —

SIGNATURE [signature] DATE 11/14/09

WITNESS DATE

AOC-6

Work continued from Page –

11-15-09

AM: PC low 50's
PM: Cloudy mid 60's

0750 - Contacted security upon arriving at Crane Gate. They called over & there was no problem getting a one-day pass for CR.

0815 - LF & CR heading out to SAR to collect samples at 002c, 038, 039, 043, 044, 048-052, 056, 061, 062, 075, 083, 084.

25 samples

I remained at the field trailer to begin processing of samples for XRF.

1230 - Arrived at hotel w/ samples & over to XRF. Began XRF of samples

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SIGNATURE [signature] DATE 11-15-09
WITNESS DATE

Work continued from Page 36

1730 - CR & LF end of day. I cont'd w/ XRF for a few more samples until 1930.

Samples collected =

XRF = 62

Note: LF at Summa is to collect additional samples for that project.

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Work continued to Page –

SIGNATURE [signature] DATE 11-15-09
WITNESS DATE

AOC-6

Work continued from Page —

11-16-09

AM: Cloudy, low 50's
PM: Cloudy, low 60's

0800 - Arrived at Visitor Center & recieved one-day pass for CR.

0840 - Enroute to SAR after stopping at field trailer to pick up sampling equipment & decon water.
Collected aliquots for the composite samples at 001C, 005, 006C. 30 samples. Initially had trouble locating firing stations at the skeet range, but after calling Rick Barringer in the PGA office, the concrete stations were located. The GPS coordinates for the 500-yd firing berm were off by about 50 feet. The area looked more like a staging area. The actual

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DATE 11-16-09
DATE

AOC-6

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berm was located about 50 feet to the ESE. The berm was completely & heavily covered in jagger bushes. Locations were individually cleared for sampling.

1230 - Finished sampling & returned to the field trailer. Unloaded samples, equipment & cleaned out vehicles.

1330 - JF demob'd from Crane. LF out to SAR to shoot GPS coordinates at sample locations. CR & myself remained at the field trailer to process samples for XRF & to begin XRF analysis.

1730 - LF back from collecting GPS coordinates. LF to help CR & myself w/ XRF.

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SIGNATURE
WITNESS
DATE 11-16-09
DATE

Work continued from Page 39

1830 - LF & CR depart Crane. I remained behind to clean up.

1845 - Battery dead on vehicle from charging cell phone. Contacted Security who would then put a call into Fire Dept. for assistance.

1910 - Two reps from Fire Dept. showed up to give me a jump start.

1945 - End of day - departed Crane.

Work continued to Page —

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SIGNATURE [signature] DATE 11-16-09
WITNESS DATE

Work continued from Page —

11-17-09

AM: Heavy rain, mid 40's
PM: Rain, mid 50's

0745 - Arrive at Visitor Center to get one-day pass for CR. LF was going direct to SAR to finish w/ GPS. CR & myself to field trailer to continue w/ samp processing & XRF analysis.

1000 - LF back at field trailer. Helping w/ XRF. Finished all XRF except for 10 samples. Had to start selection of samples for FBL analysis. Also collect six rinsate blanks. 2-MeO, 2-PAA, 2-NG. Selected sam were placed in jars, labeled & put in shipping coolers w/ ice. COCs were complete

1830 - CR & LF depart Crane enroute to Fed Ex w/ samp.

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SIGNATURE [signature] DATE 11-17-09
WITNESS DATE

TITLE MRP Sites PROJECT NO. BOOK 2644

AOC-6

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I remained behind to clean up.

2030 - End of day - departed Crane.

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SIGNATURE

WITNESS

DATE 11-17-09

DATE

TITLE MRP Sites PROJECT NO. BOOK 2644

AOC-6

Work continued from Page —

11-18-09

AM: Cloudy low 50's

0850 - Arrived at field trailer to run the remain 10 samples through XRF

1000 - Left message for LF who was coming out to take all samples back to SAR to dump at respective sites.

1030 - Departed Crane - end of shift.

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SIGNATURE

WITNESS

DATE 11-18-09

DATE

TITLE MRP Sites BOOK 2644

AOC-6

Work continued from Page –

General Field Notes that didn't make it into daily activity records.

- The site in general was very overgrown w/ thick jagger bushes, especially on the firing/target berms. The clearing took longer than expected.

- Target silhouettes were found at the 300 yd, 200 yd, 100 yd firing lines as well as the main target area. Corresponding silhouette cutout metal was found at the 500-yd firing line confirming its location.

- At the firing lines of the pistol range, gravel was encountered at the following locations.

SB007 A, E, F

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SIGNATURE

WITNESS

DATE 12-4-09

DATE

TITLE MRP Sites PROJECT NO. 112G016

BOOK 2644

AOC-6

Work continued from Page 44

SB008 A, B, H

- location B also had a thick black plastic liner

SB009 D, F, H

SB010 F

- JF spent several of the initial evenings drying samples for XRF.

- The XRF was standardized each day it was used as well as running the NIST standards that accompanied the unit. Standardization also occurred after a battery change & NIST standards were analyzed at the end of each use.

- Sample locations where fragments of clay target were observed were selected

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Work continued to Page

SIGNATURE

WITNESS

DATE 12-4-09

DATE

TITLE MRP Sites PROJECT NO. (6a) BOOK 2644

AOC-6

Work continued from Page 45

for PAH analysis at the FBL. There may be 1-2 exceptions.

- Each processed sample baggie was analyzed thru (3) times w/ the XRF & the lead concentrations were averaged. Baggie read at each corner & in center w/out mixing between readings.

Work continued to Page

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SIGNATURE

WITNESS

DATE 12-4-09

DATE

TITLE PROJECT NO.

BOOK

Work continued from Page

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SIGNATURE

WITNESS

DATE

DATE

APPENDIX A.2

Chain-of-Custody Forms

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2125 | PAGE 1 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218245	Empirical/Janice Shilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	4124430244	621 Mainstream Dr #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex/8631 2526 4157		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4oC

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Lead SW-846 6010B	COMMENTS
9/12	1200	A1SS001G0002	001	0	2	SO	G	1	1	
	1235	A1SS003G0002	003					3	3	MS/MSD
	1245	A1SS010G0002	010					1	1	
	1240	A1SS004G0002	004					1	1	
	1150	A1SS013G0002	013					1	1	FD
	1145	A1SS006G0002	006					1	1	
	1225	A1SS015G0002	015					1	1	
	1200	A1SS018G0002	018					1	1	
	0000	FD09120901	QC	—	—	QC	G	1	1	
	1500	RB09120901	QC	—	—	QC	G	2	2	
			QC							
9/14/09										

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	9/14/09	0800	1. RECEIVED BY Fed Ex		
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2126 | PAGE 2 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218245	Empirical / Janice Shilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goard	4124430244	621 Mainstream Dr #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 2526 4157		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Explosives SW846 8330A	COMMENTS
9/11	1145	X655001C0001	001	0	1	SO	C	1	1	
	1120	X655002C0001	002				C	1	1	
	1130	X655003C0001	003				C	1	1	FD
	1105	X655004C0001	004		↓		C	1	1	
	1035	X655005G0002	005		2		G	3	3	MS/MSD
	1040	X655006G0002	006		1		G	1	1	
	1045	X655007G0002	007				G	1	1	
	1050	X655008G0002	008		↓		G	1	1	
	1030	X655009G0001	009		1		G	1	1	
	1025	X655010G0002	010		2		G	1	1	
	1155	X655011C0002	011		2		C	1	1	
	1205	X655012C0002	012	↓	2	↓	C	1	1	
↓	0000	FD09110901	QC	—	—	QC	—	1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	9/14/09	0800	1. RECEIVED BY Fed Ex		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2119 | PAGE 1 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218245	NSA Crane / Steve Weddle
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	4124430244	300 Highway 361 B-2707
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Hand deliver		Crane, IN 47522

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

TYPE OF ANALYSIS: Navy Dye compounds

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS								COMMENTS
9/09	1415	A2SS001C0001	001	0	1	SO	C	1	1							FD
	1400	A2SS002C0001	002	0	1		C	1	1							
	1450	A2SB003G0406	003	4	6		G	1	1							
	1545	A2SB004G0406	004	4	6			1	1							
	1505	A2SB005G0406	005	4	6			1	1							
	1520	A2SB006G0406	006	4	6			1	1							
	1455	A2SB007G0406	007	4	6			1	1							
	1535	A2SB008G0406	008	4	6			1	1							
	1430	A2SB009G0406	009	4	6			3	3							MS/MSD
	1510	A2SB010G0406	010	4	6			1	1							
	1545	A2SS011G0002	011	0	2			1	1							
	1555	A2SS012G0002	012	0	2			1	1							
	0000	FD09090901	QC	–	–	QC		1	1							

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	9-10-09	1510	1. RECEIVED BY Steve Weddle	9-10-09	1510
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 2120 | PAGE 2 OF 2

PROJECT NO: 112G01621	FACILITY: NSA Crane	PROJECT MANAGER R. Barringer	PHONE NUMBER 4129218245	LABORATORY NAME AND CONTACT: NSA Crane / Steve Waddle
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER J. Goerdt	PHONE NUMBER 4124430244	ADDRESS 300 Highway 361 B-2707
		CARRIER/WAYBILL NUMBER Hand Deliver		CITY, STATE Crane, IN 47522

STANDARD TAT [X]
RUSH TAT [ ] [ ] 24 hr. [ ] 48 hr. [ ] 72 hr. [ ] 7 day [ ] 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4oC

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Navy Oxy Compounds	LAB SAMPLE NUMBERS / COMMENTS
9/10	1220	A45D001C0006	001	0	6	SD	C	1	1	N09SE-0240
9/10	1200	A45D002C0006	002	0	6	SD	C	1	1	N09SE-0241
9/10	1130	A45D003C0006	003	0	6	SD	C	1	1	N09SE-0242
9/10	1100	A45D004C0006	004	0	6	SD	C	3	3	ms/msD N09SE-0243
9/10	0000	FD09100901	QC	-	-	QC	-	1	1	N09SE-0244

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	9/10-09	1510	1. RECEIVED BY Steve Waddle	9-10-09	1510
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2116 | PAGE 1 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218524	Columbia Analytical Jeannine Misiukewicz
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	4124430244	1 Mustard St. Ste 250
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex/863125264180		Rochester, NY 14609

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4oC

TYPE OF ANALYSIS: Pesticides SW 8466850

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS		COMMENTS
9/9	1415	A2SS001C0001	001	0	1	SO	C	1	1	FD
	1400	A2SS002C0001	002	0	1		C	1	1	
	1450	A2SB003G0406	003	04	6		G	1	1	
	1545	A2SB004G0406	004	04				1	1	
	1505	A2SB005G0406	005	04				1	1	
	1520	A2SB006G0406	006	04				1	1	
	1455	A2SB007G0406	007	04				1	1	
	1535	A2SB008G0406	008	04				1	1	
	1430	A2SB009G0406	009	04				3	3	MS/MSD
	1510	A2SB010G0406	010	04				1	1	
	1545	A2SS011G0002	011	0	2			1	1	
	1555	A2SS012G0002	012	0	2			1	1	
	0000	FD09090901	QC	—	—	QC	—	1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	9/10/09	1500	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2117 | PAGE 2 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218524	Columbia Analytical / Misiuk Jeanine
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		J. Goerdt	4124430244	1 Mustard St. Ste 250
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 2526 4180		Rochester, NY 14609

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4°C

TYPE OF ANALYSIS: Perchlorate 314.0

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	Perchlorate 314.0	COMMENTS
9/9	1715	RB09090901	QC	–	–	QC	G	2	2	

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
	9-10-09	1800			
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2121 | PAGE 1 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8245	Empirical / Janice Shilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	412 443 0244	621 Mainstream Dr. 270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 2526 4168		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Explosives 4530A	COMMENTS
9/9	1415	A2SS001C0001	001	0	1	SO	C	1	1	FD
	1400	A2SS002C0001	002	0	1		C	1	1	
	1450	A2SB003G0406	003	4	6		G	1	1	
	1545	A2SB004G0406	004					1	1	
	1505	A2SB005G0406	005					1	1	
	1520	A2SB006G0406	006					1	1	
	1455	A2SB007G0406	007					1	1	
	1535	A2SB008G0406	008					1	1	
	1430	A2SB009G0406	009					3	3	MS/MSD
	1510	A2SB010G0406	010					1	1	
	1545	A2SS011G0002	011	0	2			1	1	
	1555	A2SS012G0002	012	0	2			1	1	
	0000	FD09090901	QC	—	—	QC	—	1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	9-10-09	1800	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2122 | PAGE 2 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218245	Empirical / Janice Shilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	4124430247	621 Mainstream Dr 270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 2526 4168		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Explosives 8330A								COMMENTS
9/9	1715	RB09090901	QC	–	–	QC	G	2	2								

1. RELINQUISHED BY [signature]	DATE 9-10-09	TIME 1800	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2130 | PAGE 1 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8524	Empirical Lab / J. Schilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		J. Goerdt	412 443 0244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C
TYPE OF ANALYSIS: SW-846 8330A NG

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS		COMMENTS
11/16	930	A6SS001C0002	001	0	2	SO	C	1	1	
11/15	1030	A6SS002C0002	002					1	1	
11/11	900	A6SS003C0002	003					1	1	
11/12	1700	A6SS004C0002	004					1	1	
11/16	1130	A6SS005C0002	005					1	1	
11/16	1050	A6SS006C0002	006					1	1	
11/14	940	A6SS007C0002	007					1	1	
11/14	1000	A6SS008C0002	008					1	1	
11/14	1100	A6SS009C0002	009					1	1	
11/14	1045	A6SS010C0002	010					3	3	MS/MSD
11/14	1120	A6SS011C0002	011					1	1	
11/16	0000	FD11160901	QC	—	—		—	1	1	
11/17	1600	RB11170901	QC	—	—	QC	G	2	2	Rinsate Blank

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	11/17/09	1830	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

FORM NO.

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2131 | PAGE 2 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412921 8524	J. Schilling / Empirical
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	412443 0244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex/8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

TYPE OF ANALYSIS: SW846 3050B/6010B/6020

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS		COMMENTS
11/11	1010	A655015G0002	015	0	2	SO	G	1	1	
11/11	945	A655022G0002	022					1	1	
11/11	1430	A655025G0002	025					1	1	
11/11	1535	A655031G0002	031					1	1	
11/11	1445	A655032G0002	032					3	3	MS/MSD
11/13	943	A655037G0002	037					1	1	
11/15	935	A655039G0002	039					1	1	
11/13	1335	A655045G0002	045					1	1	
11/13	1450	A655053G0002	053					1	1	
11/13	1555	A655057G0002	057					1	1	
11/13	1100	A655063G0002	063					1	1	
11/13	1545	A655067G0002	067					1	1	
11/13	1030	A655072G0002	072					1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	11/17/09	1830	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS: Select Metals

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2132 | PAGE 3 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8524	Empirical / J. Stilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerdt	412 4430244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4oC

TYPE OF ANALYSIS: 5035B/8260B, 8270B/6010B/6020

DATE YEAR 2008	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS		COMMENTS
11/13	1640	A655078G0002	078	0	2	SO	G	1	1	
11/13	1435	A655079G0002	079					1	1	
11/13	1700	A655085G0002	085					1	1	
11/14	1450	A655093G0002	093					1	1	
11/14	1500	A655094G0002	094					1	1	
11/14	1540	A655097G0002	097					1	1	
11/14	1450	A655100G0002	100					1	1	
11/14	1520	A655103G0002	103					1	1	
11/14	1420	A655107G0002	107					1	1	
11/14	1430	A655108G0002	108					1	1	
11/14	1455	A655111G0002	111					1	1	
11/14	1510	A655114G0002	114					1	1	
11/14	1520	A655116G0002	116					1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	11/17/09	1830	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 2134 | PAGE 4 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8524	Empirical / J. Schilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Gerald	412 443 0244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex/8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

TYPE OF ANALYSIS: SW 846 8020B/6010B/6020

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS		COMMENTS
11/13	1100	A6551196G0002	119	0	2	SO	G	1	1	
11/13	1140	A6551236G0002	123					1	1	
11/11	1625	A6551296G0002	129					1	1	
11/11	1630	A6551326G0002	132					1	1	
11/12	1545	A655~~144~~138G0002	~~144~~138					3	3	138 / MS/MSD
11/12	1530	A6551446G0002	144					1	1	
11/12	1050	A6551486G0002	148					1	1	
11/12	1100	A6551506G0002	150					1	1	
11/12	1142	A6551566G0002	156					1	1	
11/12	1230	A6551606G0002	160					1	1	
11/12	1135	A6551636G0002	163					1	1	
11/12	1150	A6551666G0002	166					1	1	
11/14	1515	A6551686G0002	168					1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	11/17/09	1830	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER 2135 | PAGE 5 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8524	Empirical / J. Schilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
[signature]		J. Goerlt	412 443 0244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G G
PRESERVATIVE USED: 4°C 4°C

TYPE OF ANALYSIS: SW 8260B/8260B; SW 8270 (PAH)

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	SW 8260B	SW 8270 (PAH)	COMMENTS
11/14	1555	A655170G0002	170	0	2	SO	G	1	1		
11/14	0000	FD111409 01	QC	–	–	QC	–	1	1		
11/12	0000	FD111209 01	QC	–	–	QC	–	1	1		
11/17	1600	RB111709 01	QC	–	–	QC	G	2	2		Rinsate Blank
11/11	955	A655020G0002	020	0	2	SO		1		1	
11/11	935	A655021G0002	021					3	~~3~~	3	MS/MSD
11/13	930	A655030G0002	030					1	~~1~~	1	
11/13	1018	A655035G0002	035					1	~~1~~	1	
11/13	955	A655036G0002	036					1	~~1~~	1	
11/13	943	A655037G0002	037					1	~~1~~	1	
11/15	1100	A655048G0002	048					1	~~1~~	1	
11/15	1040	A655049G0002	049					1	~~1~~	1	
11/15	1020	A655050G0002	050					1	~~1~~	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY [signature]	11/17/09	1830	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2136 | PAGE 6 OF 6

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barrington	412 921 8524	Empirical / J. Schilling
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		J. Goerdt	412 443 0244	621 Mainstream Dr. #270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Fed Ex / 8631 3888 2965		Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G

PRESERVATIVE USED: 4°C

TYPE OF ANALYSIS: 500 SVOC 8270 (RAM)

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	500 SVOC 8270 (RAM)	COMMENTS
11/15	1010	A655056G0002	056	0	2	SO	G	1	1	
11/15	1145	A655061G0002	061					1	1	
11/15	1120	A655062G0002	062					1	1	
11/14	1100	A655063G0002	063					1	1	
11/14	1640	A655069G0002	069					1	1	
11/14	1625	A655070G0002	070					1	1	
11/14	1610	A655071G0002	071					1	1	
11/13	1030	A655072G0002	072					1	1	
11/13	1635	A655077G0002	077					1	1	
11/15	1100	A655083G0002	083					1	1	
11/15	1045	A655084G0002	084					1	1	
11/15	0000	FD11150901	QC	—	—		—	1	1	
11/17	1600	RB11170901	QC	—	—	—	—	2	2	Rinsate Blank

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
	11/17/09	1830			
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2124 | PAGE 1 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	4129218245	NSA Crane / Steve Weddle
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		J. Goerdt	4124430244	300 Hwy 361 B270
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Hand Deliver		Crane, IN 47522

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: Hg, Dye Compounds	COMMENTS
9/11	1145	X655001C0001	001	0	1	SO	C	1	1	
	1120	X655002C0001	002		1		C	1	1	
	1130	X655003C0001	003		1		C	1	1	
	1105	X655004C0001	004		1		C	1	1	
	1035	X655005G0002	005		2		G	3	3	MS/MSD
	1040	X655006G0002	006		2		G	1	1	
	1045	X655007G0002	007		2		G	1	1	
	1050	X655008G0002	008		2		G	1	1	FD
	1030	X655009G0001	009		1		G	1	1	
	1025	X655010G0002	010		2		G	1	1	
	1155	X655011C0002	011		2		C	1	1	
	1205	X655012C0002	012		2		C	1	1	
	0000	FD09110901	QC	–	–	QC	–	1	1	

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	9-11-09	1645	1. RECEIVED BY Steve Weddle	9-11-09	1443
2. RELINQUISHED BY		1443	2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER 2123 | PAGE 2 OF 2

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G01621	NSA Crane	R. Barringer	412 921 8245	NSA Crane / Steve Weddle
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
		J. Goerdt	412 443 0244	300 Hwy 361 B-2707
		CARRIER/WAYBILL NUMBER		CITY, STATE
		Hand Deliver		Crane, IN 47522

STANDARD TAT ☐ RUSH TAT ☒
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G
PRESERVATIVE USED: 4°C
TYPE OF ANALYSIS: Nat Sic Nat Compounds

DATE YEAR 2009	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS
9/11	1415	RB0911090 1	QC	–	–	QC	G	2	2								

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	9-11-09	1743	1. RECEIVED BY Steve Weddle	9-11-09	1743
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

APPENDIX A.3

B-143 Drop Test Area

- Soil Sample Log Sheets
- GPS Coordinates

B-143 DROP TEST AREA
SAMPLE COORDINATES

Sample Location	Easting	Northing	Coordinate System
A1SB001	3016405.52	1307056.85	NAD 1983 SPCS Indiana West (Feet)
A1SB002	3016411.67	1307082.77	NAD 1983 SPCS Indiana West (Feet)
A1SB003	3016419.37	1307087.19	NAD 1983 SPCS Indiana West (Feet)
A1SB004	3016434.31	1307099.52	NAD 1983 SPCS Indiana West (Feet)
A1SB005	3016438.49	1307108.88	NAD 1983 SPCS Indiana West (Feet)
A1SB006	3016445.3	1307122.21	NAD 1983 SPCS Indiana West (Feet)
A1SB007	3016413.56	1307051.44	NAD 1983 SPCS Indiana West (Feet)
A1SB008	3016420.67	1307070.21	NAD 1983 SPCS Indiana West (Feet)
A1SB009	3016426.42	1307070.93	NAD 1983 SPCS Indiana West (Feet)
A1SB010	3016439.34	1307092.11	NAD 1983 SPCS Indiana West (Feet)
A1SB011	3016451.7	1307099.82	NAD 1983 SPCS Indiana West (Feet)
A1SB012	3016454.99	1307111.63	NAD 1983 SPCS Indiana West (Feet)
A1SB013	3016419.51	1307043.78	NAD 1983 SPCS Indiana West (Feet)
A1SB014	3016429	1307058.38	NAD 1983 SPCS Indiana West (Feet)
A1SB015	3016443.73	1307059.47	NAD 1983 SPCS Indiana West (Feet)
A1SB016	3016453.88	1307078.61	NAD 1983 SPCS Indiana West (Feet)
A1SB017	3016456.65	1307092.07	NAD 1983 SPCS Indiana West (Feet)
A1SB018	3016469.45	1307093.48	NAD 1983 SPCS Indiana West (Feet)

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Montes

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane**
B-143 Drop Test Area

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead SW-846 6010B	Field XRF			Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A1SS001G0002	HA	0-2	9/12	1200	L	G		1	X	X							Brownish tan clayey soil. Damp
A1SS002G0002	HA	0-2	9/12	1220	L	G		1		X							Very wet sample
A1SS003G0002	HA	0-2	9/12	1235	L	G		3	X	X				X			Brown sandy soil. Slightly damp
A1SS004G0002	HA	0-2	9/12	1240	L	G		1	X	X							Brown sandy soil. Slightly damp
A1SS005G0002	HA	0-2	9/12	1220	L	G		1		X							Brown sandy soil. Dry
A1SS006G0002	HA	0-2	9/12	1145	L	G		1	X	X							Salt/pepper sandy soil. Slightly damp
A1SS007G0002	HA	0-2	9/12	1155	L	G		1		X							Brown clayey soil. Wet.
A1SS008G0002	HA	0-2	9/12	1212	L	G		1		X							Brownish orange clayey soil. Moist
A1SS009G0002	HA	0-2	9/12	1230	L	G		1		X							Black sandy soil. Damp
A1SS010G0002	HA	0-2	9/12	1225	L	G		1	X	X							Brown and tan sandy soil. Damp
A1SS011G0002	HA	0-2	9/12	1207	L	G		1		X							Tan sandy soil. Slightly damp
A1SS012G0002	HA	0-2	9/12	1155	L	G		1		X							Brown sandy soil. Slightly damp
A1SS013G0002	HA	0-2	9/12	1150	L	G		1	X	X			X				Brown sandy soil. Slightly damp
A1SS014G0002	HA	0-2	9/12	1210	L	G		1		X							Brown sandy soil. Slightly damp

REMARKS:
HA = hand auger
FD = FD09120901 (A1SS013G0002)

LABORATORY:
Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Montes

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane**
B-143 Drop Test Area

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead SW-846 6010B	Field XRF			Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A1SS015G0002	HA	0-2	9/12	1225	L	G		1	X	X							Brown sandy soil. Slightly damp
A1SS016G0002	HA	0-2	9/12	1228	L	G		1		X							Brown sandy soil. Slightly damp.
A1SS017G0002	HA	0-2	9/12	1210	L	G		1		X							Brown and tan sandy soil. Slightly damp
A1SS018G0002	HA	0-2	9/12	1200	L	G		1	X	X							Brown and tan sandy soil. Slightly damp

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

APPENDIX A.4

Pyro Area Outside Test Burn Pads

- Soil Sample Log Sheets
- GPS Coordinates

PYRO AREA OUTSIDE TEST BURN PADS
SAMPLE COORDINATES

Sample Location	Easting	Northing	Coordinate System
A2SB001	3026105.2	1317548.59	NAD 1983 SPCS Indiana West (Feet)
A2SB002	3026109.35	1317515.87	NAD 1983 SPCS Indiana West (Feet)
A2SB003	3026106.99	1317553.34	NAD 1983 SPCS Indiana West (Feet)
A2SB004	3026111.17	1317548.57	NAD 1983 SPCS Indiana West (Feet)
A2SB005	3026106.89	1317547.14	NAD 1983 SPCS Indiana West (Feet)
A2SB006	3026101.54	1317551.19	NAD 1983 SPCS Indiana West (Feet)
A2SB007	3026110.32	1317519.6	NAD 1983 SPCS Indiana West (Feet)
A2SB008	3026115.19	1317514.58	NAD 1983 SPCS Indiana West (Feet)
A2SB009	3026110.96	1317511.03	NAD 1983 SPCS Indiana West (Feet)
A2SB010	3026105.15	1317513.79	NAD 1983 SPCS Indiana West (Feet)
A2SB011	3026074.62	1317549.05	NAD 1983 SPCS Indiana West (Feet)
A2SB012	3026075.48	1317508.47	NAD 1983 SPCS Indiana West (Feet)

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[X] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Montes

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - Pyro Area Outside Test Burn Pad**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Explosives SW-846 8330A	Perchlorate SW-846 6850	Navy Dye Cmpounds		Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A2SS001C0001	HA	0-1	9/9	1415	L		C	1	X	X	X		X				Black with small pebbles, moist
A2SS002C0001	HA	0-1	9/9	1400	L		C	1	X	X	X						Dark Brown. Soil. Moist
A2SB003G0406	HA	4-6	9/9	1450	L	G		1	X	X	X						Light brown. Clay/soil. Damp
A2SB004G0406	HA	4-6	9/9	1545	L	G		1	X	X	X						Tan, soily clay. Damp
A2SB005G0406	HA	4-6	9/9	1505	L	G		1	X	X	X						Dark Brown. Clay. Damp
A2SB006G0406	HA	4-6	9/9	1520	L	G		1	X	X	X						Tan, clayey soil mix. Dry
A2SB007G0406	HA	4-6	9/9	1455	L	G		1	X	X	X						Orange clay
A2SB008G0406	HA	4-6	9/9	1535	L	G		1	X	X	X						Tan, clayey soil mix. Dry
A2SB009G0406	HA	4-6	9/9	1430	L	G		3	X	X	X			X			light brown soil with some clay
A2SB010G0406	HA	4-6	9/9	1510	L	G		1	X	X	X						Tan, soily clay. Damp
A2SS011G0002	HA	0-2	9/9	1545	L	G		1	X	X	X						Brown soil with some clay. Damp
A2SS012G0002	HA	0-2	9/9	1555	L	G		1	X	X	X						Light brown soil. Slightly damp

REMARKS:
HA = hand auger
FD = FD09090901 (A2SS001C0001)

LABORATORY:
Explosives : Empirical Laboratories
Perchlorate: Columbia Analytical
Navy Dye Compounds: NSA Crane

COC No(s).:

APPENDIX A.5

Test Pads on Hill Behind B-198

- Soil Sample Log Sheets
- GPS Coordinates

APPENDIX A.6

Lake Oberlin

- Sediment Sample Log Sheets
- GPS Coordinates

LAKE OBERLIN
SAMPLE COORDINATES

Sample Location	Easting	Northing	Coordinate System
A4SD001	3012177.5102	1325873.3694	NAD 1983 SPCS Indiana West (Feet)
A4SD002	3012169.8163	1325776.1642	NAD 1983 SPCS Indiana West (Feet)
A4SD003	3012166.0853	1325591.0114	NAD 1983 SPCS Indiana West (Feet)
A4SD004	3012165.6602	1325683.5462	NAD 1983 SPCS Indiana West (Feet)

Coordinates are from the center point of each sample grid.

