DRAFT FINAL REPORT

# COMPREHENSIVE SITE EVALUATION PHASE II

## NELLIS AIR FORCE BASE, NEVADA

**June 2010**
**Rev. 02**

United States
Air Combat Command

53rd Wing
Nellis Air Force Base

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**June 2010**
**Rev. 02**

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# 1.0 INTRODUCTION

In support of the Military Munitions Response Program (MMRP), a Comprehensive Site Evaluation (CSE) Phase II was performed at Nellis Air Force Base (AFB). The goal of the United States (U.S.) Air Force (USAF) MMRP is to make munitions response areas (MRAs) safe for reuse and to protect human health and the environment in the process. The MMRP addresses issues related to munitions and explosives of concern (MEC) and munitions constituents (MC) associated with MRAs, as well as related hazardous substances, pollutants, and potential contaminants of concern (COCs) on defense sites other than operational range areas. The MRAs for Nellis AFB are presented as **Figure 1-1**.

## 1.1 Purpose

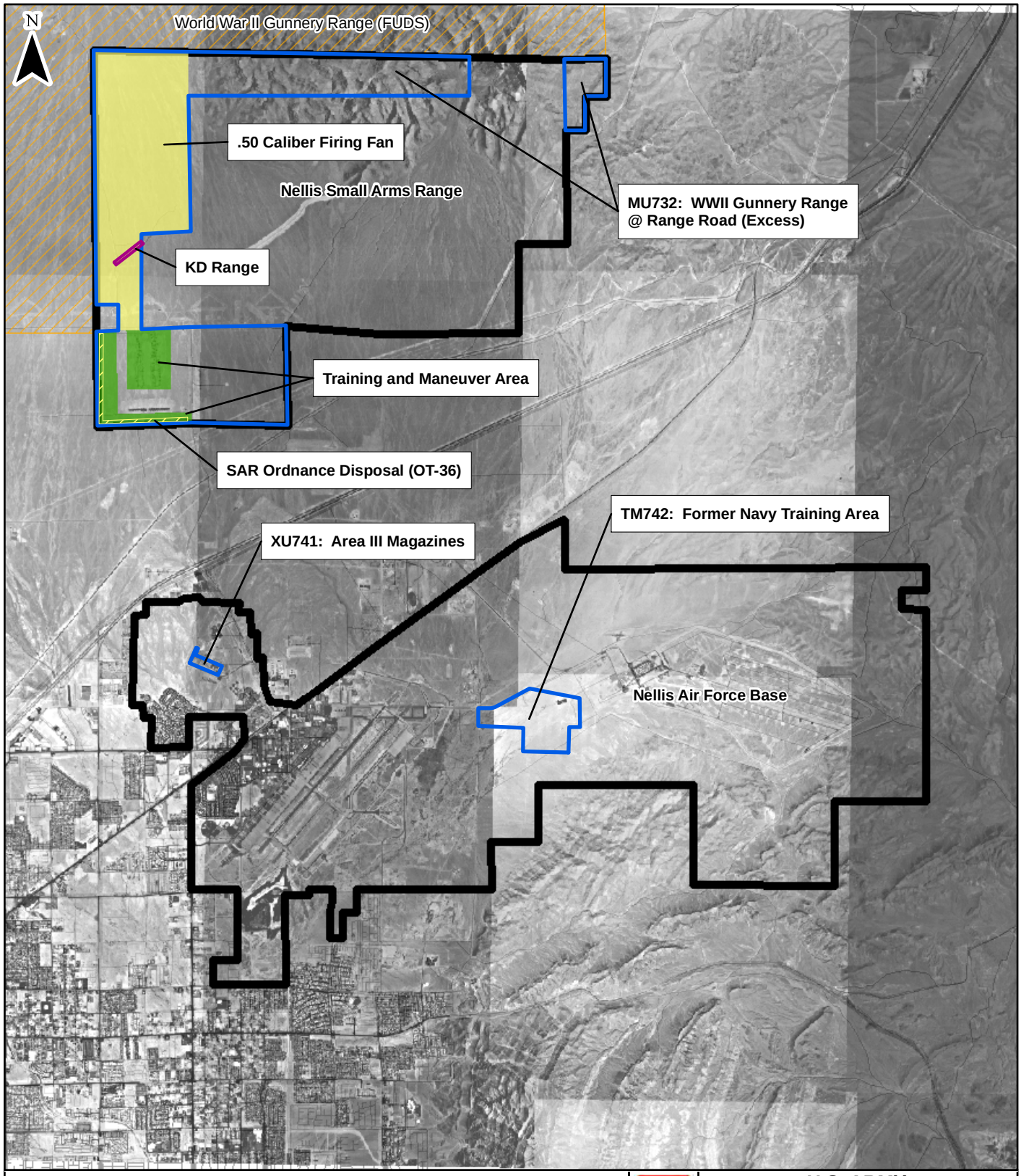
The USAF developed the CSE concept from existing data acquisition methods and data analysis, tracking, and reporting tools for sites covered under the MMRP. The CSE serves as the initial Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) Preliminary Assessment/Site Investigation (PA/SI). The CSE is a holistic approach to munitions response and environmental restoration that assesses the unique challenges faced at MRAs, including explosives safety issues posed by MEC and associated releases of MC to the environment, such as hazardous substances, pollutants, contaminants, or petroleum, oil, and lubricants (POL). An MRA is defined as any area on a defense site that is known or suspected to contain MEC or MC, such as former ranges or munitions burial areas. MEC can include unexploded ordnance (UXO), discarded military munitions (DMM), or MC in high enough concentrations to pose an explosive hazard. Based on information gathered during the CSE Phase II and depending on site-specific factors, each MRA may be designated as a single munitions response site (MRS), or it may be subdivided for the purposes of evaluation and response into multiple MRSs.

MRSs represent discrete locations within a MRA that, based on investigation or historical records, are known or suspected to contain MEC and/or MC and require a munitions response. Subdividing MRAs into multiple MRSs allows for more efficient characterization so that munitions responses specific to local conditions can be conducted.

The CSE process provides the historical, anecdotal, visual, analytical, and geophysical data that serves as the basis for USAF decision-making regarding follow-on munitions response actions. The CSE is conducted in two distinct phases; the CSE Phase I generally consists of historical records reviews (HRR), visual surveys, and interviews; the CSE Phase II generally consists of environmental sampling and geophysical surveys. The CSE Phase I and Phase II investigations differ from the traditional CERCLA PA and SI with respect to data requirements. MMRP CSE activities primarily focus on obtaining data to input into the Department of Defense (DoD) Munitions Response Site Prioritization Protocol (MRSPP) and site-sequencing for cleanup.

The CSE process utilizes an expanded array of analytical, tracking, and reporting tools to support decision-making and therefore has greater data requirements. Tools utilized as part of the CSE include the following:

- Conceptual Site Model (CSM) for project communication, hazard assessment, and data gap analysis;




LEGEND

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- .50 Caliber Firing Fan
- Training and Maneuver Area
- SAR Ordnance Disposal (OT-36)
- Known Distance (KD) Range

0 0.5 1 1.5 3 Miles

Projection : NAD83 State Plane Nevada East

U.S. ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-1

MUNITIONS RESPONSE AREAS
NELLIS AIR FORCE BASE

Shaw Shaw Environmental, Inc. Bay West

- MRSPP to prioritize sites for further munitions response actions, based on relative risk;
- Hazard Ranking System (HRS) data elements to ensure full characterization of the MRA;
- Air Force Restoration Information Management System (AFRIMS) for a range of program management functions, including data calls and audits; and
- Remedial Action Cost Engineering Requirements (RACER) for estimating the costs of future munitions response actions.

The objectives of this Nellis AFB CSE Phase II effort are to determine whether individual MRAs within Nellis AFB warrant additional munitions response activities, warrant definition as MRSs, or warrant documentation for a No Further Action (NFA) decision.

## 1.2 Project Data Quality Objectives

The data quality objectives (DQOs) for this investigation are based on data requirements specified in *Air Force Guide for Conducting the Comprehensive Site Evaluation Phase II at Air Force Munitions Response Areas* (Version 4) (USAF 2006) for completion of Phase II investigations. Collected data will be used to complete the RACER and AFRIMS worksheets, presented in **Appendices L** and **M**.

## 1.3 Project Management

This CSE Phase II Report has been prepared by Bay West, Inc. (Bay West) with technical support from Shaw Environmental, Inc. (Shaw), under the U.S. Army Corps of Engineers (USACE) Environmental Remediation Services Contract (ERSC) W9128F-04-D-0004, Task Order (TO) 34, Nellis AFB CSE Phase II.

## 1.4 Project Scope

Based on the Interim CSM and exposure pathway/migration analysis determined during the CSE Phase I, four data gap areas were identified:

- Small Arms Range Areas;
- Impact Areas;
- Munitions Storage Areas; and
- Training and Maneuver Areas.

Data requirements with respect to MEC and MC determined for each of these data gap types are summarized in **Table 1-1**.

**Table 1-1 Data Requirements**

| Data Gap Type | MRA | Scope | CSE Phase II Activities | Potential Results and Proposed Path Forward |
|---|---|---|---|---|
| Small Arms Range Areas | MU732 | Determine whether MC are present and require remedial action. | Collect surface and subsurface soil samples from small arms range berms to evaluate if lead or PAHs (skeet range areas) are present in soil above screening levels. In addition, horizontally delineate the extent of contamination, if present. | If lead or PAHs are present above action level, evaluate need for future response action. If no lead or PAHs are present above action level, NFA. |
| Impacts Areas | MU732 | Evaluate extent of MEC present at the target areas. | Perform site reconnaissance to evaluate extent of MEC at the site.<br>If MEC are present, collect surface and subsurface soil samples from areas with significant evidence of MEC for worst-case MC analysis. | If MEC evidence is observed and/or MC are above the screening level, evaluate future munitions response action.<br>If no MEC evidence is observed, no MC sampling, NFA. |
| Munitions Storage Areas | XU741 | Determine whether evidence of MEC is present.<br>Evaluate MC concentrations for worst-case scenario analysis. | Perform a field reconnaissance effort to identify evidence of MEC in former storage areas.<br>Collect surface soil samples to evaluate if MC listed in **Table 6-2** are present in soil above screening levels. Bias locations to areas where MEC is identified, or randomly collect for explosives analysis if MEC are not identified. | If MEC evidence is present or MC are above screening values, evaluate future munitions response action.<br>If no MEC evidence is present and MC are below screening levels, recommend NFA for MMRP. |
| Training and Maneuver Areas | TM742<br>MU732 | Determine whether evidence of MEC is present at the Training and Maneuver Areas. | Perform site reconnaissance to evaluate extent of MEC at the site.<br>If MEC is present, collect surface and subsurface soil samples from areas with significant evidence of MEC for worst-case MC analysis. | If MEC evidence is observed and/or MC are above the screening level, evaluated future munitions response action.<br>If no MEC evidence, no MC sampling, and NFA. |

*PAH polycyclic aromatic hydrocarbon*

## 1.5 Report Organization

This report is composed of 14 sections as follows:

- **Section 1.0 - Introduction:** This section presents the introduction, objectives, and organization of this report.
- **Section 2.0 - Installation Background:** This section describes the history of activities and the physical description for Nellis AFB.
- **Section 3.0 - Physical and Environmental Setting:** This section describes the physical characteristics of Nellis AFB.
- **Section 4.0 - Investigation Scope and Approach:** This section describes the scope of work completed during the CSE Phase II and the procedures followed.
- **Section 5.0 - Munitions Response Site Characteristics:** This section describes the Nellis AFB MRAs and presents the results of the CSE Phase II field effort.
- **Section 6.0 - Evaluation of Known/Suspected MEC:** This section describes the sources, release mechanisms, and associated MC for MEC at Nellis AFB. In addition, the Explosive Safety Submission (ESS) information is presented.
- **Section 7.0 - Evaluation of Hazardous Waste/Substances:** This section summarizes the sources of hazardous waste/substance contamination at Nellis AFB.
- **Section 8.0 - Conceptual Site Model:** This section describes the CSM that was developed for Nellis AFB and evaluates the media and transport mechanisms associated with the potential MEC/MC present.
- **Section 9.0 - Screening Level Human Health Risk Assessment:** This section presents a qualitative assessment of the analytical data collected during the CSE Phase II to evaluate potential risks to human health.
- **Section 10.0 - Screening Level Ecological Risk Assessment:** This section presents a qualitative assessment of the analytical data collected during the CSE Phase II to evaluate potential risks to ecological receptors.
- **Section 11.0 - Munitions Response Site Prioritization Protocol:** This section presents the Explosive Hazard Evaluation (EHE), Chemical Warfare Materiel Hazard Evaluation (CHE), and Health Hazard Evaluation (HHE) scores and overall MRS priority ratings for the Nellis AFB MRAs/MRSs.
- **Section 12.0 – Perchlorate Reporting:** This section discusses the need for perchlorate sampling for programmatic USAF evaluation.
- **Section 13.0 - Summary and Conclusions**
- **Section 14.0 - Recommendations (Future Investigation and/or Action)**

# 2.0 INSTALLATION BACKGROUND

Nellis AFB, "Home of the Fighter Pilot," is home to the USAF Warfare Center, the largest and most demanding advanced air combat training mission in the world. At Nellis, training for composite strike forces is provided for every type of aircraft in the USAF inventory. Training is conducted in conjunction with air and ground units of the Army, Navy, Marine Corps and Air Forces from our allied nations. The crews do not come to learn how to fly, but instead how to become the best combat aviators in the world. The physical characteristics and history of Nellis AFB applicable to the CSE Phase II activities are presented in this section. Much of the setting information described below was extracted from the *Nellis AFB CSE Phase I Report* (URS 2007).

## 2.1 Location and Setting

Nellis AFB is located approximately eight miles northeast of downtown Las Vegas, in the northeast corner of the Las Vegas Valley, in the southeastern corner of Nevada, in North Las Vegas, Clark County, Nevada (see **Figure 2-1**). The base is located adjacent to the cities of Las Vegas and North Las Vegas in Clark County. The unincorporated town of Sunrise Manor is included in the base limits and uninhabited areas of Clark County comprise the majority of the base.

The main base covers approximately 11,300 acres. Seven thousand of those acres (62 percent) are undeveloped; the remaining area is either paved or contains structures. The total land area occupied by Nellis AFB and its restricted ranges is more than 5,000 square miles. An additional 7,700 square miles of airspace north and east of the restricted ranges also are available for military flight operations.

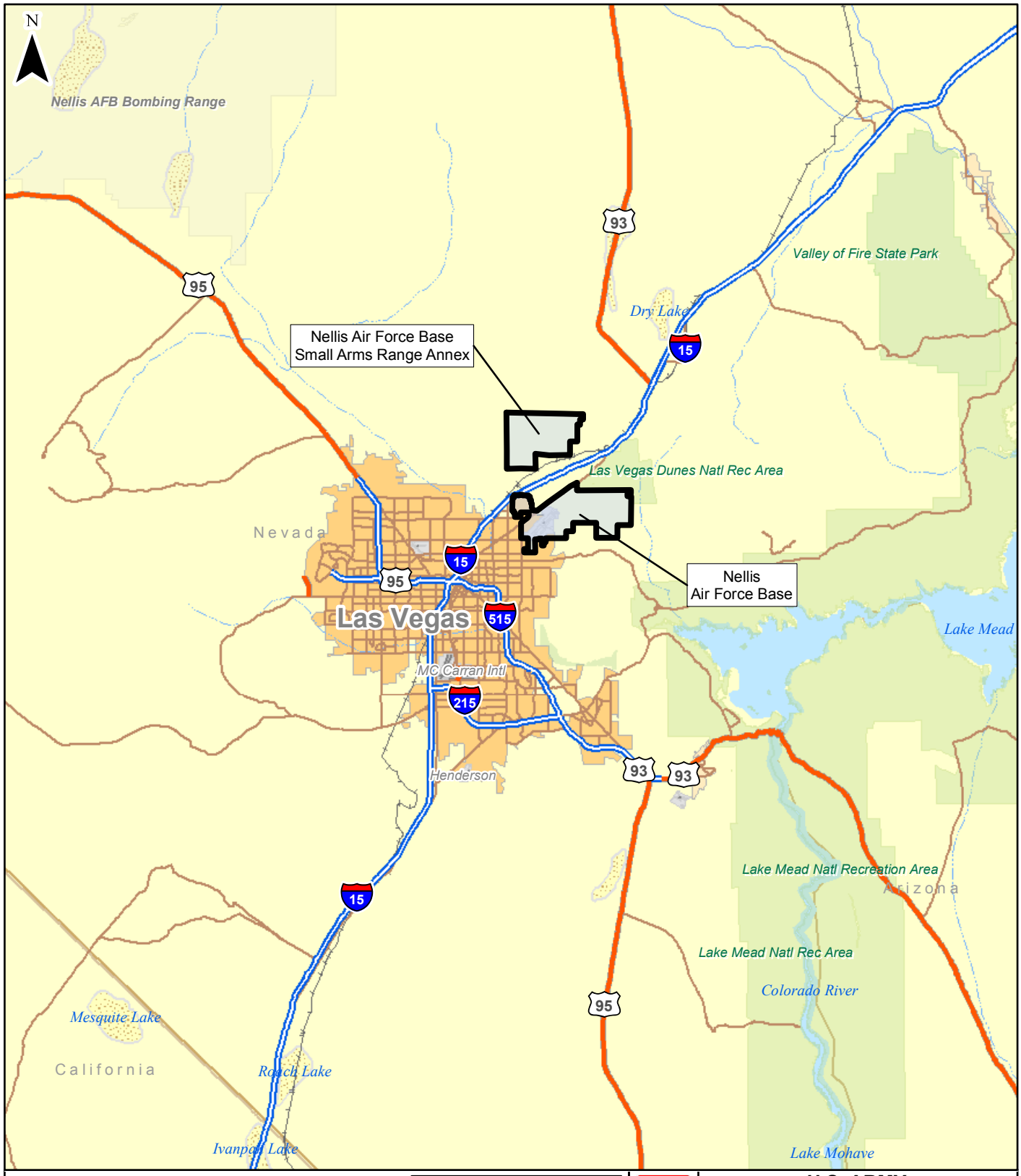
The main base is divided into three separate areas:

- Area I includes the airfield, housing, and most of the command and support structures;
- Area II is located at the northeast edge of Area I and contains the munitions storage areas; In September 1969, Area II became part of the Nellis AFB complex. Previously, it was named Lake Mead Base and served as a weapons storage area for the U.S. Navy.
- Area III is located across Las Vegas Boulevard from Area I and contains housing, the base hospital, and open space (see **Figure 2-1**).

## 2.2 Installation Mission and Operational History

The history of the base began with a survey in October 1940 by Major David M. Schlatter of the U.S. Army Air Corps, who examined various sites in the southwest, looking for a location for an aerial gunnery school. The area around Las Vegas was attractive for its clear weather that provided year-round flying conditions, and the then-impoverished city was eager for a military base. On January 2, 1941, the city bought an airstrip operated by Western Air Express and leased it to the U.S. Army Air Corps three days later, the plan being to use the strip for both military and civilian aircraft.

On January 25, 1941, Las Vegas Mayor John L. Russell signed over the property to the U.S. Army Quartermaster Corps for the development of a flexible gunnery school for the U.S. Army




LEGEND

Nellis Air Force Base Installation Boudary

0 5 10 20 Miles

Projection : NAD83 State Plane Nevada East

**U.S. ARMY CORPS OF ENGINEERS**
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER** 2-1

**SITE LOCATION**
**NELLIS AIR FORCE BASE**

Shaw Environmental, Inc.

Bay West

Air Corps. The mission of the Las Vegas Army Air Corps Gunnery School, later re-named the Las Vegas Army Air Field (LVAAF), was "to train aerial gunners to the degree of proficiency that will qualify them for combat duty." Construction of the LVAAF began in March 1941. Much of the early gunnery training, originally set to begin in September 1941 but not underway until January 1942, used machine guns mounted in trucks and targets on railroad cars to introduce students to firing at moving targets while moving themselves. World War II (WWII) made the base's mission especially urgent. By the end of 1942, the base had 9,117 gunner graduates with aircraft experience including Martin B-10s, AT-6s, A-33s, B-17 Flying Fortresses, B-24 Liberators, and B-26 Marauders.

At the height of training in 1943 and 1944, over 15,000 men and women were located at the base. Actors Ronald Reagan and Burgess Meredith came to help produce the propaganda film *Rear Gunner* in support of this mission. Much of the training was for B-17 gunners, but then, beginning in 1945, emphasis shifted to the B-29 Superfortress. An innovation was the use of a specially-designed target aircraft, the RP-63 Pinball, which was sufficiently armored to be fired upon using frangible bullets. At the war's end, the school had trained over 45,000 B-17 gunners and over 3,000 B-29 gunners.

The gunnery school closed in September 1945, and the base itself was officially deactivated in January 1947. It was reactivated by the newly-created USAF in March 1948 as an advanced single-engine school. The first USAF Gunnery Meet was held at the base on May 2, 1949, with competitors from 14 USAF units flying both prop and jet aircraft.

The base was renamed Nellis AFB on April 30, 1950 for William Harrell Nellis, a Las Vegas resident and P-47 pilot who died in action during the Battle of the Bulge. Shortly thereafter, the base was again used to prepare pilots, this time for the Korean War, and became a part of testing programs for new aircraft.

In 1969, the 57th Fighter Wing was activated to start the USAF Weapons School. This school was created in response to lessons learned from air-to-air combat in Vietnam and also led to the establishment of Red Flag exercises at Nellis AFB.

Command responsibility for Nellis AFB was transferred to the Air Combat Command (ACC) on June 1, 1992.

Nellis AFB's current mission is to assist the ACC in arranging, training, and equipping tactical USAF units. Today, Nellis AFB continues to provide training for composite strike forces which include every type of aircraft in the USAF inventory. From 1969 to present, it provides graduate-level training on all fighter weapons that USAF officers would be expected to utilize. This includes air-to-air combat with both guns and missiles and air-to-ground combat. Training is commonly conducted in conjunction with air and ground units of the U.S. Army, U.S. Navy, U.S. Marine Corps, and allied forces worldwide.