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[ ] SURFACE SOIL [X] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Montes

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - Lake Oberlin**

SAMPLE No.	SAMPLE METHOD	DEPTH (Inches)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES								SOIL DESCRIPTION
										Navy Dye Cmpounds			Field Dup	MS / MSD	USCS	PID READING	
A4SD001C0006	PD	0-6	9/10	1115	L		C	1		X							Black fine sed w/ strong organic odor
A4SD002C0006	PD	0-6	9/10	1125	L		C	1		X							Black fine sed w/ strong organic odor
A4SD003C0006	PD	0-6	9/10	1130	L		C	1		X							Black fine sed w/ strong organic odor
A4SD004C0006	PD	0-6	9/10	1145	L		C	1		X							Black fine sed w/ strong organic odor

REMARKS: PD = ponar dredge

LABORATORY:

Navy Dye Compounds: NSA Crane

COC No(s).:

APPENDIX A.7

West Gate Small Arms Range Complex

- Soil Sample Log Sheets
- GPS Coordinates

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS001C0002	HA	0-2	11/17	930	L		C	1	X			X	X				Brown soil, some clay, slightly moist
A6SS002C0002	HA	0-2	11/17	1030	L		C	1	X								Brown soil, some clay, slightly moist
A6SS003C0002	HA	0-2	11/17	900	L		C	1	X								Brown soil, some clay, slightly moist
A6SS004C0002	HA	0-2	11/17	1700	L		C	1	X								Brown soil, some clay, slightly moist
A6SS005C0002	HA	0-2	11/17	1130	L		C	1	X								Brown soil, some clay, slightly moist
A6SS006C0002	HA	0-2	11/17	1050	L		C	1	X								Brown soil, dry
A6SS007C0002	HA	0-2	11/17	940	L		C	1	X								Brn/Org soil, some clay, moist
A6SS008C0002	HA	0-2	11/17	1000	L		C	1	X								Brn/Org soil, some clay, slightly moist
A6SS009C0002	HA	0-2	11/17	1100	L		C	1	X								Brn/Org soil, some clay, moist
A6SS010C0002	HA	0-2	11/17	1045	L		C	3	X					X			Org/Brn mostly clay, moist
A6SS011C0002	HA	0-2	11/17	1120	L		C	1	X								Org/Brn mostly clay, moist
A6SS012G0002	HA	0-2	11/15	1000	L	G		1	X								Org/Brn silty clay, moist
A6SS013G0002	HA	0-2	11/15	935	L	G		1	X								Org/Brn clay, damp
A6SS014G0002	HA	0-2	11/15	950	L	G		1	X								Brown loamy clay, damp

REMARKS:
HA = hand auger
FD = FD11170901 (A6SS001C0002)

LABORATORY:
Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS015G0002	HA	0-2	11/15	1010	L	G		1	X	X							Brown, loamy clay, damp
A6SS016G0002	HA	0-2	11/15	1030	L	G		1	X								Orange brown, sandy clay, damp
A6SS017G0002	HA	0-2	11/15	1030	L	G		1	X								Brown, loamy clay, damp
A6SS018G0002	HA	0-2	11/15	1130	L	G		1	X								Orange brown, clay, moist
A6SS019G0002	HA	0-2	11/15	1130	L	G		1	X								Brown, loamy clay, moist
A6SS020G0002	HA	0-2	11/15	0955	L	G		1	X		X						Orange brown, silty clay, moist
A6SS021G0002	HA	0-2	11/15	0935	L	G		3	X		X			X			Brown, loamy clay, moist
A6SS022G0002	HA	0-2	11/15	0945	L	G		1	X	X							Orange brown, clay, damp
A6SS023G0002	HA	0-2	11/15	1420	L	G		1	X								Brown, loamy clay, damp
A6SS024G0002	HA	0-2	11/15	1420	L	G		1	X								Orange brown, clay, moist
A6SS025G0002	HA	0-2	11/15	1430	L	G		1	X	X							Brown, loamy clay, damp
A6SS026G0002	HA	0-2	11/15	1435	L	G		1	X								Dark brown, loamy clay, damp
A6SS027G0002	HA	0-2	11/15	1440	L	G		1	X								Orange brown, silty clay, moist
A6SS028G0002	HA	0-2	11/15	0955	L	G		1	X								Brown, loamy clay, damp

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS029G0002	HA	0-2	11/15	0955	L	G		1	X								Orange brown, silty clay, damp
A6SS030G0002	HA	0-2	11/15	0930	L	G		1	X		X						Brown, loamy clay, damp
A6SS031G0002	HA	0-2	11/15	1535	L	G		1	X	X							Brown, loamy clay, damp
A6SS032G0002	HA	0-2	11/15	1445	L	G		3	X	X				X			Orange brown, clay, damp
A6SS033G0002	HA	0-2	11/15	1455	L	G		1	X								Orange brown, silty clay, moist
A6SS034G0002	HA	0-2	11/15	1635	L	G		1	X								Brown, loamy clay, damp
A6SS035G0002	HA	0-2	11/15	1018	L	G		1	X		X						Brown, soil, some clay, slightly moist
A6SS036G0002	HA	0-2	11/15	955	L	G		1	X		X						Brown/orange, clayey soil, wet
A6SS037G0002	HA	0-2	11/15	943	L	G		1	X	X	X						Brown, soil, dry
A6SS038G0002	HA	0-2	11/17	915	L	G		1	X								Brown, clayey soil, moist
A6SS039G0002	HA	0-2	11/17	935	L	G		1	X	X							Brown, clayey soil, moist
A6SS040G0002	HA	0-2	11/15	1405	L	G		1	X								Brown, clayey soil, moist
A6SS041G0002	HA	0-2	11/15	1350	L	G		1	X								Light brown, clayey soil, moist
A6SS042G0002	HA	0-2	11/15	1340	L	G		1	X								Brown, clayey soil, moist

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS043G0002	HA	0-2	11/17	855	L	G		1	X								Brown, clayey soil, moist
A6SS044G0002	HA	0-2	11/17	950	L	G		1	X								Brown, clayey soil, moist
A6SS045G0002	HA	0-2	11/17	1335	L	G		1	X	X							Light brown, clayey soil, moist
A6SS046G0002	HA	0-2	11/17	1345	L	G		3	X								Light brown, clayey soil, moist
A6SS047G0002	HA	0-2	11/17	1405	L	G		1	X								Brown, clayey soil, moist
A6SS048G0002	HA	0-2	11/17	1100	L	G		1	X		X						Brown/orange, clayey soil, moist
A6SS049G0002	HA	0-2	11/17	1040	L	G		1	X		X						Brown/orange, soil, some clay, moist
A6SS050G0002	HA	0-2	11/17	1020	L	G		1	X		X						Brown/orange, soil, some clay, moist
A6SS051G0002	HA	0-2	11/17	1000	L	G		1	X								Brown/orange, soil, some clay, moist
A6SS052G0002	HA	0-2	11/17	1005	L	G		1	X								Brown/orange, soil, some clay, moist
A6SS053G0002	HA	0-2	11/17	1450	L	G		1	X	X							Brown, soil, dry
A6SS054G0002	HA	0-2	11/17	1435	L	G		1	X								Org/brn, soil, some clay, slightly moist
A6SS055G0002	HA	0-2	11/17	1425	L	G		1	X								Brown, soil, dry
A6SS056G0002	HA	0-2	11/17	1010	L	G		1	X		X						Org/brn, soil, some clay, slightly moist

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS057G0002	HA	0-2	11/17	855	L	G		1	X	X							Brown/orange, soil, some clay, moist
A6SS058G0002	HA	0-2	11/17	950	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS059G0002	HA	0-2	11/17	1335	L	G		1	X								Brown, clayey soil, wet
A6SS060G0002	HA	0-2	11/17	1345	L	G		1	X								Brown, soil, slightly moist
A6SS061G0002	HA	0-2	11/17	1405	L	G		1	X		X		X				Brown, clayey soil, wet
A6SS062G0002	HA	0-2	11/17	1100	L	G		1	X		X						Orange/brown, clayey soil, wet
A6SS063G0002	HA	0-2	11/17	1040	L	G		1	X	X	X						Brown, soil, some clay, moist
A6SS064G0002	HA	0-2	11/17	1020	L	G		1	X								Brown, soil, some clay, moist
A6SS065	NOT COLLECTED																
A6SS066G0002	HA	0-2	11/15	1005	L	G		1	X								Brown, clayey soil, moist
A6SS067G0002	HA	0-2	11/15	1450	L	G		1	X	X							Brown, clayey soil, moist
A6SS068G0002	HA	0-2	11/16	1435	L	G		1	X								Brown, soil, some clay, moist
A6SS069G0002	HA	0-2	11/17	1425	L	G		1	X		X						Brown/orange, clayey soil, wet
A6SS070G0002	HA	0-2	11/17	1010	L	G		1	X		X						Brown, soil, dry

REMARKS:
HA = hand auger
FD = FD11150901 (A6SS061G0002)

LABORATORY:
Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS071G0002	HA	0-2	11/17	1610	L	G		1	X		X						Brown/orange, soil, some clay, dry
A6SS072G0002	HA	0-2	11/17	1030	L	G		1	X	X	X						Orange/brown, clayey soil, moist
A6SS073G0002	HA	0-2	11/15	1530	L	G		1	X								Brown, soil, some clay, moist
A6SS074G0002	HA	0-2	11/16	1555	L	G		1	X								Brown, soil/clay, slightly moist
A6SS075G0002	HA	0-2	11/17	1115	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS076G0002	HA	0-2	11/16	1640	L	G		1	X								Brown, clayey soil, moist
A6SS077G0002	HA	0-2	11/16	1635	L	G		1	X		X						Brown, soil, dry
A6SS078G0002	HA	0-2	11/16	1640	L	G		1	X	X							Brown, soil, slightly moist
A6SS079G0002	HA	0-2	11/16	1435	L	G		1	X	X							Brown, soil, some clay, slightly moist
A6SS080G0002	HA	0-2	11/16	1620	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS081G0002	HA	0-2	11/17	1620	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS082G0002	HA	0-2	11/17	1620	L	G		1	X								Brown, soil, dry
A6SS083G0002	HA	0-2	11/17	1100	L	G		1	X		X						Brown, soil, some clay, slightly moist
A6SS084G0002	HA	0-2	11/17	1045	L	G		1	X		X						Brown, soil, some clay, slightly moist

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS085G0002	HA	0-2	11/17	1700	L	G		1	X	X							Brown, soil, dry
A6SS086G0002	HA	0-2	11/17	1700	L	G		1	X								Brown, soil, dry
A6SS087G0002	HA	0-2	11/17	1450	L	G		1	X								Brown, soil, dry
A6SS088G0002	HA	0-2	11/17	1710	L	G		1	X								Brown, clayey soil, slightly moist
A6SS089G0002	HA	0-2	11/17	1715	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS090G0002	HA	0-2	11/17	1700	L	G		1	X								Brown, clayey soil, wet
A6SS091G0002	HA	0-2	11/17	1425	L	G		1	X								Brown/orange, clayey soil, wet
A6SS092G0002	HA	0-2	11/17	1435	L	G		1	X								Orange/brown, clayey soil, wet
A6SS093G0002	HA	0-2	11/17	1450	L	G		1	X	X							Orange/brown, clayey soil, wet
A6SS094G0002	HA	0-2	11/17	1500	L	G		1	X	X							Orange/brown, clayey soil, wet
A6SS095G0002	HA	0-2	11/17	1510	L	G		1	X								Orange/brown, clayey soil, moist
A6SS096G0002	HA	0-2	11/17	1530	L	G		1	X								Orange/brown, clayey soil, moist
A6SS097G0002	HA	0-2	11/17	1540	L	G		1	X	X			X				Orange/brown, clayey soil, moist
A6SS098G0002	HA	0-2	11/17	1435	L	G		1	X								Brown/orange, clayey soil, moist

REMARKS:
HA = hand auger
FD = FD11140901 (A6SS0970002)

LABORATORY:
Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS099G0002	HA	0-2	11/17	1425	L	G		1	X								Orange/brown, clayey soil, wet
A6SS100G0002	HA	0-2	11/17	1450	L	G		1	X	X							Orange/brown, clayey soil, wet
A6SS101G0002	HA	0-2	11/17	1455	L	G		1	X								Orange, clayey soil, slightly moist
A6SS102G0002	HA	0-2	11/17	1510	L	G		1	X								Orange/brown, clayey soil, moist
A6SS103G0002	HA	0-2	11/17	1520	L	G		1	X	X							Orange/brown, clayey soil, moist
A6SS104G0002	HA	0-2	11/17	1530	L	G		1	X								Orange/brown, clayey soil, moist
A6SS105G0002	HA	0-2	11/17	1550	L	G		1	X								Orange, clay, wet
A6SS106G0002	HA	0-2	11/17	1605	L	G		1	X								Orange, clay, wet
A6SS107G0002	HA	0-2	11/17	1420	L	G		1	X	X							Brown, soil, dry
A6SS108G0002	HA	0-2	11/17	1430	L	G		1	X	X							Brown/orange, soil, some clay, moist
A6SS109G0002	HA	0-2	11/17	1440	L	G		1	X								Orange/brown, clayey soil, moist
A6SS110G0002	HA	0-2	11/17	1445	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS111G0002	HA	0-2	11/17	1455	L	G		1	X	X							Orange/brown, clayey soil, moist
A6SS112G0002	HA	0-2	11/15	1500	L	G		1	X								Brown/orange, clayey soil, moist

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS113G0002	HA	0-2	11/15	1545	L	G		1	X								Brown, soil, slightly moist
A6SS114G0002	HA	0-2	11/17	1510	L	G		1	X	X							Brown, soil, dry
A6SS115G0002	HA	0-2	11/17	1535	L	G		1	X								Orange, clay, wet
A6SS116G0002	HA	0-2	11/17	1520	L	G		1	X	X							Brown, soil, some clay, slightly moist
A6SS117G0002	HA	0-2	11/15	1040	L	G		1	X								Brown, soil, dry
A6SS118G0002	HA	0-2	11/15	1050	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS119G0002	HA	0-2	11/15	1100	L	G		1	X	X							Brown, soil, some clay, slightly moist
A6SS120G0002	HA	0-2	11/15	1110	L	G		1	X								Brown, soil, dry
A6SS121G0002	HA	0-2	11/15	1120	L	G		1	X								Brown, soil, some clay, slightly moist
A6SS122G0002	HA	0-2	11/15	1130	L	G		1	X								Brown, soil, dry
A6SS123G0002	HA	0-2	11/15	1140	L	G		1	X	X							Brown, soil, some clay, moist
A6SS124G0002	HA	0-2	11/15	1145	L	G		1	X								Brown, soil, dry
A6SS125G0002	HA	0-2	11/15	1150	L	G		1	X								Brown, soil, dry
A6SS126G0002	HA	0-2	11/15	1135	L	G		1	X								Brown, soil, dry

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS127G0002	HA	0-2	11/18	1620	L	G		1	X								Brown/orange, clayey soil, wet
A6SS128G0002	HA	0-2	11/18	1620	L	G		1	X								Brown/orange, clayey soil, wet
A6SS129G0002	HA	0-2	11/18	1625	L	G		1	X	X							Brown/orange, clayey soil, wet
A6SS130G0002	HA	0-2	11/18	1625	L	G		1	X								Brown/orange, clayey soil, wet
A6SS131G0002	HA	0-2	11/18	1630	L	G		1	X								Brown/orange, clayey soil, wet
A6SS132G0002	HA	0-2	11/18	1630	L	G		1	X	X							Brown/orange, clayey soil, wet
A6SS133G0002	HA	0-2	11/18	1635	L	G		1	X								Brown/orange, clayey soil, wet
A6SS134G0002	HA	0-2	11/18	1635	L	G		1	X								Brown/orange, clayey soil, wet
A6SS135G0002	HA	0-2	11/18	1640	L	G		1	X								Brown/orange, clayey soil, wet
A6SS136G0002	HA	0-2	11/18	1640	L	G		1	X								Brown/orange, clayey soil, wet
A6SS137G0002	HA	0-2	11/15	1535	L	G		1	X								Brown, loamy clay, damp
A6SS138G0002	HA	0-2	11/15	1545	L	G		3	X	X				X			Brown, loamy clay, damp
A6SS139G0002	HA	0-2	11/15	1545	L	G		1	X								Brown, loamy clay, damp
A6SS140G0002	HA	0-2	11/15	1535	L	G		1	X								Orange/brown, clay, damp

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS141G0002	HA	0-2	11/15	1530	L	G		1	X								Orange/brown, clay, damp
A6SS142G0002	HA	0-2	11/15	1520	L	G		1	X								Brown, loamy clay, damp
A6SS143G0002	HA	0-2	11/15	1525	L	G		1	X								Brown, loamy clay, damp
A6SS144G0002	HA	0-2	11/15	1530	L	G		1	X	X							Orange/brown, clay, damp
A6SS145G0002	HA	0-2	11/15	1530	L	G		1	X								Brown, clay, damp
A6SS146G0002	HA	0-2	11/15	1520	L	G		1	X								Brown, loamy clay, damp
A6SS147G0002	HA	0-2	11/15	1045	L	G		1	X								Light brown, clay, damp
A6SS148G0001	HA	0-1	11/15	1050	L	G		1	X	X							Brown, loamy clay, damp
A6SS149G0002	HA	0-2	11/15	1050	L	G		1	X								Orange/brown, silty clay, moist
A6SS150G0002	HA	0-2	11/15	1100	L	G		1	X	X							Light brown, sandy clay, damp
A6SS151G0002	HA	0-2	11/15	1055	L	G		1	X								Orange/brown, silty clay, moist
A6SS152G0002	HA	0-2	11/15	1100	L	G		3	X								Orange/brown, silty clay, moist
A6SS153G0002	HA	0-2	11/15	1105	L	G		1	X								Brown, clay, damp
A6SS154G0002	HA	0-2	11/15		L	G		1	X								

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _ Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS155G0002	HA	0-2	11/17	1130	L	G		1	X								Brn/org, soil, some clay, slightly moist
A6SS156G0002	HA	0-2	11/17	1142	L	G		1	X	X			X				Brn/org, soil, some clay, slightly moist
A6SS157G0002	HA	0-2	11/17	1150	L	G		1	X								Brn/org, soil, some clay, slightly moist
A6SS158G0002	HA	0-2	11/17	1200	L	G		1	X								Brn/org, soil, some clay, slightly moist
A6SS159G0002	HA	0-2	11/17	1215	L	G		1	X								Brn/org, soil, some clay, slightly moist
A6SS160G0002	HA	0-2	11/17	1230	L	G		1	X	X							Brn/org, soil, some clay, slightly moist
A6SS161G0002	HA	0-2	11/17	1120	L	G		1	X								Brown, soil, dry
A6SS162G0002	HA	0-2	11/17	1125	L	G		1	X								Brown/orange, clayey soil, moist
A6SS163G0002	HA	0-2	11/17	1135	L	G		1	X	X							Brown/orange, clayey soil, moist
A6SS164G0002	HA	0-2	11/17	1140	L	G		1	X								Brown/orange, clayey soil, moist
A6SS165G0002	HA	0-2	11/17	1145	L	G		1	X								Brown/orange, clayey soil, moist
A6SS166G0002	HA	0-2	11/17	1150	L	G		1	X	X							Brown/orange, clayey soil, moist
A6SS167G0002	HA	0-2	11/17	1205	L	G		1	X								Brown/orange, clayey soil, moist
A6SS168G0002	HA	0-2	11/17	1515	L	G		1	X	X							Brown/orange, clayey soil, moist

REMARKS:
HA = hand auger
FD = FD11120901 (A6SS156G0002)

LABORATORY:
Empirical Laboratories

COC No(s).:

MULTIPLE SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

[X] SURFACE SOIL [ ] SEDIMENT
[ ] SUBSURFACE SOIL [ ] LAGOON / POND
[ ] OTHER _____

SIGNATURE(S): _____

SAMPLER (S): _Goerdt/Floyd/Rumer/Foster

PROJECT NAME: **NSA Crane MRP Sites**
PROTECT NUMBER: **112G01621 CTO: F272**
YEAR **2009**

LOCATION: **NSA Crane - West Gate Small Arms Range Complex**

SAMPLE No.	SAMPLE METHOD	DEPTH (Ft.)	DATE	TIME	CONCENTRATION (L)LOW (H)HIGH	(G) GRAB	(C) COMPOSITE	TOTAL NUMBER OF CONTAINERS	ANALYSES: Lead - XRF	Select Metals SW-846 3050B/6010B/6020	PAH SW-846 8270	Nitroglycerin SW-846 8330A	Field Dup	MS / MSD	USCS	PID READING	SOIL DESCRIPTION
A6SS169G0002	HA	0-2	11/17	1500	L	G		1	X								Brown/orange, clayey soil, moist
A6SS170G0002	HA	0-2	11/17	1555	L	G		1	X	X							Brown/orange, clayey soil, moist
A6SS171G0002	HA	0-2	11/17	1600	L	G		1	X								Brown/orange, clayey soil, moist

REMARKS: HA = hand auger

LABORATORY: Empirical Laboratories

COC No(s).:

WEST GATE SMALL ARMS RANGE COMPLEX
SAMPLE COORDINATES

Sample Location	Easting	Northing	Coordinate System
A6SB001	3004075.037	1326474.402	NAD 1983 SPCS Indiana West (Feet)
A6SB002	3004676.53	1326136.656	NAD 1983 SPCS Indiana West (Feet)
A6SB003	3004903.561	1325981.886	NAD 1983 SPCS Indiana West (Feet)
A6SB004	3005171.917	1325838.998	NAD 1983 SPCS Indiana West (Feet)
A6SB005	3004421.344	1326407.64	NAD 1983 SPCS Indiana West (Feet)
A6SB006	3004540.172	1326421.005	NAD 1983 SPCS Indiana West (Feet)
A6SB007	3004449.226	1326208.693	NAD 1983 SPCS Indiana West (Feet)
A6SB008	3004425.014	1326189.489	NAD 1983 SPCS Indiana West (Feet)
A6SB009	3004369.879	1326142.245	NAD 1983 SPCS Indiana West (Feet)
A6SB010	3004344.952	1326123.63	NAD 1983 SPCS Indiana West (Feet)
A6SB011	3004325.87	1326109.208	NAD 1983 SPCS Indiana West (Feet)
A6SB012	3004669	1326378	NAD 1983 SPCS Indiana West (Feet)
A6SB013	3004738	1326349	NAD 1983 SPCS Indiana West (Feet)
A6SB014	3004807	1326321	NAD 1983 SPCS Indiana West (Feet)
A6SB015	3004877	1326292	NAD 1983 SPCS Indiana West (Feet)
A6SB016	3004946	1326263	NAD 1983 SPCS Indiana West (Feet)
A6SB017	3005015	1326235	NAD 1983 SPCS Indiana West (Feet)
A6SB018	3005085	1326206	NAD 1983 SPCS Indiana West (Feet)
A6SB019	3005154	1326178	NAD 1983 SPCS Indiana West (Feet)
A6SB020	3004645	1326354	NAD 1983 SPCS Indiana West (Feet)
A6SB021	3004703	1326306	NAD 1983 SPCS Indiana West (Feet)
A6SB022	3004760	1326257	NAD 1983 SPCS Indiana West (Feet)
A6SB023	3004817	1326209	NAD 1983 SPCS Indiana West (Feet)
A6SB024	3004875	1326161	NAD 1983 SPCS Indiana West (Feet)
A6SB025	3004932	1326113	NAD 1983 SPCS Indiana West (Feet)
A6SB026	3004985.72	1326053.4	NAD 1983 SPCS Indiana West (Feet)
A6SB027	3005051.36	1326018.79	NAD 1983 SPCS Indiana West (Feet)
A6SB028	3004616	1326336	NAD 1983 SPCS Indiana West (Feet)
A6SB029	3004656	1326272	NAD 1983 SPCS Indiana West (Feet)
A6SB030	3004697	1326209	NAD 1983 SPCS Indiana West (Feet)
A6SB031	3004737	1326146	NAD 1983 SPCS Indiana West (Feet)
A6SB032	3004777	1326083	NAD 1983 SPCS Indiana West (Feet)
A6SB033	3004818	1326019	NAD 1983 SPCS Indiana West (Feet)
A6SB034	3004894.03	1325899.91	NAD 1983 SPCS Indiana West (Feet)
A6SB035	3004588	1326326	NAD 1983 SPCS Indiana West (Feet)
A6SB036	3004613	1326255	NAD 1983 SPCS Indiana West (Feet)
A6SB037	3004638	1326184	NAD 1983 SPCS Indiana West (Feet)
A6SB038	3004673.66	1326079.89	NAD 1983 SPCS Indiana West (Feet)
A6SB039	3004699.04	1326032.8	NAD 1983 SPCS Indiana West (Feet)
A6SB040	3004714.67	1325972.73	NAD 1983 SPCS Indiana West (Feet)
A6SB041	3004749.87	1325898.56	NAD 1983 SPCS Indiana West (Feet)
A6SB042	3004764.62	1325823.35	NAD 1983 SPCS Indiana West (Feet)
A6SB043	3004586.63	1326103.89	NAD 1983 SPCS Indiana West (Feet)
A6SB044	3004609.74	1326006.9	NAD 1983 SPCS Indiana West (Feet)
A6SB045	3004616.08	1325971.02	NAD 1983 SPCS Indiana West (Feet)
A6SB046	3004628.01	1325888.55	NAD 1983 SPCS Indiana West (Feet)

A6SB047	3004631.1	1325784.79	NAD 1983 SPCS Indiana West (Feet)
A6SB048	3004542.27	1326325.22	NAD 1983 SPCS Indiana West (Feet)
A6SB049	3004536.19	1326237.53	NAD 1983 SPCS Indiana West (Feet)
A6SB050	3004536.01	1326177.53	NAD 1983 SPCS Indiana West (Feet)
A6SB051	3004531.97	1326089.88	NAD 1983 SPCS Indiana West (Feet)
A6SB052	3004544.08	1326034.48	NAD 1983 SPCS Indiana West (Feet)
A6SB053	3004532.72	1325973.88	NAD 1983 SPCS Indiana West (Feet)
A6SB054	3004533.42	1325873.07	NAD 1983 SPCS Indiana West (Feet)
A6SB055	3004537.44	1325799.68	NAD 1983 SPCS Indiana West (Feet)
A6SB056	3004472.25	1326102.23	NAD 1983 SPCS Indiana West (Feet)
A6SB057	3004471.85	1326035.48	NAD 1983 SPCS Indiana West (Feet)
A6SB058	3004456.85	1325949.91	NAD 1983 SPCS Indiana West (Feet)
A6SB059	3004436.92	1325878.26	NAD 1983 SPCS Indiana West (Feet)
A6SB060	3004424.33	1325800.34	NAD 1983 SPCS Indiana West (Feet)
A6SB061	3004489	1326326	NAD 1983 SPCS Indiana West (Feet)
A6SB062	3004457.53	1326257.54	NAD 1983 SPCS Indiana West (Feet)
A6SB063	3004435.9	1326189.34	NAD 1983 SPCS Indiana West (Feet)
A6SB064	3004412	1326115	NAD 1983 SPCS Indiana West (Feet)
A6SB066	3004365.6	1325966.65	NAD 1983 SPCS Indiana West (Feet)
A6SB067	3004325.01	1325904.47	NAD 1983 SPCS Indiana West (Feet)
A6SB068	3004315.83	1325807.77	NAD 1983 SPCS Indiana West (Feet)
A6SB069	3004456.11	1326338.72	NAD 1983 SPCS Indiana West (Feet)
A6SB070	3004409.72	1326281.96	NAD 1983 SPCS Indiana West (Feet)
A6SB071	3004377.88	1326206.19	NAD 1983 SPCS Indiana West (Feet)
A6SB072	3004327.47	1326150.14	NAD 1983 SPCS Indiana West (Feet)
A6SB073	3004209.57	1325956.69	NAD 1983 SPCS Indiana West (Feet)
A6SB074	3004160.68	1325891.6	NAD 1983 SPCS Indiana West (Feet)
A6SB075	3004424.72	1326367.65	NAD 1983 SPCS Indiana West (Feet)
A6SB076	3004376.74	1326305.33	NAD 1983 SPCS Indiana West (Feet)
A6SB077	3004311.03	1326262.72	NAD 1983 SPCS Indiana West (Feet)
A6SB078	3004259.57	1326240.84	NAD 1983 SPCS Indiana West (Feet)
A6SB079	3004206.05	1326171.5	NAD 1983 SPCS Indiana West (Feet)
A6SB080	3004140.24	1326123.59	NAD 1983 SPCS Indiana West (Feet)
A6SB081	3004088.21	1326068.62	NAD 1983 SPCS Indiana West (Feet)
A6SB082	3004023.71	1325999.68	NAD 1983 SPCS Indiana West (Feet)
A6SB083	3004401.9	1326382.11	NAD 1983 SPCS Indiana West (Feet)
A6SB084	3004342.93	1326354.41	NAD 1983 SPCS Indiana West (Feet)
A6SB085	3004279.32	1326317.7	NAD 1983 SPCS Indiana West (Feet)
A6SB086	3004216.02	1326291.65	NAD 1983 SPCS Indiana West (Feet)
A6SB087	3004126.79	1326257.43	NAD 1983 SPCS Indiana West (Feet)
A6SB088	3004056.71	1326236.95	NAD 1983 SPCS Indiana West (Feet)
A6SB089	3003996.69	1326222.49	NAD 1983 SPCS Indiana West (Feet)
A6SB090	3003917.12	1326160.83	NAD 1983 SPCS Indiana West (Feet)
A6SB091	3004284.25	1326149.28	NAD 1983 SPCS Indiana West (Feet)
A6SB092	3004307.74	1326098.86	NAD 1983 SPCS Indiana West (Feet)
A6SB093	3004325.31	1326098.72	NAD 1983 SPCS Indiana West (Feet)
A6SB094	3004350.64	1326072.93	NAD 1983 SPCS Indiana West (Feet)

A6SB095	3004371.67	1326059.3	NAD 1983 SPCS Indiana West (Feet)
A6SB096	3004401.01	1326052.45	NAD 1983 SPCS Indiana West (Feet)
A6SB097	3004425.73	1326054.17	NAD 1983 SPCS Indiana West (Feet)
A6SB098	3004249.32	1326139.67	NAD 1983 SPCS Indiana West (Feet)
A6SB099	3004266.13	1326122.08	NAD 1983 SPCS Indiana West (Feet)
A6SB100	3004293.05	1326094.65	NAD 1983 SPCS Indiana West (Feet)
A6SB101	3004320.03	1326078.28	NAD 1983 SPCS Indiana West (Feet)
A6SB102	3004335.96	1326067.43	NAD 1983 SPCS Indiana West (Feet)
A6SB103	3004360.98	1326052.37	NAD 1983 SPCS Indiana West (Feet)
A6SB104	3004392.56	1326059.56	NAD 1983 SPCS Indiana West (Feet)
A6SB105	3004415.66	1326038.08	NAD 1983 SPCS Indiana West (Feet)
A6SB106	3004430.07	1326034.1	NAD 1983 SPCS Indiana West (Feet)
A6SB107	3004226.9	1326126.46	NAD 1983 SPCS Indiana West (Feet)
A6SB108	3004254.23	1326109.38	NAD 1983 SPCS Indiana West (Feet)
A6SB109	3004280.94	1326093.4	NAD 1983 SPCS Indiana West (Feet)
A6SB110	3004305.37	1326073.07	NAD 1983 SPCS Indiana West (Feet)
A6SB111	3004342.66	1326049.67	NAD 1983 SPCS Indiana West (Feet)
A6SB112	3004362.38	1326040.78	NAD 1983 SPCS Indiana West (Feet)
A6SB113	3004380.85	1326030.33	NAD 1983 SPCS Indiana West (Feet)
A6SB114	3004400.83	1326028.5	NAD 1983 SPCS Indiana West (Feet)
A6SB115	3004432.63	1326024.68	NAD 1983 SPCS Indiana West (Feet)
A6SB116	3004457.21	1326031.23	NAD 1983 SPCS Indiana West (Feet)
A6SB117	3004643.13	1326202.25	NAD 1983 SPCS Indiana West (Feet)
A6SB118	3004640.16	1326196.48	NAD 1983 SPCS Indiana West (Feet)
A6SB119	3004634.52	1326194.38	NAD 1983 SPCS Indiana West (Feet)
A6SB120	3004636.49	1326183.63	NAD 1983 SPCS Indiana West (Feet)
A6SB121	3004612.29	1326186.68	NAD 1983 SPCS Indiana West (Feet)
A6SB122	3004621.89	1326174.09	NAD 1983 SPCS Indiana West (Feet)
A6SB123	3004611.39	1326171.86	NAD 1983 SPCS Indiana West (Feet)
A6SB124	3004619.03	1326166.75	NAD 1983 SPCS Indiana West (Feet)
A6SB125	3004606.14	1326162.72	NAD 1983 SPCS Indiana West (Feet)
A6SB126	3004603.54	1326161.81	NAD 1983 SPCS Indiana West (Feet)
A6SB127	3004910.93	1326041.7	NAD 1983 SPCS Indiana West (Feet)
A6SB128	3004917.14	1326031.99	NAD 1983 SPCS Indiana West (Feet)
A6SB129	3004906.82	1326029.51	NAD 1983 SPCS Indiana West (Feet)
A6SB130	3004911.83	1326026.5	NAD 1983 SPCS Indiana West (Feet)
A6SB131	3004901.46	1326023.97	NAD 1983 SPCS Indiana West (Feet)
A6SB132	3004905.89	1326023.49	NAD 1983 SPCS Indiana West (Feet)
A6SB133	3004890.74	1326013.99	NAD 1983 SPCS Indiana West (Feet)
A6SB134	3004899.66	1326014.54	NAD 1983 SPCS Indiana West (Feet)
A6SB135	3004883.72	1326009.6	NAD 1983 SPCS Indiana West (Feet)
A6SB136	3004887.69	1326007.5	NAD 1983 SPCS Indiana West (Feet)
A6SB137	3005121.02	1325842.9	NAD 1983 SPCS Indiana West (Feet)
A6SB138	3005125.35	1325853.48	NAD 1983 SPCS Indiana West (Feet)
A6SB139	3005131.52	1325864.31	NAD 1983 SPCS Indiana West (Feet)
A6SB140	3005137.43	1325868.43	NAD 1983 SPCS Indiana West (Feet)
A6SB141	3005144.5	1325878.3	NAD 1983 SPCS Indiana West (Feet)

A6SB142	3005127.16	1325845.6	NAD 1983 SPCS Indiana West (Feet)
A6SB143	3005133.69	1325853.53	NAD 1983 SPCS Indiana West (Feet)
A6SB144	3005138.72	1325861.8	NAD 1983 SPCS Indiana West (Feet)
A6SB145	3005147.46	1325864.11	NAD 1983 SPCS Indiana West (Feet)
A6SB146	3005148.49	1325875.47	NAD 1983 SPCS Indiana West (Feet)
A6SB147	3005409.44	1325667.42	NAD 1983 SPCS Indiana West (Feet)
A6SB148	3005423.75	1325682.37	NAD 1983 SPCS Indiana West (Feet)
A6SB149	3005433.94	1325682.03	NAD 1983 SPCS Indiana West (Feet)
A6SB150	3005432.22	1325705.59	NAD 1983 SPCS Indiana West (Feet)
A6SB151	3005445.98	1325687.76	NAD 1983 SPCS Indiana West (Feet)
A6SB152	3005459.38	1325710.16	NAD 1983 SPCS Indiana West (Feet)
A6SB153	3005450.61	1325724.22	NAD 1983 SPCS Indiana West (Feet)
A6SB154	3005452.56	1325615.62	NAD 1983 SPCS Indiana West (Feet)
A6SB155	3005464.53	1325642.21	NAD 1983 SPCS Indiana West (Feet)
A6SB156	3005470.31	1325655.76	NAD 1983 SPCS Indiana West (Feet)
A6SB157	3005475.53	1325670.46	NAD 1983 SPCS Indiana West (Feet)
A6SB158	3005480.3	1325688.66	NAD 1983 SPCS Indiana West (Feet)
A6SB159	3005491.82	1325703.98	NAD 1983 SPCS Indiana West (Feet)
A6SB160	3005492.6	1325721.81	NAD 1983 SPCS Indiana West (Feet)
A6SB161	3005441.86	1325627.72	NAD 1983 SPCS Indiana West (Feet)
A6SB162	3005451.48	1325649.72	NAD 1983 SPCS Indiana West (Feet)
A6SB163	3005456.26	1325665.64	NAD 1983 SPCS Indiana West (Feet)
A6SB164	3005464.96	1325675.01	NAD 1983 SPCS Indiana West (Feet)
A6SB165	3005472.53	1325690.42	NAD 1983 SPCS Indiana West (Feet)
A6SB166	3005478.73	1325707.09	NAD 1983 SPCS Indiana West (Feet)
A6SB167	3005481.19	1325718.16	NAD 1983 SPCS Indiana West (Feet)
A6SB168	3004478.49	1326023.83	NAD 1983 SPCS Indiana West (Feet)
A6SB169	3004467.51	1326032.68	NAD 1983 SPCS Indiana West (Feet)
A6SB170	3004450.68	1326031.51	NAD 1983 SPCS Indiana West (Feet)
A6SB171	3004460.31	1326046.61	NAD 1983 SPCS Indiana West (Feet)

APPENDIX B

SITE PHOTOGRAPHS

APPENDIX B.1

B-143 Drop Test Area

Naval Support Activity Crane - B-143 Drop Test Area (AOC 01)

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** Overall view of sample area looking southwest.	**B.1.1**

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** View from within the sample area looking northeast. Bank on left leads up to gravel roadway near buildings.	**B.1.2**

Naval Support Activity Crane - B-143 Drop Test Area (AOC 01)

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** View from within the center of the sample area looking to the northeast.	**B.1.3**

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** Photo taken within the sample area "bowl" looking northwest through cleared pathway towards gravel roadway and buildings.	**B.1.4**

Naval Support Activity Crane - B-143 Drop Test Area (AOC 01)

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** Sample collection via hand auger.	**B.1.5**

SITE: B-143 Drop Test Area	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/12/09	**DESCRIPTION:** Photo of Schonstedt GA-52Cx magnetic locator instrument used to verify clear sample areas prior to sample collection.	**B.1.6**

APPENDIX B.2

Pyro Area Outside Test Burn Pads

Naval Support Activity Crane – Pyro Area Outside Test Burn Pads (AOC 02)

SITE: Pyro Area Outside Test Burn Pad	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/9/09	**DESCRIPTION:** Photo of northern concrete basin showing the amount of concrete debris located within the basin. Composite samples collected around the inside of the basin. Building 126 and sump in background.	**B.2.1**

SITE: Pyro Area Outside Test Burn Pad	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/9/09	**DESCRIPTION:** General view of southern concrete basin. Less debris inside this particular basin, but majority of the bottom is covered. View is to the south.	**B.2.2**

Naval Support Activity Crane – Pyro Area Outside Test Burn Pads (AOC 02)

SITE:	PHOTOGRAPHER:	DESCRIPTION:	
Pyro Area Outside Test Burn Pad	J. Goerdt **DATE:** 9/9/09	Debris in northern concrete basin. Samples collected in accessible areas such as shown in bottom center of photo.	**B.2.3**

SITE:	PHOTOGRAPHER:	DESCRIPTION:	
Pyro Area Outside Test Burn Pad	J. Goerdt **DATE:** 9/9/09	General view showing distance between the two concrete basins and their location to existing buildings. View is to the North.	**B.2.4**

Naval Support Activity Crane – Pyro Area Outside Test Burn Pads (AOC 02)

SITE: Pyro Area Outside Test Burn Pad	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/9/09	**DESCRIPTION:** Photo showing the bottom of the southern concrete basin. Bottom appeared to be completely intact concrete.	**B.2.5**

SITE: Pyro Area Outside Test Burn Pad	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/9/09	**DESCRIPTION:** Photo of hole that was dug along the outer wall of the southern basin to determine overall depth of basin. Shovel point is underneath the outer wall.	**B.2.6**

APPENDIX B.3

Test Pads on Hill Behind B-198

Naval Support Activity Crane – Test Pads on Hill behind B-198 (UXO 06)

SITE: Test Pads on Hill Behind B-198	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/11/09	**DESCRIPTION:** Overall view of the two circular test pads area looking northeast. Thick vegetation approximately 3 to 4 feet high.	**B.3.1**

SITE: Test Pads on Hill Behind B-198	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/11/09	**DESCRIPTION:** Collecting soil sample down slope of the above ground concrete holding tank. View is to the northwest.	**B.3.2**

Naval Support Activity Crane – Test Pads on Hill behind B-198 (UXO 06)

SITE: Test Pads on Hill Behind B-198	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/11/09	**DESCRIPTION:** Soil sample collection via hand auger on top of sand mound. View is to the north.	**B.3.3**

SITE: Test Pads on Hill Behind B-198	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/11/09	**DESCRIPTION:** View of aboveground concrete holding tank and associated white drainage piping. Sample collected within the tank and along either side of the piping. View is to the south.	**B.3.4**

Naval Support Activity Crane – Test Pads on Hill behind B-198 (UXO 06)

SITE:	PHOTOGRAPHER:	DESCRIPTION:	
Test Pads on Hill Behind B-198	J. Goerdt **DATE:** 9/11/09	Close up view of the concrete holding tank showing some vegetative debris inside the tank.	**B.3.5**

SITE:	PHOTOGRAPHER:	DESCRIPTION:	
Test Pads on Hill Behind B-198	J. Goerdt **DATE:** 9/11/09	View of drain pipe entering the aboveground holding tank. Pin flag denotes one of the sample locations.	**B.3.6**

APPENDIX B.4

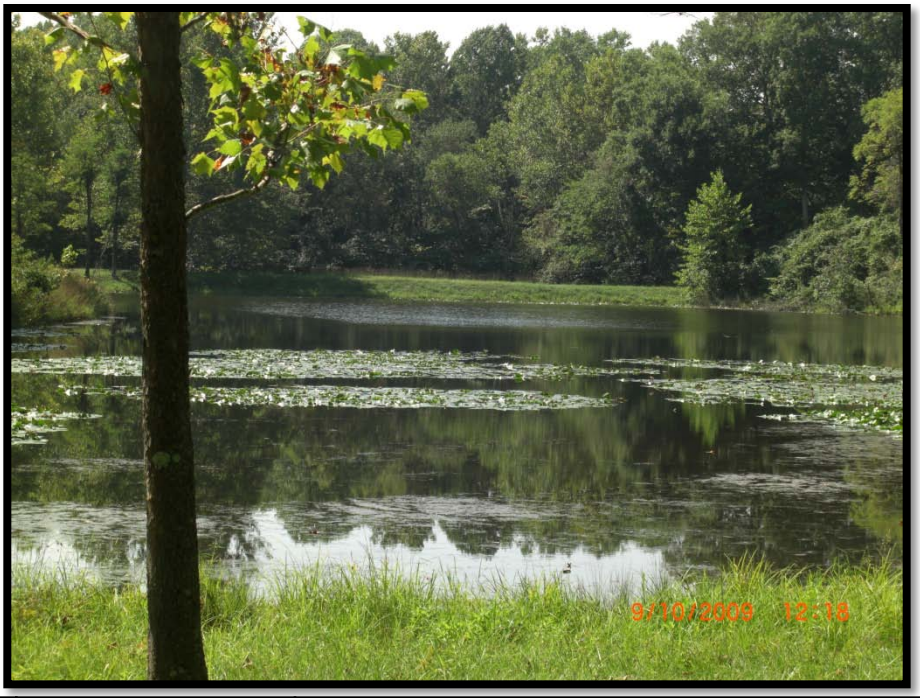
Lake Oberlin

Naval Support Activity Crane – Lake Oberlin (AOC 04)

SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	DESCRIPTION**:** View of sample boat from north end of the lake.	**B.4.1**

SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	**DESCRIPTION:** Spring-loaded ponar sampler setting on the boat interior. Used in the collection of sediment samples from the lake bottom.	**B.4.2**

Naval Support Activity Crane – Lake Oberlin (AOC 04)



SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	**DESCRIPTION:** Overall view of the lake taken from the northern bank and looking to the south towards the earth berm.	**B.4.3**

SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	**DESCRIPTION:** Overall view of the lake standing on earth dam and looking north.	**B.4.4**

Naval Support Activity Crane – Lake Oberlin (AOC 04)

SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	**DESCRIPTION:** Northwest corner of the lake from which the boat was launched.	**B.4.5**

SITE: Lake Oberlin	**PHOTOGRAPHER:** J. Goerdt **DATE:** 9/10/09	**DESCRIPTION:** Boat prep prior to launching for sediment sample collection.	**B.4.6**

APPENDIX B.5

West Gate Small Arms Range Complex

Naval Support Activity Crane – West Gate Small Arms Range Complex (AOC 06)

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/11/09	**DESCRIPTION:** View of the 200-yard firing/target berm. View to the northeast.	**B.5.1**

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/11/09	**DESCRIPTION:** Typical view of firing/target berm showing amount of briars prior to clearing.	**B.5.2**

Naval Support Activity Crane – West Gate Small Arms Range Complex (AOC 06)

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/12/09	**DESCRIPTION:** Target located at the base of hillside impact area for the 500-yard rifle range. View is to the east.	**B.5.3**

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/11/09	**DESCRIPTION:** Sample collection along earthen berm at pistol range. View is to the south.	**B.5.4**

Naval Support Activity Crane – West Gate Small Arms Range Complex (AOC 06)

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/14/09	**DESCRIPTION:** Target stations located at the base of the hillside at the pistol range. View is to the east.	**B.5.5**

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/11/09	**DESCRIPTION:** XRF analyzer located in the Tetra Tech field trailer . Analyzer used for the evaluation of lead in soil.	**B.5.6**

Naval Support Activity Crane – West Gate Small Arms Range Complex (AOC 06)

SITE: West Gate Small Arms Range Complex	**PHOTOGRAPHER:** J. Goerdt **DATE:** 11/17/09	**DESCRIPTION:** XRF analyzer with stand and protective hood within the Tetra Tech field trailer.	**B.5.7**

APPENDIX C

VALIDATED ANALYTICAL RESULTS (LAB EDD)\

(ON SEPARATE CD)

APPENDIX D

DATA USABILITY ASSESSMENTS

APPENDIX D.1

B-143 Drop Test Area

SUMMARY OF QUALITY CONTROL RESULTS

DATA QUALITY REVIEW OF SAMPLES AT B-143 DROP TEST AREA

This section contains a description of the data review processes used to determine whether analytical laboratory data collected during the sampling field effort for the B-143 Drop Test Area were of acceptable quality for use in decision-making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against the prescribed acceptance criteria. The DQIs are measures used to assess the completeness, sensitivity, accuracy, precision, comparability, and representativeness of the sample collection and sample analysis process. The output of this review was a set of alphabetic flags such as “U,” “J”, “R,” or combinations thereof, assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs presented in the Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern QAPP (August 2009) were maintained through the course of the sampling event. The Worksheets #19 and #15 of the QAPP present the analytical methods and compounds analyzed.

Data Validation Process

All of the results from analytical laboratory samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October 2004) guidelines.

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins

N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit
Q = Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

No data collected for site B-143 Drop Test Area were qualified or rejected. All data for site B-143 Drop Test Area are considered valid for their intended purpose.

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result**.**

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements intended. Samples collected and laboratory measurements make up the completeness calculations.

- Sample completeness is a measure of the usable samples collected versus those actually collected.

- Laboratory measurement completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) are those judged, after data assessment, to represent the sampling populations and not disqualified for use through data validation or additional data review. Completeness is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The sample collection and laboratory analytical completeness were 100%.

Sensitivity

The project quantitation limit goals (PQLGs) are listed in Worksheet #15 in the QAPP (August 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the QAPP.

The amount of sample volume collected also affects the ability of the laboratory to achieve the desired PQLGs. Laboratory or field blank contamination can also elevate a result above the PQLGs, resulting in samples being qualified as non-detected. All results for lead were positive so there are no instances where the non-detected sample results exceed the PQLGs either because of the laboratory's inability to meet the PQLG or because of elevated detection limits because of blank contamination.

Field and Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in both organic and inorganic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where %R = percent recovery
Ss = result of spiked sample
So = result of non-spiked sample
S = concentration of spiked amount.

There were no quality control deficiencies noted for field or laboratory accuracy.

Field and Laboratory Precision

Precision is a measure of the degree to which two or more measurements agree and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Relative Percent Difference (RPD) expresses precision for chemical parameters. RPDs, typically expressed as percentages, evaluate both field duplicate and laboratory duplicate precision. The following formula calculates RPDs:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference
V1, V2 = two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, sub-sampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

There were no quality control deficiencies noted for field or laboratory precision.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Using standardized sampling and analysis methods, as well as standardized data reporting formats assists in achieving comparability. Reporting of

results in consistent units ensured comparability with previous data. Evaluation of QC samples and adherence to the QAPP assists in the assessment of comparability.

No comparability issues were noted during the data validation process.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The QAPP (August 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

APPENDIX D.2

Pyro Area Outside Test Burn Pads

SUMMARY OF QUALITY CONTROL RESULTS

DATA QUALITY REVIEW OF SAMPLES AT PYRO AREA OUTSIDE THE TEST BURN PAD

This section contains a description of the data review processes used to determine whether analytical laboratory data collected during the sampling field effort for the Pyro Area outside the test burn pad were of acceptable quality for use in decision-making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against the prescribed acceptance criteria. The DQIs are measures used to assess the completeness, sensitivity, accuracy, precision, comparability, and representativeness of the sample collection and sample analysis process. The output of this review was a set of alphabetic flags such as “U,” “J”, “R,” or combinations thereof, assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs presented in the Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern QAPP (August 2009) were maintained through the course of the sampling event. The Worksheets #19 and #15 of the QAPP present the analytical methods and compounds analyzed.

Data Validation Process

All of the results from analytical laboratory samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October 2004) guidelines.

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A	=	Lab Blank Contamination
B	=	Field Blank Contamination
C	=	Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	=	GC/MS Tuning Noncompliance
D	=	MS/MSD Recovery Noncompliance
E	=	LCS/LCSD Recovery Noncompliance
F	=	Lab Duplicate Imprecision
G	=	Field Duplicate Imprecision
H	=	Holding Time Exceedance
I	=	ICP Serial Dilution Noncompliance
J	=	GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K	=	ICP Interference - includes ICS % R Noncompliance
L	=	Instrument Calibration Range Exceedance
M	=	Sample Preservation Noncompliance
N	=	Internal Standard Noncompliance
N01	=	Internal Standard Recovery Noncompliance Dioxins
N02	=	Recovery Standard Noncompliance Dioxins

N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit
Q = Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 5-1**.** Table 5-2 presents the rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections. The rejected data are not acceptable for performing risk assessments.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements intended. Samples collected and laboratory measurements make up the completeness calculations.

- Sample completeness is a measure of the usable samples collected versus those actually collected.

- Laboratory measurement completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) are those judged, after data assessment, to represent the sampling populations and not disqualified for use through data validation or additional data review. Completeness is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The explosives fraction had 8 out of 195 results rejected because of percent difference between columns greater than 100%. The results are likely false positives because the compounds cannot be confirmed using a second column. The laboratory measurement completeness was 95.9%, which meets the 90% completeness goal. The sample collection completeness was 100%.

Sensitivity

The project quantitation limit goals (PQLGs) are listed in Worksheet #15 in the QAPP (August 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the QAPP.

The amount of sample volume collected also affects the ability of the laboratory to achieve the desired PQLGs. Laboratory or field blank contamination can also elevate a result above the PQLGs, resulting in samples being qualified as non-detected. There are no instances where the non-detected sample results exceed the PQLGs either because of the laboratory's inability to meet the PQLG or because of elevated detection limits due to blank contamination.

Field and Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in both organic and inorganic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where	%R	=	percent recovery
	Ss	=	result of spiked sample
	So	=	result of non-spiked sample
	S	=	concentration of spiked amount.

There were several results qualified due to surrogate recovery in the explosive and dye analyses. However, the qualifications do not point to any trends showing a systematic problem with extraction efficiency. There were no quality control deficiencies noted for field accuracy.

Field and Laboratory Precision

Precision is a measure of the degree to which two or more measurements agree and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Relative Percent Difference (RPD) expresses precision for chemical parameters. RPDs, typically expressed as percentages, evaluate both field duplicate and laboratory duplicate precision. The following formula calculates RPDs:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where	RPD	=	relative percent difference
	V1, V2	=	two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, sub-sampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

There were no quality control deficiencies noted for field or laboratory precision.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Using standardized sampling and analysis methods, as well as standardized data reporting formats assists in achieving comparability. Reporting of results in consistent units ensured comparability with previous data. Evaluation of QC samples and adherence to the QAPP assists in the assessment of comparability.

No comparability issues were noted during the data validation process.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The QAPP (August 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

REJECTED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	REJECTION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS001C0001	4-NITROTOLUENE	0.062	UR	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SS001C0001-D	2-NITROTOLUENE	0.78	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SS002C0001	2,4,6-TRINITROTOLUENE	0.026	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SB003G0406	RDX	0.024	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SB004G0406	RDX	0.028	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SB006G0406	NITROBENZENE	0.029	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SB006G0406	RDX	0.033	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A2SB007G0406	RDX	0.029	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS001C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	2-NITROTOLUENE	0.067	J	R	MG/KG	SURROGATE NONCOMPLIANCE
A2SS001C0001	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001	SOLVENT GREEN 3	305027	J	CR	UG/KG	CALIBRATION AND SURROGATE NONCOMPLIANCE
A2SS001C0001	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	NITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS001C0001-D	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	SOLVENT GREEN 3	900915	J	CR	UG/KG	CALIBRATION AND SURROGATE NONCOMPLIANCE
A2SS001C0001-D	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS001C0001-D	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	2-AMINO-4,6-DINITROTOLUENE	0.071	J	R	MG/KG	SURROGATE NONCOMPLIANCE
A2SS002C0001	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS002C0001	NITROBENZENE	0.044	J	RPU	MG/KG	SURROGATE NONCOMPLIANCE, UNCERTAINITY NEAR THE DETECTION LIMIT, AND PERCENT DIFFERENCE BETWEEN COLUMNS EXCEEDANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS002C0001	NITROGLYCERIN	0.13	J	CRPU	MG/KG	CALIBRATION AND SURROGATE NONCOMPLIANCE, UNCERTAINITY NEAR THE DETECTION LIMIT, PERCENT DIFFERENCE BETWEEN COLUMNS EXCEEDANCE
A2SS002C0001	SOLVENT GREEN 3	402177	J	CR	UG/KG	CALIBRATION AND SURROGATE NONCOMPLIANCE
A2SS002C0001	SOLVENT YELLOW 3	40446	J	R	UG/KG	SURROGATE NONCOMPLIANCE
A2SS002C0001	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	PERCHLORATE	0.51	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SB003G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB003G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB004G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	PERCHLORATE	0.25	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SB004G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB004G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	HMX	0.059	J	RP	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE NONCOMPLIANCE
A2SB005G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB005G0406	PERCHLORATE	1.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SB005G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB005G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	PERCHLORATE	1.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SB006G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB006G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB007G0406	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB007G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	RDX	0.076	J	RU	MG/KG	SURROGATE NONCOMPLIANCEAND PERCENT DIFFERENCE BETWEEN COLUMNS EXCEEDANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB008G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB008G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	NITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	PERCHLORATE	1.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SB009G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB009G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB010G0406	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	HMX	0.038	J	RP	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE NONCOMPLIANCE
A2SB010G0406	NITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SB010G0406	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS011G0002	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	NITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	PERCHLORATE	1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SS011G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS011G0002	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	2,4-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	4-AMINO-2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
PYRO AREA OUSIDE TEST BURN PADS
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SS012G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	NITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	PERCHLORATE	0.98	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A2SS012G0002	SOLVENT GREEN 3	176035	J	CR	UG/KG	CALIBRATION AND SURROGATE NONCOMPLIANCE
A2SS012G0002	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A2SS012G0002	TETRYL	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

APPENDIX D.3

Test Pads on Hill Behind B-198

SUMMARY OF QUALITY CONTROL RESULTS

DATA QUALITY REVIEW OF SAMPLES AT TEST PADS ON THE HILL BEHIND B-198

This section contains a description of the data review processes used to determine whether analytical laboratory data collected during the sampling field effort for the Test Pads on the Hill Behind B-198 were of acceptable quality for use in decision-making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against the prescribed acceptance criteria. The DQIs are measures used to assess the completeness, sensitivity, accuracy, precision, comparability, and representativeness of the sample collection and sample analysis process. The output of this review was a set of alphabetic flags such as “U,” “J”, “R,” or combinations thereof, assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs presented in the Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern QAPP (August 2009) were maintained through the course of the sampling event. The Worksheets #19 and #15 of the QAPP present the analytical methods and compounds analyzed.

Data Validation Process

All of the results from analytical laboratory samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October 2004) guidelines.

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A	=	Lab Blank Contamination
B	=	Field Blank Contamination
C	=	Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	=	GC/MS Tuning Noncompliance
D	=	MS/MSD Recovery Noncompliance
E	=	LCS/LCSD Recovery Noncompliance
F	=	Lab Duplicate Imprecision
G	=	Field Duplicate Imprecision
H	=	Holding Time Exceedance
I	=	ICP Serial Dilution Noncompliance
J	=	GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K	=	ICP Interference - includes ICS % R Noncompliance
L	=	Instrument Calibration Range Exceedance
M	=	Sample Preservation Noncompliance
N	=	Internal Standard Noncompliance
N01	=	Internal Standard Recovery Noncompliance Dioxins
N02	=	Recovery Standard Noncompliance Dioxins

N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit
Q = Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 8-1**.** Table 8-2 presents the rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections. The rejected data are not acceptable for performing risk assessments.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements intended. Samples collected and laboratory measurements make up the completeness calculations.

- Sample completeness is a measure of the usable samples collected versus those actually collected.

- Laboratory measurement completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) are those judged, after data assessment, to represent the sampling populations and not disqualified for use through data validation or additional data review. Completeness is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The explosives fraction had 2 out of 195 results rejected because of percent difference between columns greater than 100%. The results are likely false positives because the compounds cannot be confirmed using a second column. The laboratory measurement completeness was 99.0%, which meets the 90% completeness goal. The sample collection completeness was 100%.

Sensitivity

The project quantitation limit goals (PQLGs) are listed in Worksheet #15 in the QAPP (August 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the QAPP.

The amount of sample volume collected also affects the ability of the laboratory to achieve the desired PQLGs. Laboratory or field blank contamination can also elevate a result above the PQLGs, resulting in samples being qualified as non-detected. There are no instances where the non-detected sample results exceed the PQLGs either because of the laboratory's inability to meet the PQLG or because of elevated detection limits due to blank contamination.

Field and Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in both organic and inorganic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where	%R	=	percent recovery
	Ss	=	result of spiked sample
	So	=	result of non-spiked sample
	S	=	concentration of spiked amount.

There were several results qualified due to surrogate recovery in the explosive and dye analyses. However, the qualifications do not point to any trends showing a systematic problem with extraction efficiency. There were no quality control deficiencies noted for field accuracy.

Field and Laboratory Precision

Precision is a measure of the degree to which two or more measurements agree and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Relative Percent Difference (RPD) expresses precision for chemical parameters. RPDs, typically expressed as percentages, evaluate both field duplicate and laboratory duplicate precision. The following formula calculates RPDs:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where	RPD	=	relative percent difference
	V1, V2	=	two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, sub-sampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

Two RDX results for one sample duplicate pair were qualified due to field duplicate imprecision in the explosives fraction. The lack of homogeneity in soil samples is common and the precision results do not indicate a site wide problem with the soil matrix.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Using standardized sampling and analysis methods, as well as standardized data reporting formats assists in achieving comparability. Reporting of results in consistent units ensured comparability with previous data. Evaluation of QC samples and adherence to the QAPP assists in the assessment of comparability.

No comparability issues were noted during the data validation process.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The QAPP (August 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

REJECTED DATA
TEST PADS ON HILL BEHIND B-198
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	REJECTION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS001C0001	RDX	0.049	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
X6SS008G0002	NITROBENZENE	0.066	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS001C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS001C0001	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS002C0001	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS003C0001	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	RDX	0.16	J	URG	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT, SURROGATE RECOVERY NONCOMPLIANCE, AND FIELD DUPLICATE IMPRECISION
X6SS003C0001	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001	SOLVENT YELLOW 33	122929	J	CPR	UG/KG	CALIBRATION, SURROGATE RECOVERY NONCOMPLIANCE AND UNCERTAINITY NEAR THE DETECTION LIMIT
X6SS003C0001-D	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS003C0001-D	RDX	0.062	UJ	G	MG/KG	Field Duplicate Imprecision

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS004C0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	RDX	0.1	J	UR	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE RECOVERY NONCOMPLIANCE
X6SS004C0001	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS004C0001	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
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CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS005G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS005G0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	NITROBENZENE	0.094	J	UR	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE RECOVERY NONCOMPLIANCE
X6SS006G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	RDX	0.089	J	UR	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE RECOVERY NONCOMPLIANCE

QUALIFIED DATA
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SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS006G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS006G0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS007G0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS008G0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	HMX	0.04	J	CRP	MG/KG	CALIBRATION, SURROGATE RECOVERY NONCOMPLIANCE AND UNCERTAINITY NEAR THE DETECTION LIMIT
X6SS008G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	RDX	0.13	J	UR	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE RECOVERY NONCOMPLIANCE
X6SS008G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	1-AMINOANTHRAQUINONE	1212.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	2-AMINOANTHRAQUINONE	1150	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	ACID BLUE 9	447.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	BASIC VIOLET 10	730	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	DISPERSE RED 9	883.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT ORANGE 3	283.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
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SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS008G0002-D	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT YELLOW 14	473.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT YELLOW 2	1105	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS008G0002-D	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS009G0001	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
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CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS010G0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS010G0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS011C0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
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SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS011C0002	SOLVENT YELLOW 33	687.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	1,3-DINITROBENZENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	1-AMINOANTHRAQUINONE	1212.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	2,4,6-TRINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	2,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	2-AMINO-4,6-DINITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	2-AMINOANTHRAQUINONE	1150	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	3-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	4-NITROTOLUENE	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	ACID BLUE 9	447.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	ACID RED 64	1629	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	BASIC VIOLET 10	730	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	DISPERSE RED 9	883.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	HMX	0.062	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	NITROGLYCERIN	0.21	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	RDX	0.14	J	UR	MG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT AND SURROGATE RECOVERY NONCOMPLIANCE
X6SS012C0002	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT ORANGE 3	283.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT ORANGE 7	881	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

QUALIFIED DATA
TEST PADS ON HILL BEHIND B-198
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SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
X6SS012C0002	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT YELLOW 14	473.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT YELLOW 2	1105	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
X6SS012C0002	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

APPENDIX D.4

Lake Oberlin

SUMMARY OF QUALITY CONTROL RESULTS

DATA QUALITY REVIEW OF SAMPLES AT LAKE OBERLIN

This section contains a description of the data review processes used to determine whether analytical laboratory data collected during the sampling field effort for the Lake Oberlin were of acceptable quality for use in decision-making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against the prescribed acceptance criteria. The DQIs are measures used to assess the completeness, sensitivity, accuracy, precision, comparability, and representativeness of the sample collection and sample analysis process. The output of this review was a set of alphabetic flags such as "U," "J", "R," or combinations thereof, assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs presented in the Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern QAPP (August 2009) were maintained through the course of the sampling event. The Worksheets #19 and #15 of the QAPP present the analytical methods and compounds analyzed.

Data Validation Process

All of the results from analytical laboratory samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October 2004) guidelines.

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins

N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit
Q = Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 6-1**.** No data collected for site Lake Oberlin were rejected. All data for site Lake Oberlin are considered valid for their intended purpose.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements intended. Samples collected and laboratory measurements make up the completeness calculations.

- Sample completeness is a measure of the usable samples collected versus those actually collected.

- Laboratory measurement completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) are those judged, after data assessment, to represent the sampling populations and not disqualified for use through data validation or additional data review. Completeness is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The sample collection and laboratory analytical completeness were 100%.

Sensitivity

The project quantitation limit goals (PQLGs) are listed in Worksheet #15 in the QAPP (August 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the QAPP.

The amount of sample volume collected also affects the ability of the laboratory to achieve the desired PQLGs. Laboratory or field blank contamination can also elevate a result above the PQLGs, resulting in samples being qualified as non-detected. There are no instances where the non-detected sample results exceed the PQLGs either because of the laboratory's inability to meet the PQLG or because of elevated detection limits due to blank contamination.

Field and Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in both organic and inorganic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where %R = percent recovery
Ss = result of spiked sample
So = result of non-spiked sample
S = concentration of spiked amount.

There were no quality control deficiencies noted for field or laboratory accuracy.

Field and Laboratory Precision

Precision is a measure of the degree to which two or more measurements agree and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Relative Percent Difference (RPD) expresses precision for chemical parameters. RPDs, typically expressed as percentages, evaluate both field duplicate and laboratory duplicate precision. The following formula calculates RPDs:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference
V1, V2 = two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, sub-sampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

There were no quality control deficiencies noted for field or laboratory precision.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Using standardized sampling and analysis methods, as well as standardized data reporting formats assists in achieving comparability. Reporting of

results in consistent units ensured comparability with previous data. Evaluation of QC samples and adherence to the QAPP assists in the assessment of comparability.

No comparability issues were noted during the data validation process.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The QAPP (August 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

QUALIFIED DATA
LAKE OBERLIN
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A4SD001C0006	ACID BLUE 1	2617	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	ACID BLUE 45	2037.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	ACID YELLOW 23	2564	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	ACID YELLOW 3	10147.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	SOLVENT RED 1	11478	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006	SOLVENT YELLOW 3	973	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006-D	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006-D	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD001C0006-D	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD002C0006	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD002C0006	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD002C0006	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD003C0006	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD003C0006	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD003C0006	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD004C0006	BASIC YELLOW 2	6670.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD004C0006	SOLVENT GREEN 3	3489.5	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE
A4SD004C0006	SOLVENT RED 24	4260	UJ	C	UG/KG	CALIBRATION NONCOMPLIANCE

APPENDIX D.5

West Gate Small Arms Range Complex

SUMMARY OF QUALITY CONTROL RESULTS

DATA QUALITY REVIEW OF SAMPLES AT WEST GATE SMALL ARMS RANGE COMPLEX

This section contains a description of the data review processes used to determine whether analytical laboratory data collected during the sampling field effort for the Skeet and Trap Range Complex were of acceptable quality for use in decision-making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against the prescribed acceptance criteria. The DQIs are measures used to assess the completeness, sensitivity, accuracy, precision, comparability, and representativeness of the sample collection and sample analysis process. The output of this review was a set of alphabetic flags such as “U,” “J”, “R,” or combinations thereof, assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs presented in the Site Inspections at NAVFAC Midwest Munitions Response Sites and Areas of Concern QAPP (August 2009) were maintained through the course of the sampling event. The Worksheets #19 and #15 of the QAPP present the analytical methods and compounds analyzed.

Data Validation Process

All of the results from analytical laboratory samples were validated according to multiple specifications. Sample data validation generally followed U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (October 1999), and U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (October 2004) guidelines.

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A	=	Lab Blank Contamination
B	=	Field Blank Contamination
C	=	Calibration Noncompliance (e.g. % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01	=	GC/MS Tuning Noncompliance
D	=	MS/MSD Recovery Noncompliance
E	=	LCS/LCSD Recovery Noncompliance
F	=	Lab Duplicate Imprecision
G	=	Field Duplicate Imprecision
H	=	Holding Time Exceedance
I	=	ICP Serial Dilution Noncompliance
J	=	GFAA PDS - GFAA MSA's $r < 0.995$ / ICP PDS Recovery Noncompliance
K	=	ICP Interference - includes ICS % R Noncompliance
L	=	Instrument Calibration Range Exceedance
M	=	Sample Preservation Noncompliance
N	=	Internal Standard Noncompliance
N01	=	Internal Standard Recovery Noncompliance Dioxins
N02	=	Recovery Standard Noncompliance Dioxins

N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (e.g. base-line drifting)
P = Uncertainty near detection limit
Q = Other problems (can encompass a number of issues; e.g. chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >25% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 7-1**.** Table 7-2 presents the rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections. The rejected data are not acceptable for performing risk assessments.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements intended. Samples collected and laboratory measurements make up the completeness calculations.

- Sample completeness is a measure of the usable samples collected versus those actually collected.

- Laboratory measurement completeness is a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) are those judged, after data assessment, to represent the sampling populations and not disqualified for use through data validation or additional data review. Completeness is determined using the following equation:

$$\%C = \frac{V}{T} \times 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The explosives fraction had 4 out of 180 results rejected because of percent difference between columns greater than 100%. The results are likely false positives because the compounds cannot be confirmed using a second column. The laboratory measurement completeness was 97.8%, which meets the 90% completeness goal. The sample collection completeness was 100%.

Sensitivity

The project quantitation limit goals (PQLGs) are listed in Worksheet #15 in the QAPP (August 2009). Analytical sensitivity was satisfactory to meet DQOs presented in the QAPP.

The amount of sample volume collected also affects the ability of the laboratory to achieve the desired PQLGs. Laboratory or field blank contamination can also elevate a result above the PQLGs, resulting in samples being qualified as non-detected. There are no instances where the non-detected sample results exceed the PQLGs either because of the laboratory's inability to meet the PQLG or because of elevated detection limits due to blank contamination.

Field and Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in both organic and inorganic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where	%R	=	percent recovery
	Ss	=	result of spiked sample
	So	=	result of non-spiked sample
	S	=	concentration of spiked amount.

There were several results qualified due to matrix spike and LCS recoveries in the explosive and metals fractions. Only one explosive compound result was qualified due to an LCS recovery greater than the laboratory quality control limit and one explosive compound result was qualified due to a matrix spike recovery less than the laboratory quality control limit. The explosive results qualified because of LCS or matrix spike recoveries do not indicate any bias with the data. Copper, lead, and zinc results were qualified due to a matrix spike recovery greater than the laboratory quality control limit. There may be a slight high bias for these results. All antimony results were qualified due to matrix spike recoveries less than the laboratory quality control limits indicating a low bias for antimony results. An impact on data quality in not expected because the spike recoveries were all greater than 30% and considered useable for risk assessment. There were no quality control deficiencies noted for field accuracy.

Field and Laboratory Precision

Precision is a measure of the degree to which two or more measurements agree and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Relative Percent Difference (RPD) expresses precision for chemical parameters. RPDs, typically expressed as percentages, evaluate both field duplicate and laboratory duplicate precision. The following formula calculates RPDs:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where	RPD	=	relative percent difference
	V1, V2	=	two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, sub-sampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

There were several results qualified due to field or laboratory duplicate imprecision in the explosives, PAH, and metals fractions. The lack of homogeneity in soil samples is common and the precision results do not indicate a site wide problem with the soil matrix.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Using standardized sampling and analysis methods, as well as standardized data reporting formats assists in achieving comparability. Reporting of results in consistent units ensured comparability with previous data. Evaluation of QC samples and adherence to the QAPP assists in the assessment of comparability.

No comparability issues were noted during the data validation process.

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The QAPP (August 2009) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed so that the final data would be accurate representations of actual site conditions. Based on field logs indicating the conditions during sample collection and laboratory audits all reported data are adequately representative of site conditions and intended populations.