## 2.3 Summary of MEC-Related Activities

There were nine operational range areas and six MRAs associated with Nellis AFB during the CSE Phase I. However, subsequent to the CSE Phase I, it was determined that the three bore-sight pits are currently being investigated and cleaned up under the Installation Restoration Program (IRP) and so were removed from the MMRP program. Therefore, these MRAs (AL738, AL739, and AL740) are not further discussed in this CSE Phase II Report. Additionally, the active range areas at Nellis AFB are not eligible for funding under the USAF MMRP and so are

not further discussed. **Table 2-1** lists the former ranges to be investigated under the MMRP, dates of operation, and known or suspected munitions used within each MRA.

Gunnery training associated with LVAAF occurred from 1941 through 1947, when the property was declared surplus. Additional bombing and gunnery range activities continued at Nellis AFB from 1950 through 1969.

**Table 2-1 Former Ranges and Impact Areas**

| Range | Dates of Operation | Known or Suspected Munitions Use |
|---|---|---|
| MU732: WWII Gunnery Range @ Range Road (Excess)[1] | 1941-1965 | Small/medium arms projectiles, rockets, bombs, incendiary items, demolitions materials; used as a small arms gunnery range, ground-to-air gunnery range, rocketry range, bombing range, ordnance disposal area. |
| XU741: Area III Magazines | 1940s-present | Stored materials included pyrotechnics and small arms; used as a storage area. |
| TM742: Former Navy Training Area | 1950s-1969 | Navy Training Area; used as a small arms range |

*[1]It should be noted that MRA MU732 was referred to as "Nellis Small Arms Range Annex-Excess" in the CSE Phase I report and the CSE Phase II Work Plan. The name of the MRA was revised to match that in AFRIMS, which maintains the official name for all MRAs.*

## 2.4 Identification of Munitions Response Areas

Three MRAs (MU732, XU741 [referred to as MS741 in the CSE Phase II Work Plan] and TM742) at Nellis AFB were investigated for the CSE Phase II. According to the CSE Phase I, the MRAs encompass a total of approximately 4,315.7 acres of the total 11,300 acres as presented on **Figure 1-1**. Suspected MEC materials at Nellis AFB ranged in size from small arms to 750 pound (lb) practice bombs and include demolition materials, bombs, rockets, projectiles, grenades, and signals.

Historical features indicating potential source areas have been identified at Nellis AFB. Ground scars and impact craters were observed during the CSE Phase I field effort in MU732. One MEC storage area was also identified. However, no MMRP-eligible open burn/open detonation (OB/OD) areas, lagoons, or landfills were identified during the CSE Phase I and no MEC manufacturing activities occurred at Nellis AFB (URS 2007).

In addition, there is no evidence indicating the potential use of radioactive weapons at MMRP-eligible areas within Nellis AFB. However, there is a potential that chemical warfare materiel (CWM) in the form of Chemical Agent Identification Set (CAIS) kits were used at Nellis AFB. The *Chemical Agent Records Search Initiative (CARSI) Phase II Report* (Miretek 1999) notes that "CAIS appears to have been present at Nellis AFB for training in 1945," but the report did not identify the location or disposition of this material.

## 2.5 Identification of Munitions Response Site Subdivisions

The MRAs at Nellis AFB were not subdivided into multiple MRSs during CSE Phase II activities. Therefore, each MRA was handled as one MRS for the CSE Phase II activities.

## 2.6 Previous Investigations

Numerous Nellis AFB-associated Formerly Used Defense Sites (FUDS) properties have been the subject of Archive Search Reports (ASRs), an IRP site decision document, and multiple explosive ordnance disposal (EOD) clearance actions. The Small Arms Range Ordnance Ejection Site OT-39, now known as OT-37, located in the active portion of the Nellis Small Arms Range was the subject of a decision document. Multiple EOD clearance actions were completed on a portion of the Nellis Small Arms Range FUDS property located west of MU732 to address 37 millimeter (mm) high-explosive (HE) rounds. However, because these sites are not eligible for the USAF MMRP, these investigations are not discussed in this report. Investigations of sites or portions of sites eligible for the USAF MMRP are discussed below.

### 2.6.1 Range Clearance Report, Portion of Nellis Rifle and Pistol Range

A Range Clearance Report was prepared and submitted by Team 1 of the 2701st EOD Squadron, Hill AFB, Utah, for range clearance operations conducted in March 1972 (USAF 1972). The EOD unit performed a clearance on a tract of land lying within Clark County, Nevada, being all of Sections 32 and 36 and the north half of Sections 33, 34, and 35 Township 18 South, Range 62 East; the north half and southwest quarter of the southwest quarter of Section 31 of Township 18 South, Range 63 East; all of Sections 1, 5, 12, 16, and 17, and the west half of Section 8 of Township 19 South, Range 62 East and issued a Certificate of Clearance with no restrictions on future use. The clearance area is shown in **Figure 2-2**.

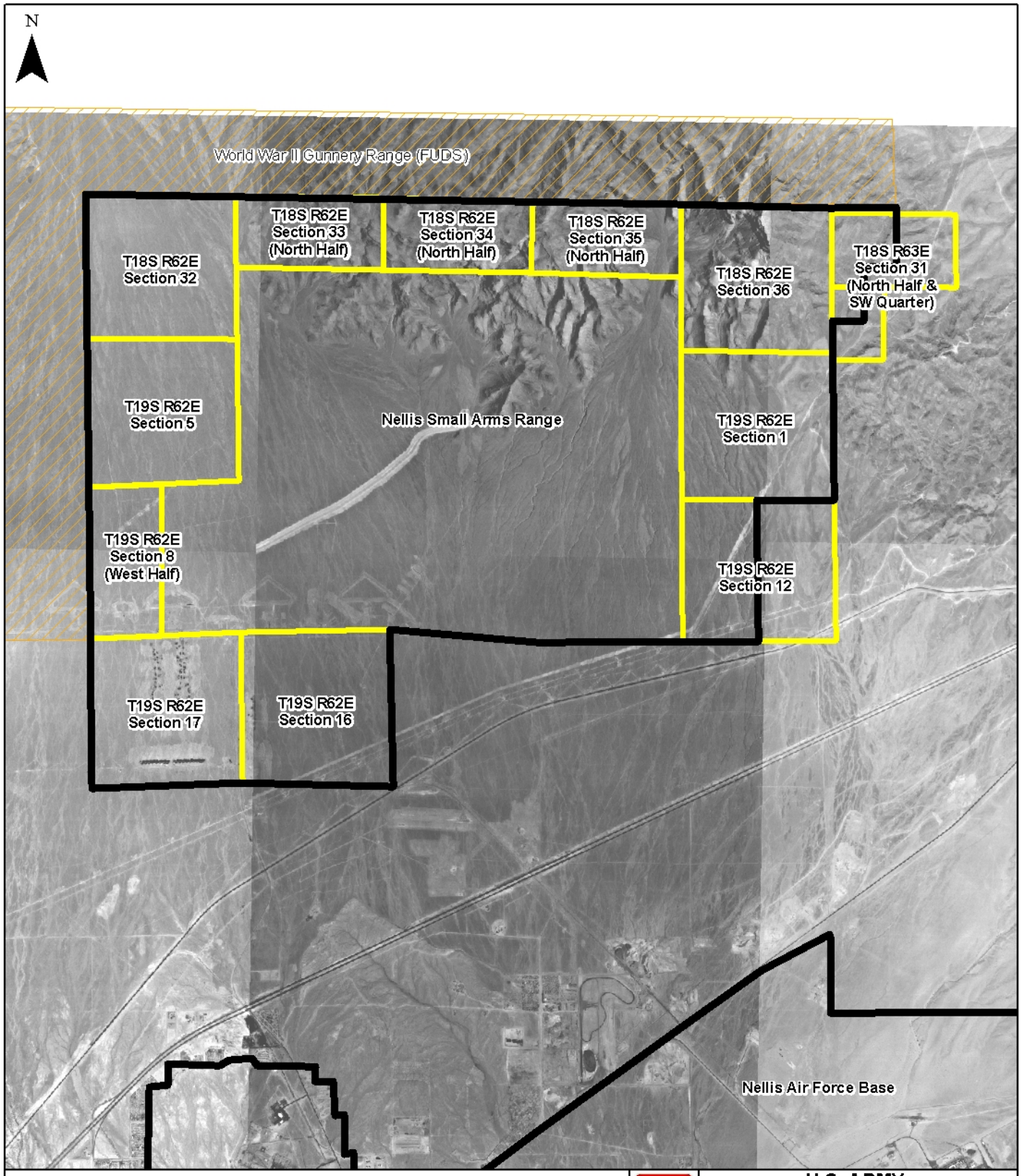
The range clearance covered approximately 5,775 acres using nine EOD personnel. The EOD team recovered and disposed of the following MEC items:

- 2.75-inch Rocket motors (2 each);
- M23 Igniters with M173 fuzes (2 each);
- M23 Igniter without fuze (1 each);
- Miscellaneous small arms up to .50 caliber (25 each); and
- Small amount of explosives residues (1 each).

The report does not describe the methodology or procedures used in the clearance, and there is no reference to intrusive activity or subsurface MEC removal. This clearance was completed at this portion of the Nellis Small Arms Range in preparation to declare this property excess to DoD requirements and to return the property to the Department of the Interior.

### 2.6.2 Nellis Small Arms Range Archive Search Report

An ASR prepared by USACE, Rock Island District included a historical records search and site inspection completed in July 1996 (USACE 1996a). The investigation focused on 36,378.28 acres of land that was used initially by the Army Air Force as a ground gunnery range during




LEGEND

- Nellis Air Force Base Installation Boudary
- FUDS Property
- Sections

0 5,000 10,000 Feet

Projection : NAD83 State Plane Nevada East

U.S. ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 2-2

EOD CLEARANCE AREAS
NELLIS AIR FORCE BASE

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WWII, and later by the USAF as an emergency jettison area and EOD area. This tract of land is adjacent to and abuts the active Nellis AFB Small Arms Range on the southeast corner. The area defined as MU732 was mistakenly identified as Bureau of Land Management (BLM) property (i.e., FUDS) and included in the report. The purpose was to characterize the site for potential MEC contamination. No sampling was completed during the fieldwork associated with this investigation.

The ASR concluded that, although there was no visual evidence of MEC observed by the site inspection team, the potential for MEC contamination exists based on historical evidence.

### 2.6.3 Explosive Ordnance Disposal Report

An incomplete copy of a 1995 EOD report is included in the Nellis AFB Small Arms Range ASR (USACE 1996a). A complete copy of this report could not be located. This EOD report was prepared and submitted by Nellis AFB EOD for range-clearance operations conducted on May 15 through July 19, 1995 (USACE 1996a). The EOD unit performed a clearance on an estimated 3,900 acres of land which is now considered MU732. All areas of MU732 were covered except a small, remote section located northeast of the active Nellis Small Arms Range.

During the eight-week clearance operation, the EOD unit located and identified over 30 MEC items requiring disposal. The MEC items located, identified, and disposed of included:

- Bombs, practice bomb dummy unit (BDU)-33/B (3 each);
- Bomb, practice Mark (MK) 106 (1 each);
- Bombs, practice MK 82 Mod 0 (8 each);
- Bomb, M117 inert (1 each);
- Rocket motors, MK 43 Mod 1 (19 each);
- Rocket warhead, M229 2.75-inch HE (1 each);
- Rocket warheads, MK 1 Mod 3 inert (2 each);
- Grenade, AN-M14 thermite (1 each);
- Ammunition, .50 caliber ball (3 each); and
- Projectile, 20mm high-explosive incendiary (HEI) (1 each).

### 2.6.4 Site LF-34 Decision Document

A decision document prepared for Landfill Site LF-34 at the Nellis Small Arms Range Annex resulted in the Nevada Division of Environmental Protection (NDEP) issuing a NFA determination for this site (USAF 1995). Site LF-34 is located in the southern part of the western portion of MU732 and was reportedly a disposal site for all waste generated at Nellis AFB during the late 1960s. The landfill has been inactive and covered for many years.

An Environmental Baseline Survey (EBS) completed for the Small Arms Range in the Spring and Summer of 1995 included LF-34 and involved a sweep of the area by EOD teams from both Nellis AFB and Luke AFB. Approximately 30 munitions-related items ranging from practice bombs to rocket motors were recovered and the clearance was determined to be successful.

Following the surface clearance, closure grading activities were completed in July 1995 to ensure all areas of exposed trash and debris were covered with at least 24 inches of native soil and to promote proper surface drainage.

The decision document also summarizes the results of eight rounds of groundwater sampling from three monitoring wells installed at the site. Low levels of trichloroethene (TCE) and dissolved metals were historically present in concentrations below maximum contaminant levels (MCLs), but all volatile organic compounds (VOCs), including TCE, were non-detect during the last round of sampling. The decision document concludes that there is no evidence to indicate that Site LF-34 is adversely affecting human health or the environment.

NDEP conducted a site visit to verify the conclusions of the decision document before issuing the NFA determination for Site LF-34 on December 18, 1996.

### 2.6.5 Site LF-37 Decision Document

A decision document prepared by James M. Montgomery, Consulting Engineers, Inc. (JMM) for Landfill Site LF-37 (now known as LF-35) at the Nellis Small Arms Range Annex of Nellis AFB resulted in the NDEP issuing a NFA determination for this site (JMM 1992). Site LF-37 reportedly was located in one of the target bunker complexes (referenced elsewhere as a moving target range), and the western portion of this site falls on MU732 property. The study found that Site LF-37 had been used as the Nellis AFB landfill during the early 1970s. Wastes including solvents, paints, and lubricants may have been disposed of in this landfill.

This site was investigated during a remedial investigation in 1991 as a potential source of contamination. Field reconnaissance activities failed to find visual evidence of significant land disposal activities in the target bunker, as originally cited. However, a small area of buried debris was noted in the northwest corner of the bunker (moving target range) to the north, and the material appeared to be Nellis AFB waste. A monitoring well was installed downgradient of this buried debris area, and no contamination was detected. There is no mention of MEC-related materials or debris in the decision document.

NDEP conducted a site visit in 1991 to verify the conclusions of the decision document before issuing the NFA determination for Site LF-35 on July 1, 1993.

### 2.6.6 Site OT-38 Decision Document

A decision document prepared by EA Engineering, Sciences, and Technology, Inc. (EA) for Small Arms Range Ordnance Disposal Site OT-38 (now known as OT-36) at the Nellis Small Arms Range Annex resulted in the NDEP issuing a NFA determination for this site. This site is an L-shaped disposal area located in the southwest corner of Nellis AFB Small Arms Range (MU732). The study found that the area had been used for small arms residue burning and munitions residue disposal. Miscellaneous skeet range target debris also was scattered throughout the site area.

The USAF IRP Phase I study determined that ordnance waste could be hazardous if improperly activated, but contaminant migration is not anticipated because of the physical characteristics of the ordnance and the relative lack of transport mechanisms at this location. The site was not considered to present significant environmental concerns and was not examined during IRP Phase II studies. In June 1992, the Nellis AFB EOD unit conducted a sweep and found no MEC hazards at the site.

NDEP conducted a site visit in 1991 to verify the conclusions of the decision document. Following completion of the EOD sweep, NDEP issued a NFA determination for the Small Arms Range Ordnance Disposal Site on November 18, 1992.

### 2.6.7 Site RW-40 Radioactive Disposal Site Decision Document

A decision document prepared by Montgomery Watson Inc. (MWI) for Radioactive Disposal Site RW-40 (now known as RW-38) at the Nellis Small Arms Range Annex resulted in the NDEP issuing a NFA determination for this site (MWI 1993). Site RW-40 was reportedly located near a gravel road leading north from the Nellis Small Arms Range Annex, with the southern portion of the site within MU732. The site reportedly consisted of 10 to 20 auger holes dug along the road for the disposal of radioactive wastes around 1960. However, the actual location of the site could not be verified in the field. A walking survey of the area was conducted by Nellis AFB Bioenvironmental Engineering in November 1992 using two Fiddler sodium iodide detectors capable of detecting radioactivity. The entire area of the suspected site location was covered during the survey but no radioactivity above background levels was measured. Therefore, no further investigation or remediation was recommended for the site. Based on the lack of evidence of contamination, no remedial alternatives were evaluated for the site. There is no mention of MEC-related materials or debris in the decision document.

NDEP conducted a site visit in 1993 to verify the conclusions of the decision document before issuing a NFA determination for the Radioactive Disposal Site on November 5, 1993.

### 2.6.8 Former Lake Mead Base Archives Search Report

An ASR prepared by USACE, Rock Island District included a historical records search and site inspection for MEC presence on a portion of the former Lake Mead Base, now known as Nellis AFB Area II. The investigation focused on 6,999 acres of land that was used by the U.S. Navy between April 1953 and June 1956 (USACE 1996b).

Based on visual evidence of MEC observed by the site inspection team and historical evidence, the ASR concluded that MEC contamination is present in two areas of the Former Lake Mead Base FUDS property. These two areas, the Mortar Impact Buffer Zone and the Emergency Jettison Area, each occupy 320 acres.

### 2.6.9 Munitions Debris Burial Pit Cleanup After Action Report

An After Action Report (AAR) was prepared by Bay West, under contract with USACE, Omaha District that documented the Munitions Debris (MD) Burial Pit Clean-up at the Nellis AFB Family Housing Privatization Project (HP Project). The AAR described the field procedures that were utilized to perform the clean-up. The clean-up consisted of performing visual and instrument-assisted (magnetometer and all-metals) screening of soils previously excavated for the presence of MD/Material Potentially Presenting an Explosive Hazard (MPPEH) and the excavation and screening of an area suspected to contain a burial pit/trench (i.e., burial pit) containing additional MD. The on-site activities also included the segregation of MD and scrap metal, off-site disposal of scrap metal and the shredding of all recovered MD by a qualified scrap recycler, documented by a Certificate of Destruction as well as the backfilling and compaction of soils excavated and screened during project activities. Approximately 9.2 tons of scrap metal and MD were removed from the project clean-up footprint.

Through digital geophysical mapping (DGM) of the site, visual observations at the site during the performance of the removal action and the quality assurance (QA) / quality control (QC) procedures implemented during the various phases of the clean-up, there is a high degree of confidence that the hazards posed to the construction contractors and future residents of the HP

Project have been removed as a result of the burial pit clean-up project. Based on the work performed, the site was recommended for and received an NFA determination.

### 2.6.10 CSE Phase I Report

In support of the MMRP at Nellis AFB, a CSE Phase I was performed in 2006 (URS 2007). The CSE Phase I was performed to characterize the site and source; evaluate actual or potential release(s) of hazardous substance(s), pollutant(s), or contaminant(s) to migration/exposure pathways (groundwater, soil, and air) from MRAs; and, evaluate associated targets of concern.

The CSE Phase I activity compiled and evaluated information on Nellis AFB relating to the possible presence of MEC, potentially explosive site physical conditions, and future land uses and activities. Sources of this information were the archival records from Nellis AFB, interviews with Nellis AFB personnel (past and present) and local residents, additional archival information collected from public sources, and observations made during the field reconnaissance. This information was reviewed and used to develop and refine an Interim CSM of potential exposures to MEC and MC. This Interim CSM related the indicated sources of explosive items to potential direct contact exposures to people at Nellis AFB, in consideration of both the current and projected future land uses. These relationships, or potentially complete exposure pathways, also considered the possible transport or migration of MEC items from place to place as the result of natural processes or people's activities. These land use scenarios were evaluated with respect as to how people would interact with the land at Nellis AFB. The compiled information was then used to conduct an assessment of the potential explosive hazards at each MRA.

Prior to the CSE Phase I, 6263.7 acres were reported in AFRIMS as being potentially impacted by previous military munitions activities. The CSE Phase I determined that potential MEC are present on 4315.7 MMRP-eligible acres of the total 11,300 on-site acres. The delta of 1,948 acres was determined to have been an incorrect calculation in AFRIMS and was recommended for Administrative Close-out. However, as the official acreage in AFRIMS was not updated to-date, this will be completed as part of the CSE Phase II effort. MEC that may be present range in size from small arms to 750-lb practice bombs, and include demolition materials, bombs, rockets, projectiles, grenades, and signals.

Six MRAs were investigated during the CSE Phase I effort at Nellis AFB, including one bombing and gunnery range, three bore-sight ranges, one munitions storage area, and one training and maneuver site as listed below:

- MU732: WWII Gunnery Range @ Range Road (Excess);
- AL738: Bore-sight Pit #1;
- AL739: Bore-sight Pit #2;
- AL740: Bore-sight Pit #3;
- No MRS ID: Area III Magazines; and
- No MRS ID: Former Navy Training Area.

Subsequent to the CSE Phase I, it was determined that the three bore-sight pits are currently being investigated and cleaned up under the IRP, and so were removed from the MMRP program. Therefore, these MRAs (AL738, AL739, and AL740) were not investigated for the CSE Phase II.

The remaining sites were evaluated using the MRSPP to prioritize sites for further munitions response actions. The results of this assessment indicated that the WWII Gunnery Range @ Range Road (Excess) (MU732) scored a priority of 2. Under this scoring system, a priority 1 score indicates the highest potential hazard and priority 8 score indicates the lowest potential hazard. This score was primarily due to the fact that sensitive munitions were identified during previous surface clearance activities completed at this former range and bomb jettison area, such as napalm bombs (e.g., bomb live unit [BLU]-27) that include white phosphorus igniters, and pyrotechnics including smoke and thermite grenades.

The Area III Magazines and Former Navy Training Area scored lower with a priority of 6. This was based on the fact that the area was a former munitions storage area (Area III Magazines) and/or that only practice munitions, pyrotechnics, and small arms are suspected to be present in the surface and subsurface (Former Navy Training Area).

# 3.0 PHYSICAL AND ENVIRONMENTAL SETTING

## 3.1 Climate

Nellis AFB is located in an arid section of the Great Basin and has an annual average precipitation of 4.3 inches, which is evenly distributed throughout the year. Summers are long and hot, and winters are short and cool. Relative humidity is low.

Summer temperatures range from a low of about 70 degrees Fahrenheit (°F) to over 100°F, while average winter temperatures range from lows in the 40s to highs in the 60s. From 1937 to 2005, Las Vegas averaged over 133 days per year above 90°F. From 1971 to 2005, it averaged over 72 days per year above 100°F, over 36 days per year over 105°F, almost 9 days per year over 110°F, and 0.6 days per year over 115°F (National Oceanic & Atmospheric Administration [NOAA] 2006).

Precipitation is usually in the form of rain, which occurs throughout the year. Snow accumulation is rare in Las Vegas. Flurries are observed once or twice during most winters, but snowfall of an inch or more occurs only once every four to five years. However, freezing temperatures do occur with some regularity each year, with a 30-year average of 24 days with low temperatures at or below 32°F. Snowfall is rather common in the mountains surrounding Las Vegas, with the Spring Mountains receiving between 5 and 10 feet annually.

Prevailing wind directions vary according to the season. From June through August, the prevailing wind direction is from the south. During spring and fall (March through May and September through November), winds are generally from the southwest. During winter (December through January), prevailing winds are from the west-southwest. The mean monthly wind speed ranges from 7 to 11.2 miles per hour.

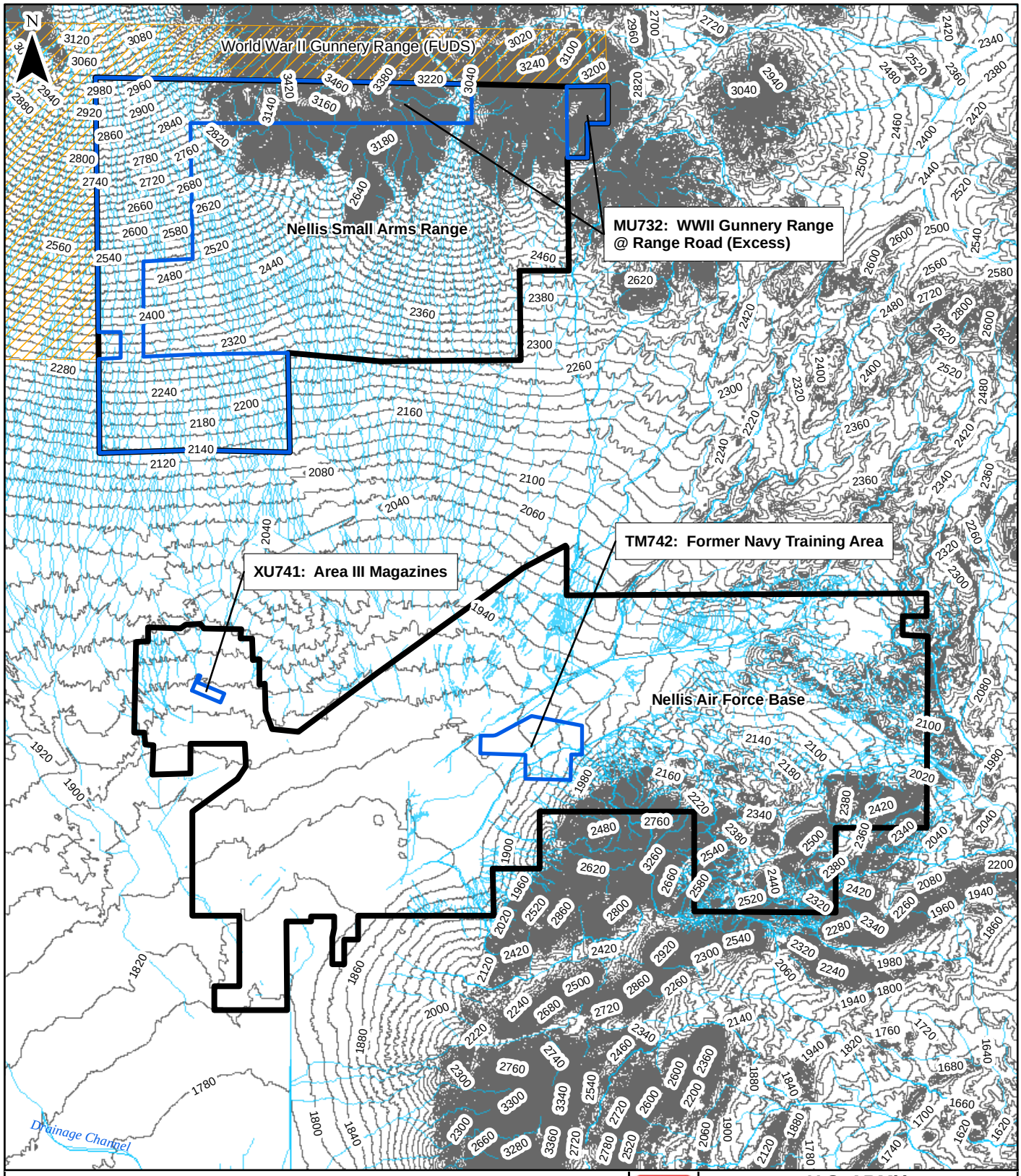
Monthly averages for relative humidity range from about 17 percent in June to 46 percent in January. The winter months typically experience higher relative humidities than the summer months.

## 3.2 Topography

Clark County lies on the southern edge of the state and is part of the Great Basin. Average elevations in the area of Nellis AFB range from approximately 3,000-7,800 feet. The terrain varies quite sharply from steep, craggy mountains to broad alluvial fans on the Las Vegas Valley floor. The area is traversed by gullies, canyons, and arroyos, which can make transportation difficult. Roads vary from site to site, from paved, maintained routes on-base to desert backroads suitable for off-road vehicles only. Some roads and trails are impassable during certain times of the year. Topography for Nellis AFB is presented as **Figure 3-1**.

## 3.3 Hydrology

The Las Vegas Valley (the Valley) is a bowl-shaped basin surrounded by rugged mountain ranges. The entire hydrographic basin is 1,600 square miles. The western edge of the Valley is approximately 5 miles west of Lake Mead, which is an impoundment on the Colorado River. The Valley occupies a structural basin in the Basin and Range Province of the northern Mojave Desert, and most shallow groundwater and all surface flows are transported to Lake Mead via the Las Vegas Wash. The Valley is bounded virtually on all sides by mountain ranges that reach a maximum elevation of almost 12,000 feet above sea level (Spring Mountains to the




LEGEND

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- 20ft Contour Interval
- River

0 0.5 1 1.5 3 Miles

Projection : NAD83 State Plane Nevada East

**U.S. ARMY CORPS OF ENGINEERS**
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

| FIGURE NUMBER | TOPOGRAPHY AND SURFACE WATER DRAINAGE FEATURES NELLIS AIR FORCE BASE |
|---|---|
| 3-1 | |

Shaw Shaw Environmental, Inc. Bay West

west). The Valley floor elevation ranges from about 3,000 feet in the west at the mountain front, to 1,500 feet in the east at the outflow of the Valley.

The Las Vegas Wash has four major flow components which include reclaimed water, urban runoff, shallow groundwater, and stormwater. These flows travel to the Las Vegas Wash through one of the tributaries, then flow into Lake Mead via the Colorado River.

Perennial streams do not exist in the vicinity of Nellis AFB. Natural surface runoff is confined to infrequent precipitation events and does not represent a significant source of groundwater recharge (CH2M Hill 1982). In the summer, localized thunderstorms can produce high-intensity, short-duration rainfall events that can result in flooding. Regional storms, which generally occur in the winter months, are typically of low intensity and the flooding potential is low.

Nellis AFB has numerous small gullies and arroyos that drain the area in a southerly direction. Surface runoff in the immediate vicinity of Nellis AFB drains to the south, where it subsequently joins the Las Vegas Wash which drains to Lake Mead (see **Figure 3-1**).

## 3.4 Soil and Vegetation Types

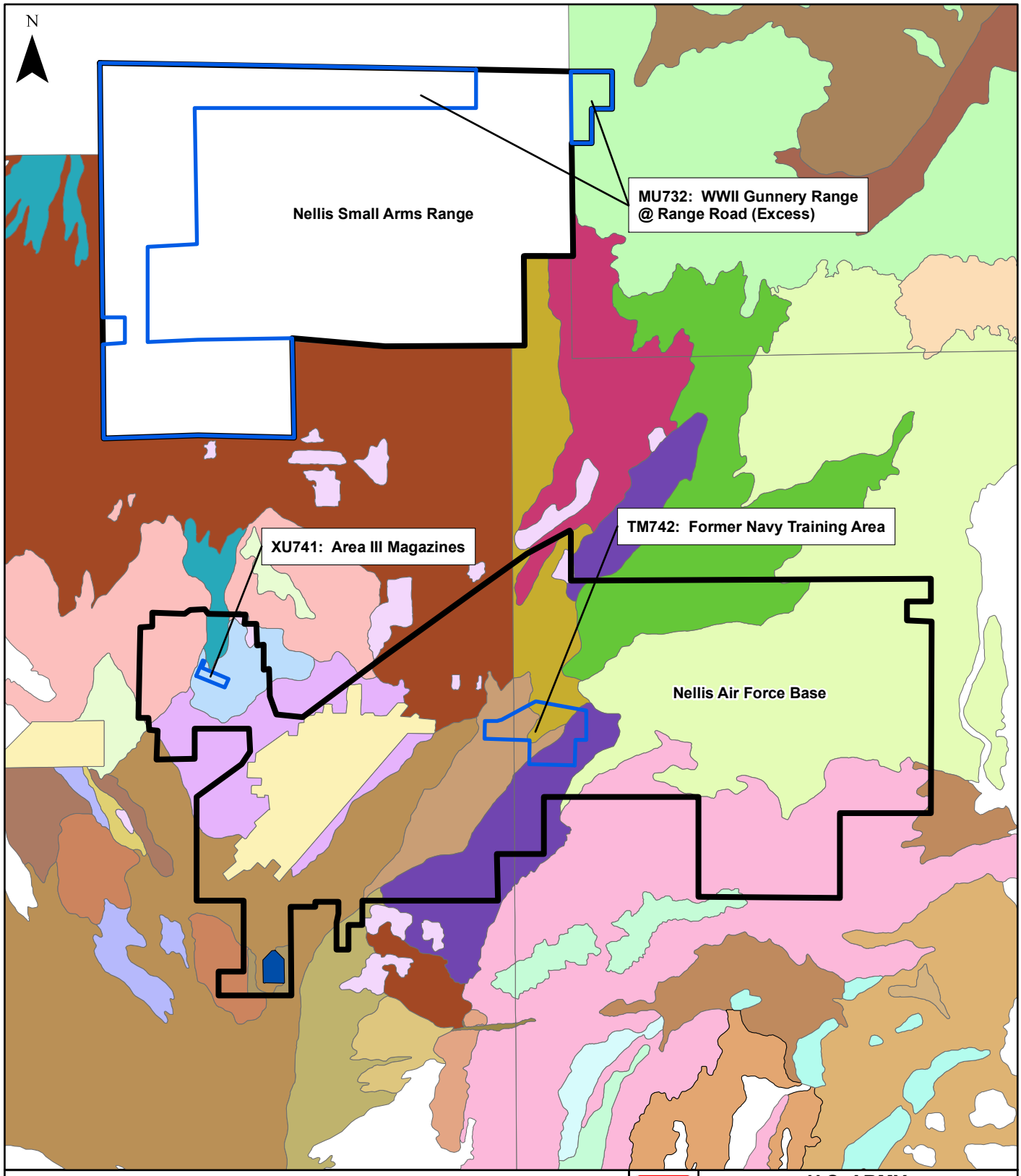
### 3.4.1 Soil Characteristics

Most Nevada soils are so-called gray desert soils, developed from material washed into the valleys from the mountains. Where the desert vegetation is thin, the ground often has a layer of gravel and small stones, called desert pavement. However, in the low areas of the basins and along the rivers, there are narrow belts of alluvial soils of finer texture. The better of these soils (e.g., Fallon fine sandy loam) are farmed successfully under irrigation. In southern Nevada, the soils are pinkish in color and are known as red desert soils. The mountains contain much rough and stony land without soil covering. Almost all Nevada soils are low in nitrogen and organic matter. Soils present at Nellis AFB are presented as **Figure 3-2A** and the legend for the soils figure is presented as **Figure 3-2B**.

### 3.4.2 Vegetation Types

Approximately 7,000 of the 11,300 acres comprising Nellis AFB are undeveloped and are populated by native flora. The most common plant types are shrubs and cacti, including creosote bush, all-scale, brittlebush, desert holly, white burrobush, shadscale, blackbrush, yucca, and white bursage. Native scrub-brush vegetation exists in both developed and undeveloped areas and is described as typically highly disturbed, even in areas labeled as undeveloped (ACC 1999). One sensitive plant species has been identified at Nellis AFB; that is the California or Las Vegas bearpoppy (Hazlett, et al. 1997). It is listed as a federal species of concern and as critically endangered by the State of Nevada.

At MU732, creosote bush-white bursage and saltbush communities are the predominant vegetation communities present at lower elevations (below 1,200 meters [m]). At higher elevations (approximately 1,200 to 1,800 m), the blackbrush community may predominate. While it is rarely the dominant species in terms of numbers or cover in these communities, the Joshua Tree contributes a significant proportionate biomass in the local area, and its mature height of up to 6 m contributes to its visual domination over the surrounding low shrubs, most of which grow to less than 1 m.




LEGEND

Nellis Air Force Base Installation Boudary

Munitions Response Area

NOTES:
1) Soil data obtained from the U.S. Department of Agriculture, Natural Resources Conservation Services.
2) Soil types have not been mapped for the Nellis Small Arms Range and Nellis Small Arms Range Complex Annex - Excess, to date.

0 0.5 1 1.5 3 Miles

Projection : NAD83 State Plane Nevada East

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-2A

SOIL TYPES
NELLIS AIR FORCE BASE

Shaw Environmental, Inc.

Bay West

# LEGEND

## Soil Type

- Akela-Rock outcrop complex, 15 to 50 percent slopes
- Arizo very gravelly fine sandy loam, 2 to 8 percent slopes
- Arizo very gravelly loamy sand, flooded, 0 to 4 percent slopes
- Bard gravelly fine sandy loam, 2 to 8 percent slopes
- Bard-Tonopah association, gently sloping
- Baseline-Guardian association
- Bracken very gravelly fine sandy loam, 2 to 8 percent slopes
- Caliza very gravelly sandy loam, 2 to 8 percent slopes
- Casaga very gravelly sandy clay loam, 0 to 8 percent slopes
- Dumps
- Glencarb silt loam
- Glencarb very fine sandy loam, saline
- Goodsprings gravelly fine sandy loam, 2 to 4 percent slopes
- Guardian-Baseline association
- Gypwash-Callville-Carrizo association
- Heleweiser-Carrizo-Teebar association
- Las Vegas gravelly fine sandy loam, 0 to 2 percent slopes
- Las Vegas-DeStazo complex, 0 to 2 percent slopes
- Las Vegas-McCarran-Grapevine complex, 0 to 4 percent slopes
- Las Vegas-Skyhaven complex, 0 to 4 percent slopes
- Pits, gravel
- Rock outcrop-Redneedle-Heleweiser association
- Rockland-St. Thomas association, very steep
- Skyhaven very fine sandy loam, 0 to 4 percent slopes
- St. Thomas association
- St. Thomas-Iceberg-Rock outcrop association
- St. Thomas-Upperline-Whitebasin complex
- Upperline-St. Thomas-Upperline association
- Upperline-Weiser-Whitebasin association
- Urban land
- Water
- Wechech-Ifteen association
- Wechech-Weiser association
- Weiser extremely gravelly fine sandy loam, 2 to 8 percent slopes
- Weiser-Goodsprings complex, 2 to 4 percent slopes
- Weiser-Oldspan-Wechech association
- Weiser-Wechech association

Soil Data Obtained from the U.S. Department of Agriculture, Natural Resources Conservation Services

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
3-2B

SOIL TYPES
NELLIS AIR FORCE BASE

Shaw Environmental, Inc.

Bay West

The sagebrush-piñon-juniper community comprises a woodland that is present in the northern portion of the range at elevations above at least 1,500 m, where increased precipitation and lower temperatures facilitate its development. The dominant species include big sagebrush, single leaf piñon, and Utah juniper in habitats with deeper soils, and black sagebrush in areas with shallow, rocky soils (99 CES/CEV 2001).

## 3.5 Geology and Hydrogeology

### 3.5.1 Geology

Nellis AFB and Las Vegas, Nevada are located in a structurally-controlled alluvial basin that contains unconsolidated sediment that is thousands of feet thick (Plume 1989; Page, et al. 2005). Mountain ranges to the west (Spring Mountains), north (Las Vegas Range), and east (Frenchman's Mountain) of the basin are composed of sedimentary rocks. The mountains to the south (McCullough Range) are primarily volcanic rock.

Coarse-grained (sand and gravel) alluvial fan deposits derived from the surrounding mountain ranges form broad piedmonts (joined and continuous fan surfaces that slope toward the basin center). Fine-grained (silt and clay) deposits underlie the central part of the basin, and are common beneath Nellis AFB.

A series of north- to northeast-trending, east-dipping faults cut the valley floor and the alluvial-fill sediments. These faults form a succession of prominent scarps as much as 160 feet high (Bell, et al. 2002). The faults are attributed to a combination of natural sediment compaction and tectonic movements (Slemmons, et al. 2001).

### 3.5.2 Hydrogeology

Nearly all of the groundwater supply in the Valley comes from a zone of confined and semi-confined principal aquifers at depths of 650-970 feet below ground surface (bgs). Impermeable caliche horizons within the alluvial fan deposits and poorly permeable clay horizons within the fine-grained basin fill create confined and semi-confined aquifer conditions and artesian flow.

Most natural recharge to the alluvial aquifers is derived from precipitation that falls on the Spring Mountains to the east of the valley. Recent estimates (Donovan and Katzer 2000) suggest the net annual recharge is in the range of 50,000-57,000 acre-feet per year. Annual groundwater withdrawals are in the range of 60,000-76,000 acre-feet per year (Bell, et al. 2002). Beginning in 1990, an artificial recharge program has been injecting 10,000-24,000 acre-feet per year. Despite the artificial recharge, overdrafting of the groundwater reservoir in the principal aquifers has occurred since the 1960s (Bell, et al. 2002). This has resulted in declining water levels in the principal aquifers (estimated at about 50 feet in the vicinity of Nellis AFB) and ground subsidence (estimated to be between 0-0.5 feet at Nellis AFB).

Because of the confined and semi-confined nature of the principal groundwater aquifers, overdrafting has not impacted the water table aquifer at Nellis AFB. Groundwater elevation data indicate seasonal variations and long-term trends. Depth to groundwater varies from site to site at Nellis AFB. Depths to the shallow aquifer (nonpotable and generally not suitable for irrigation) range from 40-90 feet bgs. Shallow groundwater flow is generally to the east or southeast.

# 4.0 INVESTIGATION SCOPE AND APPROACH

## 4.1 Visual Survey

The Bay West field team conducted a non-intrusive visual survey, using handheld Schonstedt magnetometers for safety, in selected areas within MU732, XU741, and TM742. The firing ranges within MU732 are presented as **Figure 4-1**. These areas were evaluated during the CSE Phase II to determine whether MEC are present or whether an NFA recommendation is appropriate.

The areas investigated within MU732, XU741, and TM742 totaled 4,316 acres. As it was not feasible to survey every square foot of the property due to terrain, a representative number of transects were planned to provide a sufficient level of confidence to support an NFA decision or delineate possible target areas. The proposed visual survey transects are identified on **Figures 4-2** through **4-4**.

The field team consisted of one UXO technician and a field support person (i.e., field lead or sample technician) to conduct the survey. Each group performed visual inspections along a pre-planned transect that represented a percentage of the overall area. Each group used handheld global positioning system (GPS) units to help navigate the visual surveys along transects.

During the visual surveys, both team members looked for evidence of MEC including the presence of impact craters, UXO items, fragments, and other metallic debris or scrap on the surface. The UXO technician utilized a Schonstedt magnetometer to avoid inadvertent contact with metallic objects during the visual survey.

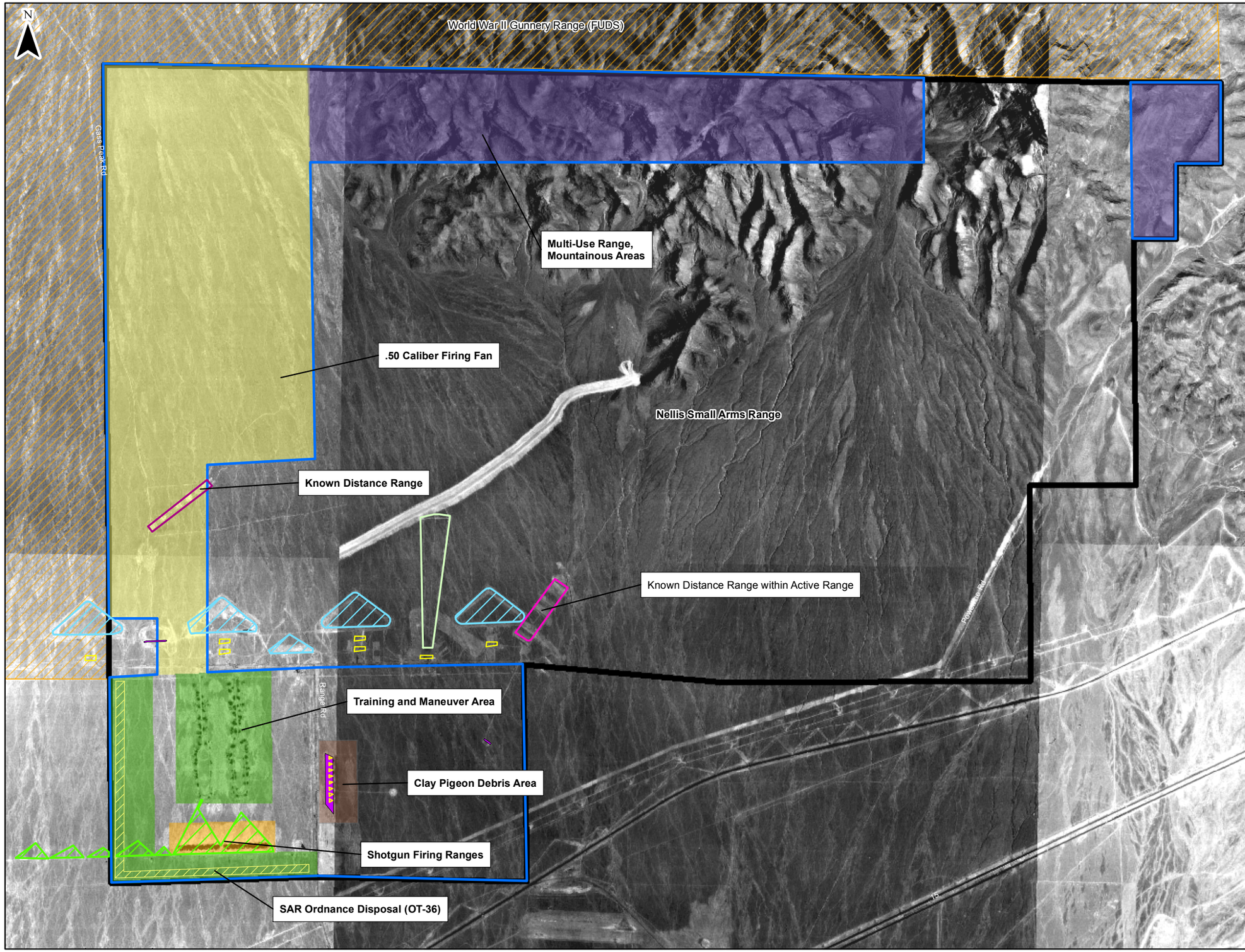
Whenever impact evidence was found during the visual survey, the UXO technician and field support person documented the evidence by entering the location and descriptive information in a field notebook (**Appendix E**). A waypoint was recorded in the GPS unit data logger to mark the geographic location, and site photos were recorded and described in the notebook (**Appendix D**).