REJECTED DATA
WEST GATE SMALL ARMS RANGE COMPLEX
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	REJECTION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A2SB007G0406	RDX	0.029	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A6SS001C0002	2-NITROTOLUENE	0.09	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A6SS001C0002	HMX	0.05	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A6SS001C0002-D	2-NITROTOLUENE	0.03	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%
A6SS004C0002	2,4,6-TRINITROTOLUENE	0.05	R	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS GREATER THAN 100%

QUALIFIED DATA
WEST GATE SMALL ARMS RANGE COMPLEX
NSA CRANE
CRANE, INDIANA

SAMPLE ID	PARAMETER	SAMPLE RESULT	VALIDATION QUALIFIER	QUALIFICATION CODE	UNITS	REASON FOR QUALIFICATION
A6SS001C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002	RDX	0.34	J	UG	MG/KG	
A6SS001C0002-D	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002-D	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002-D	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002-D	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS001C0002-D	RDX	0.06	UJ	G	MG/KG	FIELD DUPLICATE IMPRECISION
A6SS002C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS002C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS002C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS002C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS003C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS003C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS003C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS003C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS004C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS004C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS004C0002	HMX	0.24	J	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS NONCOMPLIANCE
A6SS004C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS004C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS005C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

A6SS005C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS005C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS006C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS006C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS006C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS007C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS007C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS007C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS008C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS008C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS008C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS009C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS009C0002	2-AMINO-4,6-DINITROTOLUENE	0.16	J	CEU	MG/KG	CALIBRATION, LCS RECOVERY, AND PERCENT DIFFERENCE BETWEEN COLUMNS NONCOMPLIANCE
A6SS009C0002	HMX	0.13	J	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS NONCOMPLIANCE
A6SS009C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS009C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS009C0002	RDX	0.06	J	U	MG/KG	PERCENT DIFFERENCE BETWEEN COLUMNS NONCOMPLIANCE
A6SS010C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS010C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS010C0002	HMX	0.06	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS010C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS010C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE

A6SS011C0002	1,3,5-TRINITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS011C0002	2-AMINO-4,6-DINITROTOLUENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS011C0002	NITROBENZENE	0.06	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS011C0002	NITROGLYCERIN	0.3	UJ	C	MG/KG	CALIBRATION NONCOMPLIANCE
A6SS015G0002	ANTIMONY	0.313	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS015G0002	COPPER	5.07	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS015G0002	LEAD	53.2	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS015G0002	ZINC	25.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS020G0002	ACENAPHTHENE	2.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS020G0002	ANTHRACENE	5.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS020G0002	BENZO(K)FLUORANTHENE	31	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS020G0002	PHENANTHRENE	23	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	BENZO(A)PYRENE	4.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS021G0002	BENZO(B)FLUORANTHENE	7.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	BENZO(K)FLUORANTHENE	2.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	FLUORANTHENE	4.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	INDENO(1,2,3-CD)PYRENE	3.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	PHENANTHRENE	1.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS021G0002	PYRENE	5.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS022G0002	ANTIMONY	0.308	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS022G0002	COPPER	11.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS022G0002	LEAD	113	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS022G0002	ZINC	51.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS025G0002	ANTIMONY	0.293	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS025G0002	COPPER	14.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS025G0002	LEAD	15.5	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS025G0002	ZINC	61.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS030G0002	BENZO(B)FLUORANTHENE	2.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS030G0002	FLUORANTHENE	1.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS030G0002	PYRENE	2.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS031G0002	ANTIMONY	0.302	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS031G0002	COPPER	6.92	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS031G0002	LEAD	127	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS031G0002	ZINC	32.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS032G0002	ANTIMONY	0.301	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS032G0002	COPPER	8.81	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS032G0002	LEAD	31	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS032G0002	ZINC	29.7	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS036G0002	1-METHYLNAPHTHALENE	2.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	2-METHYLNAPHTHALENE	3.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	ACENAPHTHYLENE	1.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	BENZO(B)FLUORANTHENE	3.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	FLUORANTHENE	3.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS036G0002	FLUORENE	1.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	NAPHTHALENE	2.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	PHENANTHRENE	2.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS036G0002	PYRENE	4.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	ANTHRACENE	2.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	ANTIMONY	0.306	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS037G0002	BENZO(A)ANTHRACENE	3.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	BENZO(A)PYRENE	6.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	BENZO(B)FLUORANTHENE	19	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	BENZO(G,H,I)PERYLENE	12	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	BENZO(K)FLUORANTHENE	5.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	CHRYSENE	16	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	COPPER	9.04	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS037G0002	DIBENZO(A,H)ANTHRACENE	4.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	FLUORANTHENE	2.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	INDENO(1,2,3-CD)PYRENE	9.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	LEAD	23.5	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS037G0002	PYRENE	4.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS037G0002	ZINC	48	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS039G0002	ANTIMONY	0.296	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS039G0002	COPPER	13.1	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS039G0002	LEAD	29	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS039G0002	ZINC	49.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS045G0002	ANTIMONY	0.305	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS045G0002	COPPER	5.97	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS045G0002	LEAD	113	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS045G0002	ZINC	32.9	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS048G0002	ACENAPHTHENE	1.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	ANTHRACENE	2.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	BENZO(A)ANTHRACENE	37	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	BENZO(B)FLUORANTHENE	44	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	BENZO(G,H,I)PERYLENE	35	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS048G0002	BENZO(K)FLUORANTHENE	15	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	DIBENZO(A,H)ANTHRACENE	8.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	FLUORANTHENE	46	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	INDENO(1,2,3-CD)PYRENE	30	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	PHENANTHRENE	12	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS048G0002	PYRENE	49	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS049G0002	1-METHYLNAPHTHALENE	2.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS049G0002	2-METHYLNAPHTHALENE	4.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS049G0002	NAPHTHALENE	9.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS050G0002	1-METHYLNAPHTHALENE	2.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS050G0002	2-METHYLNAPHTHALENE	5.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS050G0002	NAPHTHALENE	10	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS050G0002	PYRENE	1.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS053G0002	ANTIMONY	0.313	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS053G0002	COPPER	7.45	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS053G0002	LEAD	46.8	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS053G0002	ZINC	30.8	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS056G0002	1-METHYLNAPHTHALENE	3.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS056G0002	2-METHYLNAPHTHALENE	6.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS056G0002	NAPHTHALENE	5.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS057G0002	ANTIMONY	0.303	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS057G0002	COPPER	57.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS057G0002	LEAD	0.454	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS057G0002	ZINC	31.2	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS061G0002	1-METHYLNAPHTHALENE	6.7	J	GP	UG/KG	FIELD DUPLICATE IMPRECISION AND UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002	2-METHYLNAPHTHALENE	12	J	CG	UG/KG	CALIBRATION NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION
A6SS061G0002	ACENAPHTHENE	12	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002	ANTHRACENE	18	J	GP	UG/KG	FIELD DUPLICATE IMPRECISION AND UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002	BENZO(A)ANTHRACENE	550	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	BENZO(A)PYRENE	480	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	BENZO(B)FLUORANTHENE	580	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	BENZO(G,H,I)PERYLENE	350	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	BENZO(K)FLUORANTHENE	170	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	CHRYSENE	850	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	DIBENZO(A,H)ANTHRACENE	1.6	UJ	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	FLUORANTHENE	520	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	FLUORENE	4.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002	INDENO(1,2,3-CD)PYRENE	300	J	G	UG/KG	FIELD DUPLICATE IMPRECISION

A6SS061G0002	NAPHTHALENE	14	J	GP	UG/KG	FIELD DUPLICATE IMPRECISION AND UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002	PHENANTHRENE	120	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002	PYRENE	560	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	1-METHYLNAPHTHALENE	110	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	2-METHYLNAPHTHALENE	210	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	ANTHRACENE	100	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	BENZO(A)ANTHRACENE	2500	J	CG	UG/KG	CALIBRATION NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	BENZO(A)PYRENE	2500	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	BENZO(B)FLUORANTHENE	2700	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	BENZO(G,H,I)PERYLENE	1600	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	BENZO(K)FLUORANTHENE	910	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	CHRYSENE	3400	J	CG	UG/KG	CALIBRATION NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	DIBENZO(A,H)ANTHRACENE	460	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	FLUORANTHENE	2400	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	FLUORENE	21	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS061G0002-D	INDENO(1,2,3-CD)PYRENE	1800	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	NAPHTHALENE	130	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	PHENANTHRENE	590	J	G	UG/KG	FIELD DUPLICATE IMPRECISION
A6SS061G0002-D	PYRENE	2600	J	G	UG/KG	FIELD DUPLICATE IMPRECISION

A6SS062G0002	1-METHYLNAPHTHALENE	6.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS062G0002	2-METHYLNAPHTHALENE	13	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS062G0002	NAPHTHALENE	12	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS063G0002	1-METHYLNAPHTHALENE	5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS063G0002	2-METHYLNAPHTHALENE	10	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS063G0002	ANTIMONY	0.295	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS063G0002	COPPER	11.9	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS063G0002	LEAD	12.8	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS063G0002	NAPHTHALENE	14	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS063G0002	ZINC	39.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS067G0002	ANTIMONY	0.299	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS067G0002	COPPER	7.63	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS067G0002	LEAD	44.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS067G0002	ZINC	31.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS069G0002	1-METHYLNAPHTHALENE	16	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS069G0002	2-METHYLNAPHTHALENE	31	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS069G0002	ACENAPHTHENE	8.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS069G0002	ANTHRACENE	12	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS069G0002	FLUORENE	3.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS069G0002	NAPHTHALENE	37	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	1-METHYLNAPHTHALENE	18	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS070G0002	2-METHYLNAPHTHALENE	37	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	ANTHRACENE	2.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	BENZO(A)ANTHRACENE	18	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	BENZO(B)FLUORANTHENE	27	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	BENZO(G,H,I)PERYLENE	17	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	BENZO(K)FLUORANTHENE	10	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	CHRYSENE	24	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	FLUORANTHENE	27	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	INDENO(1,2,3-CD)PYRENE	19	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	NAPHTHALENE	36	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	PHENANTHRENE	11	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS070G0002	PYRENE	25	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS071G0002	1-METHYLNAPHTHALENE	20	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS071G0002	2-METHYLNAPHTHALENE	42	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS071G0002	NAPHTHALENE	31	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS072G0002	ANTIMONY	0.293	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS072G0002	COPPER	9.85	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS072G0002	LEAD	20.9	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS072G0002	ZINC	33.3	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS077G0002	1-METHYLNAPHTHALENE	16	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS077G0002	2-METHYLNAPHTHALENE	32	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS077G0002	NAPHTHALENE	36	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS077G0002	PHENANTHRENE	2.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS078G0002	ANTIMONY	0.329	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS078G0002	COPPER	7.24	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS078G0002	LEAD	130	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS078G0002	ZINC	37.2	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS079G0002	ANTIMONY	0.304	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS079G0002	COPPER	7.42	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS079G0002	LEAD	17.1	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS079G0002	ZINC	20.1	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS083G0002	ACENAPHTHENE	1.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS083G0002	ANTHRACENE	2.4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	BENZO(A)ANTHRACENE	5.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	BENZO(A)PYRENE	4.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	BENZO(B)FLUORANTHENE	5.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	BENZO(G,H,I)PERYLENE	4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	BENZO(K)FLUORANTHENE	3.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	CHRYSENE	5.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	DIBENZO(A,H)ANTHRACENE	3.1	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	FLUORANTHENE	6.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	FLUORENE	2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	INDENO(1,2,3-CD)PYRENE	4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	PHENANTHRENE	4.2	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS083G0002	PYRENE	5.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT

A6SS084G0002	BENZO(A)ANTHRACENE	5.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	BENZO(A)PYRENE	7.5	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	BENZO(B)FLUORANTHENE	10	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	BENZO(G,H,I)PERYLENE	5.9	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	BENZO(K)FLUORANTHENE	4	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	CHRYSENE	8.7	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	FLUORANTHENE	6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	INDENO(1,2,3-CD)PYRENE	5.8	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	PHENANTHRENE	2.6	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS084G0002	PYRENE	6.3	J	P	UG/KG	UNCERTAINITY NEAR THE DETECTION LIMIT
A6SS085G0002	ANTIMONY	0.304	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS085G0002	COPPER	9.6	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS085G0002	LEAD	14	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS085G0002	ZINC	36.7	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS093G0002	ANTIMONY	0.295	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS093G0002	COPPER	8.95	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS093G0002	LEAD	321	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS093G0002	ZINC	29.1	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS094G0002	ANTIMONY	0.586	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS094G0002	COPPER	0.586	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION

A6SS094G0002	LEAD	0.176	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS094G0002	ZINC	0.586	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS097G0002	ANTIMONY	0.295	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS097G0002	COPPER	16.7	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS097G0002	LEAD	258	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS097G0002	ZINC	25.9	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS097G0002-D	ANTIMONY	0.293	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS097G0002-D	ZINC	31.8	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS100G0002	ANTIMONY	0.579	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS100G0002	COPPER	0.579	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS100G0002	LEAD	0.174	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS100G0002	ZINC	0.579	J	DF	MG/KG	MATRIX SPIKE NONCOMPLIANCE AND LABORATORY DUPLICATE IMPRECISION
A6SS103G0002	ANTIMONY	0.287	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS103G0002	ZINC	21.6	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS107G0002	ANTIMONY	0.304	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS107G0002	ZINC	36.2	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS108G0002	ANTIMONY	0.307	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS108G0002	ZINC	28.6	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS111G0002	ANTIMONY	0.302	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS111G0002	ZINC	28.7	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS114G0002	ANTIMONY	0.305	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS114G0002	ZINC	32.8	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS116G0002	ANTIMONY	0.308	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS116G0002	ZINC	30.3	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS119G0002	ANTIMONY	0.303	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS119G0002	ZINC	51.4	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS123G0002	ANTIMONY	0.32	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

A6SS123G0002	ZINC	57.2	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS129G0002	ANTIMONY	0.31	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS129G0002	ZINC	37.6	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS132G0002	ANTIMONY	0.319	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS132G0002	ZINC	37.7	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS138G0002	ANTIMONY	0.305	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS138G0002	ZINC	33	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS144G0002	ANTIMONY	0.299	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS144G0002	ZINC	31	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS148G0002	ANTIMONY	0.332	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS148G0002	ZINC	23.7	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS150G0002	ANTIMONY	0.345	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS150G0002	ZINC	21	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS156G0002	ANTIMONY	0.299	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS156G0002	ZINC	25.3	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS156G0002-D	ANTIMONY	0.291	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS156G0002-D	ZINC	36.2	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS160G0002	ANTIMONY	0.309	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS160G0002	ZINC	38	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS163G0002	ANTIMONY	0.318	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS163G0002	ZINC	27	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS166G0002	ANTIMONY	0.312	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS166G0002	ZINC	43.9	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS168G0002	ANTIMONY	0.295	UJ	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS168G0002	ZINC	31.4	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS170G0002	ANTIMONY	0.471	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE
A6SS170G0002	ZINC	42.4	J	D	MG/KG	MATRIX SPIKE NONCOMPLIANCE

APPENDIX E

XRF/FBL CORRELATION STATISTICAL EVALUATIONS

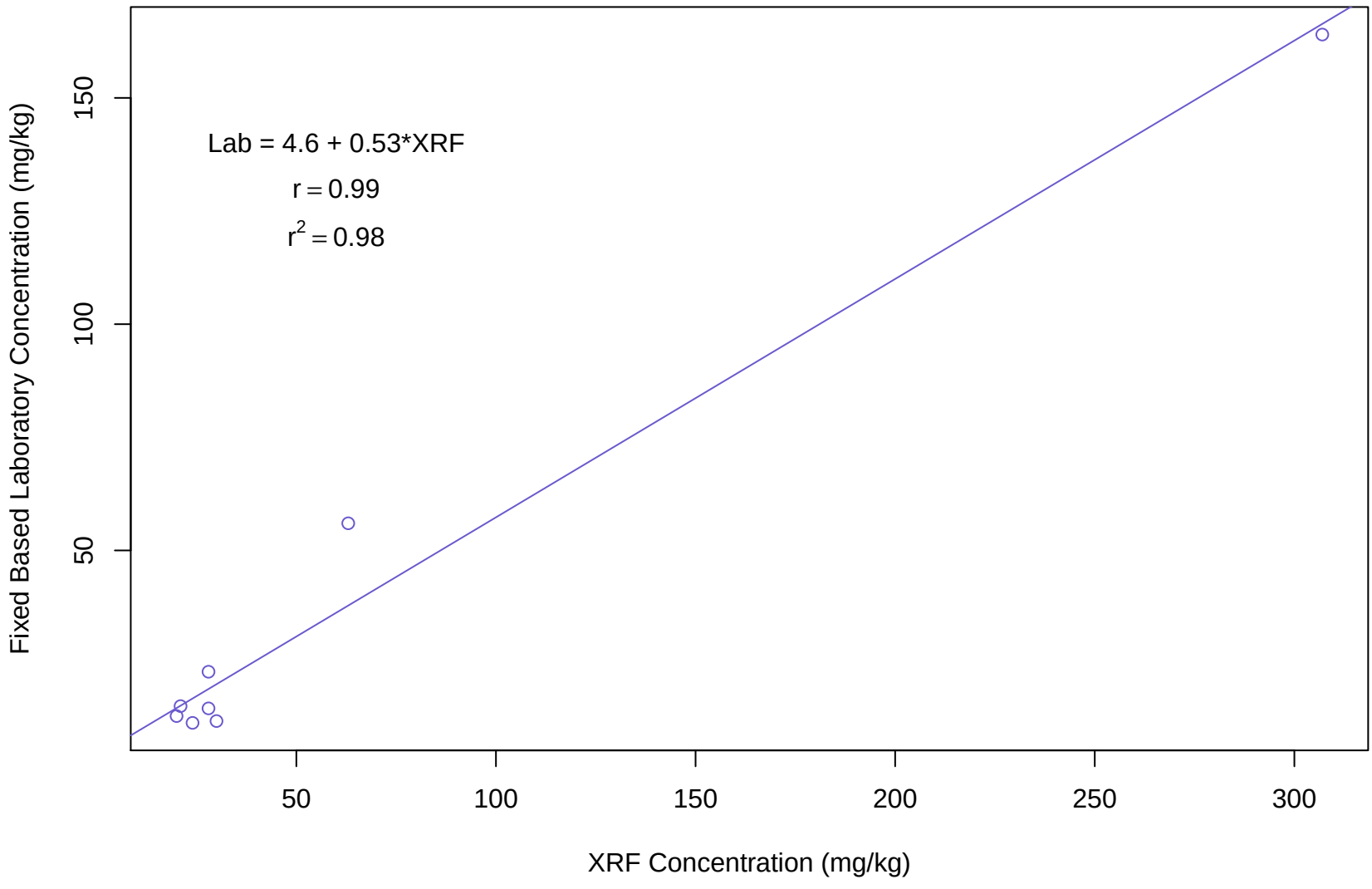
APPENDIX E.1

B-143 Drop Test Area

Correlation Analysis

Figure 1 is a scatterplot of the XRF Lead results and the Laboratory lead results for each sample. From the scatterplot, a strong positive linear trend is evident. The correlation between the fixed based laboratory concentrations and the XRF is 0.99. The correlation always falls between -1 and 1. Values of r near 0 indicate a very weak linear relationship. The strength of the linear relationship increases as r moves away from 0 toward either -1 or 1. Values of r close to -1 and 1 indicate that the points lie close to a straight line. The extreme values -1 and 1 occur only in the case of a perfect linear relationship. So the correlation indicates a strong linear trend. The R-squared value is .98. This value represents the percent of variation in laboratory lead concentrations that can be explained by the lead XRF concentration. An R-Squared value greater than about 80 is considered to indicate a very strong relationship between the two measurement methods. The maximum possible value is 100 percent. Based on the correlation the XRF concentrations can be used to predict the Laboratory concentrations. It should be noted that the correlation analysis was conducted on a limited sample size (8) and it is assumed that the rest of the population can be modeled using this relationship.

Figure 1
AOC 1
Correlation Analysis
Lead



APPENDIX E.2

West Gate Small Arms Range Complex

Correlation Analysis

Figure 1 presents the scatterplot of the XRF Lead results and the Laboratory Lead results for samples with concentrations less than 400 mg/kg. To evaluate the relationship between the XRF and Laboratory concentrations a regression analysis was conducted and the correlation was computed. The correlation between the XRF and Laboratory concentrations is 0.69 and the corresponding R^2 value is 0.48. The correlation always falls between -1 and 1. Correlation values near 0 indicate a very weak linear relationship. The strength of the linear relationship increases as r moves away from 0 toward either -1 or 1. Values of r close to -1 and 1 indicate that the points lie close to a straight line. The extreme values -1 and 1 occur only in the case of a perfect linear relationship. An R^2 value between 0 and 0.30 is considered weak, 0.30 to 0.7 is considered moderate, and greater than about 0.80 is considered to indicate a very strong relationship between the two measurement methods. The maximum possible value is 100 percent. The correlation indicates a moderate relationship trend. As mentioned in the Data Usability assessment if a correlation coefficient of 0.65 or greater is obtained the fit will be considered adequate to translate field XRF concentrations to the equivalent laboratory lead concentrations with confidence. Therefore, the regression equation can be used to estimate laboratory concentrations for XRF concentrations that are less than 400 mg/kg using the following equation:

$$Lab\ Lead\ Concentration\ mg/kg = -3.3 + 0.91 * XRFmg/kg$$

Figure 2 is a scatterplot of the XRF Lead results and the Laboratory lead results for each sample from AOC 6. From the scatterplot, a moderate positive linear trend is evident for samples with XRF and Laboratory concentrations less than 400mg/kg. The correlation between the fixed based laboratory concentrations and the XRF is 0.59. The R-squared value is 0.35. This value represents the percent of variation in laboratory lead concentrations that can be explained by the lead XRF concentration. The majority of the samples have laboratory and XRF concentrations less than 400 mg/kg while there are only three samples with XRF and Laboratory concentrations greater than 400 mg/kg.

Figure 1
AOC 6
Correlation Analysis
XRF and Laboratory Concentrations Less 400 mg/kg

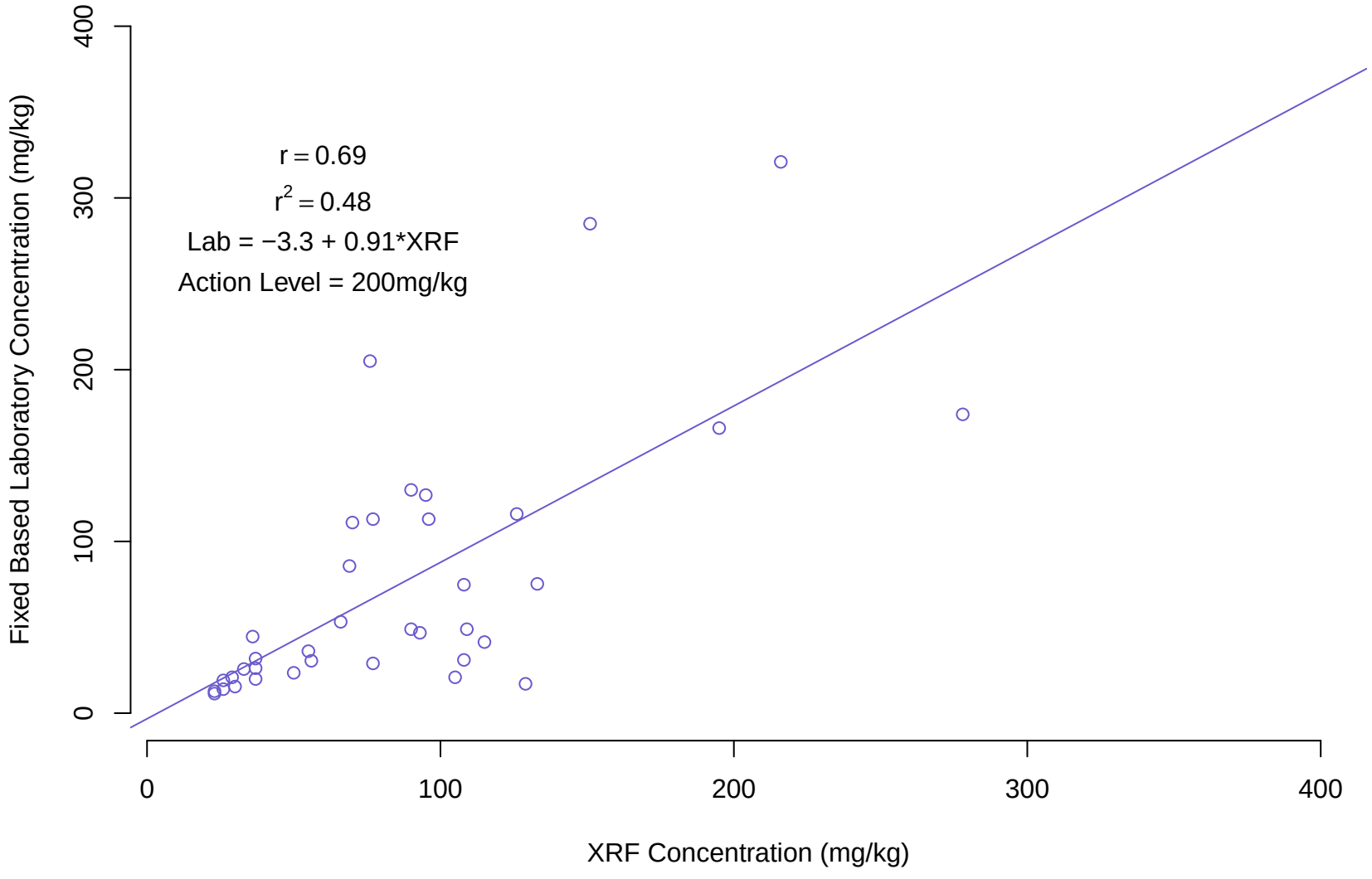
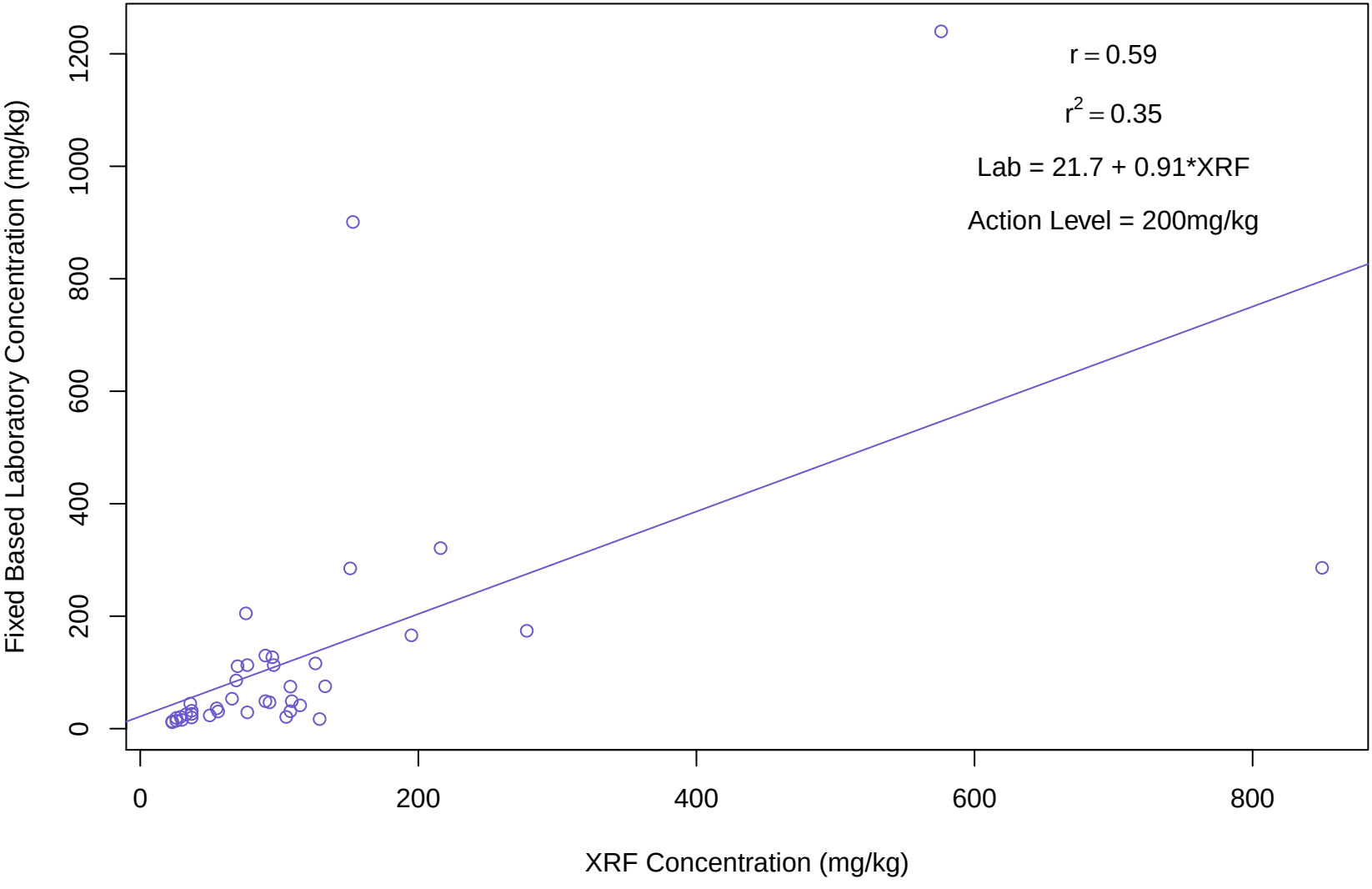


Figure 2
AOC 6
Correlation Analysis



APPENDIX F

HUMAN HEALTH RELATED INFORMATION

APPENDIX F: HUMAN HEALTH RISK SCREENING

METHODOLOGY

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at each of the five MRP sites. The risk screening methodology includes the following general steps involved in a baseline human health risk evaluation:

- Identification of chemicals of potential concern (COPCs)
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

Identification of Chemicals of Potential Concern

For each site, Tetra Tech used the following considerations in determining COPCs:

- Occurrence and distribution of chemicals in the environmental media
- Chemical toxicity
- Occurrence of chemical in background samples

Surface soil and subsurface soil were evaluated as one interval for the purposes of identifying COPCs. For some sites, Tetra Tech divided the site into smaller areas of interest based on site characteristics that lead to a meaningful subdivision of the site. Summary tables for the Human Health Risk Screening Supporting documentation are included in this appendix.

Identification of Chemicals of Potential Concern in Soil

For Tetra Tech to designate a chemical as a COPC in soil for an area of interest and depth category, the chemical had to satisfy the following criteria:

- The chemical had to be detected at least once in the area of interest and depth interval.
- If the chemical was detected at least once in the area of interest, then the maximum detected concentration had to exceed at the human health risk-based screening levels (RBSLs).

The evaluation of inorganic chemical concentrations detected in soil in relation to background levels follows guidance presented in the U.S. EPA's Role of Background in the CERCLA Cleanup Program (USEPA, 2002). This guidance document recommends that all chemicals which exceed risk-based

screening concentrations be evaluated in the risk assessment. Therefore, if the maximum concentration of any inorganic chemical exceeded screening levels (i.e., was selected as a COPC), risks were calculated for that chemical. Potential risks attributed to background levels are discussed in the risk characterization section for each site. Inorganic chemicals present at background levels were not retained as chemicals of concern (COCs) in accordance with Navy guidance (Navy, 2004).

Human Health Risk-Based Screening Levels

Tetra Tech developed human health RBSLs to address two pathways:

- direct contact exposures to soil.
- protection of groundwater.

RBSLs Based on Direct Contact Exposures to Soil. Direct contact exposures include incidental ingestion of soil, dermal contact with soil, and inhalation of chemicals emitted from the soil. As residential direct contact RBSLs in soil, Tetra Tech used USEPA's Regional Screening Levels (RSLs) for residential direct contact exposures to soil and IDEM Risk Integrated System Closure (RISC) default closure levels. The RSLs were developed and are maintained through a cooperative agreement between Oak Ridge National Laboratory and USEPA's Office of Superfund, and are considered to be USEPA screening criteria. The risk-based USEPA RSLs correspond to a HQ of 1 (for noncarcinogens) or an ILCR of 1×10^{-6} (for carcinogens). One-tenth the RSL was used for non-carcinogenic compounds to account for the potential cumulative effects of multiple compounds affecting the same target organ.

The IDEM default closure levels for soil are based on the lower of the risk based direct contact criteria, soil attenuation capacity, soil saturation concentration, and migration from soil to groundwater criteria (IDEM, 2009). The IDEM risk based default closure levels correspond to systemic Hazard Quotient (HQ) of 1 (for noncarcinogens) or an incremental lifetime cancer risk (ILCR) of 1×10^{-5} (for carcinogens).

RBSLs Based on Protection of Groundwater. USEPA has developed two soil screening levels (SSLs) to be protective of groundwater, one based on the residential tap water RSL and the other based on the MCL (if available). The risk-based SSL was used for the RBSLs in soil for protection of groundwater in this evaluation. The USEPA RSLs for protection of groundwater were developed with a dilution-attenuation factor (DAF) of 1. However, the USEPA's Soil Screening Guidance (USEPA, May 1996) states "The EPA has selected a default DAF of 20 to account for contaminant dilution and attenuation during transport through the saturated zone to a compliance point (i.e., receptor well). At most sites, this adjustment will more accurately reflect a contaminant's threat to ground water resources than assuming a DAF of 1 (i.e., no dilution or attenuation)." The guidance further states, "A DAF of 20 is protective for sources up to 0.5 acres in size" and "can be protective of larger sources as well." Therefore, soil

concentrations were also compared to soil to groundwater criteria based on a DAF of 20. The IDEM RISC default closure levels for migration from soil to groundwater are based on a DAF of 20.

Chemicals without Toxicity Criteria. Three PAHs do not have toxicity data to calculate human health RBSLs: acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. For these chemicals, the RBSLs for other chemicals with similar chemical properties were used as surrogates. The surrogate for acenaphthylene was acenaphthene, while the surrogate for both benzo(g,h,i)perylene and phenanthrene was pyrene. Also no RSLs are available for the dyes: solvent green 3, solvent yellow 3, and solvent yellow 33. Human health media cleanup standards derived for the SWMU 2 - Dye Burial Ground (Tetra Tech, August 2000, and September 2000) were used as screening criteria for these dyes.

Summary of RBSLs. Table 1 presents the RBSLs used to evaluate direct contact exposures to soil. Table 2 presents the RBSLs used to evaluate the migration from soil to groundwater pathway.

Exposure Assessment

In the exposure assessment for each site, Tetra Tech described current and potential future uses for the site and identified potential receptors and exposure pathways. Tetra Tech also conservatively estimated an exposure point concentration (EPC) for each area of interest and depth interval. Tetra Tech used the maximum detected soil concentration as the EPC.

Risk Characterization

The risk characterization component of the human health risk screening evaluation involved the evaluation of different exposure pathways in more detail for chemicals that were identified as COPCs. For evaluating direct contact exposures to chemicals in soil, the chemical concentrations in soil were compared to risk-based concentrations (RBCs) in soil. For evaluating the soil to groundwater pathway, the maximum concentrations of chemicals were compared to RBCs in soil for protection of groundwater for DAFs of 1 and 20.

In this human health risk screening evaluation, calculated ILCRs were interpreted using the USEPA's "target range" (1×10^{-6} to 1×10^{-4}), and HIs will be evaluated using a value of 1.0. USEPA has defined the range of 1×10^{-6} to 1×10^{-4} as the ILCR "target range" for most hazardous waste facilities addressed under CERCLA and RCRA. IDEM has defined the same range for the nondefault evaluation under their RISC program. Individual or cumulative ILCRs greater than 1×10^{-4} will typically not be considered as protective of human health and ILCRs less than 1×10^{-6} will typically be regarded as protective. Risk management decisions are necessary when the ILCR is within the 1×10^{-4} to 1×10^{-6} cancer risk range.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organ effects associated with exposure to COPCs was performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) were regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

Calculation of Risks and Hazard Indices

For a number of exposure pathways, the risk characterization involved developing conservative estimates of cancer risks and noncancer HIs by comparing EPCs of COPCs to applicable RBCs. For cases in which a chemical exhibits both carcinogenic and non-carcinogenic human health effects, Tetra Tech used RBCs based on cancer and noncancer effects. For direct contact exposures to soil, Tetra Tech calculated risks and HIs for residential and non-residential uses of each site.

Human Health Effects – Carcinogens

Tetra Tech estimated the risk presented by carcinogenic COPCs by calculating the ILCR according to the following equation:

$$ILCR = \sum_{i=1}^{n} \left(\frac{C_i}{RBC_i} \text{ x } TRL \right)$$

where:

ILCR	=	Incremental lifetime cancer risk (unitless)
C_i	=	Maximum detected site concentration for compound i (mg/kg or µg/kg)
RBC_i	=	Risk-based concentration for compound i (mg/kg or µg/kg)
TRL	=	Target risk level used to calculate the RBCs (unitless)

To evaluate direct contact exposures to soil in a residential setting, Tetra Tech used USEPA's cancer-based RSLs for residential direct contact exposures to soil as the RBCs (USEPA, 2009). To evaluate direct contact exposures to soil in a non-residential setting, Tetra Tech used USEPA's noncancer-based RSLs for non-residential direct contact exposures to soil as the RBC In developing the non-residential RSLs, USEPA assumed direct contact exposures to soil by a worker 250 days per year for a total of 25 years (USEPA, 2009). The target risk level for calculating the residential and non-residential RSLs for direct contact exposures to soil is 10^{-6}. Table 3 provides the cancer-based residential and non-residential direct contact RBCs for soil.

Tetra Tech compared the calculated ILCR to the USEPA target range for carcinogenic risks of 10^{-4} to 10^{-6}, and a result greater than 10^{-4}, which corresponds with one individual developing cancer in their lifetime out of an exposed population of 10,000 people, is typically deemed an unacceptable risk. The calculated ILCR should serve as conservative risk estimates because the calculation presumes that an individual is exposed to the maximum concentration of each COPC present in an area of interest over a lifetime of exposure.

Human Health Effects – Non-Carcinogens

Tetra Tech estimated the health hazard presented by non-carcinogens by calculating the HQ and then calculating the HI by summing the individual HQs. The equations for HQs and the HI are as follows:

$$HQ_i = \frac{C_i}{RBC_i} \times THQ$$

$$HI = \sum_{i=1}^{n} HQ_i$$

where:

HQ	= Hazard quotient (unitless)
C_i	= Maximum detected site concentration (mg/kg)
RBC_i	= Risk-based concentration for compound i (mg/kg or µg/kg)
THQ	= Target hazard quotient used to calculate RBCs (unitless)
HI	= Hazard index (unitless)

To evaluate direct contact exposures to soil in a residential setting, Tetra Tech used USEPA's noncancer-based RSLs for residential direct contact exposures to soil as the RBCs (USEPA). To evaluate direct contact exposures to soil in a non-residential setting, Tetra Tech used USEPA's noncancer-based RSLs for non-residential direct contact exposures to soil as the RBCs, the target HQ for calculating the residential and non-residential RSLs for direct contact exposures to soil is 1. Table 3 provides the noncancer-based residential and non-residential direct contact RBCs for soil.

In general, USEPA regards HIs greater than 1 as unacceptable in terms of exposure risk. However, because various chemicals can have different mechanisms of action and affect different organs of the human body, a HI greater than 1 is not necessarily an unacceptable risk for non-carcinogenic effects. If the HI is greater than 1, the chemicals are separated into categories according to the human organ that

each primarily targets. HIs greater than 1 for any target organ are generally considered to represent unacceptable risk.

Human Health Effects from Exposures to Lead

USEPA uses pharmaco-kinetic models to evaluate concentrations of lead in the environment. Therefore, lead cannot be evaluated using the cancer risk and noncancer HI methodology described above. Instead, Tetra Tech evaluated lead concentrations separately from all other chemicals. For direct contact exposures to soil, Tetra Tech compared maximum lead concentrations to residential and non-residential screening levels in soil. Tetra Tech used the USEPA residential and industrial RSLs of 400 mg/kg and 800 mg/kg (USEPA, 2009), respectively and the IDEM residential and industrial direct contact values of 400 mg/kg and 1,300 mg/kg, respectively for evaluating exposures to lead in soil (IDEM, 2009).

Evaluation of the Soil to Groundwater Pathway

For evaluating the soil to groundwater pathway, Tetra Tech compared the maximum concentrations of COPCs in soil to RBCs in soil for protection of groundwater for a range of DAFs. As discussed previously, USEPA has developed two soil RSLs to be protective of groundwater, one based on the residential tap water RSL and the other based on the MCL (if available). USEPA derived both RSLs using a DAF of 1 (i.e., the leachate from soil with concentrations at or below the RSL should be safe to drink directly). This is a very conservative assumption, since leachate is rarely the only source of water to groundwater. For very large sites (hundreds of acres), leachate may be the predominant source of water in a water table aquifer, but for smaller sites, upgradient groundwater is often the main source of water in a water table aquifer. For such sites, a DAF greater than 1 is appropriate. In addition, many chemicals attenuate (i.e., experience changes) as they migrate with groundwater. Chemical processes acting on chemicals include biological degradation and abiotic reactions with other chemicals in soil and water (e.g., hydrolysis, precipitation). These attenuation processes can significantly reduce chemical concentrations in groundwater.

For this evaluation, Tetra Tech used the two soil RSLs determined using a DAF of 1 as RBCs. Tetra Tech also multiplied these RSLs by 20 to obtain RBCs in soil for a DAF of 20 and used these as additional RBCs in soil for protection of groundwater. Table 2 presents the RBCs in soil for evaluating the soil to groundwater pathway.

<u>Uncertainty Analysis</u>

Various uncertainties are associated with each step of the human health risk screening evaluation. Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the

grouping of samples taken from the site, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables, the determination of EPCs, and the predictions regarding future land use and potential receptors. Uncertainty in the toxicity assessment includes evidence for determining the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk screening process.

Although uncertainty exists from multiple sources, the direction of uncertainty can be influenced by decisions made throughout the risk screening evaluation; in general, assumptions are made so that the risk estimates are overestimated rather than underestimated. This is done in an effort to ensure that no unacceptable risk to potential receptors goes unrecognized.

Generally, risk evaluations include two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements (e.g., uncertainty associated with sample collection and analysis). The resulting risk screening evaluation reflects the accumulated variances of the individual values used. Informational uncertainty is due to unavailability of information needed to complete the toxicity and exposure assessments. Examples include the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or on the behavior of a chemical in a particular medium.

After the risk screening evaluation is complete, the uncertainty involved must be assessed to interpret the results. Reliance on results from a risk screening evaluation without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward overpredicting both carcinogenic risks and non-carcinogenic HIs. Thus, the results of the risk screening evaluation and the uncertainties associated with those estimates must be considered when making risk management decisions.

This interpretation is especially relevant when the risk estimates exceed the point of departure for defining “acceptable” risk. For example, when risks calculated using conservative assumptions to account for a high degree of uncertainty are less than an “acceptable” risk level, the interpretation of no significant risk is typically straightforward. However, when risks calculated using conservative assumptions to account

for a high degree of uncertainty exceed an “acceptable” risk level, a conclusion can be difficult unless uncertainty is considered.

Uncertainty in Selection of COPCs

The following issues may contribute to uncertainty in COPC selection for the five MRP sites: the existing database and the RSLs used. These issues are discussed below.

Existing Database

All laboratory analyzed soil data used for this risk screening evaluation were validated according to USEPA Region 5 data validation guidelines. Therefore, uncertainties associated with the quality of the data are considered to be minimal because no data were deemed unreliable due to laboratory non-compliances. Uncertainty attributed to sample collection is also considered to be minimal due to use of a site sampling plan designed with site characteristics in mind in an attempt to ensure adequate sample collection and to incorporate known and likely sources of contaminants.

COPC Screening Levels

Tetra Tech chose conservative soil screening levels for this evaluation. Using residential RSLs as RBSLs for direct contact exposures to soil is conservative because these sites are unlikely to be redeveloped for residential purposes.

The RBSLs used to select COPCs correspond to an ILCR of 10^{-6} and a HQ of 0.1. The use of these values ensures that chemicals are retained as COPCs that could possibly be contributors to risk for a site. The elimination of chemicals present at concentrations equal to or less than an ILCR of 10^{-6} and a HQ less than 0.1 should not affect the final conclusions of the risk screening evaluation because these chemicals are not expected to contribute significantly to the total cumulative risk or total cumulative HI. These RBSLs should result in all chemicals that could contribute significantly to the cumulative risk or cumulative HI being retained as COPCs.

Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises because of assumptions made about current and future land use, selection of potential human receptors, the methods used to calculate EPCs, and selection of exposure parameters.

Potential Receptors and Land Use

The current and future land uses at the sites vary. For this evaluation, residential land use was assumed when developing RBSLs. Also, for chemicals retained as COPCs, risks and HIs were calculated for a residential use scenario, which is conservative because it is likely that none of the five sites will be redeveloped for residential purposes. Risks and HIs were calculated for a generic non-residential use scenario to assess exposures for a more realistic future use scenario.

Exposure Point Concentrations

The maximum detected concentration of each COPC was used as the EPC to quantify potential risks. It is extremely unlikely that a receptor would be exposed to the maximum concentration of each COPC over the entire site area and the entire time spent at a site. Thus, the use of the maximum concentration likely results in overestimation of potential risks and HIs.

Exposure Parameters

The RBCs used to calculate risks and HIs for direct contact exposures to soil were USEPA RSLs. These RSLs are calculated using default exposure assumptions for residential and non-residential scenarios. These exposure assumptions are designed to conservatively estimate risks, and thus using these values leads to an overestimation of potential risks.

Uncertainty in the Toxicological Evaluation

Uncertainties in the toxicity assessment of COPCs arise from the determination of the oral cancer slope factors (CSFs), inhalation unit risks (IURs), oral reference doses (RfDs), and inhalation reference concentrations (RfCs) used to calculate RBCs. CSFs and IURs are upper-bound estimates of the probability of a response per unit of exposure to an individual. RfDs and RfCs are estimates of daily exposure to particular chemicals that are unlikely to result in harmful non-carcinogenic health effects even to members of sensitive populations. CSFs, IURs, RfDs and RfCs are estimated by USEPA from available animal or human toxicological data. These toxicity parameters are estimated so as to overestimate potential health effects and thus be conservative. The USEPA RSLs are based on the most recent CSFs, IURs, RfDs, and RfCs developed by USEPA. Because USEPA accounts for uncertainty due to toxicology by conservatively estimating CSFs, IURs, RfDs, and RfCs, the use of these toxicity parameters should result in an overestimation of risk in this human health risk screening evaluation.

Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the human body. Therefore, it may be inappropriate to assume that all effects are additive. However, the assumption of additivity is made to provide conservative estimates of cancer risks and noncancer HIs.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, the impact of this uncertainty on the risk screening evaluation cannot be determined because the uncertainty may result in either an underestimation or overestimation of potential human health risks.

The risk characterization also evaluates the soil to groundwater pathway. This evaluation involves comparing the maximum detected concentration to two RBCs, one using a DAF of 1, the other using a DAF of 20. The RBC using a DAF of 1 is very conservative because it assumes no dilution or attenuation occurs and the leachate is used directly as a source of drinking water. The RBC using a DAF of 20 is more realistic, since most chemicals experience some dilution and some attenuation (sometimes a great deal of dilution and attenuation). In fact, for chemicals that are readily degradable, the actual DAF could be 100, 1,000, or higher. Thus, for chemicals that react or degrade in the environment with maximum concentrations that exceed RBCs using a DAF of 20, it is possible that actual impacts to groundwater for these chemicals will be negligible. However, by comparing concentrations to the RBCs for the two DAFs, context is provided for the uncertainty in evaluating this pathway while still providing a conservative evaluation.

TABLE 1

HUMAN HEALTH SCREENING CRITERIA USED IN THE SELECTION OF CHEMICALS OF POTENTIAL CONCERN NAVAL SUPPORT ACTIVITY CRANE CRANE, INDIANA

CAS No.	Chemical	USEPA RSL[1] Residential Soil	IDEM RISC[2] Residential Direct Contact
PAHs (ug/kg)			
90-12-0	1-Methylnaphthalene	22,000 C	NA
91-57-6	2-Methylnaphthalene	310,000 N	630,000 N
83-32-9	Acenaphthene	3,400,000 N	9,500,000 N
208-96-8	Acenaphthylene	3,400,000 N[3]	1,100,000 N
120-12-7	Anthracene	17,000,000 N	47,000,000 N
--	Benzo(a)pyrene Equivalents	15 C	500 C
56-55-3	Benzo(a)anthracene	150 C	5,000 C
50-32-8	Benzo(a)pyrene	15 C	500 C
205-99-2	Benzo(b)fluoranthene	150 C	5,000 C
191-24-2	Benzo(g,h,i)perylene	1,700,000 N[4]	4,700,000 N[4]
207-08-9	Benzo(k)fluoranthene	1,500 C	50,000 C
218-01-9	Chrysene	15,000 C	500,000 C
53-70-3	Dibenzo(a,h)anthracene	15 C	500 C
206-44-0	Fluoranthene	2,300,000 N	6,300,000 N
86-73-7	Fluorene	2,300,000 N	6,300,000 N
193-39-5	Indeno(1,2,3-cd)pyrene	150 C	5,000 C
91-20-3	Naphthalene	3,600 C	3,200,000 N
85-01-8	Phenanthrene	1,700,000 N[4]	470,000 N
129-00-0	Pyrene	1,700,000 N	4,700,000 N
Dyes (ug/kg)			
128-80-3	Solvent Green 3	125,000 N[5]	
97-56-3	Solvent Yellow 3	130 C[5]	
8003-22-3	Solvent Yellow 33	3,100,000 N[5]	
Explosives (mg/kg)			
35572-78-2	2-Amino-4,6-Dinitrotoluene	150 N	NA
88-72-2	2-Nitrotoluene	2.9 C	NA
2691-41-0	HMX	3,800 N	NA
98-95-3	Nitrobenzene	4.8 C	91 N
55-63-0	Nitroglycerin	6.1 N	NA
121-82-4	RDX	5.5 C	NA
Inorganic (mg/kg)			
7440-36-0	Antimony	31 N	140 N
7440-38-2	Arsenic	0.39 C	3.9 C
7440-50-8	Copper	3,100 N	14,000 N
7439-92-1	Lead	400	400
7440-66-6	Zinc	23,000 N	100,000 N
Miscellaneous (ug/kg)			
14797-73-0	Perchlorate	55,000 N	NA

Notes:

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. [Cancer benchmark value = 1E-06, Hazard index (HI) = 1.0].

2 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].

3 - Acenaphthene is used as a surrogate for acenaphthylene.

4 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

5 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).

NA - Not available.

C - Carcinogenic.

N - Noncarcinogenic.

SSLs - Soil screening level.

TABLE 2

SCREENING CRITERIA FOR SOIL TO GROUNDWATER PATHWAY
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS No.	Chemical	USEPA RSL[1] Risk-Based SSLs		IDEM RISC[2] Migration to Groundwater
		DAF = 1	DAF = 20	
PAHs (ug/kg)				
90-12-0	1-Methylnaphthalene	12	240	NA
91-57-6	2-Methylnaphthalene	750	15,000	3,100
83-32-9	Acenaphthene	22,000	440,000	130,000
208-96-8	Acenaphthylene	22,000 [3]	440,000 [3]	18,000
120-12-7	Anthracene	360,000	7,200,000	2,700,000
--	Benzo(a)pyrene Equivalents	3.5	70	8,200
56-55-3	Benzo(a)anthracene	10	200	19,000
50-32-8	Benzo(a)pyrene	3.5	70	8,200
205-99-2	Benzo(b)fluoranthene	35	700	57,000
191-24-2	Benzo(g,h,i)perylene	120,000 [4]	2,400,000 [4]	4,600,000 [4]
207-08-9	Benzo(k)fluoranthene	350	7,000	570,000
218-01-9	Chrysene	1,100	22,000	1,900,000
53-70-3	Dibenzo(a,h)anthracene	11	220	18,000
206-44-0	Fluoranthene	160,000	3,200,000	6,300,000
86-73-7	Fluorene	27,000	540,000	170,000
193-39-5	Indeno(1,2,3-cd)pyrene	120	2,400	160,000
91-20-3	Naphthalene	0.47	9.4	700
85-01-8	Phenanthrene	120,000 [4]	2,400,000 [4]	13,000
129-00-0	Pyrene	120,000	2,400,000	4,600,000
Dyes (ug/kg)				
128-80-3	Solvent Green 3	NA	NA	NA
97-56-3	Solvent Yellow 3	NA	NA	NA
8003-22-3	Solvent Yellow 33	NA	NA	NA
Explosives (mg/kg)				
35572-78-2	2-Amino-4,6-Dinitrotoluene	0.056	1.12	NA
88-72-2	2-Nitrotoluene	0.00029	0.0058	NA
2691-41-0	HMX	2.3	46	NA
98-95-3	Nitrobenzene	0.000079	0.00158	0.028
55-63-0	Nitroglycerin	0.0016	0.032	NA
121-82-4	RDX	0.00023	0.0046	NA
Inorganic (mg/kg)				
7440-36-0	Antimony	0.66	13.2	5.4
7440-38-2	Arsenic	0.0013	0.026	5.8
7440-50-8	Copper	51	1,020	920
7439-92-1	Lead	14 [5]	280 [5]	81
7440-66-6	Zinc	680	13,600	14,000
Miscellaneous (ug/kg)				
14797-73-0	Perchlorate	NA	NA	NA

Notes:
1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
2 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009).
3 - Acenaphthene is used as a surrogate for acenaphthylene.
4 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
5 - A risk-based value is not available for lead so the MCL value is presented.
NA - Not available.
SSLs - Soil screening level.

TABLE 3

SCREENING CRITERIA USED IN ESTIMATING RISKS
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS No.	Chemical	USEPA RSLs[1]				Target Organ
		Residential		Industrial		
		Cancer (mg/kg)	Noncancer (mg/kg)	Cancer (mg/kg)	Noncancer (mg/kg)	
PAHs						
90-12-0	1-Methylnaphthalene	22	5,500	99	72,000	Respiratory System
91-57-6	2-Methylnaphthalene	NA	310	NA	4,100	Respiratory System
83-32-9	Acenaphthene	NA	3,400	NA	33,000	Liver
208-96-8	Acenaphthylene	NA	3,400 [2]	NA	33,000 [2]	Blood
120-12-7	Anthracene	NA	17,000	NA	170,000	No Observe Effect Level
--	Benzo(a)pyrene Equivalents	0.015	NA	0.21	NA	Cancer
191-24-2	Benzo(g,h,i)perylene	NA	1,700 [3]	NA	17,000 [3]	Kidney
206-44-0	Fluoranthene	NA	2,300	NA	22,000	Liver
86-73-7	Fluorene	NA	2,300	NA	22,000	Blood
91-20-3	Naphthalene	3.6	140	18	620	Body Weight
85-01-8	Phenanthrene	NA	1,700 [3]	NA	17,000 [3]	Kidney
129-00-0	Pyrene	NA	1,700	NA	17,000	Kidney
Dyes						
128-80-3	Solvent Green 3	NA	125 [4]	NA	1,250 [4]	Body Weight
97-56-3	Solvent Yellow 3	0.13 [4]	NA	0.45 [4]	NA	Cancer
8003-22-3	Solvent Yellow 33	NA	3,100 [4]	NA	31,000 [4]	No Observe Adverse Effects Level
Explosives						
35572-78-2	2-Amino-4,6-Dinitrotoluene	NA	150	NA	2,000	Liver
88-72-2	2-Nitrotoluene	2.9	70	13	920	Spleen
2691-41-0	HMX	NA	3,800	NA	49,000	Liver, Blood
98-95-3	Nitrobenzene	4.8	130	24	1,200	Blood
55-63-0	Nitroglycerin	29	6.1	100	62	Cardiovascular System
121-82-4	RDX	5.5	230	24	2,800	Prostate
Inorganic						
7440-36-0	Antimony	NA	31	NA	410	Blood
7440-38-2	Arsenic	0.39	22	1.6	260	Skin, Cardiovascular System
7440-50-8	Copper	NA	3,100	NA	41,000	Gastrointestinal System
7439-92-1	Lead	400		800		Neurological
7440-66-6	Zinc	NA	24,000	NA	310,000	Blood
Miscellaneous						
14797-73-0	Perchlorate	NA	55	NA	720	Thyroid

Notes:
1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. [Cancer benchmark value = 1E-06, Hazard index (HI) = 1.0].
2 - Acenaphthene is used as a surrogate for acenaphthylene.
3 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
4 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).
NA - Not available.
C - Carcinogenic.
N - Noncarcinogenic.
SSLs - Soil screening level.

APPENDIX F.1

B-143 Drop Test Area

F.1 HUMAN HEALTH RISK SCREENING EVALUATION

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at the AOC 1 – B-143 Drop Test Area. The human health risk screening followed the steps which presented the general methodology for the human health risk screening. These steps are:

- Identification of COPCs
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

F.1.1 Identification of Chemicals of Potential Concern

Tetra Tech identified human health COPCs in soil with the following considerations:

- Occurrence and distribution of chemicals in the environmental media
- Chemical toxicity
- Occurrence of chemical in background samples

Using the methodology described Tetra Tech compared the maximum concentration of each chemical in soil to risk-based screening levels based on direct contact exposures to soil and protection of groundwater. If the maximum concentration of a chemical exceeded the direct contact exposure criteria then that chemical was retained as a COPC and cancer risks and hazard indices were estimated for that chemical. The potential for chemicals to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration of each chemical to screening criteria for the protection of groundwater.

Soil samples at AOC 1 were only analyzed for lead. Appendix F, Table F-1.1 presents a comparison of the maximum detected concentrations of lead to USEPA and IDEM screening levels. The detected concentrations of lead in all samples were less than the screening criteria; therefore lead is not retained as a direct contact COPC in soil at AOC 1.

F.1.2 Exposure Assessment

Details on the site background, physical setting, previous investigations, and hazard identification were presented in Section 4.1. Summarizing the information from Section 4.1, the B-143 Drop Test Area was

used from 1968 to 1980 for testing inert Mk 118 Mod 0, Rockeye bomblets. Quantities of munitions tested at the B-143 Drop Test Area are unknown. During its period of use, the B-143 Drop Test Area consisted of a 40-foot drop tower, a test building, and a concrete drop pad located adjacent to the building. The test building and concrete drop pad have been removed from the site, and it is assumed that any remaining ordnance would also have been disposed of at the time of their removal; however, no removal records have been located.

At present, the only evidence that remained of the former test area was a slight depression located in a clearing at the center of a lightly wooded area with young trees and sparse undergrowth. The former drop tower location is overgrown with vegetation and covered with leaf litter. No change in land use of the adjacent areas is anticipated. There are no access controls or restrictions in place to limit access to the B-143 Drop Test Area, and upon access to the installation, Navy personnel, contractors, and visitors are not specifically restricted from the former drop test area. The B-143 Drop Test Area is located at the top of a ridge that slopes to the southeast. An unnamed tributary to Boggs Creek is located at the base of the ridge, which receives surface water runoff from the B-143 Drop Test Area. The B-143 Drop Test Area is located in the central drainage basin.

Soils present at this site are well to moderately drained, and contaminants could infiltrate into subsurface soil and ultimately leach from soil into groundwater. Additional, although unlikely, migration pathways would include storm water runoff that could transport contaminated surface soil, affecting nearby soil and possibly the unnamed tributary at the bottom of the ridge. Contaminant dilution would occur during overland transport.

Current human receptors at B-143 Drop Test Area that could come into contact with soil include military and civilian personnel, contractors, trespassers, and hunters.

F.1.3 Risk Characterization

Concentrations of lead in all soil samples were less than the USEPA and IDEM residential direct contact screening criteria. Therefore, no adverse risks are anticipated from exposures to lead in soil.

F.1.4 Evaluation of the Soil to Groundwater Pathway

Using the procedures presented Tetra Tech evaluated the soil to groundwater pathway for COPCs in the surface and subsurface soil samples. Appendix F, Table F-1.2 presents the comparison of the maximum detected concentration for lead to the screening criteria for the protection of migration from soil to groundwater. Detected concentrations of lead exceeded the screening criteria; therefore lead was

retained as a COPC for the migration from soil to groundwater pathway. Concentrations of lead in soil samples exceed the USEPA SSL based on a DAF of 1 in 5 of 8 samples but were less than the EPA SSL based on a DAF of 20 in all samples. The maximum detected concentration of lead in soil also exceeded the IDEM migration from soil to groundwater value in one sample. Concentrations of lead only exceeded the background concentration of lead in two samples. This indicates that there is not a large source area of lead contamination at AOC 1 and therefore concentrations of lead in soil are not expected to adversely impact groundwater. As noted above, groundwater from the AOC 1 is not used as a source of drinking water, so the pathway is currently incomplete.

F.1.5 Uncertainty Analysis

The methodology provides a detailed discussion of the sources of uncertainty in the human health risk screening evaluation.

F.1.6 Human Health Risk Screening Evaluation Summary

In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the B-143 Drop Test Area. Soil samples were only analyzed for lead. The detected concentrations of lead in all samples were less than the USEPA and IDEM direct contact screening criteria; therefore lead was not retained as a direct contact COPC in soil at AOC 1.

Concentrations of lead in soil samples exceeded the USEPA SSL for migration from soil to groundwater based on a DAF of 1 in 5 of 8 samples but were less than the EPA SSL based on a DAF of 20 in all samples. The maximum detected concentration of lead in soil also exceeded the IDEM migration from soil to groundwater value in one sample. This indicates that there is not a large source area of lead contamination at AOC 1 and therefore concentrations of lead in soil are not expected to adversely impact groundwater. Groundwater from the AOC 1 is not used as a source of drinking water, so the pathway is currently incomplete.

TABLE F-1.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SOIL
AOC 1 - B-143 DROP TEST AREA
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Residential(5)	IDEM RISC Direct Contact(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
AOC 1	**Inorganics**													
	7439-92-1	Lead	11.9	164	mg/kg	A1SS010G0002	8/8	-	164	27	400	400	No	BSL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A1SS001G0002
A1SS003G0002
A1SS004G0002
A1SS006G0002
A1SS010G0002
A1SS013G0002
A1SS015G0002
A1SS018G0002

Definitions:
COPC = Chemical Of Potential Concern
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE F-1.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER
AOC 1 - B-143 DROP TEST AREA
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Migration from Soil to Groundwater(5)		IDEM RISC Migration from Soil to Groundwater(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
											DAF = 1	DAF = 20			
AOC 1	**Inorganics**														
	7439-92-1	**Lead**	11.9	164	mg/kg	A1SS010G0002	8/8	-	164	**27**	**14**	280	**81**	**Yes**	ASL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May, 1 2009).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A1SS001G0002
A1SS003G0002
A1SS004G0002
A1SS006G0002
A1SS010G0002
A1SS013G0002
A1SS015G0002
A1SS018G0002

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

APPENDIX F.2

Pyro Area Outside Test Burn Pads

F.2 HUMAN HEALTH RISK SCREENING EVALUATION

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at the AOC 2 – Pyro Area Outside Test Burn Pad. The human health risk screening followed the steps which presented the general methodology for the human health risk screening. These steps are:

- Identification of COPCs
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

F.2.1 Identification of Chemicals of Potential Concern

Tetra Tech identified human health COPCs in soil with the following considerations:

- Occurrence and distribution of chemicals in the environmental media
- Chemical toxicity
- Occurrence of chemical in background samples

Using the methodology described Tetra Tech compared the maximum concentration of each chemical in soil to risk-based screening levels based on direct contact exposures to soil and protection of groundwater. If the maximum concentration of a chemical exceeded the direct contact exposure criteria then that chemical was retained as a COPC and cancer risks and hazard indices were estimated for that chemical. The potential for chemicals to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration of each chemical to screening criteria for the protection of groundwater.

Soil samples at AOC 2 were analyzed for explosives, dyes, and perchlorate. Four explosives, two dyes, and perchlorate were detected in the soil samples collected at AOC 2. Two soil samples (A2SS001C0001 and A2SS002C0001) were collected from within concrete basins and are more representative of material disposed of in the basins than in surrounding soil. Therefore these two samples will be evaluated separately. Appendix F, Table F-2.1 presents a comparison of the maximum detected concentrations of chemicals in soil samples collected outside of the concrete basins to USEPA and IDEM screening levels. Solvent green 3 was the only chemical detected at concentrations exceeding the direct contact risk-based COPC screening levels and was retained as a COPC for soil from outside the concrete basins at AOC 2. Solvent green was only detected in one soil sample at AOC 2.

Appendix F, Table F-2.2 presents a comparison of the maximum detected concentrations of chemicals in soil samples collected inside of the concrete basins to USEPA and IDEM screening levels. Solvent green 3 and solvent yellow 3 were the only chemicals detected at concentrations exceeding the direct contact risk-based COPC screening levels and were retained as a COPC for soil from inside the concrete basins at AOC 2.

F.2.2 Exposure Assessment

Details on the site background, physical setting, previous investigations, and hazard identification were presented in Section 5.1. Summarizing the information from Section 5.1, the Pyro Area Outside Test Burn Pad consists of two square concrete basins (approximately 6-feet by 6-feet and approximately 30 feet apart) used from 1984 to 1985 to test various types of pyrotechnics that were developed at NSA Crane, such as flares, signals, and screening smokes. The depths of the basins are unknown because they are partially filled with dirt and ash. The walls of the basins are approximately 2 to 3 feet above the ground surface and are in poor condition. It is unknown whether the concrete basins have solid concrete bottoms. During the TtNUS site visit (2009), large chunks of concrete were observed inside the basins.

A fence surrounds the entire area of the pyrotechnics testing and assembly area in which the Pyro Area outside the Test Burn Pad is located. The fencing limits access to the pyrotechnics construction buildings and prohibits access to the area. The area also has a 24-hour security guard who controls access.

Currently, the site is vacant and the immediate surrounding areas are used for storage. The land use for the site and surrounding areas is not anticipated to change for the foreseeable future.

The Pyro Area Outside Test Burn Pad is located within the central portion of the installation in the central drainage basin. Surface water runoff from the site drains south into an unnamed tributary that flows southwest into Boggs Creek

Current human receptors at this site that could come into contact with contamination in soil include military and civilian personnel, contractors, and visitors

F.2.3 Risk Characterization

Soils Outside of the Concrete Basins

ILCRs and HIs were estimated for the identified COPCs using the methodology presented. Appendix F, Tables F-2.3 and F-2.4 presents the ILCRs and HIs for exposures to soil by residents and industrial

workers, respectively. HIs of 1 for residential exposures and 0.1 for industrial exposures are less than or equal to unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions. There are no carcinogenic toxicity criteria available for the identified COPCs therefore ILCRs could not be calculated.

Soils on the Concrete Basins

Appendix F, Tables F-2.5 and F-2.6 presents the ILCRs and HIs for exposures to soil on the concrete basins by residents and industrial workers, respectively. The HI of 3 for residential exposures exceeds the acceptable level of 1. Solvent Green 3 (HI = 3) was the major contributor to the HI for residential exposures. The HI of 0.3 for industrial exposures is less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for industrial exposures under the defined exposure conditions.

The ILCR of 3×10^{-4} for residential exposures exceeds USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}. Solvent yellow 3 (ILCR = 3×10^{-4}) was the major contributor to the ILCR for residential exposures. The ILCR of 9×10^{-5} for industrial exposures is within USEPA's and IDEM's target risk range.

It is very unlikely that future residents would be exposed to soil collected from within the concrete basins. In the future if the site was developed for residential use then the concrete basins would be removed. It is also unlikely that industrial workers would have prolonged contact with the soil in the concrete basins. Therefore, the ILCRs and HIs calculated for potential exposures to soil in the concrete basins are very conservative and are presented to aid in risk management decisions.

F.2.4 Evaluation of the Soil to Groundwater Pathway

Using the procedures presented Tetra Tech evaluated the soil to groundwater pathway for COPCs in the surface and subsurface soil samples. Appendix F, Table F-2.7 presents the comparison of the maximum detected concentration in soil samples collected outside of the concrete basins to the screening criteria for the protection of migration from soil to groundwater. RDX was the only chemical detected at concentrations exceeding the screening criteria therefore RDX was retained as a COPC for the migration from to soil groundwater at AOC 2. RDX was only detected in one soil sample and the detected concentration exceeded the USEPA's SSLs based on DAFs of 1 and 20. There is no IDEM migration from soil to groundwater value for RDX. The available data indicates there is not a significant source area of RDX in soils at AOC 2 therefore the single detected concentration of RDX is not expected to adversely impact groundwater at AOC 2. As noted above, groundwater from the AOC 2 is not used as a source of drinking water, so the pathway is currently incomplete.