In addition to looking for evidence of impact, each survey group also conducted a general site reconnaissance noting any significant topographical features, vegetation density, evidence of former and present land use, site access, and roads. This information was used to update the RACER (**Appendix L**) and AFRIMS worksheets (**Appendix M**).

## 4.2 Environmental Media Sampling and Analysis

Representative surface soil and subsurface soil samples were collected and analyzed to determine if MEC-related MC or lead and/or polycyclic aromatic hydrocarbons (PAHs) associated with small arms range use have been released to the environment. Sampling activities at small arms ranges conducted during the CSE Phase II sought to characterize the full horizontal and vertical extent of lead contamination. In addition, the use of real-time measurement technologies as the primary method of sample analysis, with off-site laboratory analysis using U.S. Environmental Protection Agency (USEPA) methods for correlation and QA/QC purposes was performed at small arms ranges. Additional off-site laboratory samples were collected to characterize the PAH contamination associated with clay pigeon use at the skeet range. At non-small arms ranges, the MC sampling program was designed to determine the worst-case concentrations present at the MRA. Analytical data were used to identify potential risks to receptors given various exposure pathways, and to assess whether nearby receptors had been affected by

releases. Sampling locations were recorded in the field using a hand-held GPS unit and uploaded into the Nellis AFB geographic information system (GIS).




LEGEND

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- Known Distance Range
- Firing Line
- Firing Range Fan
- Firing Target
- Known Distance Range (within Active Range)
- Small Arms Range Berm
- Triangular Depression (Use Unknown)

**MU732 Subdivisions**

- .50 Caliber Firing Fan
- Clay Pigeon Debris Area
- Shotgun Firing Ranges
- Training and Maneuver Area
- Multi-Use Range, Mountainous Areas
- SAR Ordnance Disposal (OT-36)

0 2,000 4,000 Feet

Projection : NAD83 State Plane Nevada East

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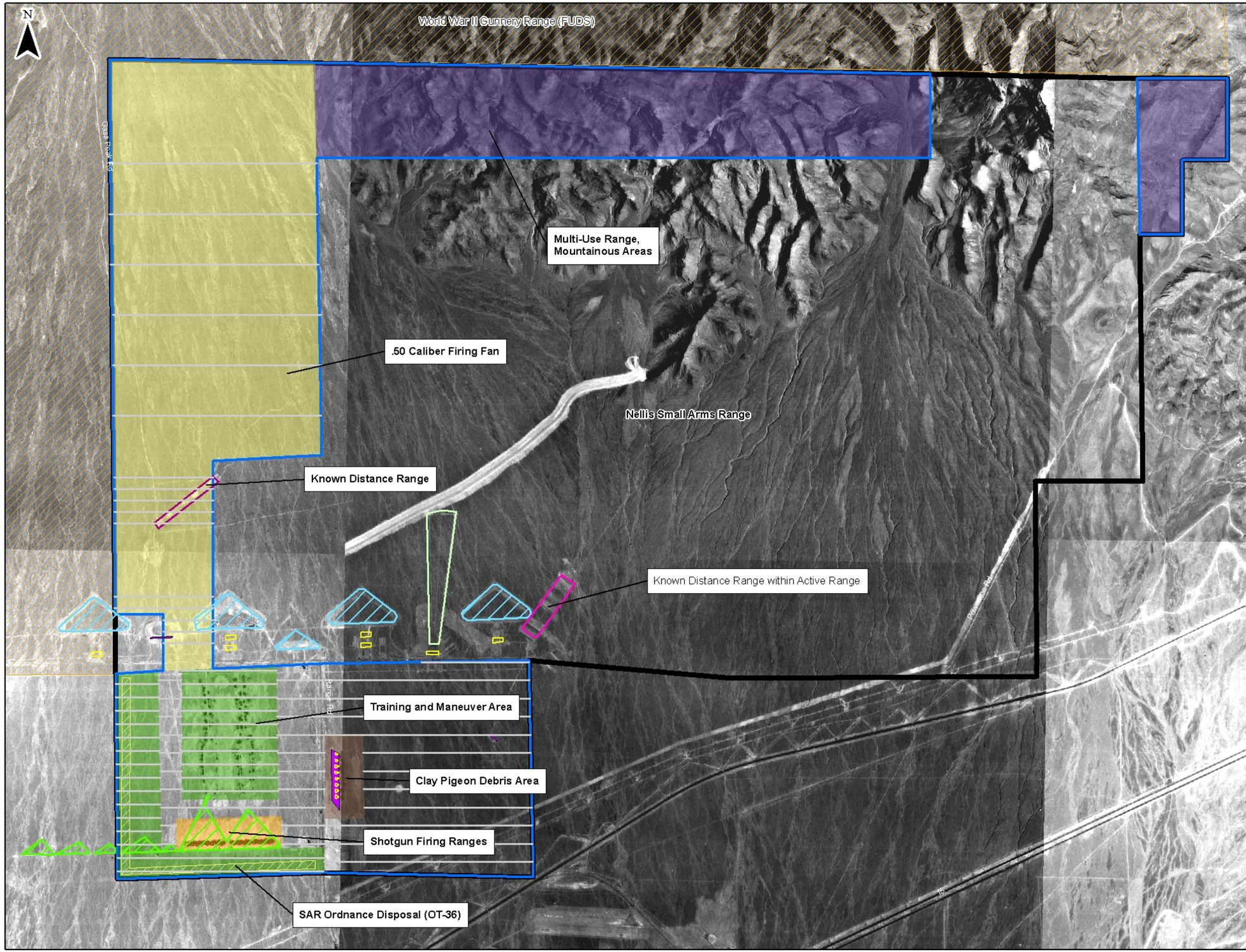
**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER** 4-1

**MU732 FIRING RANGES NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West



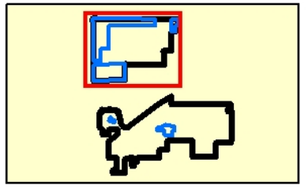

LEGEND

- Proposed Transects
- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- Known Distance Range
- Firing Line
- Firing Range Fan
- Firing Target
- Known Distance Range (within Active Range)
- Small Arms Range Berm
- Triangular Depression (Use Unknown)

**MU732 Subdivisions**

- .50 Caliber Firing Fan
- Clay Pigeon Debris Area
- Shotgun Firing Ranges
- Training and Maneuver Area
- Multi-Use Range, Mountainous Areas
- SAR Ordnance Disposal (OT-36)

0 2,000 4,000 Feet



Projection : NAD83 State Plane Nevada East

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 4-2

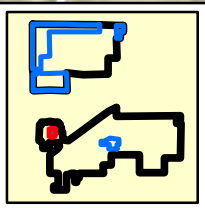
MU732 PROPOSED
VISUAL SURVEY TRANSECTS
NELLIS AIR FORCE BASE

Shaw Environmental, Inc. Bay West

LEGEND

Munitions Response Area

Proposed Transects



0 300 600 Feet

Projection : NAD83 State Plane Nevada

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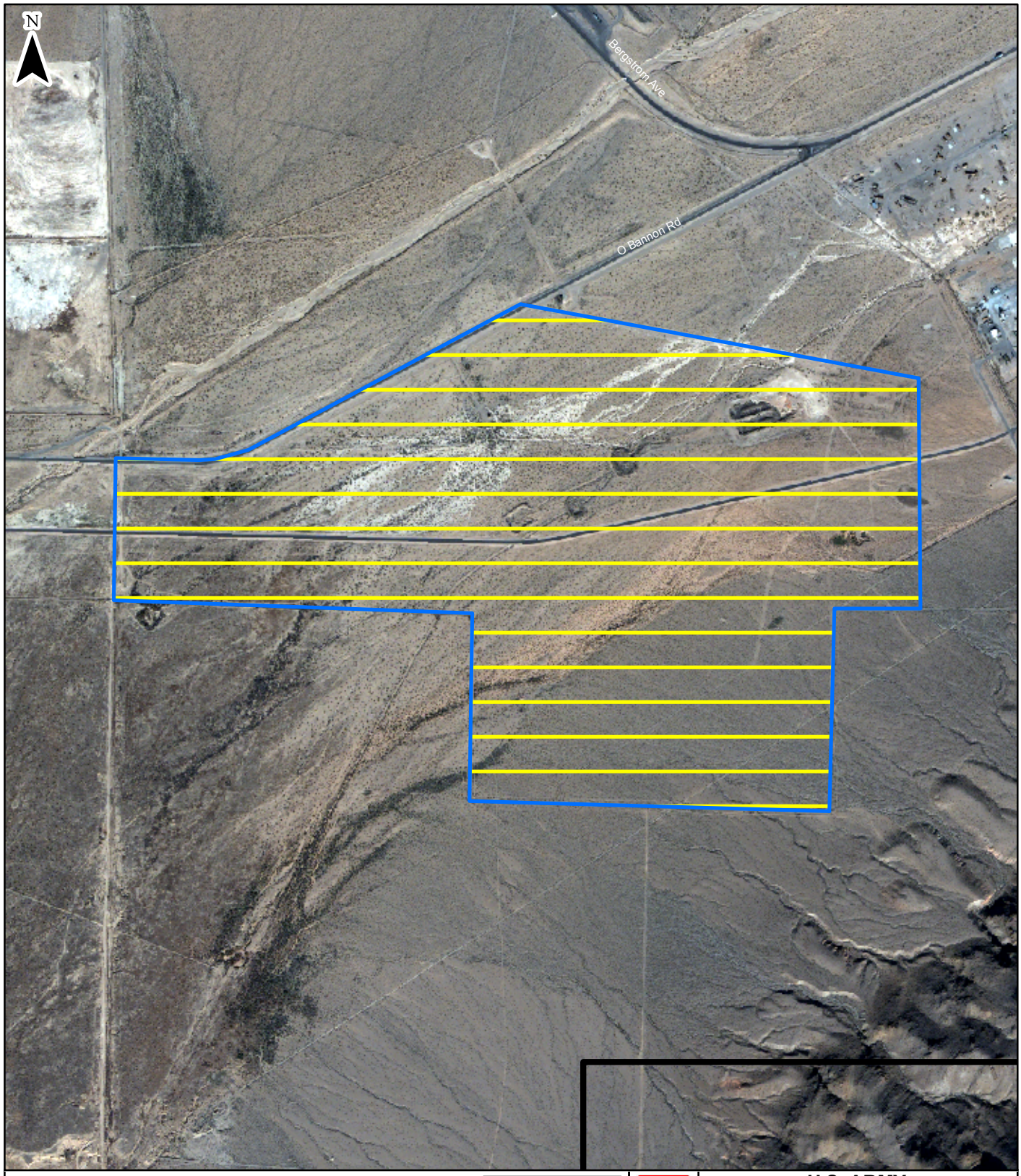
**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER**
**4-3**

**XU741 PROPOSED**
**VISUAL SURVEY TRANSECTS**
**NELLIS AIR FORCE BASE**

Shaw Environmental, Inc.

Bay West

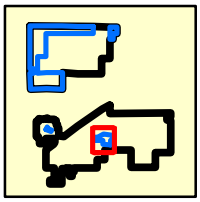



LEGEND

Nellis Air Force Base Installation Boudary

Munitions Response Area

Proposed Transects



0 500 1,000 2,000 Feet

Projection : NAD83 State Plane Nevada East

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**FIGURE NUMBER** 4-4

**TM742 PROPOSED VISUAL SURVEY TRANSECTS NELLIS AIR FORCE BASE**

Shaw Environmental, Inc.

Bay West

The MC associated with the MEC used at Nellis AFB were evaluated. The number and type of samples collected are presented as **Table 4-1**.

**Table 4-1 Number and Types of Samples Collected and Analyzed**

| Parameters | Media | Samples |
|---|---|---|
| **MU732 Sampling Effort** | | |
| **MU732 XRF Samples** | | |
| Lead | Surface and Subsurface Soils | 203 In-situ and<br>165 Ex-situ – March 2008<br>52 Ex-situ – September 2009 |
| **MU732 Off-site Laboratory Samples** | | |
| Lead | Surface Soil | 15 – March 2008<br>14 – September 2009 |
| Lead | Subsurface Soil | 5 – March 2008<br>19 – September 2009 |
| 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Flouranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene | Surface Soil | 43 |
| 1-Methylnaphthalene, 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Flouranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene | Subsurface Soil | 14 |
| **XU741 Sampling Effort** | | |
| **XU741 Off-site Laboratory Samples** | | |
| RDX, PETN, Nitroglycerin, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and Tetryl | Surface Soil | 1 |
| **QC Samples – MU732 and XU741** | | |
| MU732 Field Duplicates - Lead | Surface and Subsurface Soil | 3 – March 2008<br>3 – September 2009 |

**Table 4-1 Number and Types of Samples Collected and Analyzed**

| Parameters | Media | Samples |
|---|---|---|
| MU732 Field Duplicates - PAHs | Surface and Subsurface Soil | 5 |
| XU741 Field Duplicates | Surface Soil | 1 |
| **Total Environmental Samples** | | **420 XRF and 111 Laboratory** |
| **Total QC Samples** | | **12** |
| **Total Samples** | | **420 XRF & 123 Laboratory** |

### 4.2.1 XRF Survey and Surface Soil Sampling at Small Arms Ranges

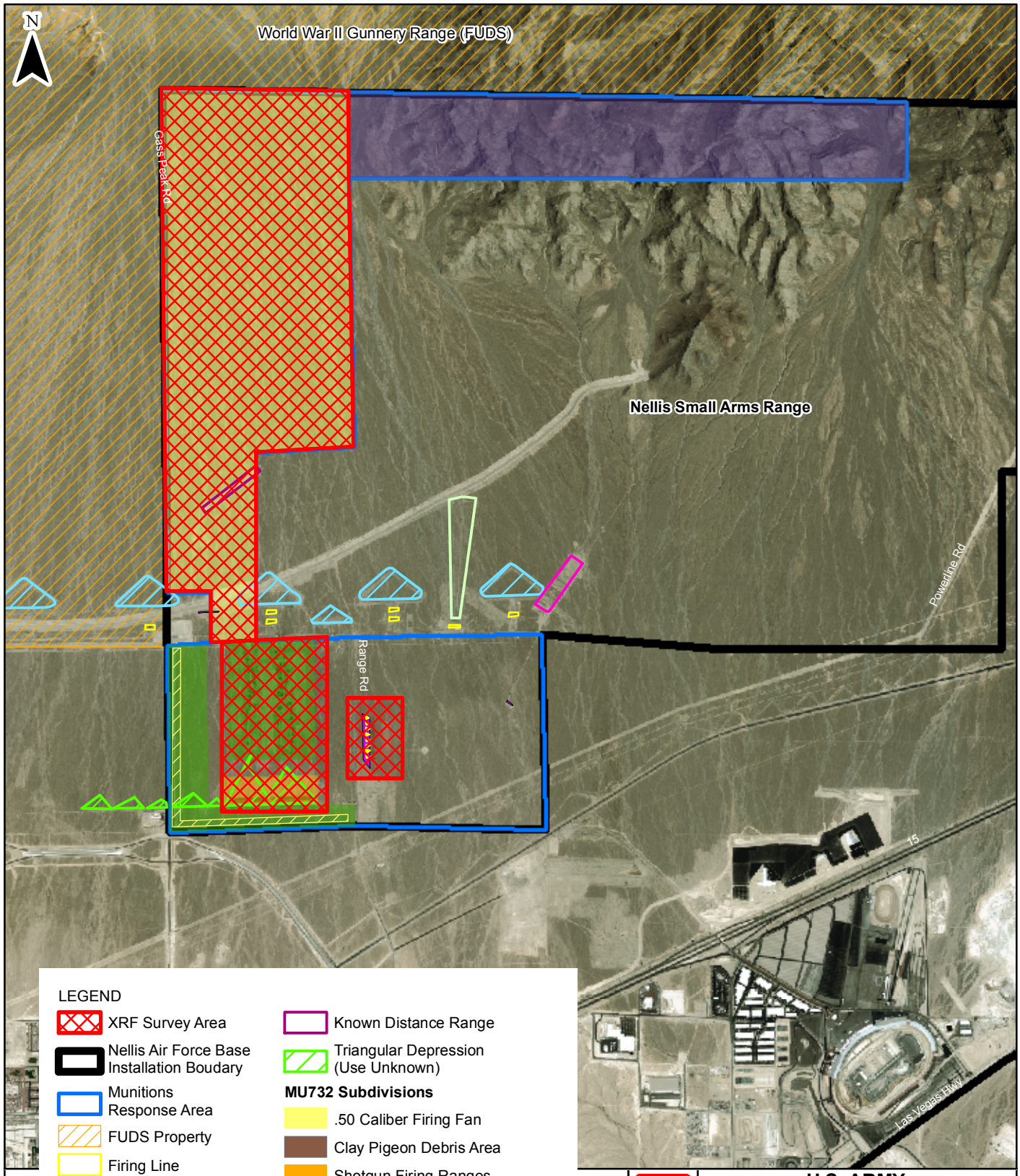
An energy-dispersive, portable x-ray fluorescence (XRF) instrument was used in the three small arms ranges in MU732 (.50 Caliber Firing Fan, Shotgun Firing Ranges, and Clay Pigeon Debris Areas) to evaluate the lead impacts associated with small arms range use. The objective of the XRF survey was to collect data of sufficient quantity and quality to determine the lateral and vertical extent of lead concentrations present in soil or to support an NFA determination at the small arms ranges. Areas where lead was anticipated (i.e., small arms range berms or firing points) were first evaluated to determine if lead is present at the surface above 200 milligrams per kilogram (mg/kg), which is one-half of the State of Nevada's Human Health Screening Level of 400 mg/kg, using in-situ sampling methods. In-situ locations with concentrations above 200 mg/kg were then immediately evaluated using ex-situ sampling techniques.

Areas with potential lead impacts were delineated to support a human health screening evaluation (see Section 7.0). If the lead concentrations were below the screening levels, significant impacts associated with small arms ranges use were assumed to not have occurred and NFA was recommended. **Figure 4-5** shows the portion of the Nellis MRA where the XRF was used. The details on the in-situ and ex-situ XRF sampling methods and correlation laboratory sampling collection methods are presented in the following paragraphs.

**In-situ XRF Sampling**. The in-situ sampling consisted of using a disposable or decontaminated stainless-steel trowel to prepare a surface area by scraping away vegetative matter and rocks. Metallic debris and bullet fragments, if present, were noted in the sample log, along with a description of site conditions. Metal fragments then were removed by hand from the soil before starting the analysis. The XRF was placed on the surface of the soil at the location and a direct, in-situ measurement taken. Data from the XRF display was recorded manually in the field log and stored electronically in the XRF data logger and GPS unit.

**Ex-situ XRF Sampling.** Samples for ex-situ XRF analysis were collected from all in-situ locations with results exceeding 200 mg/kg to delineate lead impacted areas. In addition, ex-situ samples were collected from site features where elevated lead was likely (e.g., soil berms, areas where lead shot was observed, etc). The entire Nellis AFB team, which included the installation, USACE, and regulators, reviewed and either approved or added sampling locations as needed.

Samples were field-prepared using a disposable or decontaminated trowel and the presence of metallic debris was visually assessed. Any metallic debris found were removed and described in the sample log and the soil was placed in a resealable plastic bag.




LEGEND

- XRF Survey Area
- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- Firing Line
- Firing Range Fan
- Firing Target
- Known Distance Range (within Active Range)
- Small Arms Range Berm
- Known Distance Range
- Triangular Depression (Use Unknown)

**MU732 Subdivisions**

- .50 Caliber Firing Fan
- Clay Pigeon Debris Area
- Shotgun Firing Ranges
- Training and Maneuver Area
- Multi-Use Range, Mountainous Areas
- SAR Ordnance Disposal (OT-36)

0 4,000 8,000 Feet

Projection : NAD83 State Plane Nevada East

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**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER 4-5**

**XRF SURVEY AREAS NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West

The XRF was placed on top of the prepared soil in the plastic bag and analysis initiated. The duration of the sampling run was approximately 30 seconds, timing which is anticipated to have a low standard deviation (error) and provide an accurate reading. Each sample had replicate readings taken by the XRF (e.g., minimum of three replicate XRF readings per sample or location). Any pertinent visual observations of the soils or MD present were detailed in the field logs. Ex-situ sample locations were given a sequential numerical designation and their location recorded with the GPS unit. Pin flags were used to mark the ex-situ sample location. Data from the XRF display were manually recorded in the field logs and stored electronically in the XRF data logger and GPS unit.

**Off-site Laboratory Lead Surface Soil Sampling and Subsurface Soil Sampling.** Lead correlation samples for off-site analysis were selected to bracket the 400 mg/kg human health screening level for the State of Nevada such that low, medium, and high concentrations were selected. In March 2008, 15 surface soil (0-0.5 feet bgs) and 5 subsurface soil samples (three samples from 0.5-1.0 feet bgs, one sample from 1.0-1.5 feet bgs, and one sample from 1.5-2.0 feet bgs) were collected from MU732, to correlate the results of the XRF soil sampling with off-site laboratory analysis.