Appendix F, Table F-2.8 presents the comparison of the maximum detected concentration in soil samples collected from inside of the concrete basins to the screening criteria for the protection of migration from soil to groundwater. The following chemicals were detected at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for soil inside the concrete basins at AOC 2.

Explosives [2-amino-4, 6-dinitrotoluene, 2-nitrotoluene, nitrobenzene, and nitroglycerin]

Nitrobenzene exceeded the USEPA SSLs based on DAFs of 1 and 20 and the IDEM migration from soil to groundwater criteria. Concentrations of 2-amino-4, 6-dinitrotoluene exceeded the USEPA SSL based on a DAF of 1 but were less than the SSL based on a DAF of 20. Concentrations of 2-nitrotoluene and nitroglycerin exceeded the USEPA's SSLs based on DAFs of 1 and 20. There are no IDEM migration from soil to groundwater value for 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, and nitroglycerin.

F.2.5 Uncertainty Analysis

The methodology provides a detailed discussion of the sources of uncertainty in the human health risk screening evaluation.

F.2.6 Human Health Risk Screening Evaluation Summary

In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the AOC 2 – Pyro Area Outside Test Burn Pad as well as for soil samples collected within the concrete basins. Soil samples at AOC 2 were analyzed for explosives, dyes, and perchlorate. Two soil samples (A2SS001C0001 and A2SS002C0001) were collected from within concrete basins and are more representative of material disposed of in the basins than in surrounding soil. Therefore these two samples were evaluated separately. Solvent green 3 was the only chemical detected at concentrations exceeding the USEPA and IDEM direct contact risk-based COPC screening levels and was retained as a COPC for soil from outside the concrete basins at AOC 2. Solvent green 3 and solvent yellow 3 were the only chemicals detected at concentrations exceeding the USEPA and IDEM direct contact risk-based COPC screening levels and were retained as COPCs for soil from inside the concrete basins at AOC 2.

HIs for residential and industrial exposures to soil outside of the concrete basins were less than or equal to unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions. There are no carcinogenic toxicity criteria available for the identified COPCs in soil from outside the concrete basins; therefore ILCRs could not be calculated.

The HI for residential exposures to soil inside of the concrete basins exceeds the acceptable level of 1. Solvent Green 3 was the major contributor to the HI for residential exposures. The HI for industrial exposures to soil inside of the concrete basins was less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated for industrial exposures under the defined exposure conditions. The ILCR for residential exposures to soil inside of the concrete basins exceeded the USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}. Solvent yellow 3 was the major contributor to the ILCR for residential exposures. The ILCR for industrial exposures to soil inside of the concrete basins was within USEPA's and IDEM's target risk range. It is very unlikely that future residents would be exposed to soil collected from within the concrete basins. In the future if the site was developed for residential use then the concrete basins would be removed. It is also unlikely that industrial workers would have prolonged contact with the soil in the concrete basins. Therefore, the ILCRs and HIs calculated for potential exposures to soil in the concrete basins are very conservative and are presented to aid in risk management decisions.

RDX was the only chemical detected in soil from outside the concrete basins at concentrations exceeding the screening criteria for the protection of migration from soil to groundwater; therefore RDX was retained as a COPC for the migration from to soil groundwater at AOC 2. RDX was only detected in one soil sample and the detected concentrations exceeded the USEPA's SSLs based on DAFs of 1 and 20. The available data indicates there is not a significant source area of RDX in soils at AOC 2 therefore the single detected concentration of RDX is not expected to adversely impact groundwater at AOC 2. Groundwater from the AOC 6 is not used as a source of drinking water, so the pathway is currently incomplete.

The following chemicals were detected in soil from inside the concrete basins at concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for soil inside the concrete basins at AOC 2.

Explosives [2-amino-4, 6-dinitrotoluene, 2-nitrotoluene, nitrobenzene, and nitroglycerin]

Nitrobenzene exceeded the USEPA SSLs based on DAFs of 1 and 20 and the IDEM migration from soil to groundwater criteria. Concentrations of 2-amino-4, 6-dinitrotoluene exceeded the USEPA SSL based on a DAF of 1 but were less than the SSL based on a DAF of 20. Concentrations of 2-nitrotoluene and nitroglycerin exceeded the USEPA SSLs based on DAFs of 1 and 20.

TABLE F-2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SOIL
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Residential(5)	IDEM RISC Direct Contact(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
AOC 2	**Explosives**													
	2691-41-0	HMX	0.038 J	0.059 J	mg/kg	A2SB005G0406	2/10	0.062 - 0.062	0.059	NA	380 N	NA	No	BSL
	121-82-4	RDX	0.076 J	0.076 J	mg/kg	A2SB008G0406	1/6	0.062 - 0.062	0.076	NA	5.5 C	NA	No	BSL
	Dyes													
	128-80-3	**Solvent Green 3**	176,035 J	176,035 J	ug/kg	A2SS012G0002	1/10	3489.5 - 3489.5	176,035	NA	**12,500 N(8)**	NA	**Yes**	ASL
	Miscellaneous													
	14797-73-0	Perchlorate	0.25 J	5.5	ug/kg	A2SB008G0406	10/10	-	5.5	NA	5,500 N	NA	No	BSL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for explosives, dyes, and perchlorate.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A2SB003G0406
A2SB004G0406
A2SB005G0406
A2SB006G0406
A2SB007G0406
A2SB008G0406
A2SB009G0406
A2SB010G0406
A2SS011G0002
A2SS012G0002

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE F-2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT SOIL IN CONCRETE BASINS
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD - CONCRETE BASINS
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Residential(5)	IDEM RISC Direct Contact(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
Basins	**Explosives**													
	35572-78-2	2-Amino-4,6-Dinitrotoluene	0.071 J	0.071 J	mg/kg	A2SS002C0001	1/2	0.062 - 0.062	0.071	NA	15 N	NA	No	BSL
	88-72-2	2-Nitrotoluene	0.067 J	0.067 J	mg/kg	A2SS001C0001	1/2	0.062 - 0.062	0.067	NA	2.9 C	NA	No	BSL
	98-95-3	Nitrobenzene	0.044 J	0.044 J	mg/kg	A2SS002C0001	1/2	0.062 - 0.062	0.044	NA	4.8 C	91 N	No	BSL
	55-63-0	Nitroglycerin	0.13 J	0.13 J	mg/kg	A2SS002C0001	1/2	0.21 - 0.21	0.13	NA	0.61 N	NA	No	BSL
	Dyes													
	128-80-3	**Solvent Green 3**	305,027 J	402,177 J	ug/kg	A2SS002C0001	2/2	-	402,177	NA	**12,500 N(8)**	NA	**Yes**	ASL
	97-56-3	**Solvent Yellow 3**	40,446 J	40,446 J	ug/kg	A2SS002C0001	1/2	973 - 973	40,446	NA	**130 C(8)**	NA	**Yes**	ASL
	Miscellaneous													
	14797-73-0	Perchlorate	3.2	5	ug/kg	A2SS001C0001	2/2	-	5	NA	5,500 N	NA	No	BSL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - No background data is available for explosives, dyes, and perchlorate.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A2SS001C0001
A2SS002C0001

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE F-2.3

SUMMARY OF HYPOTHETICAL FUTURE RESIDENTIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	Residential Media Cleanup Standard[1] (mg/kg)	Estimated ILCR	Primary Target Organs	Residential Media Cleanup Standard[1] (mg/kg)	Estimated HQ
Dyes							
128-80-3	Solvent Green 3	176	NA	--	Body Weight	125	1
			Total Carcinogenic Risk	**--**		**Total HI - All Chemicals**	**1**

Footnotes:
NA - Not applicable. A cancer slope factor (CSF) is not available for solvent green 3.
1 - TtNUS, August 2000, September 2000.

TABLE F-2.4

SUMMARY OF INDUSTRIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	Industrial Media Cleanup Standard[1] (mg/kg)	Estimated ILCR	Primary Target Organs	Industrial Media Cleanup Standard[1] (mg/kg)	Estimated HQ
Dyes							
128-80-3	Solvent Green 3	176	NA	--	Body Weight	1,250	0.1
			Total Carcinogenic Risk	**--**		**Total HI - All Chemicals**	**0.1**

Footnotes:
NA - Not applicable. A cancer slope factor (CSF) is not available for solvent green 3.
1 - TtNUS, August 2000, September 2000.

TABLE F-2.5

SUMMARY OF HYPOTHETICAL FUTURE RESIDENTIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL IN CONCRETE BASINS
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	Residential Media Cleanup Standard[1] (mg/kg)	Estimated ILCR	Primary Target Organs	Residential Media Cleanup Standard[1] (mg/kg)	Estimated HQ
Dyes							
128-80-3	Solvent Green 3	402	NA	--	Body Weight	125	3
97-56-3	Solvent Yellow 3	40.4	0.13	3E-04	--	NA	--
			Total Carcinogenic Risk	**3E-04**		**Total HI - All Chemicals**	**3**

Footnotes:
NA - Not applicable. A cancer slope factor (CSF) is not available for solvent green 3 and a reference dose (RfD) is not available for solvent yellow 3.
1 - TtNUS, August 2000, September 2000.

TABLE F-2.6

SUMMARY OF INDUSTRIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL IN CONCRETE BASINS
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	Industrial Media Cleanup Standard[1] (mg/kg)	Estimated ILCR	Primary Target Organs	Industrial Media Cleanup Standard[1] (mg/kg)	Estimated HQ
Dyes							
128-80-3	Solvent Green 3	402	NA	--	Body Weight	1,250	0.3
97-56-3	Solvent Yellow 3	40.4	0.45	9E-05	--	NA	--
			Total Carcinogenic Risk	**9E-05**		**Total HI - All Chemicals**	**0.3**

Footnotes:
NA - Not applicable. A cancer slope factor (CSF) is not available for solvent green 3 and a reference dose (RfD) is not available for solvent yellow 3.
1 - TtNUS, August 2000, September 2000.

TABLE F-2.7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Migration from Soil to Groundwater(5)		IDEM RISC Migration from Soil to Groundwater(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
											DAF = 1	DAF = 20			
AOC 2	**Explosives**														
	2691-41-0	HMX	0.038 J	0.059 J	mg/kg	A2SB005G0406	2/10	0.062 - 0.062	0.059	NA	2.3	46	NA	No	BSL
	121-82-4	**RDX**	0.076 J	0.076 J	mg/kg	A2SB008G0406	1/6	0.062 - 0.062	0.076	NA	**0.00023**	**0.0046**	NA	**Yes**	ASL
	Dyes														
	128-80-3	Solvent Green 3	176,035 J	176,035 J	ug/kg	A2SS012G0002	1/10	3489.5 - 3489.5	176,035	NA	NA	NA	NA	No	NTX
	Miscellaneous														
	14797-73-0	Perchlorate	0.25 J	5.5	ug/kg	A2SB008G0406	10/10	-	5.5	NA	NA	NA	NA	No	NTX

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
4 - No background data is available for explosives, dyes, and perchlorate.
4 - To determine whether chemical concentrations were within background levels, a statistical analysis was conducted using the site and background datasets.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May, 1 2009).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level
and is statistically determined to be greater than site background.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A2SB003G0406
A2SB004G0406
A2SB005G0406
A2SB006G0406
A2SB007G0406
A2SB008G0406
A2SB009G0406
A2SB010G0406
A2SS011G0002
A2SS012G0002

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level
NTX = No toxicity criteria

TABLE F-2.8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER - SOIL IN CONCRETE BASINS
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD - CONCRETE BASINS
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Scenario Timeframe:
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Migration from Soil to Groundwater(5)		IDEM RISC Migration from Soil to Groundwater(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
											DAF = 1	DAF = 20			
Basins	**Explosives**														
	35572-78-2	**2-Amino-4,6-Dinitrotoluene**	0.071 J	0.071 J	mg/kg	A2SS002C0001	1/2	0.062 - 0.062	0.071	NA	**0.056**	1.12	NA	**Yes**	ASL
	88-72-2	**2-Nitrotoluene**	0.067 J	0.067 J	mg/kg	A2SS001C0001	1/2	0.062 - 0.062	0.067	NA	**0.00029**	**0.0058**	NA	**Yes**	ASL
	98-95-3	**Nitrobenzene**	0.044 J	0.044 J	mg/kg	A2SS002C0001	1/2	0.062 - 0.062	0.044	NA	**0.000079**	**0.00158**	**0.028**	**Yes**	ASL
	55-63-0	**Nitroglycerin**	0.13 J	0.13 J	mg/kg	A2SS002C0001	1/2	0.21 - 0.21	0.13	NA	**0.0016**	**0.032**	NA	**Yes**	ASL
	Dyes														
	128-80-3	Solvent Green 3	305,027 J	402,177 J	ug/kg	A2SS002C0001	2/2	-	402,177	NA	NA	NA	NA	No	NTX
	97-56-3	Solvent Yellow 3	40,446 J	40,446 J	ug/kg	A2SS002C0001	1/2	973 - 973	40,446	NA	NA	NA	NA	No	NTX
	Miscellaneous														
	14797-73-0	Perchlorate	3.2	5	ug/kg	A2SS001C0001	2/2	-	5	NA	NA	NA	NA	No	NTX

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
4 - No background data is available for explosives, dyes, and perchlorate.
4 - To determine whether chemical concentrations were within background levels, a statistical analysis was conducted using the site and background datasets.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May, 1 2009).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level
and is statistically determined to be greater than site background.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
A2SS001C0001
A2SS002C0001

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level
NTX = No toxicity criteria

APPENDIX F.3

Test Pads on Hill Behind B-198

F.3 HUMAN HEALTH RISK SCREENING EVALUATION

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at the UXO 6 – Test Pads behind Building 198. The human health risk screening followed the steps which presented the general methodology for the human health risk screening. These steps are:

- Identification of COPCs
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

F.3.1 Identification of Chemicals of Potential Concern

Tetra Tech identified human health COPCs in soil with the following considerations:

- Occurrence and distribution of chemicals in the environmental media
- Chemical toxicity
- Occurrence of chemical in background samples

Using the methodology described Tetra Tech compared the maximum concentration of each chemical in soil to risk-based screening levels based on direct contact exposures to soil and protection of groundwater. If the maximum concentration of a chemical exceeded the direct contact exposure criteria then that chemical was retained as a COPC and cancer risks and hazard indices were estimated for that chemical. The potential for chemicals to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration of each chemical to screening criteria for the protection of groundwater.

Soil samples at UXO 6 were analyzed for dyes and explosives. The dye, solvent yellow 33, and the explosives; HMX, nitrobenzene, and RDX were the only chemicals detected in the soil samples from UXO 6. Appendix F, Table F-3.1 presents a comparison of the maximum detected concentrations of chemicals to USEPA and IDEM screening levels. The detected concentrations of all chemicals were less than the screening criteria; therefore no chemical was retained as a direct contact COPC for soil at UXO 6.

F.3.2 Exposure Assessment

Details on the site background, physical setting, previous investigations, and hazard identification were presented in Section 8.1. Summarizing the information from Section 8.1, the Test Pads on Hill behind

B-198 site situated in the middle of a cleared woodland area covered with various types of wild grasses and other vegetation in the west-central portion of NSA Crane. The Test Pads on Hill behind B-198 are separated from B-198 (which is currently used for research and development) by approximately 2,000 feet of grass and woodlands.

There are no known zoning/land use restrictions for the Test Pads on Hill Behind B-198; however, the land use of the site and surrounding areas is not anticipated to change for the foreseeable future. Although access to NSA Crane is restricted, there are no controls or restrictions in place to limit specific access to the Test Pads on Hill behind B-198. Because B-198 is a research and development building, individuals within the area are required to check in with personnel located inside B-198.

The site's circular sand test pads, constructed from non-native sand with a reported approximate thickness of 6 inches, were used from 1983 through 1985 to develop and test safe disposal methods for various types of dyes. The sand provided a barrier to prevent surface soil penetration of explosives and dyes. A plastic liner and a series of flexible slotted plastic drain pipes were placed beneath the sand pads to intercept infiltrating rainwater and liquids. A concrete holding tank located east of the pads at a lower elevation was used for potential contamination containment.

During the 2009 TtNUS site visit, features observed included plastic sheeting and slotted drainage piping exposed at the ground surface. Most of the sand material that had previously been on the test pads appeared to have been scraped off the test pads and pushed into a mound located immediately north of the test pad site. This sand mound contained visible metallic debris which may be related to the testing of 2.75-inch warheads.

Surface water runoff from the site drains south into an unnamed tributary which flows southwest into Boggs Creek. The Test Pads on Hill behind B-198 lie within the central drainage basin.

Contaminants, if present, may migrate through the remnants of the broken drain system and discharge to the surface soil near the former collection tank. Potential contaminants could infiltrate into subsurface soil and ultimately leach from the soil into the groundwater. An additional migration pathway may be storm water run-off that could have transported contaminated surface soil to a location downgradient of the sand pads and the sand mound which could affect nearby soil and groundwater and possibly the unnamed tributary which discharges into Boggs Creek. Contaminant dilution would occur during overland transport.

Current human receptors at this site that could come into contact with contamination in soil include military and civilian personnel, contractors, trespassers, and hunters.

F.3.3 Risk Characterization

Concentrations of chemicals in all soil samples were less than the USEPA and IDEM direct contact screening criteria. Therefore, no adverse risks are anticipated from exposures to soil at UXO 6.

F.3.4 Evaluation of the Soil to Groundwater Pathway

Using the procedures presented Tetra Tech evaluated the soil to groundwater pathway for COPCs in the surface and subsurface soil samples. Appendix F, Table F-3.2 presents the comparison of the maximum detected concentration to the screening criteria for the protection of migration from soil to groundwater. Concentrations of nitrobenzene and RDX exceeded the screening criteria and therefore these chemicals were retained as COPCs for migration from soil to groundwater at UXO 6. Nitrobenzene was only detected in one sample. The detected concentration of nitrobenzene exceeded the USEPA SSLs based on DAFs of 1 and 20 and the IDEM migration from soil to groundwater criteria. While the detected concentration of nitrobenzene exceeded the screening criteria for migration from soil to groundwater, the available data indicates there is not a significant source area of nitrobenzene contamination at UXO 6. Consequently, the single detected concentration of nitrobenzene in soil is not expected to adversely impact groundwater. RDX was detected in 5 samples. Concentrations of RDX exceeded the USEPA SSLs based on DAFs of 1 and 20 in all samples in which it was detected. There is no IDEM migration from soil to groundwater value for RDX. As noted above, groundwater from the UXO 6 is not used as a source of drinking water, so the pathway is currently incomplete.

F.3.5 Uncertainty Analysis

The methodology provides a detailed discussion of the sources of uncertainty in the human health risk screening evaluation.

F.3.6 Human Health Risk Screening Evaluation Summary

In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the Test Pads behind Building 198. Soil samples at UXO 6 were analyzed for dyes and explosives. The detected concentrations of all chemicals were less than the USEPA and IDEM direct contact screening criteria; therefore no chemical was retained as a direct contact COPC for soil at UXO 6.

Concentrations of nitrobenzene and RDX exceeded the screening criteria for protection of migration from soil to groundwater and therefore these chemicals were retained as COPCs. Nitrobenzene was only detected in one sample and the detected concentration exceeded the USEPA SSLs based on DAFs of 1 and 20 and the IDEM migration from soil to groundwater criteria. While the detected concentration of

nitrobenzene exceeded the screening criteria for migration from soil to groundwater, the available data indicates there is not a significant source area of nitrobenzene contamination at UXO 6. Consequently, the single detected concentration of nitrobenzene in soil is not expected to adversely impact groundwater. Concentrations of RDX exceeded the USEPA SSLs based on DAFs of 1 and 20 in all samples in which it was detected. Groundwater from the UXO 6 is not used as a source of drinking water, so the pathway is currently incomplete.

TABLE F-3.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SOIL
UX0 6 - TEST PADS BEHIND BUILDING 198
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(2)	Concentration Used for Screening(3)	Range of Background Concentrations(4)	USEPA RSL Residential(5)	IDEM RISC Direct Contact(6)	COPC Flag	Rationale for Contaminant Deletion or Selection(7)
UXO 6	**Dyes**													
	8003-22-3	Solvent Yellow 33	122,929 J	122,929 J	ug/kg	X6SS003C0001	1/12	687.5 - 687.5	122,929	NA	310,000 N(8)	NA	No	BSL
	Explosives													
	2691-41-0	HMX	0.04 J	0.04 J	mg/kg	X6SS008G0002	1/12	0.062 - 0.062	0.04	NA	380 N	NA	No	BSL
	98-95-3	Nitrobenzene	0.094 J	0.094 J	mg/kg	X6SS006G0002	1/11	0.062 - 0.062	0.094	NA	4.8 C	91 N	No	BSL
	121-82-4	RDX	0.089 J	0.16 J	mg/kg	X6SS003C0001	5/11	0.062 - 0.062	0.16	NA	5.5 C	NA	No	BSL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
X6SS001C0001
X6SS002C0001
X6SS003C0001
X6SS004C0001
X6SS005G0002
X6SS006G0002
X6SS007G0002
X6SS008G0002
X6SS009G0001
X6SS010G0002
X6SS011C0002
X6SS012C0002

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level

TABLE F-3.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER
UX0 6 - TEST PADS BEHIND BUILDING 198
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Range of Background Concentrations[4]	USEPA RSL Migration from Soil to Groundwater[5]		IDEM RISC Migration from Soil to Groundwater[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
											DAF = 1	DAF = 20			
UXO 6	**Dyes**														
	8003-22-3	Solvent Yellow 33	122,929 J	122,929 J	ug/kg	X6SS003C0001	1/12	687.5 - 687.5	122,929	NA	NA	NA	NA	No	NTX
	Explosives														
	2691-41-0	HMX	0.04 J	0.04 J	mg/kg	X6SS008G0002	1/12	0.062 - 0.062	0.04	NA	2.3	46	NA	No	BSL
	98-95-3	**Nitrobenzene**	0.094 J	0.094 J	mg/kg	X6SS006G0002	1/11	0.062 - 0.062	0.094	NA	**0.000079**	**0.00158**	**0.028**	**Yes**	ASL
	121-82-4	**RDX**	0.089 J	0.16 J	mg/kg	X6SS003C0001	5/11	0.062 - 0.062	0.16	NA	**0.00023**	**0.0046**	NA	**Yes**	ASL

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May, 1 2009).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Human Health Media Cleanup Standard (TtNUS, August 2000, September 2000).
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples
X6SS001C0001
X6SS002C0001
X6SS003C0001
X6SS004C0001
X6SS005G0002
X6SS006G0002
X6SS007G0002
X6SS008G0002
X6SS009G0001
X6SS010G0002
X6SS011C0002
X6SS012C0002

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BSL = Below COPC Screening Level
NTX = No toxicity criteria

APPENDIX F.4

Lake Oberlin

F.4 HUMAN HEALTH RISK SCREENING EVALUATION

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at the AOC 4 – Lake Oberlin. Since there were no exceedences for any of the chemicals, there are no associated Human Health information.

APPENDIX F.5

West Gate Small Arms Range Complex

F.5 HUMAN HEALTH RISK SCREENING EVALUATION

The purpose of the human health risk screening evaluation is to conservatively estimate risks posed to potential human receptors from chemicals present at the AOC 6 – West Gate Small Arms Range Complex. The human health risk screening followed the steps which presented the general methodology for the human health risk screening. These steps are:

- Identification of COPCs
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

F.5.1 Identification of Chemicals of Potential Concern

Tetra Tech identified human health COPCs in soil with the following considerations:

- Occurrence and distribution of chemicals in the environmental media
- Chemical toxicity
- Occurrence of chemical in background samples

Using the methodology described Tetra Tech compared the maximum concentration of each chemical in soil to risk-based screening levels based on direct contact exposures to soil and protection of groundwater. If the maximum concentration of a chemical exceeded the direct contact exposure criteria then that chemical was retained as a COPC and cancer risks and hazard indices were estimated for that chemical. The potential for chemicals to migrate from soil and adversely impact groundwater was also evaluated by comparing the maximum detected concentration of each chemical to screening criteria for the protection of groundwater.

Soil samples at AOC 6 were analyzed for PAHs, explosives, and inorganics. Nineteen PAHs, three explosives, and five inorganics were detected in the soil samples at AOC 6. Appendix F, Table F-5.1 presents a comparison of the maximum detected concentrations of chemicals to USEPA and IDEM screening levels. The following chemicals were detected in soils at maximum concentrations exceeding the direct contact risk-based COPC screening levels and were retained as COPCs for soil at AOC 6.

- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene equivalents]
- Inorganics [arsenic and lead]

Concentrations of arsenic were within basewide background levels.

F.5.2 Exposure Assessment

Details on the site background, physical setting, previous investigations, and hazard identification were presented in Section 7.1. Summarizing the information from Section 7.1, the West Gate Small Arms Range Complex is located south of Highway 5, outside of the western gate of NSA Crane on Navy property. This area is currently not being used by NSA Crane. There are no access controls or restrictions in place to limit access to this area. The site consists of four small arms munitions ranges: a 500-yard Rifle Range, a 60-yard Pistol Range, a Skeet Range, and a Trap Range. Remains of the old trap house, and other structures and targets can be found within the site boundaries. It is not known whether underground utilities exist at the site.

The 500-yard Rifle Range covers 12 acres; was constructed, graded, and seeded in 1966; and was opened in 1967. The range had 100-yard, 200-yard, 300-yard, and 500-yard firing lines. During the TtNUS site visit (2009), there was visible evidence of small arms (.22-caliber) rifle fire on the 500-yard Rifle Range.

The remains of the 60-yard Pistol Range were observed during the TtNUS site visit to the south of where the 400-yard firing line would have been located on the 500-yard Rifle Range. Pistols at the Pistol Range were fired to the southwest where the natural hillside acted as a target backstop.

The Skeet Range faced to the south and used the contours of the natural hillside to help contain expended shot and clay pigeons. Multiple expended shotgun shells were observed on the ground surface in this area.

The location of the Trap Range was identified based on the position of the former trap house structure, and also faced south toward the natural hillside. An observed drainage channel in front of the trap house that flows east past the Skeet Range contained skeet fragments and plastic shotgun wads. In the portion of the site where the Trap Range and Skeet Range overlap, expended shotgun wads, clay pigeon fragments, larger missed clay pigeons, and areas of expended shotfall containing accumulated lead shot were observed.

Human receptors at this site that could come into direct contact with contamination in surface soil are military and civilian personnel, contractors, trespassers, and hunters working or recreating at the site. Contaminants in surface soil could also infiltrate into the subsurface soil and ultimately leach from the soil

into the groundwater. An additional migration pathway may be storm water runoff that could transport contaminated surface soil through drainage channels to a downgradient location which could contaminate nearby soil and groundwater. Contaminant dilution would occur during overland transport.

F.5.3 Risk Characterization

ILCRs and HIs were estimated for the identified COPCs using the methodology presented. Appendix F, Tables F-5.2 and F-5.3 presents the ILCRs and HIs for residential and industrial exposures, respectively. HIs of 0.5 for residential exposures and 0.04 for industrial exposures are less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions.

The ILCRs of 7×10^{-5} for residential exposures and 1×10^{-5} for industrial exposures are within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}. Concentrations of arsenic were within basewide background levels. The ILCRs for only site-related COPCs would be 4×10^{-5} for residential exposures and 3×10^{-6} for industrial exposures, which are also within USEPA's and IDEM target risk level.

Lead was selected as a COPC in soil due to the maximum lead concentration of 1,240 mg/kg detected in sample A6SS170G0002. The only other lead concentration that exceeded residential COPC selection criteria was the result of 901 mg/kg detected in sample A6SS057G0002. The arithmetic mean lead concentration for soil is 130 mg/kg which is less than the residential COPC selection criterion for lead (400 mg/kg). The USEPA pharmaco-kinetic models used to evaluate concentrations of lead in the environment recommend using the arithmetic mean lead concentration as the lead exposure point concentration (EPC); therefore, lead concentrations in these soils were not further evaluated in this human health risk screening evaluation.

F.5.4 Evaluation of the Soil to Groundwater Pathway

Using the procedures presented Tetra Tech evaluated the soil to groundwater pathway for COPCs in the surface soil samples. Appendix F, Table F-5.4 presents the comparison of the maximum detected concentration to the screening criteria for the protection of migration from soil to groundwater. The following chemicals were detected in soil at maximum concentrations exceeding COPC screening levels for migration from soil to groundwater and were retained as COPCs for soil at AOC 6.

- PAHs [1-methylnaphathalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, and benzo(a)pyrene equivalents]
- Explosives [2-amino-4,6-dinitrotoluene and RDX]

- Inorganics [arsenic, copper, and lead]

Concentrations of all chemicals except for arsenic and lead were less than the IDEM migration from soil to groundwater criteria. Concentrations of 1-methylnaphthalene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, 2-amino-4,6-dinitrotoluene, and copper exceeded the USEPA SSL based on a DAF of 1 but were less than the USEPA SSL based on a DAF of 20. Arsenic concentrations were within base-wide background levels. All PAHs have relatively low solubility in water, but the more soluble PAHs that are COPCs (i.e., 1-methylnaphtahlene, naphthalene) are readily biodegradable, so if these PAHs leach from soil into groundwater, there is a good chance that some or all of these chemicals will degrade in groundwater. The PAHs with very low solubility in water have much higher affinity for soil solids over soil water. It could take a long time (years to decades) for these PAHs to leach through the soil and reach groundwater. The PAHs with very low solubility are also susceptible to biodegradation and even a low rate of biodegradation could remove the chemicals from the leachate before it reaches the groundwater. As noted above, groundwater from the AOC 6 is not used as a source of drinking water, so the pathway is currently incomplete.

F.5.5 Uncertainty Analysis

The methodology provides a detailed discussion of the sources of uncertainty in the human health risk screening evaluation.

F.5.6 Human Health Risk Screening Evaluation Summary

In the human health risk screening evaluation, Tetra Tech evaluated soil sampling data for the AOC 6 – West Gate Small Arms Range Complex. Soil samples at AOC 6 were analyzed for PAHs, explosives, and inorganics. Maximum concentrations of the following chemicals exceeded the USEPA and IDEM direct contact risk-based COPC screening levels and these chemicals were retained as COPCs for soil at AOC 6.

- PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene equivalents]
- Inorganics [arsenic and lead]

HIs for residential and industrial exposures are less than unity (1), indicating that adverse non-carcinogenic effects are not anticipated under the defined exposure conditions. ILCRs for residential and industrial exposures were within USEPA's and IDEM's target risk range of 10^{-4} to 10^{-6}.

The following chemicals were detected in soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for soil at AOC 6.

- PAHs [1-methylnaphathalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, and benzo(a)pyrene equivalents]
- Explosives [2-amino-4,6-dinitrotoluene and RDX]
- Inorganics [arsenic, copper, and lead]

Concentrations of all chemicals except for arsenic and lead were less than the IDEM migration from soil to groundwater criteria. Concentrations of 1-methylnaphthalene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3,-cd)pyrene, 2-amino-4,6-dinitrotoluene, and copper exceeded the USEPA SSL based on a DAF of 1 but were less than the USEPA SSL based on a DAF of 20. Arsenic concentrations were within base-wide background levels. All PAHs have relatively low solubility in water, but the more soluble PAHs that are COPCs (i.e., naphthalene) are readily biodegradable, so if these PAHs leach from soil into groundwater, there is a good chance that some or all of these chemicals will degrade in groundwater. The PAHs with very low solubility in water have much higher affinity for soil solids over soil water. It could take a long time (years to decades) for these PAHs to leach through the soil and reach groundwater. The PAHs with very low solubility are also susceptible to biodegradation and even a low rate of biodegradation could remove the chemicals from the leachate before it reaches the groundwater. Groundwater from the AOC 6 is not used as a source of drinking water, so the pathway is currently incomplete.

TABLE F-5.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SOIL
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Range of Background Concentrations[4]	USEPA RSL Residential[5]	IDEM RISC Direct Contact[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
AOC 6	**PAHs**													
	90-12-0	1-Methylnaphthalene	2.3 J	65	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	65	NA	22,000 C	NA	No	BSL
	91-57-6	2-Methylnaphthalene	3.4 J	120	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	120	NA	31,000 N	630,000 N	No	BSL
	83-32-9	Acenaphthene	1.7 J	60	ug/kg	A6SS035G0002	6/20	1.5 - 1.7	60	NA	340,000 N	9,500,000 N	No	BSL
	208-96-8	Acenaphthylene	1.7 J	1.7 J	ug/kg	A6SS036G0002	1/20	1.5 - 1.8	1.7	NA	340,000 N[8]	1,100,000 N	No	BSL
	120-12-7	Anthracene	2.2 J	18 J	ug/kg	A6SS061G0002	7/20	1.5 - 1.7	18	NA	1,700,000 N	47,000,000 N	No	BSL
	- -	**Benzo(a)pyrene Equivalents**	2.01	626	ug/kg	A6SS061G0002	11/20	1.5 - 1.7	626	NA	**15 C**	**500 C**	**Yes**	ASL
	56-55-3	**Benzo(a)anthracene**	3.6 J	550 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	550	NA	**150 C**	5,000 C	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	4.2 J	480 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	480	NA	**15 C**	500 C	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	2.4 J	580 J	ug/kg	A6SS061G0002	11/20	1.5 - 1.7	580	NA	**150 C**	5,000 C	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	4 J	350 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	350	NA	170,000 N[9]	4,700,000 N[9]	No	BSL
	207-08-9	Benzo(k)fluoranthene	2.5 J	170 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	170	NA	1,500 C	50,000 C	No	BSL
	218-01-9	Chrysene	5.9 J	850 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	850	NA	15,000 C	500,000 C	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	3.1 J	21	ug/kg	A6SS020G0002	4/20	1.5 - 1.8	21	NA	**15 C**	500 C	**Yes**	ASL
	206-44-0	Fluoranthene	1.9 J	2,000	ug/kg	A6SS035G0002	12/20	1.5 - 1.7	2,000	NA	230,000 N	6,300,000 N	No	BSL
	86-73-7	Fluorene	1.7 J	4.1 J	ug/kg	A6SS061G0002	4/20	1.5 - 1.7	4.1	NA	230,000 N	6,300,000 N	No	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	3.8 J	300 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	300	NA	**150 C**	5,000 C	**Yes**	ASL
	91-20-3	Naphthalene	2.9 J	82	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	82	NA	3,600 C	3,200,000 N	No	BSL
	85-01-8	Phenanthrene	1.8 J	470	ug/kg	A6SS035G0002	11/20	1.5 - 1.6	470	NA	170,000 N[9]	470,000 N	No	BSL
	129-00-0	Pyrene	1.8 J	2,100	ug/kg	A6SS035G0002	13/20	1.5 - 1.7	2,100	NA	170,000 N	4,700,000 N	No	BSL
	Explosives													
	35572-78-2	2-Amino-4,6-Dinitrotoluene	0.16 J	0.16 J	mg/kg	A6SS009C0002	1/11	0.06 - 0.06	0.16	NA	15 N	NA	No	BSL
	2691-41-0	HMX	0.13 J	0.24 J	mg/kg	A6SS004C0002	2/10	0.06 - 0.06	0.24	NA	380 N	NA	No	BSL
	121-82-4	RDX	0.06 J	0.34 J	mg/kg	A6SS001C0002, A6SS004C0002	3/11	0.06 - 0.06	0.34	NA	5.5 C	NA	No	BSL
	Inorganics													
	7440-36-0	Antimony	0.471 J	0.471 J	mg/kg	A6SS170G0002	1/40	0.287 - 0.586	0.471	6.9	3.1 N	140 N	No	BSL, BKG
	7440-38-2	**Arsenic**	0.347	11	mg/kg	A6SS025G0002	40/40	-	11	11.8	**0.39 C**	**3.9 C**	**Yes**	ASL, BKG
	7440-50-8	Copper	0.579 J	121	mg/kg	A6SS170G0002	40/40	-	121	**32.4**	310 N	14,000 N	No	BSL
	7439-92-1	**Lead**	0.174 J	1240	mg/kg	A6SS170G0002	40/40	-	1240	**27**	**400**	**400**	**Yes**	ASL
	7440-66-6	Zinc	0.579 J	61.3 J	mg/kg	A6SS025G0002	40/40	-	61.3	65.6	2,300 N	100,000 N	No	BSL, BKG

TABLE F-5.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SOIL
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009. The noncarcinogenic values (denoted with a "N" flag) are the screening level divided by 10 to correspond to a target hazard quotient of 0.1. Carcinogenic values represent an incremental cancer risk of 1.0E-06 (carcinogens denoted with a "C" flag).
6 - Indiana Department of Environmental Management (IDEM) , Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May 1, 2009). [Cancer benchmark value = 1E-05, Hazard index (HI) = 1.0].
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Acenaphthene is used as a surrogate for acenaphthylene.
9 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value
N = Noncarcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

Associated Samples

A6SS001C0002	A6SS035G0002	A6SS077G0002	A6SS132G0002
A6SS002C0002	A6SS036G0002	A6SS078G0002	A6SS138G0002
A6SS003C0002	A6SS037G0002	A6SS079G0002	A6SS144G0002
A6SS004C0002	A6SS039G0002	A6SS083G0002	A6SS148G0002
A6SS005C0002	A6SS045G0002	A6SS084G0002	A6SS150G0002
A6SS006C0002	A6SS048G0002	A6SS085G0002	A6SS156G0002
A6SS007C0002	A6SS049G0002	A6SS093G0002	A6SS160G0002
A6SS008C0002	A6SS050G0002	A6SS094G0002	A6SS163G0002
A6SS009C0002	A6SS053G0002	A6SS097G0002	A6SS166G0002
A6SS010C0002	A6SS056G0002	A6SS100G0002	A6SS168G0002
A6SS011C0002	A6SS057G0002	A6SS103G0002	A6SS170G0002
A6SS015G0002	A6SS061G0002	A6SS107G0002	
A6SS020G0002	A6SS062G0002	A6SS108G0002	
A6SS021G0002	A6SS063G0002	A6SS111G0002	
A6SS022G0002	A6SS067G0002	A6SS114G0002	
A6SS025G0002	A6SS069G0002	A6SS116G0002	
A6SS030G0002	A6SS070G0002	A6SS119G0002	
A6SS031G0002	A6SS071G0002	A6SS123G0002	
A6SS032G0002	A6SS072G0002	A6SS129G0002	

TABLE F-5.2

SUMMARY OF HYPOTHETICAL FUTURE RESIDENTIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	RSL - Residential[1] (mg/kg)	Estimated ILCR	Primary Target Organs[2]	RSL - Residential[1] (mg/kg)	Estimated HQ
Semivolatile Organic Compounds							
--	Benzo(a)pyrene Equivalents	0.626	0.015	4E-05	--	NA	--
Inorganics							
7440-38-2	Arsenic[3]	11	0.39	3E-05	Skin, CVS	22	0.5
			Total Carcinogenic Risk - All Chemicals	**7E-05**		**Total HI - All Chemicals**	**0.5**
			Total Carcinogenic Risk - Site Related Chemicals	**4E-05**		**Total HI - Site Related Chemicals**	**--**

Footnotes:
NA - Not applicable. The U.S. EPA has not established a reference dose (RfD) for benzo(a)pyrene.
1 - USPEA Regional Screening Level (RSL) Table, December 2009.
2 - Primary Target Organs are from IRIS
3 - Concentrations of arsenic were within background levels.

Note: Lead risks are not evaluated in this table.

TABLE F-5.3

SUMMARY OF INDUSTRIAL RISKS AND HAZARDS INDICES FOR EXPOSURES TO SOIL
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

CAS Number	Chemical	Incremental Lifetime Carcinogenic Risk (ILCR)			Estimated Non-Carcinogenic Hazard Quotient (HQ)		
		Maximum Detected Concentration (mg/kg)	RSL - Industrial[1] (mg/kg)	Estimated ILCR	Primary Target Organs[2]	RSL - Industrial[1] (mg/kg)	Estimated HQ
Semivolatile Organic Compounds							
--	Benzo(a)pyrene Equivalents	0.626	0.21	3E-06	--	NA	--
Inorganics							
7440-38-2	Arsenic[3]	11	1.6	7E-06	Skin, CVS	260	0.04
			Total Carcinogenic Risk - All Chemicals	**1E-05**		**Total HI - All Chemicals**	**0.04**
			Total Carcinogenic Risk - Site Related Chemicals	**3E-06**		**Total HI - Site Related Chemicals**	**--**

Footnotes:
NA - Not applicable. The U.S. EPA has not established a reference dose (RfD) for benzo(a)pyrene.
1 - USPEA Regional Screening Level (RSL) Table, December 2009.
2 - Primary Target Organs are from IRIS
3 - Concentrations of arsenic were within background levels.

Note: Lead risks are not evaluated in this table.

TABLE F-5.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Exposure Point	CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[2]	Concentration Used for Screening[3]	Range of Background Concentrations[4]	USEPA RSL Migration from Soil to Groundwater[5]		IDEM RISC Migration from Soil to Groundwater[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
											DAF = 1	DAF = 20			
AOC 6	**PAHs**														
	90-12-0	**1-Methylnaphthalene**	2.3 J	65	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	65	NA	**12**	240	NA	**Yes**	ASL
	91-57-6	2-Methylnaphthalene	3.4 J	120	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	120	NA	750	15,000	3,100	No	BSL
	83-32-9	Acenaphthene	1.7 J	60	ug/kg	A6SS035G0002	6/20	1.5 - 1.7	60	NA	22,000	440,000	130,000	No	BSL
	208-96-8	Acenaphthylene	1.7 J	1.7 J	ug/kg	A6SS036G0002	1/20	1.5 - 1.8	1.7	NA	22,000 [8]	440,000 [8]	18,000	No	BSL
	120-12-7	Anthracene	2.2 J	18 J	ug/kg	A6SS061G0002	7/20	1.5 - 1.7	18	NA	360,000	7,200,000	2,700,000	No	BSL
	- -	**Benzo(a)pyrene Equivalents**	2.01	626	ug/kg	A6SS061G0002	11/20	1.5 - 1.7	626	NA	**3.5**	**70**	8,200	**Yes**	ASL
	56-55-3	**Benzo(a)anthracene**	3.6 J	550 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	550	NA	**10**	**200**	19,000	**Yes**	ASL
	50-32-8	**Benzo(a)pyrene**	4.2 J	480 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	480	NA	**3.5**	**70**	8,200	**Yes**	ASL
	205-99-2	**Benzo(b)fluoranthene**	2.4 J	580 J	ug/kg	A6SS061G0002	11/20	1.5 - 1.7	580	NA	**35**	700	57,000	**Yes**	ASL
	191-24-2	Benzo(g,h,i)perylene	4 J	350 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	350	NA	120,000 [9]	2,400,000 [9]	4,600,000 [9]	No	BSL
	207-08-9	Benzo(k)fluoranthene	2.5 J	170 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	170	NA	350	7,000	570,000	No	BSL
	218-01-9	Chrysene	5.9 J	850 J	ug/kg	A6SS061G0002	8/20	1.5 - 1.7	850	NA	1,100	22,000	1,900,000	No	BSL
	53-70-3	**Dibenzo(a,h)anthracene**	3.1 J	21	ug/kg	A6SS020G0002	4/20	1.5 - 1.8	21	NA	**11**	220	18,000	**Yes**	ASL
	206-44-0	Fluoranthene	1.9 J	2,000	ug/kg	A6SS035G0002	12/20	1.5 - 1.7	2,000	NA	160,000	3,200,000	6,300,000	No	BSL
	86-73-7	Fluorene	1.7 J	4.1 J	ug/kg	A6SS061G0002	4/20	1.5 - 1.7	4.1	NA	27,000	540,000	170,000	No	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	3.8 J	300 J	ug/kg	A6SS061G0002	9/20	1.5 - 1.7	300	NA	**120**	2,400	160,000	**Yes**	ASL
	91-20-3	**Naphthalene**	2.9 J	82	ug/kg	A6SS083G0002	13/20	1.6 - 1.7	82	NA	**0.47**	**9.4**	700	**Yes**	ASL
	85-01-8	Phenanthrene	1.8 J	470	ug/kg	A6SS035G0002	11/20	1.5 - 1.6	470	NA	120,000 [9]	2,400,000 [9]	13,000	No	BSL
	129-00-0	Pyrene	1.8 J	2,100	ug/kg	A6SS035G0002	13/20	1.5 - 1.7	2,100	NA	120,000	2,400,000	4,600,000	No	BSL
	Explosives														
	35572-78-2	**2-Amino-4,6-Dinitrotoluene**	0.16 J	0.16 J	mg/kg	A6SS009C0002	1/11	0.06 - 0.06	0.16	NA	**0.056**	1.12	NA	**Yes**	ASL
	2691-41-0	HMX	0.13 J	0.24 J	mg/kg	A6SS004C0002	2/10	0.06 - 0.06	0.24	NA	2.3	46	NA	No	BSL
	121-82-4	**RDX**	0.06 J	0.34 J	mg/kg	A6SS001C0002, A6SS004C0002	3/11	0.06 - 0.06	0.34	NA	**0.00023**	**0.0046**	NA	**Yes**	ASL
	Inorganics														
	7440-36-0	Antimony	0.471 J	0.471 J	mg/kg	A6SS170G0002	1/40	0.287 - 0.586	0.471	6.9	0.66	13.2	5.4	No	BSL, BKG
	7440-38-2	**Arsenic**	0.347	11	mg/kg	A6SS025G0002	40/40	-	11	11.83	**0.0013**	**0.026**	**5.8**	**Yes**	ASL, BKG
	7440-50-8	**Copper**	0.579 J	121	mg/kg	A6SS170G0002	40/40	-	121	**32.4**	**51**	1,020	920	**Yes**	ASL
	7439-92-1	**Lead**	0.174 J	1240	mg/kg	A6SS170G0002	40/40	-	1240	**27**	**14**	**280**	**81**	**Yes**	ASL
	7440-66-6	Zinc	0.579 J	61.3 J	mg/kg	A6SS025G0002	40/40	-	61.3	65.6	680	13,600	14,000	No	BSL, BKG

TABLE F-5.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SOIL TO GROUNDWATER
AOC 6 - WEST GATE SMALL ARMS RANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Footnotes:
1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Values presented are sample-specific quantitation limits.
3 - The maximum detected concentration is used for screening purposes.
4 - TtNUS, 2001. Final Basewide Background Soil Investigation Report, Naval Surface Warfare Center Crane, Crane, Indiana. January.
5 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, December 2009.
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) residential closure levels for soil (IDEM, May, 1 2009).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is statistically determined to be greater than site background.
8 - Acenaphthene is used as a surrogate for acenaphthylene.
9 - Pyrene is used as a surrogate for benzo(g,h,i)perylene and phenanthrene.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and site background.

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

Associated Samples

A6SS001C0002	A6SS035G0002	A6SS077G0002	A6SS132G0002
A6SS002C0002	A6SS036G0002	A6SS078G0002	A6SS138G0002
A6SS003C0002	A6SS037G0002	A6SS079G0002	A6SS144G0002
A6SS004C0002	A6SS039G0002	A6SS083G0002	A6SS148G0002
A6SS005C0002	A6SS045G0002	A6SS084G0002	A6SS150G0002
A6SS006C0002	A6SS048G0002	A6SS085G0002	A6SS156G0002
A6SS007C0002	A6SS049G0002	A6SS093G0002	A6SS160G0002
A6SS008C0002	A6SS050G0002	A6SS094G0002	A6SS163G0002
A6SS009C0002	A6SS053G0002	A6SS097G0002	A6SS166G0002
A6SS010C0002	A6SS056G0002	A6SS100G0002	A6SS168G0002
A6SS011C0002	A6SS057G0002	A6SS103G0002	A6SS170G0002
A6SS015G0002	A6SS061G0002	A6SS107G0002	
A6SS020G0002	A6SS062G0002	A6SS108G0002	
A6SS021G0002	A6SS063G0002	A6SS111G0002	
A6SS022G0002	A6SS067G0002	A6SS114G0002	
A6SS025G0002	A6SS069G0002	A6SS116G0002	
A6SS030G0002	A6SS070G0002	A6SS119G0002	
A6SS031G0002	A6SS071G0002	A6SS123G0002	
A6SS032G0002	A6SS072G0002	A6SS129G0002	

APPENDIX G

ECOLOGICAL RISK RELATED INFORMATION

APPENDIX G: ECOLOGICAL RISK ASSESSMENT SCREENING

METHODOLOGY

The goal of this Ecological Risk Assessment (ERA) screening was to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through historical activities at AOC 1, AOC 2, AOC 4, AOC 6, and UXO 6. This ERA screening contains information that enables risk managers to conclude that either ecological risks at the site are negligible or that further information is necessary to evaluate potential ecological risks at the site.

The ERA screening methodology is in accordance with guidance presented in the following documents:

- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997).

This ERA screening consists of Steps 1, 2, and 3a of the eight step ERA process. The first two screening steps comprise the screening-level ecological risk assessment (SERA), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step of a baseline ecological risk assessment (BERA) and consists of refining the conservative assumptions following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. The remaining steps of the ERA process are not included in this ERA screening methodology.

Problem Formulation

Problem formulation is the first phase of an ERA and discusses the goals, size, and focus of the assessment. It includes general descriptions of the MRP sites with emphasis on the habitats and ecological receptors present. This phase also involves characterization of site-related chemicals, chemical sources, migration routes, and an evaluation of routes of chemical exposure. The assessment and measures of effects to be evaluated are also selected. Finally, a conceptual site model (CSM) is developed that describes how chemicals associated with the site in question may come into contact with ecological receptors.

The objectives of this step is to initially identify and characterize the habitats and ecological resources throughout the site, and to describe the likely chemical sources, release mechanisms, migration pathways, and the fate of chemicals resulting from site-related activities, as well as ecological receptors that could be adversely affected by chemicals. The environmental setting and potential contaminant sources are discussed separately within the site-specific ERA screening sections.

Potential Exposure Pathways – Surface Soil

Surface soils for the purpose of this ERA screening are soil samples with a starting depth of 0 feet and ending depth of 1 foot or 2 feet. Several groups of terrestrial ecological receptors can be exposed to chemicals in the surface soil. Invertebrates, such as earthworms, are exposed to chemicals as they move through the soil and ingest soil particles while searching for food. Plants are exposed to chemicals via direct contact as chemicals are absorbed through the roots and may then translocate to different parts of the plants (i.e., leaves, seeds).

Small mammals and birds may be exposed to chemicals in the soil via several exposure routes. They may be exposed by direct contact as they search for food or burrow into the soil. Exposure of terrestrial wildlife to chemicals in the soil via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of chemicals across dermal tissue. Small mammals and birds are most likely exposed to chemicals in the soil via incidental ingestion of soil, and ingestion of plants and/or invertebrates that have accumulated chemicals from the soil.

Larger predatory species, such as the red fox and red-tailed hawk, can be exposed (indirectly) to site chemicals in the soil by ingesting small mammals that have accumulated chemicals from the soil and food items.

Endpoints

Assessment Endpoints

Assessment endpoints are an explicit expression of the environmental value that is to be protected (USEPA, 1997). The selection of these endpoints is based on the habitats present, the migration pathways of chemicals, and the routes that chemicals may take to enter receptors.

For this ERA screening, the assessment endpoints include the protection of the following groups of receptors from a reduction in growth, survival, and/or reproduction caused by site-related chemicals:

- Soil invertebrates
- Terrestrial vegetation
- Insectivorous birds and mammals
- Herbivorous birds and mammals

The following paragraphs discuss why the above assessment endpoints were selected for this ERA screening.

Soil Invertebrates: Soil invertebrates present at the site aid in the formation of soil, as well as redistribution and decomposition of organic matter in the soil, and serve as a food source for higher trophic-level organisms. They can also accumulate some contaminants, which can then be transferred to the higher trophic-level organisms that consume invertebrates.

Terrestrial Vegetation: Terrestrial vegetation at the site consists of grasses, shrubs, and trees. They serve as a food source, provide shade and cover for many organisms, and help prevent soil erosion, among other important functions. They can also accumulate some contaminants, which can then be transferred to the higher trophic-level organisms that consume plants.

Insectivorous Birds and Mammals: Insectivorous birds and mammals consume soil invertebrates and insects and in turn serve as a food source for higher trophic level carnivores. These birds and mammals are exposed to, and can accumulate, chemicals that are present in the food items they consume.

Herbivorous Birds and Mammals: Herbivorous birds and mammals (i.e., animals that consume only plant tissue) are present at the site because of the vegetative habitats (i.e., forested, open field). Their role in the community is essential because without them, higher trophic levels could not exist (Smith, 1966). They may be exposed to and accumulate contaminants that are present in the plants they consume.

As indicated in United States Environmental Protection Agency (USEPA) (1997), “it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants from the site.” Therefore, this ERA screening focused on the endpoints that tend to yield the highest risks, which will account for endpoints that have lower risks.

Carnivorous birds and mammals generally have large home ranges. The land area of the sites range from approximately 0.002 acres at AOC 02, 0.06 acres at AOC 01, 0.6 acres at UXO 06, 3 acres at AOC 04, and 34 acres at AOC 06. When the size of the sites are compared to the home range of top carnivores, such as the red-tailed hawk (with an average of 1,692 acres) and the red fox (with an average of 1,793 acres), carnivores would only receive a very small portion of their diet from MRP sites and, therefore, are not included as receptors in this ERA screening. Threshold oral toxicity values for reptiles and amphibians are not available for most chemicals, so risks to reptiles and amphibians were not quantitatively evaluated. With the above factors in mind, reptiles and carnivores were not selected as assessment endpoints.

Measures of Effects

Measures of effects are estimates of biological impacts (i.e., survival, growth and/or reproduction) that are used to evaluate the assessment endpoints. The following measures of effects were used to evaluate the assessment endpoints in this ERA screening.

- Decreases in survival, growth, and/or reproduction of plants and soil invertebrates were evaluated by comparing the measured concentrations of chemicals in the surface soil to screening values designed to be protective of ecological receptors.

- Decreases in survival, reproduction, and/or increases in developmental effects of birds and mammals were evaluated by comparing the estimated ingested dose of contaminants in the surface soil to no-observed-adverse-effects levels (NOAELs) and lowest-observed-adverse-effects levels (LOAELs) for surrogate wildlife species.

Ecological Effects Evaluation

The preliminary ecological effects assessment is an investigation of the relationship between the exposure to a chemical and the potential for adverse effects resulting from exposure. In this step, screening levels for toxicity of the chemicals to ecological receptors were compiled.

Terrestrial Plants and Invertebrates

Potential risks to terrestrial plants and invertebrates resulting from exposure to chemicals in the surface soil were evaluated by comparing chemical concentrations to ecological screening levels. The screening levels consisted of the USEPA Ecological Soil Screening Levels (Eco SSLs) (USEPA, 2005a to 2005c and 2007a to 2007c), USEPA Region 5 Ecological Screening Levels (ESLs) (USEPA, 2003), values computed in the NOAA SQuiRT Tables (Buchman, 2008), and proposed plant-based and invertebrate-based tolerance values for explosives (Sunhara, et al, 2009). These toxicity values are expressed in units of concentration because terrestrial plants and invertebrates are in direct contact with the soil. Eco SSLs were used first because they are the most current soil screening levels. If an Eco-SSL was not available, then the USEPA Region 5 ESLs were used, followed by the NOAA SQuiRT Tables, and tolerance values for explosives. However, when a USEPA Region 5 ESL was not based on plants or invertebrates, but the screening level presented on the NOAA table was based on plants or invertebrates, the NOAA screening level was used in place of the Region 5 ESL. The soil screening levels are presented in Table 1.

Mammals and Birds

Potential risks to mammals and birds resulting from exposure to chemicals in the surface soil were evaluated by comparing chemical concentrations to ecological screening levels. The screening levels consisted of the USEPA Eco SSLs (USEPA, 2005a to 2005c and 2007a to 2007c), USEPA Region 5 ESLs (USEPA, 2003). Eco SSLs were used first because they are the most current soil screening levels. If an Eco-SSL was not available, then the USEPA Region 5 ESLs were used. If a chemical concentration exceeded its screening level or a screening level was not available, risks to mammals and birds were determined using food chain models.

Risk to wildlife from exposure to chemicals in surface soil and sediment were determined by estimating the Chronic Daily Intake (CDI) using food chain models and comparing the CDI to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs were developed from NOAELs and LOAELs obtained from wildlife studies. The majority of the TRVs was obtained from the USEPA Eco SSL documents and was supplemented with other toxicity information when necessary. The TRVs for explosives were obtained from the US Army Center for Health Promotion and Preventive Medicine (USA CHPPM, 2001, 2002, 2006, 2007).

Appendix G presents the TRVs and the sources of the NOAELs and LOAELs used in this ERA. If a subchronic study was used to develop the TRV, the final value was multiplied by a factor of 0.1 to account for uncertainty between subchronic and chronic effects. Also, the LOAEL was multiplied by a factor of 0.1 to estimate a NOAEL TRV if only a LOAEL study was available. The chemical-specific Eco SSL documents provide both NOAELs and LOAELS for various studies, but overall TRVs are calculated only for NOAELs. The geometric mean of the chemical-specific growth and reproduction LOAELs from the chemical-specific Eco SSL documents were used as the LOAEL TRVs. For the explosive, RDX, the NOAELs and LOAELs were based on the LED_{10} and ED_{10}, respectively. The LED_{10} is a lower bound value on the benchmark dose at the 10 percent level. The ED_{10} is the benchmark does at the 10 percent effect level.

Characterization of Exposure

This portion of the ERA screening includes identification of contaminant concentration data used as the exposure point concentrations (EPCs) to represent ecological exposure in various media. Terrestrial plants and invertebrates are exposed to chemicals in the surface soil through ingestion and/or direct contact. Maximum chemical concentrations were used as the EPCs for the initial screening step. Data collected from grab samples and composite samples were combined for this ERA screening.

As discussed above, the total exposure dose of terrestrial wildlife to chemicals in soil and associated food items such as plants and invertebrates were estimated using food chain models. Selection of a particular species is required so that intake through ingestion can be estimated. The following surrogate species were used for the food chain modeling:

- Herbivorous mammal: meadow vole
- Herbivorous bird: bobwhite quail
- Insectivorous mammal: short-tailed shrew
- Insectivorous bird: American robin

Receptor profiles for the surrogate species, including the exposure parameters used in the food-chain modeling are included in Appendix G.

The following equation was used to calculate the CDI for wildlife receptors:

$$CDI = \frac{[(Cf * If) + (Cs * Is)] * H}{BW}$$

Where:

CDI	=	Chronic daily intake [(mg/kg)-day]
Cf	=	Chemical concentration in food – (see discussion below)
Cs	=	Chemical concentration in surface soil (mg/kg)
If	=	Food ingestion rate (kg/day)
Is	=	Incidental surface soil ingestion rate (kg/day)
H	=	Portion of food intake from the contaminated area (unitless)
BW	=	Body weight (kg)

Chemical concentrations in food items for soil invertivorous and herbivorous receptors were calculated using soil-to-invertebrate or soil-to-plant bioaccumulation factors (BAFs) and regression equations from the USEPA Eco SSL Guidance Document (USEPA, 2007d) or other published sources. The sources of the BAFs are documented in Appendix G. The following equation was used to calculate the chemical concentration in plants or invertebrates when BAFs are used:

$$Cf = Cs * BAF$$

Where:

Cf	=	Contaminant concentration in food (mg/kg)
Cs	=	Contaminant concentration in surface soil (mg/kg)
BAF	=	Biota-soil bioaccumulation factor (unitless)

Table 2 summarizes the exposure factors that were used for the food chain model. The food ingestion rates were on a dry weight basis. The following input parameters were used in the dose equations under the conservative screening scenario:

- Maximum surface soil concentrations
- Maximum BAFs
- Conservative receptor body weights and ingestion rate

For refining the conservative exposure assumptions in Step 3a, the following input parameters were used:

- Average surface soil concentrations
- Average BAFs (for some chemicals, these are the same as the conservative BAFs)
- Average receptor body weights and ingestion rates

Risk Characterization

The risk characterization is the final phase of an ERA that compares exposure to ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a stressor is evaluated. An ecological effects quotient (EEQ) approach was used to characterize the potential risk to ecological receptors by comparing exposure concentrations and doses to effects data. When EEQ values exceed 1.0, it is an indication that ecological receptors are potentially at risk; additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially since most benchmarks are developed using conservative exposure assumptions and/or studies. The EEQ value should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an EPC exceeds or is less than a benchmark.

The EEQs for surface soil receptors were calculated as follows:

$$EEQ = \frac{Css}{SSSL}$$

where:

EEQ	=	Ecological Effects Quotient (unitless)
Css	=	Chemical concentration in surface soil (µg/kg or mg/kg)
SSSL	=	Surface soil screening level (µg/kg or mg/kg)

The EEQs for wildlife were calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where:

EEQ	=	Ecological effects quotient (unitless)
CDI	=	Chronic daily intake dose (mg/kg-day)
TRV	=	Toxicity reference value (NOAEL or LOAEL) (mg/kg-day)

Selection of Chemicals of Potential Concern

The final part of the screening evaluation is selection of chemicals of potential concern (COPCs). Chemicals that are not selected as COPCs are assumed to present negligible risk to ecological receptors and were not considered for further evaluation in the ERA. Chemicals that are retained as COPCs were evaluated further in Step 3a. Ecological COPCs were selected using the following procedures:

- Chemicals with EEQs greater than 1.0 (using screening values) were retained as COPCs for further evaluation because they have a potential to cause risk to ecological receptors.

- Chemicals with EEQs greater than 1.0 based on the conservative food chain model using NOAELs were retained as COPCs, because they have the potential to cause risk to mammals or birds.

- Chemicals without screening values were retained as COPCs, but were only evaluated qualitatively.

The selection of COPCs for each site is presented in the site-specific ERA screening section.

Step 3A Refinement

Step 3a consists of a refinement of the conservative exposure assumptions and concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a evaluation is to further refine the number of chemicals that are retained as COPCs in order to focus additional efforts on chemicals that are of major ecological concern. The following describes the process for further evaluating chemicals initially selected as COPCs in soil.

For chemicals that are evaluated further in Step 3a, the following factors were evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations. Note that all of these factors may not be discussed for each chemical and/or receptor group.

- Magnitude of criterion exceedance: Although the magnitude of the risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability and concern that an unacceptable risk exists.

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity and concentrations and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample represents.

- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the environment in forms that are typically not bioavailable, and the limited bioavailability was considered when evaluating the exposures of receptors to site contaminants. Contaminants with generally less bioavailability are considered to be less toxic than the more bioavailable contaminants, all other factors being equal.

- More Appropriate Benchmarks: More appropriate benchmarks were used to further evaluate risks to specific groups of ecological receptors (e.g., plants and invertebrates) because while screening levels are useful for initial screening they are very conservative and not appropriate for evaluating all of the assessment endpoints.

TABLE 1

SOIL SCREENING VALUES
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

	Ecological Screening Level							
	Invertebrates		Plants		Avian		Mammals	
Parameter	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**	**Value**	**Source**
PAHs (ug/kg)								
1-Methylnaphthalene[1]	29000	EcoSSL	3240	Region 5	3240	Region 5	100000	EcoSSL
2-Methylnaphthalene	29000	EcoSSL	3240	Region 5	3240	Region 5	100000	EcoSSL
Acenaphthene	29000	EcoSSL	682000	Region 5	682000	Region 5	100000	EcoSSL
Acenaphthylene	29000	EcoSSL	682000	Region 5	682000	Region 5	100000	EcoSSL
Anthracene	29000	EcoSSL	1480000	Region 5	1480000	Region 5	100000	EcoSSL
Benzo(a)anthracene	18000	EcoSSL	5210	Region 5	5210	Region 5	1100	EcoSSL
Benzo(a)pyrene	18000	EcoSSL	1520	Region 5	1520	Region 5	1100	EcoSSL
Benzo(b)fluoranthene	18000	EcoSSL	59800	Region 5	59800	Region 5	1100	EcoSSL
Benzo(g,h,i)perylene	18000	EcoSSL	119000	Region 5	119000	Region 5	1100	EcoSSL
Benzo(k)fluoranthene	18000	EcoSSL	148000	Region 5	148000	Region 5	1100	EcoSSL
Chrysene	18000	EcoSSL	4730	Region 5	4730	Region 5	1100	EcoSSL
Dibenzo(a,h)anthracene	18000	EcoSSL	18400	Region 5	18400	Region 5	1100	EcoSSL
Fluoranthene	29000	EcoSSL	122000	Region 5	122000	Region 5	100000	EcoSSL
Fluorene	29000	EcoSSL	122000	Region 5	122000	Region 5	100000	EcoSSL
Indeno(1,2,3-cd)pyrene	18000	EcoSSL	109000	Region 5	109000	Region 5	1100	EcoSSL
Naphthalene	29000	EcoSSL	99.4	Region 5	99.4	Region 5	100000	EcoSSL
Phenanthrene	29000	EcoSSL	45700	Region 5	45700	Region 5	100000	EcoSSL
Pyrene	18000	EcoSSL	78500	Region 5	78500	Region 5	1100	EcoSSL
Dyes								
Solvent green 3	NA	NA	NA	NA	NA	NA	NA	NA
Solvent yellow 33	NA	NA	NA	NA	NA	NA	NA	NA
Explosives (mg/kg)								
2-Amino-4,6-dinitrotoluene[2]	7	Sunhara[3]	5	Sunhara[3]	0.0328	Region 5	0.0328	Region 5
HMX	>600	Sunhara[3]	>9341	Sunhara[3]	NA	NA	NA	NA
Nitrobenzene	1.31	Region 5	1.31	Region 5	1.31	Region 5	1.31	Region 5
RDX	98	Sunhara	>9537	Sunhara	NA	NA	NA	NA
Inorganics (mg/kg)								
Antimony	78	EcoSSL	5	NOAA	0.142	Region 5	0.27	EcoSSL
Arsenic	60	NOAA	18	EcoSSL	43	EcoSSL	46	EcoSSL
Copper	80	EcoSSL	70	EcoSSL	28	EcoSSL	49	EcoSSL
Lead	1700	EcoSSL	120	EcoSSL	11	EcoSSL	56	EcoSSL
Zinc	120	EcoSSL	160	EcoSSL	46	EcoSSL	79	EcoSSL
Miscellaneous								
Perchlorate	NA	NA	NA	NA	NA	NA	NA	NA

Screening Level Sources in the order of Preference:
Eco SSL - EPA Ecological Soil Screening Levels (EPA, 2003, 2005, 2006, 2007, 2008)
Region 5 - USEPA Region 5 Ecological Screening Levels, August 22, 2003 available at http://www.epa.gov/reg5rcra/ca/edql.ht
NOAA - NOAA's Quick Reference Tables (Buchman, 2008)
Sunhara - Ecotoxicology of Explosives (Sunahara, et al. 2009)
1 - Used 2-methylnaphthalene screening level as a surrogate.
2 - Used 2,6-dinitrotoluene as a surrogate.

TABLE 2

EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Species/Exposure Inputs	Conservative Inputs		Average Inputs	
	Values	Units	Values	Units
Bobwhite Quail				
Body Weight = BW	1.540E-01	kg	1.751E-01	kg
Food Ingestion Rate = If	1.628E-02	kg/day	1.361E-02	kg/day
Soil Ingestion Rate = Is	2.263E-03	kg/day	8.304E-04	kg/day
Home Range = HR	Assume 100% on site		1.880E+01	acres
Meadow Vole				
Body Weight = BW	1.700E-02	kg	3.580E-02	kg
Food Ingestion Rate = If	1.878E-03	kg/day	1.744E-03	kg/day
Soil Ingestion Rate = Is	6.010E-05	kg/day	2.093E-05	kg/day
Home Range = HR	Assume 100% on site		6.590E-02	acres
American Robin				
Body Weight = BW	7.73E-02	kg	8.04E-02	kg
Food Ingestion Rate = If	1.25E-02	kg/day	1.19E-02	kg/day
Soil Ingestion Rate - Is	2.046E-03	kg/day	7.601E-04	kg/day
Home Range = HR	Assume 100% on site		6.095E-01	acres
Short-Tailed Shrew				
Body Weight = BW	1.500E-02	kg	1.610E-02	kg
Food Ingestion Rate = If	1.600E-03	kg/day	1.433E-03	kg/day
Soil Ingestion Rate - Is	4.801E-05	kg/day	1.289E-05	kg/day
Home Range = HR	Assume 100% on site		9.699E-01	acres

Notes:
The exposure factors were derived as presented in Appendix F.