During the data review process, a number of XRF samples detected between 50 mg/kg and 1,000 mg/kg were identified as having relative standard deviation (RSD) values greater than 20% which indicated a wide variance in the calculated average XRF values. It was further noted that the XRF results and laboratory sample results were not within an acceptable correlation factor. A review of laboratory procedures indicated that the samples were sieved by the laboratory prior to analysis. For well-graded, gravelly soils, such as was encountered at Nellis, sieving likely biased the analysis high relative to the field data by concentrating the finer soil particles in the samples. Typically, lead is primarily found in the fine fraction. Based upon this data review, it was determined that XRF locations with RSD values greater than 20% should be retested to confirm initial results. Laboratory samples were also resubmitted for confirmation of initial analysis.

Consequently, a re-sampling effort took place on September 10-11, 2009. This sampling included 14 surface soil (0-0.5 feet bgs) and 19 subsurface soil samples (twelve samples from 0.5-1.0 feet bgs, three samples from 1.0-1.5 feet bgs, two samples from 1.5-2.0 feet bgs, one sample from 2.0-2.5 feet bgs, and one sample from 2.5-3.0 feet bgs) were collected from MU732, to verify the results of the XRF sampling (see **Figure 4-6**). The 2009 sampling effort included 16 locations that bad previously been sampled in 2008. The re-sampling method included additional care and efforts to assure sample homogeneity including field sieving. Soils were retained in plastic bags from the XRF sampling effort and were transferred to the appropriate sample bottles and shipped to the laboratory for lead analysis. Upon receipt of the XRF field soil samples, the laboratory was told to not sieve the field XRF soil sample to guarantee a direct comparison of the soil sample. The XRF and laboratory correlation results are presented in **Table 4-2**. An analysis of the correlation results is provided in Section 4.4.1.

**Table 4-2 MU732 Lead XRF & Lab Correlation Results**

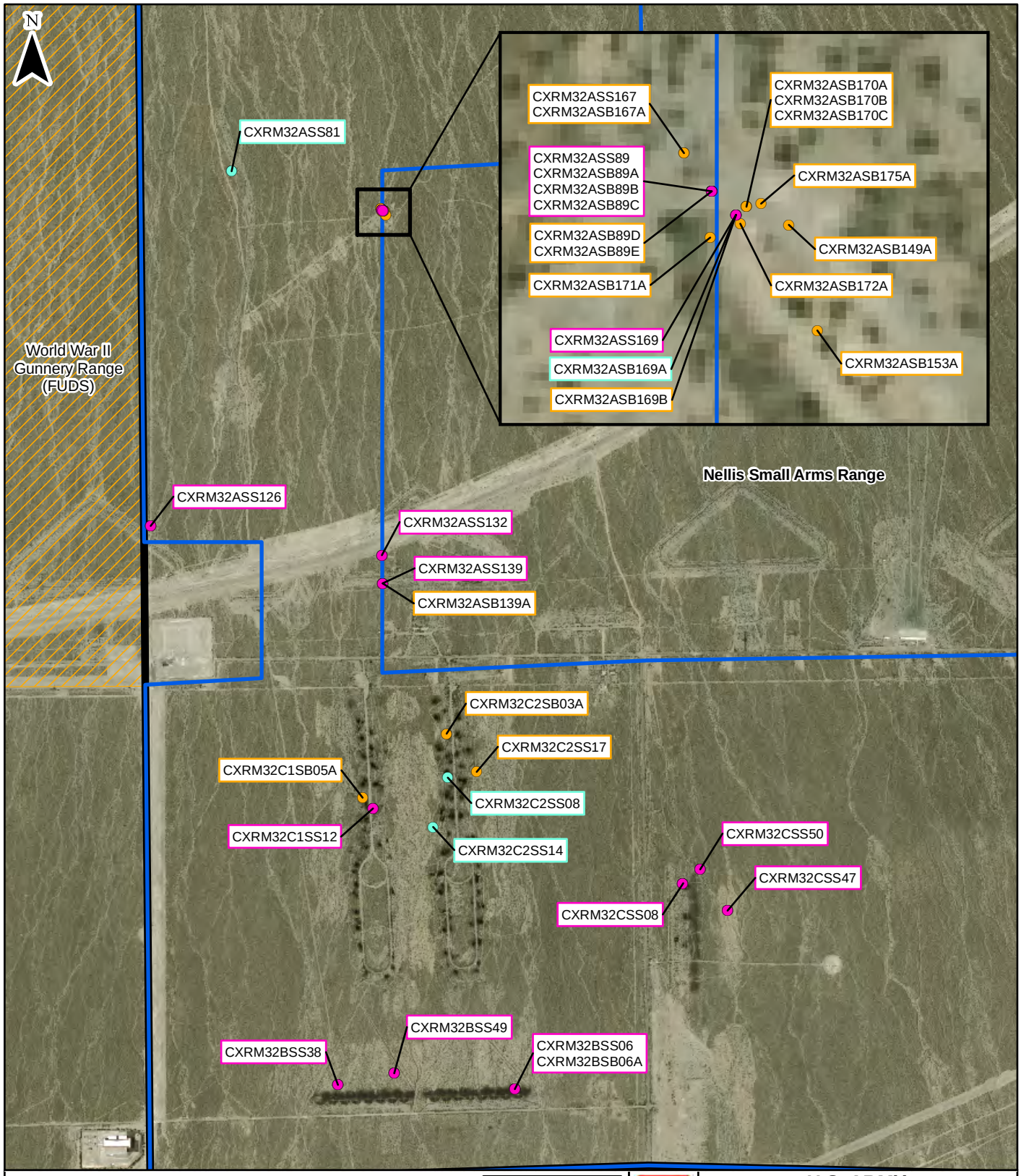
| Sample ID | XRF Result - 3/2008 (mg/kg) | Lab Result - 3/2008 (mg/kg) | XRF Result - 9/2009 (mg/kg) | Lab Result - 9/2009 (mg/kg) |
|---|---|---|---|---|
| CXRM32ASS81 | 57 | 51 | 18 | - |
| CXRM32ASS89 | 1498 | 2200 | 1806 | 3500 |
| CXRM32ASB89A | 349 | 1300 | 143 | 150 |
| CXRM32ASB89B | 332 | 210 | 11 | 6.9 |
| CXRM32ASB89C | 24 | 22 | 909 | 2200 |
| CXRM32ASB89D | - | - | 511 | 600 |
| CXRM32ASB89E | - | - | 35 | 27 |
| CXRM32ASS126 | 112 | 110 | 85 | 52 |
| CXRM32ASS132 | 69 | 74 | 62 | 50 |
| CXRM32ASS139 | 188 | 4700 | 300 | 210 |
| CXRM32ASB139A | - | - | 194 | 180 |
| CXRM32ASB149A | - | - | 43 | 58 |
| CXRM32ASB153A | - | - | 36 | 26 |
| CXRM32ASS167 | 333 | - | 1079 | 1500 |
| CXRM32ASB167A | - | - | 130 | 95 |
| CXRM32ASS169 | 1008 | 2100 | 1542 | 2600 |
| CXRM32ASB169A | 136 | 110 | 836 | - |
| CXRM32ASB169B | - | - | 97 | 86 |
| CXRM32ASB170A | 164 | - | 381 | 440 |
| CXRM32ASB170B | - | - | 555 | 510 |
| CXRM32ASB170C | - | - | 120 | 160 |
| CXRM32ASB171A | - | - | 53 | 41 |
| CXRM32ASB172A | - | - | 27 | 18 |
| CXRM32ASB175A | - | - | 62 | 60 |
| CXRM32BSS06 | 360 | 650 | 49 | 140 |
| CXRM32BSB06A | 24 | 25 | 83 | 310 |
| CXRM32BSS38 | 189 | 250 | 39 | 40 |
| CRXM32BSS49 | 71 | 76 | 80 | 60 |
| CXRM32C2SS17 | 24 | - | 28 | 18 |
| CXRM32C2SB03A | 811 | - | 42 | 78 |
| CXRM32C1SB05A | - | - | 77 | 130 |
| CXRM32C1SS12 | 62 | 380 | 166 | 480 |
| CXRM32CSS47 | 45 | 49 | 75 | 83 |
| CXRM32CSS50 | 7 | 7.8 | 20 | 14 |
| CRM32C2SS14 | 17 | 13 | - | - |
| CRM32CSS08 | 100 | 230 | 47 | 61 |
| CXRM32C2SS08 | 239 | 440 | - | - |

**Off-site Laboratory PAH Surface Soil Sampling and Subsurface Soil Sampling.** In addition to lead analysis at the small arms ranges, an evaluation of PAHs associated with clay pigeons was also performed. In skeet range areas, PAH sample locations were biased to locations where clay pigeon fragments were observed during site activities. From MU732, 43 surface soil and 14 subsurface soil samples were collected and analyzed for PAHs where clay pigeon debris was present. The subsurface soil locations were selected on the basis of the observed distribution of clay target accumulation, where PAH soil impacts would be the most likely. The locations of these samples are shown on **Figure 4-7**. Samples were collected using a disposable trowel. The surface interval, 0-0.5 feet bgs, was collected and any vegetative matter and rocks were removed. A subsurface soil sample was collected below the surface soil sample at a depth of 0.5-1.0 feet bgs.

### 4.2.2 Surface Soil/Subsurface Soil Sampling at Non-Small Arms Ranges

XU741 (Area III Magazines) had the potential for surface soil explosives contamination due to past MEC storage activities. The Bay West Team used visual observations to select discrete sample locations for laboratory analysis from the most likely area or as determined by the presence of MEC. As no evidence of MEC was observed at the MRA, it was agreed by the Project Team (i.e., Major Command (MAJCOM) ACC, Nellis AFB, USACE, and NDEP) that discrete surface soil samples would be collected from outside of and near the doorway of the magazine buildings, where potential poor management practices (e.g. dumping, sweeping, etc.) may have caused an impact to surface soils. Upon visual observation of each of the magazine structures, it was apparent that the entry/exit was capped with asphalt or concrete at all of the magazines except for one, which had gravel/soil present near the doorway. The Project Team agreed that due to the absence of MEC evidence and the site conditions near the magazine structures, only one surface soil sample from the magazine that did not have an asphalt cap should be collected and analyzed for explosives from XU741 to evaluate potential impacts from explosives storage at the MRA.

This sample was collected using a disposable trowel. The surface interval, 0-0.5 feet bgs, was collected, removing any vegetative matter and rocks. The sample was then transferred to the appropriate sample bottles for laboratory analysis and placed in a cooler on ice.




LEGEND

Lead Correlation Sample Location

- Collected March 2008
- Collected September 2009
- Collected During Both Sampling Events

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property

0 1,500 3,000 Feet

Projection : NAD83 State Plane Nevada East

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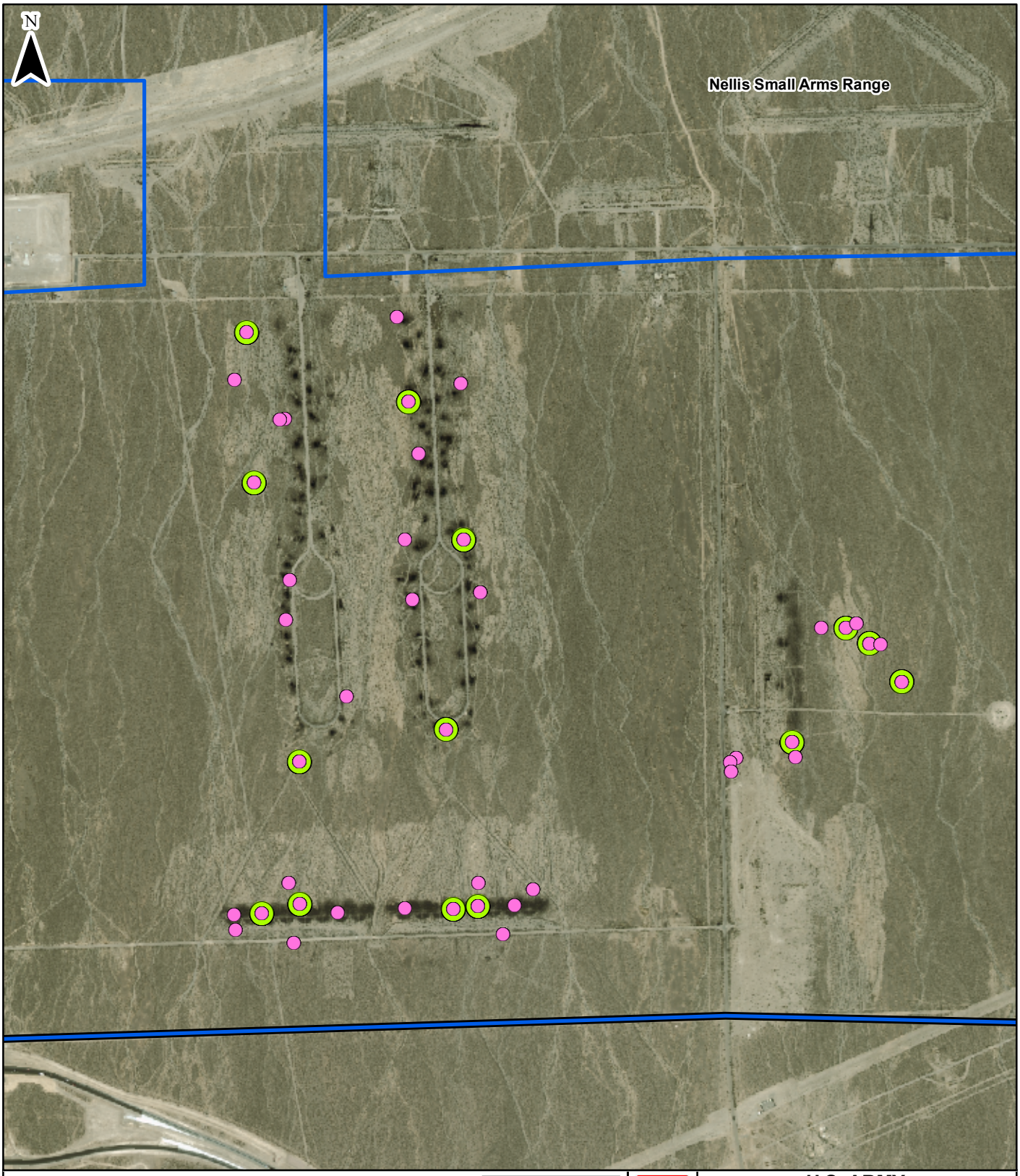
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER** 4-6

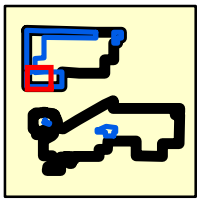
**MU732 LEAD CORRELATION SAMPLE LOCATIONS NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West




LEGEND

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- PAH Surface Sample Location
- PAH Subsurface Sample Location



0 500 1,000 2,000 Feet

Projection : NAD83 State Plane Nevada East

**U.S. ARMY CORPS OF ENGINEERS**
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER 4-7**

**MU732 PAH LABORATORY SAMPLE LOCATIONS NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West

## 4.3 Screening Levels

In this section, screening values for environmental media investigated for the CSE Phase II (surface and subsurface soil) are identified. Screening levels for the CSE Phase II analytical data are discussed below and are presented as **Table 4-3**.

Lead results obtained for surface and subsurface soil were compared to the existing background dataset currently being utilized for environmental investigations performed for Nellis AFB's IRP (James M. Montgomery Consulting Engineers, Inc. 1989). These background values were statistically derived 95% upper confidence limit (UCL) concentrations. The background dataset was used for site-to-background comparisons to identify constituents of concern at Nellis AFB sites and/or evaluate the nature and extent of site-related contamination. In addition, background data were evaluated to support human health and ecological risk assessments, and NFA recommendations. The background analysis is presented in **Appendix J**.

### 4.3.1 Soil Screening Values

In addition to the assessment of lead against the background dataset, analytical results for concentrations of organic and inorganic analytes in soil were compared with Regional Screening Levels (SLs) for soil (Oak Ridge National Laboratory [ORNL] 2008). It should be noted that the values proposed in the Nellis CSE Phase II Work Plan were the USEPA Region 9 Preliminary Remedial Goals (PRGs). For the CSE Phase II report, the Regional SLs were utilized based on USEPA directive that the PRGs were superseded by the Regional SLs. However, it is noted that the USEPA Region 9 Residential PRG and the USEPA Region Residential SL for lead are both 400 mg/kg. In addition, ecological screening values (ESVs) were also evaluated because rare, threatened, and/or endangered species have been identified at Nellis AFB.

### 4.3.2 Screening Values Uncertainty Analysis

The screening values used to assess chemical constituent concentrations measured in soil, and the screening level approach itself, are associated with a degree of uncertainty. Risk-based screening levels are by definition generic, and based on a conservative (health protective) default set of exposure assumptions for a typical site. Therefore, the use of a screening level approach and "off the shelf" screening level values will almost always over-estimate, rather than under-estimate, potential human health and ecological risk or hazard. Some site-specific considerations have been taken into account, for particular sub-sites or chemicals, when possible, and where appropriate, for the level of detail consistent with a CSE-type screening-level evaluation. For example, the Regional SLs are considered to be protective of recreational visitors and trespassers, including children. The exposure assumptions for the residential scenario are more conservative because the frequency and duration of exposure to a resident would be much greater than that of the recreational visitor to the MRAs.

**Table 4-3 Screening Levels for MC**

| Analyte | Nellis Site-Specific Background | Human Health Soil Screening Values | | Ecological Soil Screening Values | | | | | | Minimum Soil Criteria Level [g] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Res. USEPA Regional Screening Level | Ind. USEPA Regional Screening Level | USEPA EcoSSL [a] | LANL Eco Benchmark [b] | ORNL PRG [c] | ORNL Wildlife Benchmark [d] | Talmage et al (1999) [e] | Recommended Eco Screening Value [f] | |
| **Explosives SW-846 8330 Modified** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| 1,3,5-Trinitrobenzene | NA | 1800 | 18000 | NA | 0.99 | NA | NA | 4.4 | 0.99 | 0.99 |
| 1,3-Dinitrobenzene | NA | 6.1 | 62 | NA | 7.5 | NA | NA | 15 | 7.5 | 6.1 |
| 2,4,6-Trinitrotoluene | NA | 16 | 57 | NA | 71 | NA | NA | NA | 71 | 16 |
| 2,4-Dinitrotoluene | NA | 120 | 1200 | NA | 6.4 | NA | NA | 5.6 | 6.4 | 6.4 |
| 2,6-Dinitrotoluene | NA | 61 | 620 | NA | 0.52 | NA | NA | NA | 0.52 | 0.52 |
| 2-Amino-4,6-dinitrotoluene | NA | 120 | 1200 | NA | 0.37 | NA | NA | NA | 0.37 | 0.37 |
| 4-Amino-2,6-dinitrotoluene | NA | 120 | 1200 | NA | 2.1 | NA | NA | 80 | 2.1 | 2.1 |
| 2-Nitrotoluene | NA | 780 | 10000 | NA | 0.73 | NA | NA | NA | 0.73 | 0.73 |
| 3-Nitrotoluene | NA | NA | NA | NA | 6.6 | NA | NA | 1.4 | 6.6 | 6.6 |
| 4-Nitrotoluene | NA | 30 | 110 | NA | 0.073 | NA | NA | 0.41 | 0.073 | 0.073 |
| HMX | NA | 3100 | 31000 | NA | 2 | NA | NA | NA | 2 | 2 |
| Nitrobenzene | NA | 31 | 280 | NA | 2.4 | NA | NA | NA | 2.4 | 2.4 |
| RDX | NA | 4.4 | 16 | NA | 4.4 | NA | NA | NA | 4.4 | 4.4 |
| Tetryl | NA | 240 | 2500 | NA | 27 | NA | NA | 5.6 | 27 | 27 |
| PETN | NA | NA | NA | NA | 2.2 | NA | NA | NA | 2.2 | 2.2 |
| Nitroglycerine | NA | 6.1 | 62 | NA | 8600 | NA | NA | NA | 8600 | 6.1 |
| **Metals SW-846 6010B** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Lead | 12 | 400 | 800 [h] | 11 | 14 | 40.5 | 0.94 | NA | 11 | 12 |
| **PAHs SW-846 8270C SIM [i]** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| 1-Methylnaphthalene (LMW) | NA | 22 | 99 | 29 | NA | NA | NA | NA | 29 | 22 |
| 2-Methylnaphthalene (LMW) | NA | 310 | 4100 | 29 | 2.5 | NA | NA | NA | 29 | 29 |
| Acenaphthene (LMW) | NA | 3400 | 33000 | 29 | NA | 20 | NA | NA | 29 | 29 |
| Acenaphthylene (LMW) | NA | NA | NA | 29 | 120 | NA | NA | NA | 29 | 29 |
| Anthracene (LMW) | NA | 17000 | 170000 | 29 | 210 | NA | NA | NA | 29 | 29 |
| Benzo(a)anthracene (HMW) | NA | 0.15 | 2.1 | 1.1 | 3 | NA | NA | NA | 1.1 | 0.15 |
| Benzo(a)pyrene (HMW) | NA | 0.015 | 0.21 | 1.1 | 9.6 | NA | 1.98 | NA | 1.1 | 0.015 |

**Table 4-3 Screening Levels for MC**

| Analyte | Nellis Site-Specific Background | Human Health Soil Screening Values | | Ecological Soil Screening Values | | | | | | Minimum Soil Criteria Level [g] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Res. USEPA Regional Screening Level | Ind. USEPA Regional Screening Level | USEPA EcoSSL [a] | LANL Eco Benchmark [b] | ORNL PRG [c] | ORNL Wildlife Benchmark [d] | Talmage et al (1999) [e] | Recommended Eco Screening Value [f] | |
| Benzo(b)fluoranthene (HMW) | NA | 0.15 | 2.1 | 1.1 | 18 | NA | NA | NA | 1.1 | 0.15 |
| Benzo(g,h,i)perylene (HMW) | NA | NA | NA | 1.1 | 24 | NA | NA | NA | 1.1 | 1.1 |
| Benzo(k)fluoranthene (HMW) | NA | 1.5 | 21 | 1.1 | 62 | NA | NA | NA | 1.1 | 1.1 |
| Chrysene (HMW) | NA | 15 | 210 | 1.1 | 2.4 | NA | NA | NA | 1.1 | 1.1 |
| Dibenz(a,h)anthracene (HMW) | NA | 0.015 | 0.21 | 1.1 | 12 | NA | NA | NA | 1.1 | 0.015 |
| Fluoranthene (HMW) | NA | 2300 | 22000 | 1.1 | 22 | NA | NA | NA | 1.1 | 1.1 |
| Fluorene (LMW) | NA | 2300 | 22000 | 29 | 4.1 | 30 | NA | NA | 29 | 29 |
| Indeno(1,2,3-cd)pyrene (HMW) | NA | 0.15 | 2.1 | 1.1 | 62 | NA | NA | NA | 1.1 | 0.15 |
| Naphthalene (LMW) | NA | 3.9 | 20 | 29 | 0.34 | NA | NA | NA | 29 | 3.9 |
| Phenanthrene (LMW) | NA | NA | NA | 29 | 10 | NA | NA | NA | 29 | 29 |
| Pyrene (HMW) | NA | 1700 | 17000 | 1.1 | 18 | NA | NA | NA | 1.1 | 1.1 |

*mg/kg = milligrams per kilogram = parts per million*
*µg/kg = micrograms per kilogram = parts per billion*
*NA - Value not available.*
*USEPA Regional Screening Level Source: Oakridge National Laboratories, 7 July 2008*
[a] *From Ecological Soil Screening Levels (EcoSSLs) (USEPA, 2005) and on-line updates as of 9/27/2007.*
[b] *Los Alamos National Laboratory (LANL), New Mexico, Eco Risk Database, Release 2.2, September 2005.*
[c] *From ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2.*
*Efroymson, R.A., M.E. Will, and G.W. Suter 1997, Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process, ES/ER/TM-126/R2 (invertebrates only).*
*Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten, 1997, Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Terrestrial Plants, ES/ER/TM-85/R3.*
[d] *From ORNL: Sample, B.E., D.M. Opresko, and G.W. Suter, 1996, Toxicological Benchmarks for Wildlife, ES/ER/TM-86/R3.*
*Lowest NOAEL-based terrestrial wildlife benchmarks for food (100% uptake from soil to prey assumed).*
[e] *From Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, Talmage et al., 1999, Rev. Environ. Contamin. Toxicol., 161: 1-156.*
*(Direct contact benchmark or wildlife benchmark for food [100% uptake from soil to prey assumed]).*
[f] *The following hierarchy was used to select the soil screening benchmarks:*
*1. USEPA EcoSSL (plants, invertebrates, wildlife)*
*2. LANL (2005) (various endpoints)*
*3. ORNL PRGs (1997) (plants, invertebrates, wildlife)*
*4. ORNL (1996) (wildlife)*
*5. Talmage et al. (1999)*
[g] Minimum of Human Health Soil Screening Values and Recommended Eco Screening Value (see Footnote F) unless value less than background, in which case background values were used.
[h] *Region 9 Industrial Preliminary Remedial Goal was used as a USEPA Regional Screening Level for industrial exposure has not been developed.*
[i] Low and High molecular weight (LMW, HMW) PAHs based on the number of ring structures (less than 4 rings = LMW; 4 or more rings = HWM).

In addition, the use of individual sample results in the screening-level assessment, as compared with a statistical approach (e.g., use of a 95 percent UCL on the mean), is also a conservative approach that results in an over-estimate, rather than under-estimate, of potential human health and ecological risk or hazard.

## 4.4 Data Quality

QA is defined as the overall system for assuring the reliability of data produced. The system integrates quality planning, assessment, and improvement efforts from various groups in an organization to provide and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the generation of valid and complete data through its subsequent review, validation, and documentation. This section summarizes the QA and QC procedures and presents the results of the QC assessment for the analytical data (compiled in **Appendix H**) acquired during the March 2008 and September 2009 field events at Nellis AFB. All procedures were conducted in accordance with the *Nellis Air Force Base Comprehensive Site Evaluation Phase II Final Work Plan* (USACE 2008).

A Quality Assurance Project Plan (QAPP) was developed as part of the CSE Phase II Sampling and Analysis Plan. The QAPP was implemented through the integration of well-defined QC elements for activities associated with the task assignment. The QC criteria defined for sampling and analysis activities were developed in accordance with specifications contained in the USACE EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001), USEPA *Data Quality Objectives Process for Hazardous Waste Site Investigations* EPA QA/G-4HW (USEPA 2000), and the *DoD Quality Systems Manual for Environmental Laboratories, Final Version 3* (QSM; DoD 2006).

Documentation required for this project was reviewed and deficiencies, if any, were identified. Required project documentation included the following:

- Field Logbooks/Forms: Hardback logbooks with numbered pages were used to log daily activities and data collected during the course of field activities. Designated logbooks were also used to record calibration records and equipment maintenance as they were performed.
- Chain of Custody: Samples were collected and relinquished under stringent chain-of-custody protocols as specified in the project QAPP. A review of chain-of-custody forms indicates that all sample collection, identification, and project information was correctly supplied.
- Document Control: Documents generated by or provided for Bay West Team in support of project activities were added to the Bay West Team Document Control System. A unique control number was assigned to each document prior to its being archived into the system. Access into and out of the document control system was restricted to designated personnel.

Sampling activities were performed in compliance with standard operating procedures (SOPs), and each individual performing sampling was aware of the requisite protocols for collection of environmental samples. Each sample technician was experienced in soil characterization and sampling techniques for the media collected. Team members were provided with copies of the associated Work Plan which included the Field Sampling Plan, QAPP, and Health and Safety Plan.

### 4.4.1 Data Quality Objectives

DQOs were developed concurrently with the Work Plan to ensure: 1) the reliability of field sampling and chemical/field analyses; 2) the collection of sufficient data; 3) the quality of data generated was acceptable for its intended use; and 4) valid assumptions could be inferred from the data.

XRF QC requirements included analysis of instrument blanks (e.g. quartz sand), calibration checks, and replicate samples. Daily QC included the analysis of blanks, at least three calibration standards bracketing the expected concentration ranges, replicates (minimum of three readings), and a check sample or SRM. All blanks were less than the instrument detection limits. The daily SRM and continuing calibrations were within the ±20 percent difference (%D) of the certified value.

Correlation analysis included split sample analysis between XRF and off-site laboratory methods. The results were used to develop a correlation between the site-specific XRF and offsite laboratory methods. The correlating ex-situ XRF and lab analysis results were plotted and reviewed using a linear regression process to measure the correlation coefficient. The March 2008 correlation plot is presented as **Figure 4-8**. However, as discussed in Section 4.2.1, the correlation was found to be unacceptably low. Consequently, the data collection and analytical procedures were evaluated. As a result of this evaluation, a re-sampling effort was completed in September 2009. All of the re-sampled soils had XRF data with RSD values less than 20% and the laboratory and XRF data correlation coefficient was calculated at 0.97. The September 2009 correlation plot is presented as **Figure 4-9**. The guidance provided in USEPA Method 6200 indicates that data with a correlation coefficient greater than 0.90 is considered definitive. Therefore, the Nellis AFB XRF results are considered to be definitive data and can be used for decision making and risk assessment purposes.

For the analytical data, attainment of DQOs was assessed through evaluation of all data collected using the following data quality indicators:

- Precision – a quantitative measure of the variability of a group of measurements in comparison to the average value measured using relative percent difference (RPD) or %D. This included evaluating field sample duplicates, laboratory sample duplicates, and matrix spike duplicates.
- Accuracy – the bias in a measurement system measured using percent recovery (%R). This included evaluating laboratory control samples, matrix spikes, serial dilutions, and surrogates.
- Representativeness – the degree to which the measured results accurately reflect the medium being sampled. Representativeness is assessed based on accuracy, precision, and completeness. This includes evaluating holding times and laboratory control systems.
- Completeness – the percentage of measurements which are judged to be usable measured using %R. This included evaluating sampling and analytical completeness.
- Comparability – defined as a qualitative parameter expressing the confidence with which one data set can be compared with another. This includes evaluating the analytical methods performed.

**Figure 4-8 March 2008 X-Ray Fluorescence and Lab Correlation Plot**

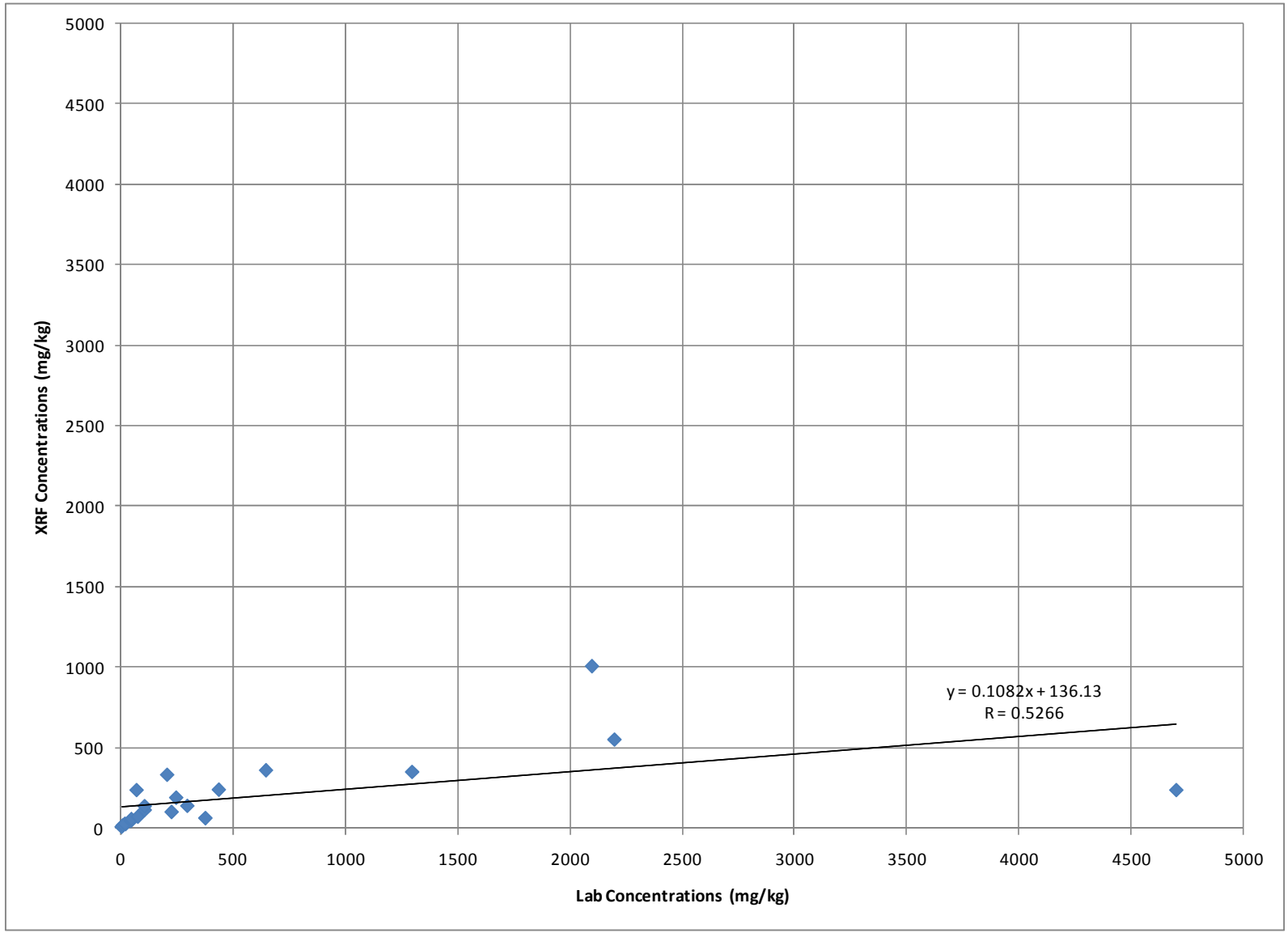
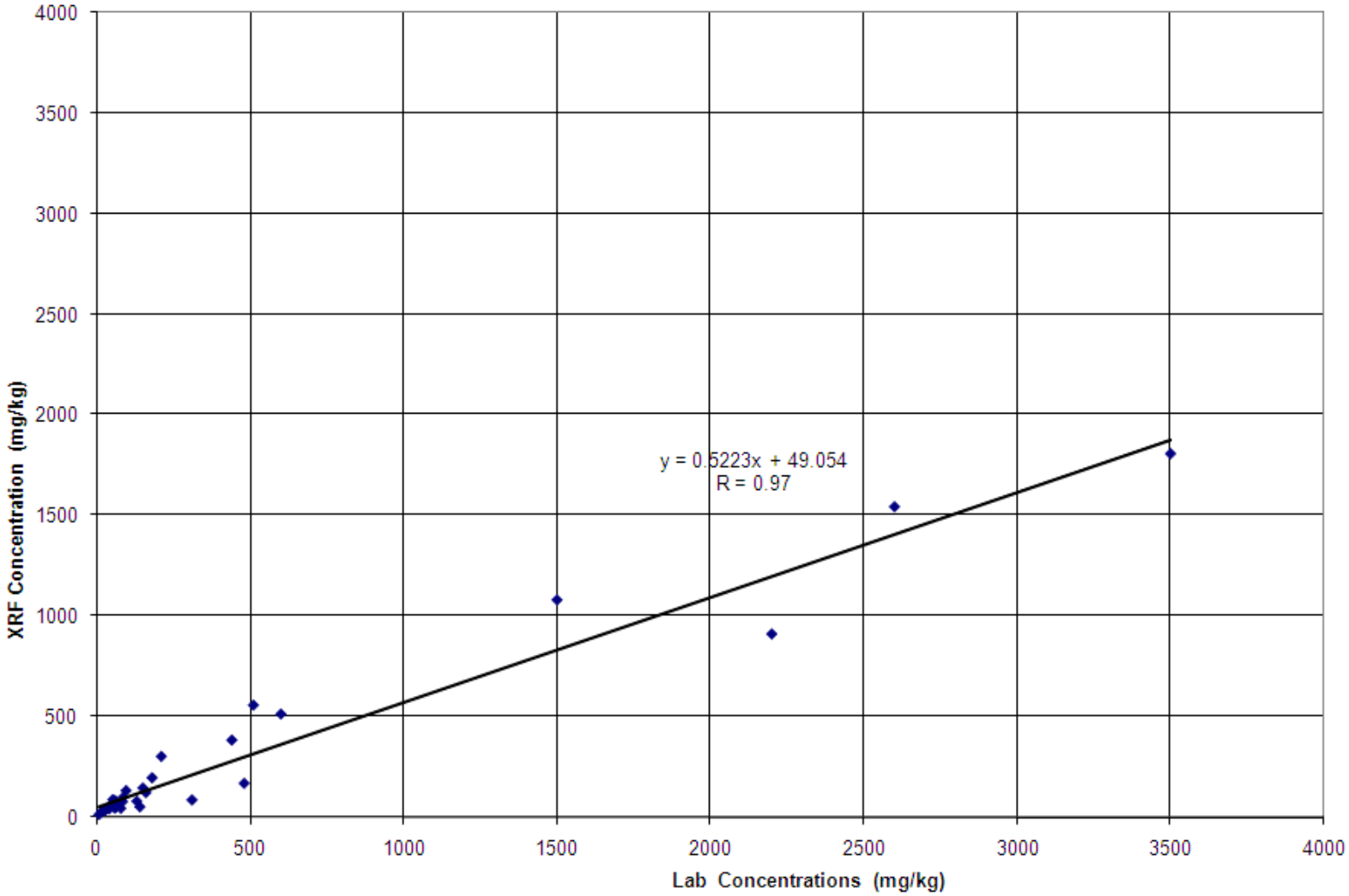


**Figure 4-9 September 2009 X-Ray Fluorescence and Lab Correlation Plot**



- Sensitivity – describes the method detection limits (MDLs), quantitation limits, and method reporting limits (MRLs), which are dependent upon the sample characteristics (i.e., sample volumes used, percent solids, dilutions, etc.) and the analytical method

The off-site laboratory QC elements (e.g. calibrations, blanks, laboratory control samples [LCS]/matrix spike/matrix spike duplicates [MS/MSD], duplicates, etc.) were reviewed and evaluated during the data validation process. They are discussed in Section 4.4.4 and in further detail in the validation reports located in **Appendix I** of this report. All correlation samples proposed for analysis were collected. The overall analytical completeness percentage was 100% for all sampling events for the CSE Phase II off-site analysis.

### 4.4.2 Analytical Methodology

The analytical services for the sampling effort were provided by TestAmerica -Denver, a National Environmental Laboratory Accreditation Conference (NELAC) and Air Force Center for Engineering and the Environment-accredited laboratory located in Arvada, Colorado (CO). The laboratory provided analytical support for collected soil samples using *Test Methods for Evaluating Solid Waste Physical/Chemical Methods, (SW-846) Update IIIB* (USEPA 2004a), as well as laboratory SOPs for this project. The analytical scope included analysis for explosives (8330 Modified), PAHs (8270C SIM) and metals (6010B).

### 4.4.3 Data Review

All analytical data packages were provided to Bay West in Contract Laboratory Program (CLP)-like Level 4 deliverables with Environmental Restoration Program Information Management System (ERPIMS) and American Standard Code for Information Interchange (ASCII) delimited electronic data deliverable files from the laboratory. Detected target compound values above the MRL and within the acceptable calibration range were reported as determined to no more than three significant figures. Target analytes detected below the lower calibration standard or MRL and above the MDL were reported as estimated values. Appropriate data qualifiers were applied during the validation process. The data validation reports may be found in **Appendix I**. All data values were also recorded in an electronic database.

Data obtained from the laboratory were reviewed and data validation was conducted by the Bay West Team Project Chemist to determine whether the project-specific DQOs, as defined in the associated Work Plans and Sampling and Analysis Plans, were met. No more than 20 samples were analyzed per sample batch.

### 4.4.4 Data Validation

Data validation determines the acceptability or unacceptability of the analytical data quality based on a set of pre-defined criteria. Data validation is defined as the systematic process for reviewing a data package against a set of criteria to provide assurance that the data is adequate for its intended uses. These criteria depend upon the type(s) of data involved and the purpose for which data is collected. The intended use of the data and the associated acceptance criteria for data quality was determined before the data collection effort began. Data validation services for the CSE Phase II sampling effort were provided by Bay West Team personnel located in Edgewood, Maryland. The Bay West Team used a combination of project-specific Work Plan/QAPP criteria, *DoD QSM* (DoD, 2006), method-specific criteria following *USEPA Office of Solid Waste and Emergency Response Test Methods for Evaluating Solid Waste*

*Physical/Chemical Methods (SW-846), Update IIIB* (USEPA 2004a), and subcontract laboratory SOPs. The data qualifier scheme was consistent with the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 1999), and the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 2004).

All analytical data packages were validated to ensure compliance with specified analytical, QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria. This includes (as applicable), but is not limited to:

- Sample preservation and holding times;
- Instrument performance checks;
- Calibrations (initial and continuing);
- Blanks (method and rinse);
- Matrix spikes and spike duplicates;
- Laboratory and field sample duplicates;
- Serial dilutions;
- Surrogates;
- Laboratory control samples;
- Internal standards and retention times; and,
- Quantitative verification (5 percent minimum per matrix).

Analytical results were assessed for accuracy and precision of laboratory analysis to determine the limitations and quantity of data. The quality of the data collected in support of the sampling activity was considered acceptable, unless qualified rejected "R" during the validation process. Samples qualified "J" or "UJ" were considered acceptable as estimated with noted definitions. The data validation reports are presented in **Appendix I**.

## 4.5 Data Management

### 4.5.1 Electronic Data

The electronic files provided by Nellis AFB were securely stored within a specified project directory on a secure private network located at the Bay West Team office in St. Paul, Minnesota (MN). Access to these files is restricted to only those personnel with key responsibilities to the project and who have been granted authority by the Bay West Team Project Manager. These electronic files are backed up daily, weekly, monthly, and yearly.

### 4.5.2 Hardcopy Data

Various hardcopy files including technical reports, correspondences, figures, and drawings also are stored within the secure Nellis AFB project files located at the Bay West Team office in Centennial, CO. Access to the office is limited to Bay West Team personnel though a door security system and all employees and visitors are badged.

### 4.5.3 GIS Data

The GIS data layer files are stored on a separate directory within the secure private network located at the Bay West office in St. Paul, MN. Again, access to these files is restricted to only those personnel with key responsibilities to the project and who have been granted explicit access rights. These electronic files also are backed-up daily, weekly, monthly, and yearly.

The conversion of raw data into the database and mapping software was performed at the Bay West Team office in Centennial, CO. CSE Phase II MEC location data was stored and managed using GIS software. Field data collected during sampling was entered manually into the database and checked by another member of the field team. The output from the database was checked by the Bay West Team QC Specialist or designee to determine if it was consistent with the raw data.

# 5.0 MUNITIONS RESPONSE SITE CHARACTERISTICS

Nellis AFB encompasses approximately 11,300 acres and includes three individual MRAs evaluated as part of the CSE Phase II effort. Due to the size of the facility and the variety of MRAs, site characteristics of each MRA vary greatly; therefore, this section has been broken down into individual MRAs.

## 5.1 MU732: WWII Gunnery Range @ Range Road (Excess)

### 5.1.1 Site Description

MU732 was originally reported as a 5,590-acre MRA in AFRIMS. However, during the CSE Phase I, it was determined that the MRA footprint was actually 3,982 acres. This was confirmed during the CSE Phase II. The delta of 1,608 acres will be administratively closed following this CSE Phase II as it represents a miscalculation in AFRIMS from the actual footprint of the MRA. The MRA is located north of the main base at Nellis AFB. The majority of the MRA, with the exception of the Multi-Use Range Mountainous Area, consists of relatively flat terrain with low vegetation.

### 5.1.2 History of MEC Activities

MU732 was a section of the original 46,954 acres established for Flexible Gunnery School in 1941. An area of 6,957 acres is still an active range used by Nellis AFB for weapons training and qualifications. The remaining area of about 36,000 acres has been transferred to various entities. MU732 also has been referred to as the Ground Gunnery Range, Sheep Mountain Gunnery Range, Sheep Mountain Ground Gunnery Range, Sheep Mountain Bombing Range, Las Vegas Gunnery Range, Las Vegas Ground Gunnery Range, Nellis Rifle and Pistol Range, and the Nellis Small Arms Range Annex.

The types of training that may have been conducted on MU732 include small arms gunnery practice (pistol, rifle, and skeet/trap), air-to-ground gunnery (strafing), ground-to-air gunnery, air-to-air gunnery, bombing (practice), rocketry, and demolition/burning operations. The mountainous area of the site was also used as an emergency drop/jettison area for hung bombs and rockets, wing-tip tanks, and pylons. Nellis AFB EOD personnel have observed practice bombs as well as napalm bombs in the mountainous area during aerial surveys, and actual MEC items have been discovered as recently as 1995. The rugged, nearly inaccessible terrain complicates disposal and removal actions.