The soil ingestion rates were calculated by multiplying the food ingestion rates by the following incidental soil/sediment ingestion rates:

	Conservative	Average	Source
Bobwhite Quail	13.90%	6.10%	1, 2
Meadow Vole	3.20%	1.20%	1
American Robin	16.40%	6.40%	1,3
Short-tailed Shrew	3%	0.90%	1

1 - USEPA (U.S. Environmental Protection Agency), 2007. Ecological Soil Screening Level Guidance, Office of Emergency and Remedial Response. February.
2 - Based on the mourning dove.
3 - Based on the American woodcock

APPENDIX G.1

B-143 Drop Test Area

G.1 ECOLOGICAL RISK SCREENING EVALUATION

G.1.1 Site Description

Section 4.1 presents a detailed description of the site location, history, and background of the site. The Site covers 0.06 acres and is located in a lightly wooded area in the west-central portion of NSA Crane. The potential sources of contamination are submunitions released from the drop tower.

G.1.2 Potential Ecological Receptors and Exposure Pathways

The contaminated media to which ecological receptors may be exposed include surface soil. These potential ecological receptors and exposure pathways are described in detail in the methodology.

G.1.3 Ecological Screening

The first part of the evaluation is selection of COPCs.

G.1.3.1 COPCs for Terrestrial Invertebrates and Plants

Table G-1.1 of Appendix G presents the chemicals that were retained as COPCs in surface soil for potential risks to plants and invertebrates.

Lead was the only detected chemical at AOC 1. Lead was not selected as a COPC for terrestrial invertebrates in surface soil because the maximum concentration of lead was less than the screening level. Lead was selected as a COPC for terrestrial plants in surface soil because lead was detected at a concentration that exceeded its screening level.

G.1.3.2 COPCs for Mammals and Birds

Table G-1.1 of Appendix G presents the chemicals that were retained for food chain modeling for terrestrial mammals and birds because they were detected at concentrations above screening levels. Lead was retained as a COPC for food chain modeling because it was detected at a concentration that exceeded the screening level for birds and mammals.

Table G-1.2 of Appendix G summarizes the results of the conservative inputs food chain modeling for terrestrial receptors. Appendix G presents the calculation worksheets. Using maximum concentrations and conservative input parameters for food chain modeling, lead had EEQs greater than 1.0 for the quail, robin, and shrew.

G.1.4 Step 3A Refinement

Step 3a consists of a refinement of the conservative exposure assumptions/concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may be eliminated as a COPC in soil based on risks to soil invertebrates and plants but may be retained for evaluating risks to wildlife.

G.1.4.1 Terrestrial Invertebrates and Plants

No chemicals were retained as COPCs for terrestrial invertebrates.

Lead was selected as a COPC for terrestrial plants in surface soil because it was detected at a maximum concentration (164 mg/kg) that exceeded its screening level of 120 mg/kg. Lead only exceeded its screening level in one sample (A1SS010G0002) and all samples had concentrations of lead well below the screening level. Therefore, the slight exceedance of the screening level in one sample is not likely to cause a significant impact to plants at the site. Also note that the all of the XRF results were less that the plant screening level further supporting the conclusion that risk to plants are not likely. For that reason, lead is eliminated as a COPC for risks to plants.

G.1.4.2 Mammals and Birds

The EEQs from the terrestrial food chain modeling were greater than 1.0 for lead using the maximum chemical concentration and conservative exposure assumptions (see Section G.1.3.2). Therefore, as part of the Step 3a refinement, risks for this pathway were recalculated using the average chemical concentration in surface soil and less conservative exposure assumptions (i.e., average ingestion rates, average body weights) (see Table G-1.3).

Table 4-3 of Appendix F summarizes the results of the less conservative inputs food chain modeling for terrestrial receptors. Appendix G presents the calculation worksheets. Lead has an EEQ for the robin greater slightly than 1.0 using the NOAEL as the TRV (EEQ = 1.6); however, none of the receptors have EEQs greater than 1.0 using the LOAEL as the TRV. As discussed in Section G.1.1, the site is only 0.06 acres in size, which is ten times lower than the conservative home range of a robin (0.6 acres). Therefore, assuming that a robin would only obtain 10 percent of its food from the site, than the EEQ would be less than 1.0. For that reason, lead is eliminated as a COPC from the site.

G.1.5 Ecological Risk Screening Summary

This section presents a summary of the conclusions of the ecological risk assessment that was conducted for the site. Lead was eliminated as a COPC for terrestrial invertebrates, plants, mammals, and birds based on comparisons to screening levels, the magnitude and frequency of detections greater than screening levels, and site-use factors.

TABLE G-1.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
AOC 1 - B-143 DROP TEST AREA
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects	Overall Average[1]	Average of Positive Results[2]	Ecological Screening Level				COPC Flag	Rationale for COPC Selection
								Invertebrates	Plants	Avian	Mammals		
Inorganics (mg/kg)													
Lead	11.9	164	A1SS010G0002	8/8	-	38.9	38.9	1700	**120**	**11**	**56**	YES	ASL

Footnotes:
Shaded cells indicate that the maximum concentration exceeds the screening level.

1 Average of all analytical results.
2 Average of detected concentrations only.

COPC = Chemical of Potential Concern

Rationale Codes for COPC Selection:
ASL = Above COPC Screening Level

TABLE G-1.2

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS
AOC 1 - B-143 DROP TEST AREA
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Inorganics								
LEAD	1.8E+00	6.5E-02	2.3E-01	5.9E-03	7.5E+00	2.8E-01	1.2E+00	3.1E-02

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE G-1.3

TERRESTRIAL FOOD CHAIN MODEL - AVERAGE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS AOC 1 - B-143 DROP TEST AREA
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Inorganics								
LEAD	2.1E-01	7.7E-03	2.6E-02	6.6E-04	1.6E+00	5.9E-02	3.0E-01	7.5E-03

Cells are shaded if the value is greater than 1.0

NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

APPENDIX G.2

Pyro Area Outside Test Burn Pads

G.2 ECOLOGICAL RISK SCREENING EVALUATION

G.2.1 Site Description

Section 5.1 presents a detailed description of the site location, history, and background of the site. The Site covers 0.002 acres and consists of two concrete basins in the north-central portion of NSA Crane. The potential sources of contamination are pyrotechnics tested with the concrete basins.

G.2.2 Potential Ecological Receptors and Exposure Pathways

The contaminated media to which ecological receptors may be exposed include surface soil. These potential ecological receptors and exposure pathways are described in detail in the methodology.

G.2.3 Ecological Screening

The first part of the evaluation is selection of COPCs. Although twelve soil samples were collected from the site, one sample was collected from each of the two concrete test burn basins. There is no ecological habitat in the basins so the samples were not included in the ERA. Four additional soil samples were collected around each of the two concrete test burn basins, but they were collected from 4 to 6 feet deep where there is very limited ecological exposure. Therefore, those were not evaluated in the ERA. One surface soil sample was collected about 25 feet west of each concrete test burn basin, and those samples were evaluated in this ERA.

G.2.3.1 COPCs for Terrestrial Invertebrates and Plants

Table G-2.1 of Appendix G presents the chemicals that were retained as COPCs in surface soil for potential risks to plants and invertebrates. These tables also present the chemicals that were retained for food chain modeling for mammals and birds (discussed further in Section G.2.3.2).

Solvent green 3 and perchlorate were detected at AOC 2. Solvent green 3 and perchlorate were selected as COPCs for terrestrial invertebrates and plants because screening levels were not available.

G.2.3.2 COPCs for Mammals and Birds

Table G-2.1 of Appendix G presents the chemicals that were retained for food chain modeling for terrestrial mammals and birds because they were detected at concentrations above screening levels Both solvent green 3 and perchlorate were retained as COPCs for food chain modeling because they did not have screening level for birds or mammals.

Table G-2.2 of Appendix G summarizes the results of the conservative inputs food chain modeling for terrestrial receptors. Appendix G presents the calculation worksheets. The following summarizes the results of the food chain modeling using maximum concentrations and conservative input parameters:

- Solvent green 3 had EEQs less than 1.0 in the food chain model for the vole and shrew receptors.
- Perchlorate had EEQs less than 1.0 in the food chain model for the receptors.
- Avian TRVs were not available for solvent green 3.

G.2.4 Step 3A Refinement

Step 3a consists of a refinement of the conservative exposure assumptions/concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may be eliminated as a COPC in soil based on risks to soil invertebrates and plants but may be retained for evaluating risks to wildlife.

G.2.4.1 Terrestrial Invertebrates and Plants

Solvent green 3 was detected in one of two surface soil samples. Terrestrial invertebrate and plant screening levels for solvent green 3 were not available so risks to invertebrates and plants from solvent green 3 could not be further evaluated. For that reason, solvent green 3 was retained as a COPC for terrestrial invertebrates and plants. Perchlorate was detected at low concentrations (0.00098 mg/kg and 0.001 mg/kg) in both of the two surface soil samples. Limited data indicated that perchlorate did not have an effect on plants and earthworms at low concentrations (< 10 mg/kg; Yoo, et al, undated). Plants were slightly more sensitive than earthworms to perchlorate toxicity. When a sodium perchlorate solution was added to soil for a 28-day seedling growth test for lettuce, growth was more sensitive than germination or survival (USEPA, 2002). A screening benchmark of 4 mg/kg wet-weight was calculated from this study (USEPA, 2002). Based on earthworms exposure to soil irrigated with sodium perchlorate, a screening benchmark of 1 mg/kg wet-weight was calculated. Based on the available data, perchlorate is not expected to impact plants and invertebrates based on the low concentrations detected; therefore, perchlorate was eliminated as a COPC for terrestrial invertebrates and plants.

G.2.4.2 Mammals and Birds

The EEQs from the terrestrial food chain modeling were less than 1.0 using maximum chemical concentrations and conservative exposure assumptions (see Section 5.6.3.2). Therefore, risks were not recalculated using average chemical concentrations in surface soil and sediment and less conservative exposure assumptions (i.e., average ingestion rates, average body weights). Although avian TRVs were not available for solvent green 3, it is not likely to impact birds based on the low EEQs for mammals, and the fact that the site is only 0.002 acres in size and therefore birds would only obtain a very small portion of their food from the site.

G.2.5 Ecological Risk Screening Summary

This section presents a summary of the conclusions of the ecological risk assessment that was conducted for the site.

Solvent green 3 was not eliminated as a COPC for risks to plants and invertebrates because toxicity data were not available.

No chemicals were retained as COPCs for terrestrial wildlife.

TABLE G-2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	A2SS011G0002	A2SS012G0002	Ecological Screening Level				COPC Flag	Rationale for COPC Selection
			Invertebrates	Plants	Avian	Mammals		
Dyes (ug/kg)								
Solvent Green 3	3,490 UJ	176,035 J	**NA**	**NA**	**NA**	**NA**	**YES**	NSL
Miscellaneous (ug/kg)								
Perchlorate	1 J	0.98 J	**NA**	**NA**	**NA**	**NA**	**YES**	NSL

Footnotes:
Shaded cells indicate that the maximum concentration exceeds the screening level.

COPC = Chemical of Potential Concern
NA = Not available or not applicable
J = Estimated concentration
UJ = Non-detect, estimated concentration

Rationale Codes for COPC Selection:
NSL = No Screening Level Available

TABLE G-2.2

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS AOC 2 - PYRO AREA OUTSIDE TEST BURN PAD
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Dyes								
SOLVENT GREEN 3	#VALUE!	#VALUE!	9.8E-01	9.8E-02	#VALUE!	#VALUE!	9.4E-01	9.4E-02
Miscellaneous								
PERCHLORATE	9.3E-06	4.6E-06	1.8E-05	3.6E-06	1.4E-05	7.2E-06	1.7E-05	3.4E-06

Cells are shaded if the value is greater than 1.0

#VALUE! - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

APPENDIX G.3

Test Pads on Hill Behind B-198

G.3 ECOLOGICAL RISK SCREENING EVALUATION

G.3.1 Site Description

Section 8.1 presents a detailed description of the site location, history, and background of the site. The Site covers 0.6 acres near building 198 at NSA Crane. The potential sources of contamination are from the development of dyes and testing of disposal methods for dyes.

G.3.2 Potential Ecological Receptors and Exposure Pathways

The contaminated media to which ecological receptors may be exposed include surface soil. These potential ecological receptors and exposure pathways are described in detail in the methodology.

G.3.3 Ecological Screening

The first part of the evaluation is selection of COPCs. Discrete and composite surface soil samples were evaluated for UXO 6.

G.3.3.1 COPCs for Terrestrial Invertebrates and Plants

Table G-3.1 of Appendix G presents the chemicals that were retained as COPCs in surface soil for potential risks to plants and invertebrates.

Solvent yellow 33 and three explosives were detected at UXO 6. Solvent yellow 33 was selected as a COPC for terrestrial invertebrates and plants because a screening level was not available.

G.3.3.2 COPCs for Mammals and Birds

Table G-3.1 of Appendix G presents the chemicals that were retained for food chain modeling for terrestrial mammals and birds because they were detected at concentrations above screening levels. One dye, and two explosive were retained as COPCs for food chain modeling because they did not have screening level for birds or mammals.

Table G-3.2 of Appendix G summarizes the results of the conservative inputs food chain modeling for terrestrial receptors. Appendix F presents the calculation worksheets. The following summarizes the results of the food chain modeling using maximum concentrations and conservative input parameters:

- Solvent yellow, HMX, and RDX had EEQs less than 1.0 in the food chain model for the vole and shrew.
- RDX had EEQs less than 1.0 in the food chain model for the quail and robin.
- Avian TRVs were not available for solvent yellow 33 or HMX.

G.3.4 Step 3A Refinement

Step 3a consists of a refinement of the conservative exposure assumptions/concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may be eliminated as a COPC in soil based on risks to soil invertebrates and plants but may be retained for evaluating risks to wildlife.

G.3.4.1 Terrestrial Invertebrates and Plants

Solvent yellow 33 was detected in one of 12 samples. Solvent yellow 33 was detected in a composite sample (X6SS003C0001). Terrestrial invertebrate and plant screening levels for solvent green 3 were not available so risks to invertebrates and plants from solvent green 3 could not be further evaluated. For that reason, solvent green 3 was retained as a COPC for terrestrial invertebrates and plants. However, it was only detected in one of twelve samples and the site is heavily wooded so there is uncertainty in whether plants or invertebrates are actually being impacted at the site.

G.3.4.2 Mammals and Birds

The EEQs from the terrestrial food chain modeling were less than 1.0 using maximum chemical concentrations and conservative exposure assumptions (see Section G.3.3.2). Therefore, risks were not recalculated using average chemical concentrations in surface soil and sediment and less conservative exposure assumptions (i.e., average ingestion rates, average body weights). Although avian TRVs were not available for solvent green 3, it is not likely to impact birds based on the low EEQs for mammals, because it was only detected in one of twelve samples, and the fact that the entire site is only 0.6 acres in size. Although, that size is within the conservative home range for robins, its low detection frequency indicates it is not widespread across the site so actual exposure to solvent green 3 is expected to be low. For that reason, solvent green 3 is eliminated as a COPC for birds. and therefore birds would only obtain a very small portion of their food from the site. Also, although avian TRVs were not available for HMX, it is not likely to impact birds because a subchronic study confirms no adverse effects to birds from

exposures as high as 10,000 ppm HMX in feed), suggesting that HMX is largely not available for absorption (USACHPPM, 2001). Therefore, HMX is eliminated as a COPC for birds.

G.3.5 Ecological Risk Screening Summary

This section presents a summary of the conclusions of the ecological risk assessment that was conducted for the site. Because terrestrial invertebrate and plant screening levels for solvent green 3 were not available so risks to invertebrates and plants from solvent green 3 could not be further evaluated and solvent green 3 was retained as a COPC for these receptors. However, it was only detected in one of twelve samples and the site is heavily wooded so there is uncertainty in whether plants are actually being impacted at the site.

No chemicals were retained as COPCs for terrestrial wildlife.

TABLE G-3.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
UX0 6 - TEST PADS BEHIND BUILDING 198
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Frequency of	Range of Nondetects	Overall Average[1]	Average of Positive Results[2]	Ecological Screening Level				COPC Flag	Rationale for COPC Selection
								Invertebrates	Plants	Avian	Mammals		
Dyes (ug/kg)													
Solvent Yellow 33	122,929 J	122,929 J	X6SS003C0001	1/12	687.5 - 687.5	10559	122929	**NA**	**NA**	**NA**	**NA**	**YES**	NSL
Explosives (mg/kg)													
HMX	0.04 J	0.04 J	X6SS008G0002	1/12	0.062 - 0.062	0.03	0.04	>600	>9341	**NA**	**NA**	**YES**	NSL
Nitrobenzene	0.094 J	0.094 J	X6SS006G0002	1/11	0.062 - 0.062	0.04	0.09	1.31	1.31	1.31	1.31	NO	BSL
RDX	0.089 J	0.16 J	X6SS003C0001	5/11	0.062 - 0.062	0.07	0.12	98	>9537	**NA**	**NA**	**YES**	NSL

Footnotes:
Shaded cells indicate that the maximum concentration exceeds the screening level.

1 Average of all analytical results.
2 Average of detected concentrations only.

COPC = Chemical of Potential Concern
NA = Not available or not applicable
J = Estimated concentration

Rationale Codes for COPC Selection:
BSL = Below COPC Screening Level
NSL = No Screening Level Available

TABLE G-3.2

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS UXO 6 - TEST PADS BEHIND BUILDING 198
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Dyes								
SOLVENT YELLOW 33	#VALUE!	#VALUE!	2.8E-01	2.8E-02	#VALUE!	#VALUE!	2.7E-01	2.7E-02
Explosives								
HMX	#VALUE!	#VALUE!	7.5E-02	1.5E-02	#VALUE!	#VALUE!	7.3E-02	1.5E-02
RDX	2.8E-03	1.2E-03	7.3E-03	3.2E-03	4.4E-03	2.0E-03	7.0E-03	3.1E-03

Cells are shaded if the value is greater than 1.0

#VALUE! - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

APPENDIX G.4

Lake Oberlin

G.4 ECOLOGICAL RISK SCREENING EVALUATION

G.4.1 Site Description

Section 6.1 presents a detailed description of the site location, history, and background of the site. The Site covers approximately 3 acres and was formed by the construction of an earthen dam across an unnamed tributary. Since there were no exceedences for any of the chemicals, there are no associated Ecological Risk information.

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APPENDIX G.5

West Gate Small Arms Range Complex

G.5 ECOLOGICAL RISK SCREENING EVALUATION

G.5.1 Site Description

Section 7.1 presents a detailed description of the site location, history, and background of the site. The Site West Gate Small Arms Range Complex (AOC 06) covers approximately 34 acres.

G.5.2 Potential Ecological Receptors and Exposure Pathways

The contaminated media to which ecological receptors may be exposed include surface soil. These potential ecological receptors and exposure pathways are described in detail in the methodology.

G.5.3 Ecological Screening

The first part of the evaluation is selection of COPCs. For this screening, both discrete samples and composite soil samples collected at the site. Composite soil samples analyzed for explosives were included in the evaluation for AOC; however, the composite soil samples analyzed for lead by XRF were not included in the evaluation because XRF data were not used quantitatively in this ERA.

G.5.3.1 COPCs for Terrestrial Invertebrates and Plants

Table G-5.1 of Appendix G presents the chemicals that were retained as COPCs in surface soil for potential risks to plants and invertebrates.

PAHs, explosives, and metals were detected at AOC 2. Copper was selected as a COPC for terrestrial invertebrates because it was detected at a concentrations that exceeded its screening level. Copper and lead were the only chemicals selected as COPCs for terrestrial plants in surface soil because they were detected at concentrations that exceeded their respective screening levels.

G.5.3.2 COPCs for Mammals and Birds

Table G-5.1 of Appendix G presents the chemicals that were retained for food chain modeling for terrestrial mammals and birds because they were detected at concentrations above screening levels. One PAH, one explosive, and four metals were retained as COPCs for food chain modeling because they were detected at a concentration that exceeded their respective screening levels for birds and/or mammals. Two explosives were retained as COPCs for food chain modeling because they did not have screening level for birds or mammals.

Table G-5.2 of Appendix G summarizes the results of the conservative inputs food chain modeling for terrestrial receptors. Appendix F presents the calculation worksheets. The following summarizes the results of the food chain modeling using maximum concentrations and conservative input parameters:

- 2-Amino-4, 6-dinitrotoluene was the only explosive with an EEQ greater than 1.0 in the food chain model.
- Copper and lead had EEQs greater than 1.0 in the food chain model.
- Avian TRVs were not available for HMX, and antimony.

G.5.4 Step 3A Refinement

Step 3a consists of a refinement of the conservative exposure assumptions/concentrations to evaluate the potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). The objective of the Step 3a refinement is to better define those chemicals that contribute to potentially unacceptable levels of ecological risk, and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. The Step 3a evaluation is designed to eliminate chemicals from further evaluation for certain groups of receptors. For example, a chemical may be eliminated as a COPC in soil based on risks to soil invertebrates and plants but may be retained for evaluating risks to wildlife.

G.5.4.1 Terrestrial Invertebrates and Plants

Copper was detected at a concentration (121 mg/kg) that exceeded its screening level of 70 mg/kg for plants and 80 mg/kg for invertebrates in one sample (A6SS170G0002) of 40 samples. The sample was located in the middle of the skeet range but is surrounded by other samples with low copper concentrations. Therefore, risks to invertebrates and plants from copper are not significant so copper is eliminated as a COPC for invertebrates and plants.

Concentrations of lead exceeded its screening level of 120 mg/kg in 10 samples of 40 samples. Four of the concentrations just slightly exceeded the screening level, while the other six had concentrations between 200 and 320 mg/kg and two had concentrations between 900 and 1250 mg/kg. The greatest concentrations of lead were found in the middle of the skeet range. Therefore, although potential impacts to plants are limited to a few areas, because the site is heavily wooded, and because the bioavailability of the lead from the shot pellets is not known, there is uncertainty in whether plants are actually being impacted at the site.

G.5.4.2 Mammals and Birds

The EEQs from the terrestrial food chain modeling were greater than 1.0 for several chemicals using maximum chemical concentrations and conservative exposure assumptions (see Section 7.6.3.2). Therefore, as part of the Step 3a refinement, risks for this pathway were recalculated using average chemical concentrations in surface soil and sediment and less conservative exposure assumptions (i.e., average ingestion rates, average body weights) (see Table 2).

Table G-5.3 of Appendix G summarizes the results of the less conservative inputs food chain modeling for terrestrial receptors. Appendix F presents the calculation worksheets. A discussion of the risks to mammal and birds are presented below.

- Copper had an EEQ less than 1.0 using the NOAEL as the TRV. Therefore, copper is eliminated as a COPC.

- Lead has an EEQ for the robin greater slightly than 1.0 using the NOAEL as the TRV (EEQ = 1.1); however, none of the receptors have EEQs greater than 1.0 using the LOAEL as the TRV. Lead was present in greatest concentrations in the middle of the skeet range. However, because the EEQ based on the NOAEL was only slightly greater than 1.0, it is unlikely that lead will significantly impact birds at the site. For that reason, lead was eliminated as a COPC for birds.

- 2-Amino-4, 6-dinitrotoluene has an EEQ for the robin greater slightly than 1.0 using the NOAEL as the TRV (EEQ = 1.6); however, none of the receptors have EEQs greater than 1.0 using the LOAEL as the TRV. This explosive was only detected in 1 of 11 samples. Its only detection was in one of the five composite samples from the pistol range, which is less than 0.5 acres in size. Therefore, assuming that a robin would only obtain 50 percent of its food from the pistol range, than the EEQ would be less than 1.0. For that reason, 2-Amino-4, 6-dinitrotoluene is eliminated as a COPC from the site.

Although avian TRVs were not available for HMX, it is not likely to impact birds because a subchronic study confirms no adverse effects to birds from exposures as high as 10,000 ppm HMX in feed), suggesting that HMX is largely not available for absorption (USACHPPM, 2001). Therefore, HMX is eliminated as a COPC for birds.

G.5.5 <u>Ecological Risk Screening Summary</u>

This section presents a summary of the conclusions of the ecological risk assessment that was conducted for the site.

No chemicals were retained as COPCs for terrestrial invertebrates or mammals.

Lead was the only chemical retained as a COPC for potential risks to plants, however, because the site is heavily wooded, and because the bioavailability of the lead from the shot pellets is not known, there is uncertainty in whether plants are actually being impacted at the site.

Reference

USACHPPM (U.S. Army Center for Health Promotion and Preventive Medicine), 2001. Wildlife Toxicity Assessment for HMX, Project Number 39-EJ-1138-01E, Aberdeen Proving Ground, Maryland, November 2001.

TABLE G-5.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL
AOC 6 - WEST GATE SMALL ARMS TANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Minimum Concentration	Maximum Concentration	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects	Overall Average[1]	Average of Positive Results[2]	Ecological Screening Level				COPC Flag	Rationale for COPC Selection
								Invertebrates	Plants	Avian	Mammals		
PAHs (ug/kg)													
1-Methylnaphthalene	2.3 J	65	A6SS083G0002	13/20	1.6 - 1.7	11	17	29000	3240	3240	100000	NO	BSL
2-Methylnaphthalene	3.4 J	120	A6SS083G0002	13/20	1.6 - 1.7	21	32	29000	3240	3240	100000	NO	BSL
Acenaphthene	1.7 J	60	A6SS035G0002	6/20	1.5 - 1.7	4.9	14	29000	682000	682000	100000	NO	BSL
Acenaphthylene	1.7 J	1.7 J	A6SS036G0002	1/20	1.5 - 1.8	0.86	1.7	29000	682000	682000	100000	NO	BSL
Anthracene	2.2 J	18 J	A6SS061G0002	7/20	1.5 - 1.7	2.8	6.5	29000	1480000	1480000	100000	NO	BSL
Benzo(a)anthracene	3.6 J	550 J	A6SS061G0002	8/20	1.5 - 1.7	52	130	18000	5210	5210	1100	NO	BSL
Benzo(a)pyrene	4.2 J	480 J	A6SS061G0002	9/20	1.5 - 1.7	49	107	18000	1520	1520	1100	NO	BSL
Benzo(b)fluoranthene	2.4 J	580 J	A6SS061G0002	11/20	1.5 - 1.7	57	103	18000	59800	59800	1100	NO	BSL
Benzo(g,h,i)perylene	4 J	350 J	A6SS061G0002	8/20	1.5 - 1.7	35	87	18000	119000	119000	1100	NO	BSL
Benzo(k)fluoranthene	2.5 J	170 J	A6SS061G0002	9/20	1.5 - 1.7	18	39	18000	148000	148000	1100	NO	BSL
Chrysene	5.9 J	850 J	A6SS061G0002	8/20	1.5 - 1.7	79	197	18000	4730	4730	1100	NO	BSL
Dibenzo(a,h)anthracene	3.1 J	21	A6SS020G0002	4/20	1.5 - 1.8	2.5	9.3	18000	18400	18400	1100	NO	BSL
Fluoranthene	1.9 J	2,000	A6SS035G0002	12/20	1.5 - 1.7	150	249	29000	122000	122000	100000	NO	BSL
Fluorene	1.7 J	4.1 J	A6SS061G0002	4/20	1.5 - 1.7	1.2	2.7	29000	122000	122000	100000	NO	BSL
Indeno(1,2,3-cd)pyrene	3.8 J	300 J	A6SS061G0002	9/20	1.5 - 1.7	31	67	18000	109000	109000	1100	NO	BSL
Naphthalene	2.9 J	82	A6SS083G0002	13/20	1.6 - 1.7	18	28	29000	99.4	99.4	100000	NO	BSL
Phenanthrene	1.8 J	470	A6SS035G0002	11/20	1.5 - 1.6	36	65	29000	45700	45700	100000	NO	BSL
Pyrene	1.8 J	2,100	A6SS035G0002	13/20	1.5 - 1.7	159	244	18000	78500	78500	**1100**	**YES**	ASL
Explosives (mg/kg)													
2-Amino-4,6-Dinitrotoluene[3]	0.16 J	0.16 J	A6SS009C0002	1/11	0.06 - 0.06	0.04	0.16	7	5	**0.0328**	**0.0328**	**YES**	ASL
HMX	0.13 J	0.24 J	A6SS004C0002	2/10	0.06 - 0.06	0.06	0.19	>600	>9341	**NA**	**NA**	**YES**	NSL
RDX	0.06 J	0.34 J	A6SS001C0002, A6SS004C0002	3/11	0.06 - 0.06	0.09	0.25	98	>9537	**NA**	**NA**	**YES**	NSL
Inorganics (mg/kg)													
Antimony	0.471 J	0.471 J	A6SS170G0002	1/40	0.287 - 0.586	0.17	0.47	78	5	**0.142**	**0.27**	**YES**	ASL/NSL
Arsenic	3.33	11	A6SS025G0002	40/40	-	6.6	6.6	60	18	43	46	NO	BSL
Copper	5.07 J	121	A6SS170G0002	40/40	-	15	15	**80**	**70**	**28**	**49**	**YES**	ASL
Lead	12.8 J	1240 J	A6SS170G0002	40/40	-	130	130	1700	**120**	**11**	**56**	**YES**	ASL
Zinc	20.1 J	61.3 J	A6SS025G0002	40/40	-	35	35	120	160	**46**	79	**YES**	ASL

Footnotes:
Shaded cells indicate that the maximum concentration exceeds the screening level.

1 Average of all analytical results.
2 Average of detected concentrations only.
3 Degradation product 2,6-dinitrotoluene used as surrogate.

COPC = Chemical of Potential Concern
NA = Not available or not applicable
J = Estimated concentration

Rationale Codes for COPC Selection:
ASL = Above COPC Screening Level
BSL = Below COPC Screening Level
NSL = No Screening Level Available

TABLE G-5.2

TERRESTRIAL FOOD CHAIN MODEL - CONSERVATIVE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS AOC 6 - WEST GATE SMALL ARMS TANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
Chemical	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**	**NOAEL**	**LOAEL**
PAHs								
Pyrene	9.5E-02	9.5E-03	2.8E-01	4.5E-03	1.5E-01	1.5E-02	2.7E-01	4.4E-03
Explosives								
2-Amino-4,6-Dinitrotoluene	4.6E+00	3.6E-02	5.2E-03	9.7E-04	7.1E+00	5.5E-02	5.0E-03	9.4E-04
HMX	#VALUE!	#VALUE!	4.5E-01	9.0E-02	#VALUE!	#VALUE!	4.4E-01	8.7E-02
RDX	5.9E-03	2.6E-03	1.6E-02	6.8E-03	9.4E-03	4.2E-03	1.5E-02	6.5E-03
Inorganics								
ANTIMONY	#VALUE!	#VALUE!	6.5E-02	1.4E-03	#VALUE!	#VALUE!	6.1E-02	1.3E-03
COPPER	7.8E-01	9.0E-02	3.3E-01	2.2E-02	1.3E+00	1.5E-01	3.2E-01	2.1E-02
LEAD	1.2E+01	4.4E-01	1.3E+00	3.2E-02	2.2E+01	7.9E-01	1.2E+00	3.0E-02
ZINC	8.9E-02	3.4E-02	7.2E-02	1.8E-02	1.4E-01	5.4E-02	6.9E-02	1.8E-02

Cells are shaded if the value is greater than 1.0

#VALUE! - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient

TABLE G-5.3

TERRESTRIAL FOOD CHAIN MODEL - AVERAGE SCENARIO
INSECTIVOROUS AND HERBIVOROUS RECEPTORS AOC 6 - WEST GATE SMALL ARMS TANGE COMPLEX
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Chemical	Herbivorous Receptors EEQs				Insectivorous Receptors EEQs			
	Bobwhite Quail		Meadow Vole		Robin		Short-Tailed Shrew	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
PAHs								
Pyrene	4.8E-06	4.8E-07	9.2E-06	1.5E-07	9.2E-06	9.2E-07	1.7E-05	2.7E-07
Explosives								
2-Amino-4,6-Dinitrotoluene	8.3E-01	6.4E-03	5.7E-04	1.1E-04	1.6E+00	1.2E-02	1.0E-03	1.9E-04
HMX	#VALUE!	#VALUE!	5.1E-02	1.0E-02	#VALUE!	#VALUE!	9.2E-02	1.8E-02
RDX	9.9E-04	4.4E-04	1.7E-03	7.5E-04	1.9E-03	8.5E-04	3.1E-03	1.4E-03
Inorganics								
ANTIMONY	#VALUE!	#VALUE!	7.9E-03	1.7E-04	#VALUE!	#VALUE!	1.4E-02	2.9E-04
COPPER	1.3E-01	1.5E-02	5.1E-02	3.5E-03	2.4E-01	2.8E-02	9.2E-02	6.3E-03
LEAD	5.7E-01	2.1E-02	5.8E-02	1.5E-03	1.1E+00	4.1E-02	9.9E-02	2.5E-03
ZINC	4.3E-02	1.7E-02	2.3E-02	5.7E-03	8.2E-02	3.2E-02	4.1E-02	1.0E-02

Cells are shaded if the value is greater than 1.0

#VALUE! - Value Not Available
NOAEL - No Observed Adverse Effects Level
LOAEL - Lowest Observed Adverse Effects Level
EEQ - Ecological Effects Quotient