Historical documents indicate that for many years, the area was used for training flexible machine gunners using .30 and .50 caliber ammunition and 12-gauge skeet ammunition. Power turrets and 20mm and 37mm anti-aircraft guns are also documented as being ordered for the area. Occasionally, 37mm projectiles have been discovered in gullies and washouts after heavy rainstorms within 0.5 miles of MU732.

Historical evidence indicates that ordnance was used at MU732 at least from 1941 to 1965. As discussed in Section 2.6, a number of EOD range clearances have been completed at the site.

MEC anticipated to be present at MU732 are as follows:

- Bomb, practice, with MK 4 signal: BDU-33/B MK 5, MK 23, MK 43, MK 106, MK 76;

- Bomb, practice, with signal, M38A2;
- Bomb, practice, MK 82 Mod 0;
- Bomb, practice 750-lb;
- Bomb, M117 inert;
- Napalm bomb (no nomenclature provided);
- BLU-27;
- 2.75-inch Rocket, M229 HE warhead;
- Rocket motor, MK40 Mod 1;
- 5-inch Rocket, MK 1 Mod 0 HE;
- Grenade, AN-M14 incendiary;
- Demolition block, M3 and M5;
- 20mm projectile, target practice (TP), armor-piercing tracer (AP-T), and HEI; and
- 37mm projectile, HE.

In addition, small arms have potentially been used at MU732 as follows:

- .30 caliber cartridge, M2 ball, M2 armor-piercing (AP), and M1 tracer;
- .45 caliber cartridge, M1911 ball; and
- .50 caliber cartridge, M2 ball, and M2 AP.

### 5.1.3 Current Land Use

MU732 is currently inactive and classified as a closed range. The land is scheduled to be returned to BLM upon completion of the munitions assessment, clearance, and certification. The Southern Nevada Water Authority has constructed facilities associated with the Grand Teton Reservoir Project on MU732 property. These facilities include a covered potable water storage reservoir, a pumping station, two underground pipelines, and a stormwater diversion structure that transverses in a northeast to southwest direction through the western portion of MU732.

### 5.1.4 Access Controls

MU732 currently has a chain-link fence that runs along the southern and western boundaries. The northern boundary is mountainous and inaccessible by vehicle. The eastern boundary of MU732 is shared with the active Nellis Small Arms Range. There is only one access gate along the fence. The gate, located on the southern boundary, is open during daylight hours and secured by USAF personnel at night.

### 5.1.5 Restrictions

“No Trespassing” signs are posted around the southern and western perimeter of MU732. Department of Interior, National Wildlife Refuge signs are posted along some of the remote roads that lead to the BLM property near the mountainous area.

### 5.1.6 Field Investigation Results

#### *5.1.6.1 Site Reconnaissance Observations*

The Bay West Team completed visual surveys of MU732 as part of the CSE Phase II field effort. **Figure 5-1** depicts the surface findings of this MRA. Due to the size and historical use of the MRA, the observation for each of the areas within MU732 is presented below. These areas are identified on **Figure 5-1** for reference.

**.50 Caliber Firing Fan**

The Bay West team visually surveyed approximately 1,575 acres in the .50 Caliber Firing Fan in MU732. The primarily flat terrain and low vegetation allowed the team to visually survey about 50-75 feet per transect. There were a few heavy erosion channels observed up to 8 feet deep and 30 feet wide. The original transect spacing for this area was one-quarter mile and was later reduced to one-eighth mile when additional transects were applied to increase the amount of coverage. Two UXO items (grenade simulators) and one munitions debris item (750-lb practice bomb, concrete filled) were identified during the visual reconnaissance.

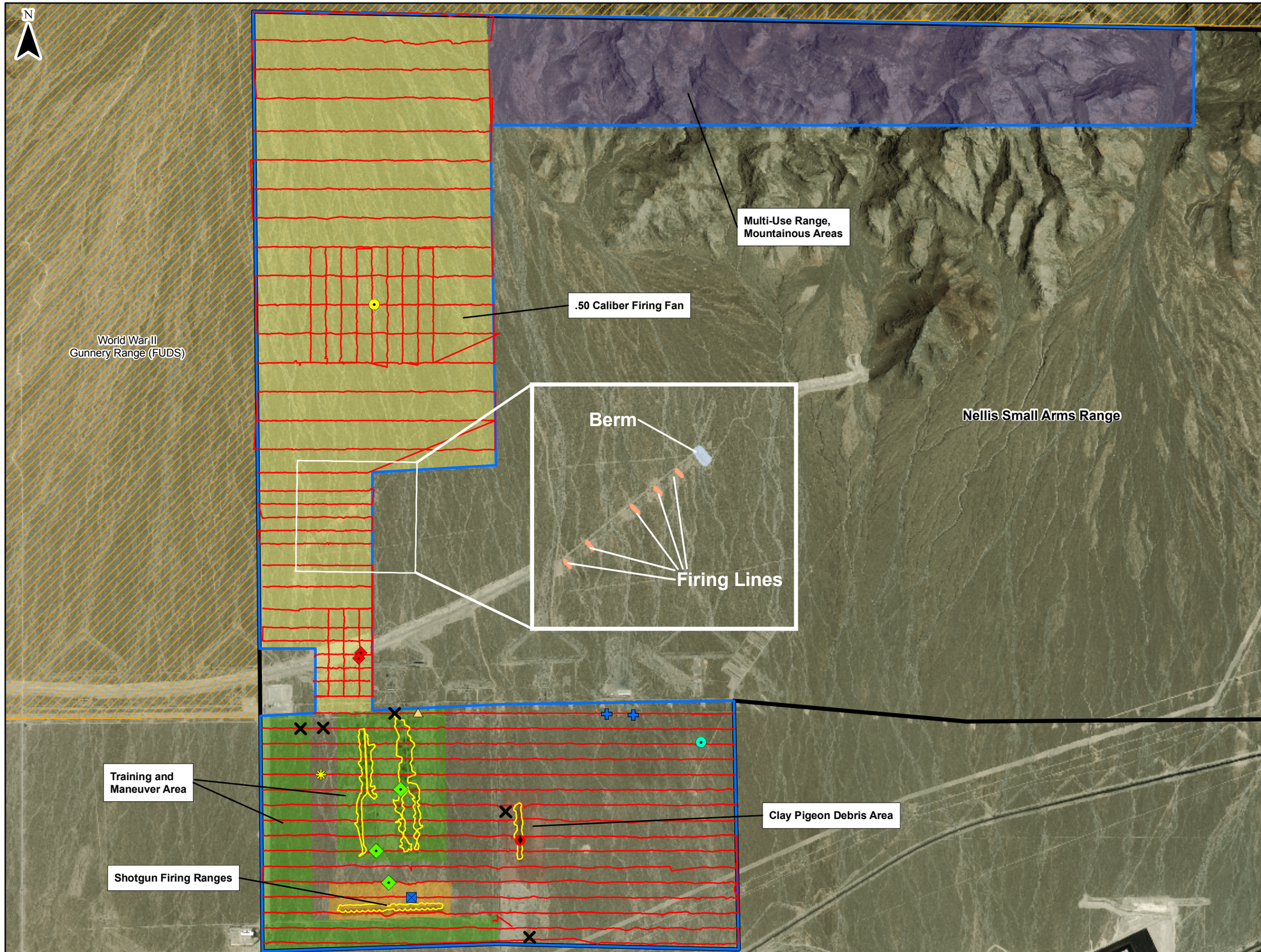
Approximately three-quarters of a mile south of the northern boundary of the .50 Caliber Firing Fan, signage indicates the area is a wildlife refuge. There are also signs indicating that east of this area is an active firing range. This area is also potential Desert Tortoise habitat. During field activities, several burrows, a few shells and one mature adult, were observed.

**.50 Caliber Firing Fan Berm**

While the visual survey of the .50 Caliber Firing Fan was performed, a portion of the area was surveyed with 300-foot transect spacing near a previously undefined feature. The feature was determined to be a firing line, which included a large earthen backstop approximately 150 feet long 12 feet wide and 10 feet high. The back of the backstop was constructed of concrete. The feature also included what appeared to be firing position berms spaced in 100- and 200-foot intervals extending southwest of the backstop. The “firing berms” were similar to the backstop in footprint but only 3-4 feet high.

**Shotgun Firing Range**

The proposed transect spacing for this area was 350 feet. Due to the level terrain and low vegetation, the team could survey about 50-75 feet. The Shotgun Firing Range was comprised of two series of connected half circles (visible in site boundary walk) constructed of asphalt pathways 2-3 feet wide. At the center of each arc was a concrete pad and at each point where the half circles connected was a concrete vault. Between the two concrete structures and along the pathway was a three-sided building foundation, which may have been a firing position. Aerial imagery from this area showed large triangles encompassing the firing range. The northern point of the triangle appears to be a berm, but it becomes a ditch area as it progresses to the south. The southern boundary is an asphalt road. The clay pigeon debris had migrated downgradient into the firing structures. The clay pigeon debris within the Shotgun Firing Range was observed at thickness ranging from 0 inches to 8 inches. The team located two MD items (a fire bomb igniter and a smoke grenade) during the visual survey.




LEGEND

- Nellis Air Force Base Installation Boudary
- Munitions Response Area
- FUDS Property
- Completed CSE Phase II Transect
- Completed CSE Phase II Transect Delineating Clay Pigeon Debris
- Burn Pit
- MD - 750 lb Practice Bomb
- MD - Fire Bomb Igniter
- MD - MK23 Practice Bomb
- MD - Signal Flare
- MD - Smoke Grenade
- MD
- Small Arms
- UXO - Hand Grenade Simulator
- UXO - MK 4 Signal Cartridge

0 2,000 4,000 Feet

Projection : NAD83 State Plane Nevada East

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 5-1

MU732
VISUAL SURVEY OBSERVATIONS
NELLIS AIR FORCE BASE

Shaw Shaw Environmental, Inc. Bay West

**Clay Pigeon Debris Area**

The proposed transect spacing for the Clay Pigeon Debris Area was 350 feet. Due to the level terrain and low vegetation, the team could survey about 50-75 feet. The Clay Pigeon Debris Area had a berm running north and south near the western edge of the MRA. The berm was about 4 feet wide at the top and 1-3 feet high. Two rows of concrete structures ran parallel to the berm. The location of the structures in relation to the debris field seemed to indicate an easterly firing direction. The majority of the clay pigeon debris ground coverage was less than 50%, only in a few low locations did the debris accumulate to a measurable depth. One UXO item (MK 4 signal cartridge) was observed in the middle of the MRA. In addition, the team located small arms debris (shot gun casings) in the area.

**Training and Maneuver Area**

The proposed transect spacing for this area was 350 feet. Due to the level terrain and low vegetation, the team could survey about 50-75 feet. In the Training and Maneuver Area, the previously unknown feature was identified as two clay pigeon debris lanes, where scattered clay pigeon debris was observed. Near most of the clay pigeon debris areas was a mound of soil with lumber around the bottom. This suggests that the berms were manmade with a 2-inch x 12-inch board (still in place) around the bottom of the berm to hold the berm in place. It appeared by the remnants of clay pigeons that there was a portable thrower used behind the berm and the clay pigeon was shot in one direction. It was assumed that the clay pigeons were shot from a moving vehicle on a path that still exists today. It is further assumed that the portable thrower was moved to different locations throughout the training. The majority of clay pigeon debris was within 100 feet of the two asphalt roads. The field team also located two MD items (two smoke grenades) in this area. In addition, a burn pit was located to the north of the clay pigeon debris lanes.

**Remaining Area in Southern Half of MU732**

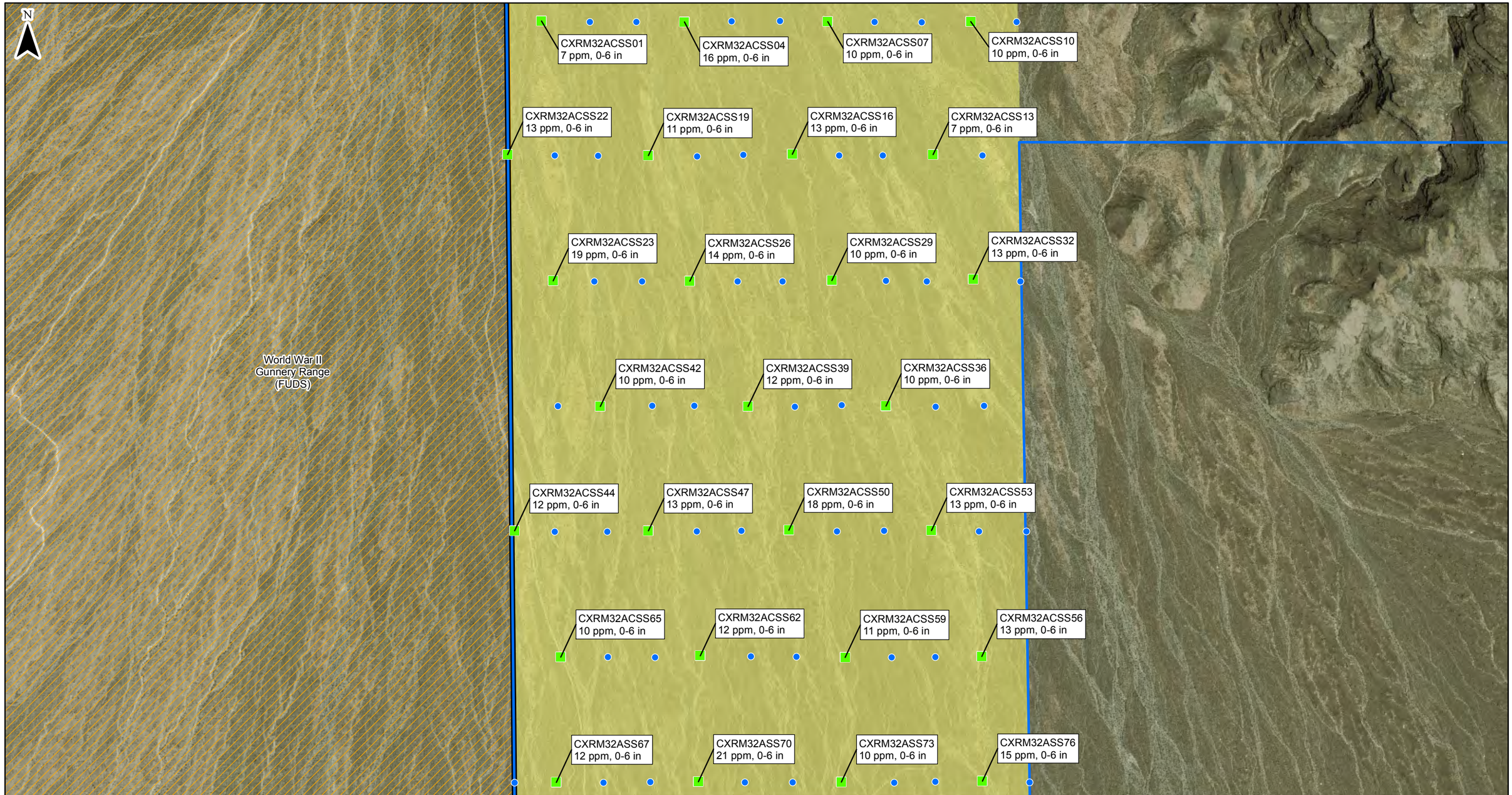
The proposed transect spacing for this area was 350 feet. Due to the level terrain and low vegetation, the team could survey about 50-75 feet. The team located several MD items (MK23 practice bombs, signal flares) and small arms debris (shot gun casings).

#### *5.1.6.2 Geophysical Survey Results*

A geophysical survey was not performed at MU732 as it was not warranted to achieve the DQOs for this MRA.

#### *5.1.6.3 Media Sampling Results*

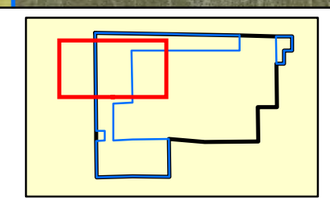
On-site screening analysis of site soils for lead contamination using a portable XRF instrument was performed in the .50 Caliber Firing Fan, .50 Caliber Firing Fan Berm, Shotgun Firing Range, and in the two areas within the Training and Maneuver Area where clay pigeon debris was observed. The purpose of the XRF screening was to horizontally and vertically delineate areas where lead was above the screening levels. In-situ and ex-situ sampling methods were performed, as described in Section 4.2.1. The locations of the XRF survey samples for MU732 are presented as **Figures 5-2** through **5-6**.




LEGEND

- Munitions Response Area
- FUDS Property
- .50 Caliber Firing Fan
- In-Situ Lead <200 ppm
- In-Situ Lead ≥200 ppm
- Ex-Situ Lead <400 ppm
- Ex-Situ Lead ≥400 ppm

0 500 1,000 2,000 Feet



Projection : NAD83 State Plane Nevada East

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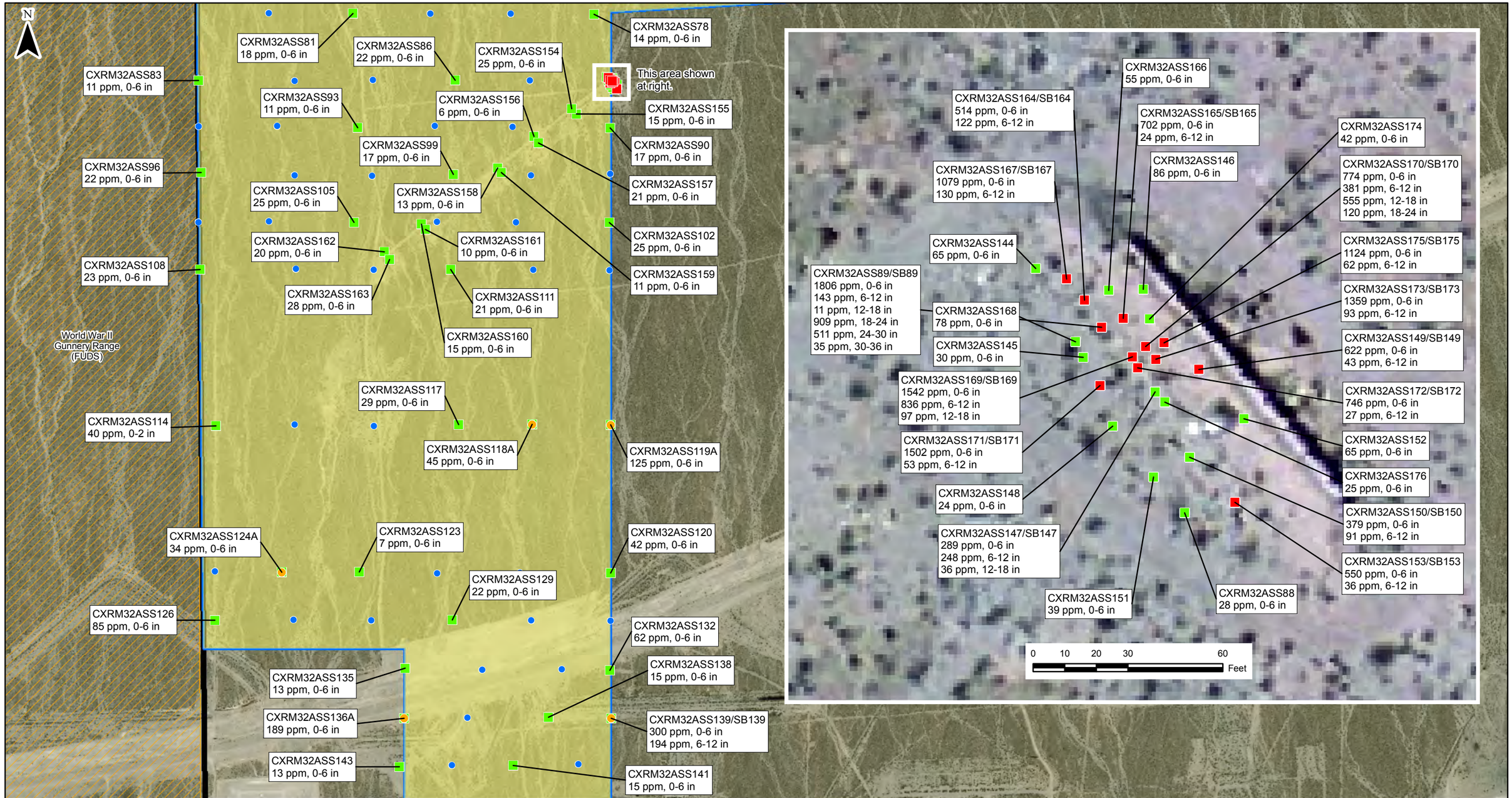
FIGURE NUMBER 5-2

MU732 XRF SAMPLE RESULTS
(.50 CALIBER FIRING FAN - NORTH)
NELLIS AIR FORCE BASE

Shaw Shaw Environmental, Inc. Bay West




LEGEND

- Munitions Response Area
- FUDS Property
- .50 Caliber Firing Fan
- In-Situ Lead <200 ppm
- In-Situ Lead ≥200 ppm
- Ex-Situ Lead <400 ppm
- Ex-Situ Lead ≥400 ppm

0 200 400 600 1,200 Feet

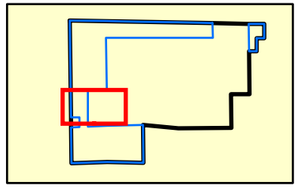


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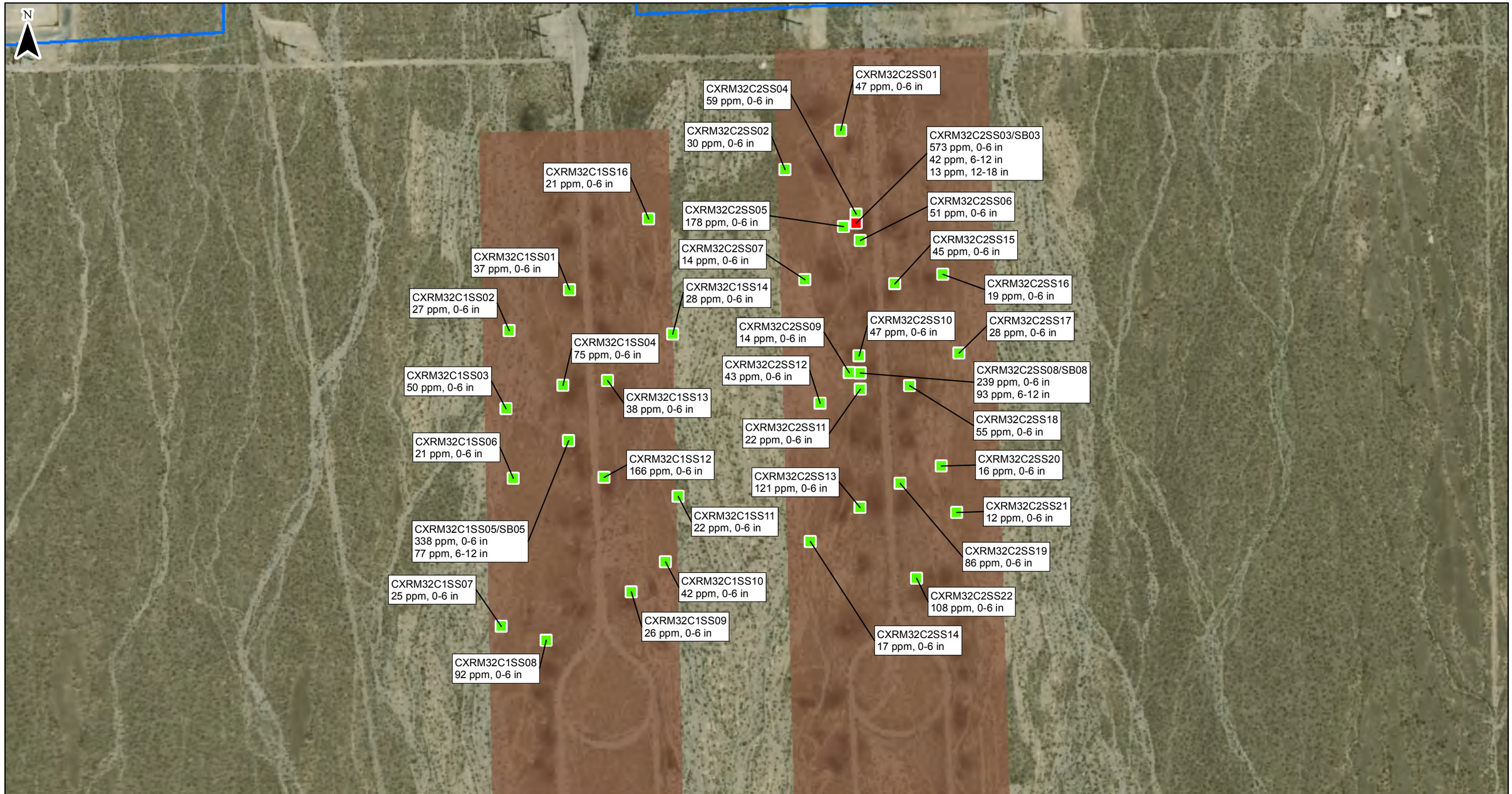
FIGURE NUMBER 5-3

MU732 XRF SAMPLE RESULTS
(.50 CALIBER FIRING FAN - SOUTH)
NELLIS AIR FORCE BASE

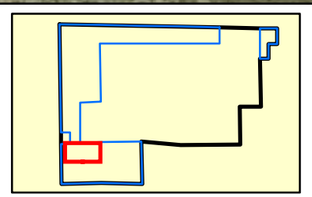
Shaw Environmental, Inc. Bay West




LEGEND

- Munitions Response Area
- Clay Pigeon Debris Area
- In-Situ Lead <200 ppm
- In-Situ Lead ≥200 ppm
- Ex-Situ Lead <400 ppm
- Ex-Situ Lead ≥400 ppm

0 300 600 Feet



Projection : NAD83 State Plane Nevada East

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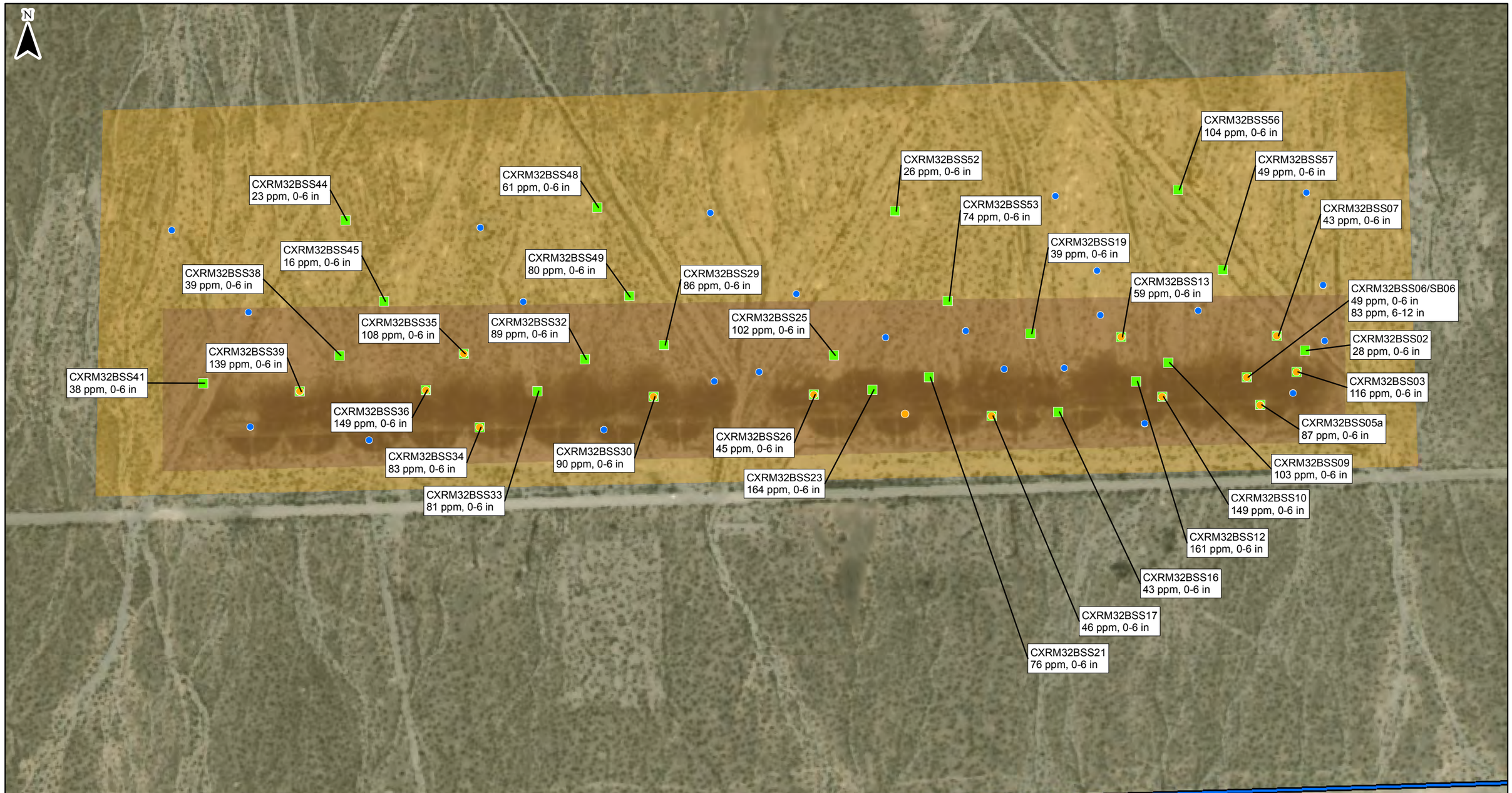
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 5-4

MU732 XRF SAMPLE RESULTS
(TRAINING AND MANEUVER AREA)
NELLIS AIR FORCE BASE

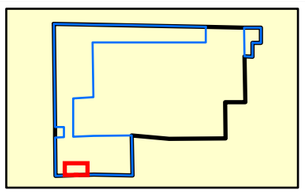
Shaw Shaw Environmental, Inc. Bay West




LEGEND

- Munitions Response Area
- Shotgun Firing Ranges
- Clay Pigeon Debris Area
- In-Situ Lead <200 ppm
- In-Situ Lead ≥200 ppm
- Ex-Situ Lead <400 ppm
- Ex-Situ Lead ≥400 ppm

0 100 200 400 Feet



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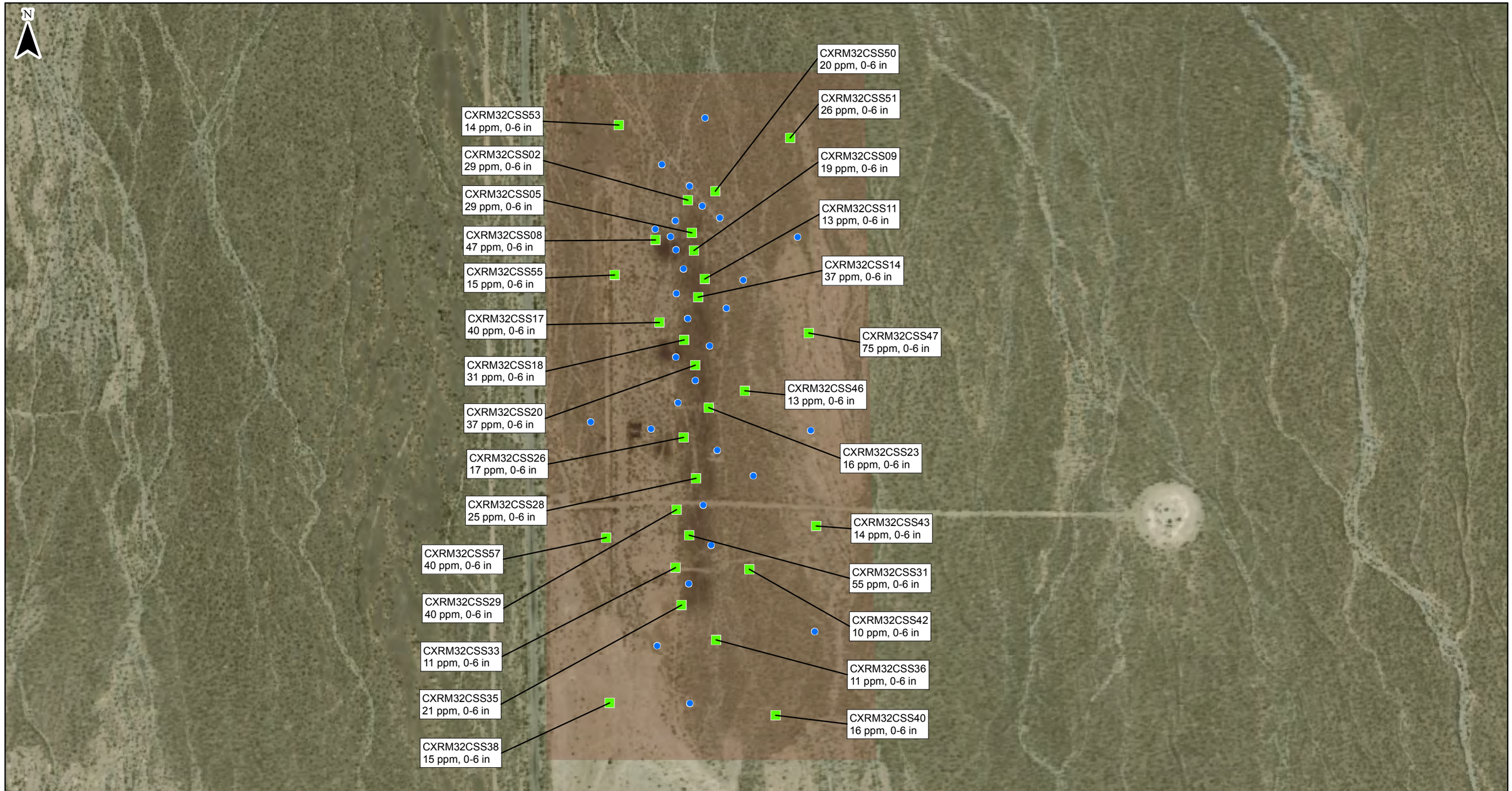
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 5-5

MU732 XRF SAMPLE RESULTS (SHOTGUN FIRING RANGE) NELLIS AIR FORCE BASE

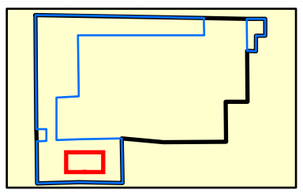
Shaw Shaw Environmental, Inc. Bay West




LEGEND

- Clay Pigeon Debris Area
- In-Situ Lead <200 ppm
- In-Situ Lead ≥200 ppm
- Ex-Situ Lead <400 ppm
- Ex-Situ Lead ≥400 ppm

0 300 600 Feet



Projection : NAD83 State Plane Nevada East

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FIGURE NUMBER 5-6

MU732 XRF SAMPLE RESULTS
(CLAY PIGEON DEBRIS AREA)
NELLIS AIR FORCE BASE

Shaw Shaw Environmental, Inc. Bay West

As discussed in Section 4.4.1, XRF sample results outside of the acceptable range were reanalyzed and replaced with the new dataset. A total of 217 ex-situ samples and 203 in-situ samples were collected as part of this effort. The XRF sampling in combination with the clay pigeon observations were the primary lines of evidence used to determine the nature and extent of lead contamination and thereby refine areas where MC impacts are indicated as well as those where no MC impacts are anticipated in MU732. The ex-situ results from the XRF surveys at MU732 are presented in **Table 5-1**.

Off-site samples for lead correlation analysis were selected to bracket the XRF survey results, such that samples from high, medium, and low XRF results were selected as presented in **Table 4-2**. In addition, 43 surface and 14 subsurface soil sample locations were collected and analyzed for PAHs from the Shotgun Firing Range, Training and Maneuver Area, and Clay Pigeon Debris Area based on the presence of clay pigeons identified during the visual survey. Five duplicate samples were also collected for QC evaluation (i.e., sample IDs ending in "D"). These samples were analyzed at a fixed-base laboratory for PAHs (1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene). All method criteria were met during analysis. Laboratory analytical results were compared to the screening levels presented in **Table 4-3**.

PAH analytical results for the MU732 samples are presented on **Table 5-2**. Please note that samples IDs ending in "D" denote duplicate samples collected for QC evaluation. The PAH sample locations with an assessment of the screening value exceedances are illustrated on **Figure 5-7**.

**.50 Caliber Firing Fan**

A total of 67 samples were collected at the .50 Caliber Firing Fan. Lead was detected below screening level of 400 mg/kg at the .50 Caliber Firing Fan (see **Figures 5-2** and **5-3,** and **Table 5-1**).

**.50 Caliber Firing Fan Berm**

A total of 46 samples were collected at the .50 Caliber Firing Fan Berm. Lead was detected in soil samples at concentrations greater than the screening level of 400 mg/kg in 16 samples from 12 locations at the small arms berm. Lead concentrations at the berm ranged from 11 mg/kg to 1,806 mg/kg (see inset on **Figure 5-3** and **Table 5-1**).

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| **MU732 .50 Caliber Firing Fan** | CXRM32ACSS01 | 3/17/2008 | 0-6 | 3 | < LOD | 7 | 0% |
| | | | | 4 | < LOD | | |
| | | | | 5 | < LOD | | |
| | CXRM32ACSS04 | 3/17/2008 | 0-6 | 8 | 14 | 16 | 27% |
| | | | | 9 | 13 | | |
| | | | | 10 | 21 | | |
| | CXRM32ACSS07 | 3/17/2008 | 0-6 | 13 | 16 | 10 | 58% |
| | | | | 14 | < LOD | | |
| | | | | 15 | < LOD | | |
| | CXRM32ACSS10 | 3/17/2008 | 0-6 | 18 | 17 | 10 | 60% |
| | | | | 19 | < LOD | | |
| | | | | 20 | < LOD | | |
| | CXRM32ACSS13 | 3/17/2008 | 0-6 | 23 | < LOD | 7 | 0% |
| | | | | 24 | < LOD | | |
| | | | | 25 | < LOD | | |
| | CXRM32ACSS16 | 3/17/2008 | 0-6 | 28 | 13 | 13 | 13% |
| | | | | 29 | 12 | | |
| | | | | 30 | 15 | | |
| | CXRM32ACSS19 | 3/17/2008 | 0-6 | 33 | < LOD | 9 | 45% |
| | | | | 34 | 13 | | |
| | | | | 35 | < LOD | | |
| | CXRM32ACSS22 | 3/17/2008 | 0-6 | 39 | < LOD | 13 | 45% |
| | | | | 40 | 17 | | |
| | | | | 41 | 17 | | |
| | CXRM32ACSS23 | 3/17/2008 | 0-6 | 42 | 22 | 19 | 14% |
| | | | | 43 | 19 | | |
| | | | | 44 | 17 | | |
| | CXRM32ACSS26 | 3/17/2008 | 0-6 | 47 | 13 | 14 | 13% |
| | | | | 48 | 16 | | |
| | | | | 49 | 14 | | |
| | CXRM32ACSS29 | 3/17/2008 | 0-6 | 52 | 12 | 10 | 33% |
| | | | | 53 | 13 | | |
| | | | | 54 | < LOD | | |
| | CXRM32ACSS32 | 3/17/2008 | 0-6 | 57 | 13 | 13 | 6% |
| | | | | 58 | 14 | | |
| | | | | 59 | 13 | | |
| | CXRM32ACSS36 | 3/17/2008 | 0-6 | 63 | < LOD | 10 | 57% |
| | | | | 64 | < LOD | | |
| | | | | 65 | 16 | | |
| | CXRM32ACSS39 | 3/17/2008 | 0-6 | 68 | < LOD | 12 | 46% |
| | | | | 69 | 12 | | |
| | | | | 70 | 17 | | |
| | CXRM32ACSS42 | 3/17/2008 | 0-6 | 74 | < LOD | 10 | 59% |
| | | | | 75 | < LOD | | |
| | | | | 76 | 17 | | |
| | CXRM32ACSS44 | 3/17/2008 | 0-6 | 81 | < LOD | 12 | 38% |
| | | | | 82 | 14 | | |
| | | | | 83 | 14 | | |
| | CXRM32ACSS47 | 3/17/2008 | 0-6 | 86 | 13 | 13 | 9% |
| | | | | 87 | 12 | | |
| | | | | 88 | 14 | | |
| | CXRM32ACSS50 | 3/17/2008 | 0-6 | 91 | 23 | 18 | 21% |
| | | | | 92 | 17 | | |
| | | | | 93 | 15 | | |
| | CXRM32ACSS53 | 3/17/2008 | 0-6 | 96 | < LOD | 13 | 48% |
| | | | | 97 | 13 | | |
| | | | | 98 | 19 | | |
| | CXRM32ACSS56 | 3/17/2008 | 0-6 | 101 | 19 | 13 | 50% |
| | | | | 102 | < LOD | | |
| | | | | 103 | 12 | | |
| | CXRM32ACSS59 | 3/17/2008 | 0-6 | 106 | 13 | 11 | 36% |
| | | | | 107 | 14 | | |
| | | | | 108 | < LOD | | |
| | CXRM32ACSS62 | 3/17/2008 | 0-6 | 111 | 13 | 12 | 41% |
| | | | | 112 | < LOD | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | 113 | 16 | | |
| | CXRM32ACSS65 | 3/17/2008 | 0-6 | 116 | < LOD | 10 | 65% |
| | | | | 117 | < LOD | | |
| | | | | 118 | 18 | | |
| | CXRM32ASS67 | 3/20/2008 | 0-6 | 4 | 12 | 12 | 20% |
| | | | | 5 | 16 | | |
| | | | | 6 | 11 | | |
| | CXRM32ASS70 | 3/20/2008 | 0-6 | 9 | 18 | 21 | 14% |
| | | | | 10 | 24 | | |
| | | | | 11 | 21 | | |
| | CXRM32ASS73 | 3/20/2008 | 0-6 | 14 | 10 | 10 | 18% |
| | | | | 15 | 8 | | |
| | | | | 16 | 11 | | |
| | CXRM32ASS76 | 3/20/2008 | 0-6 | 19 | 17 | 15 | 11% |
| | | | | 20 | 14 | | |
| | | | | 21 | 14 | | |
| | CXRM32ASS78 | 3/20/2008 | 0-6 | 23 | 12 | 14 | 17% |
| | | | | 24 | 14 | | |
| | | | | 25 | 16 | | |
| | CXRM32ASS81 | 9/10/2009 | 0-6 | 54 | 23 | 18 | 29% |
| | | | | 55 | 13 | | |
| | | | | 56 | 17 | | |
| | CXRM32ASS83 | 3/21/2008 | 0-6 | 4 | 9 | 11 | 23% |
| | | | | 5 | 11 | | |
| | | | | 6 | 14 | | |
| | CXRM32ASS86 | 3/21/2008 | 0-6 | 9 | 16 | 22 | 29% |
| | | | | 10 | 22 | | |
| | | | | 11 | 29 | | |
| | CXRM32ASS88 | 3/21/2008 | 0-6 | 13 | 32 | 28 | 20% |
| | | | | 14 | 31 | | |
| | | | | 15 | 22 | | |
| | CXRM32ASS90 | 3/21/2008 | 0-6 | 29 | 12 | 17 | 27% |
| | | | | 30 | 20 | | |
| | | | | 31 | 18 | | |
| | CXRM32ASS93 | 3/21/2008 | 0-6 | 34 | 9 | 11 | 30% |
| | | | | 35 | 10 | | |
| | | | | 36 | 15 | | |
| | CXRM32ASS96 | 3/21/2008 | 0-6 | 39 | 22 | 22 | 6% |
| | | | | 40 | 24 | | |
| | | | | 41 | 21 | | |
| | CXRM32ASS99 | 3/21/2008 | 0-6 | 44 | 23 | 17 | 30% |
| | | | | 45 | 13 | | |
| | | | | 46 | 16 | | |
| | CXRM32ASS102 | 3/21/2008 | 0-6 | 49 | 29 | 25 | 24% |
| | | | | 50 | 27 | | |
| | | | | 51 | 18 | | |
| | CXRM32ASS105 | 3/21/2008 | 0-6 | 54 | 28 | 25 | 16% |
| | | | | 55 | 21 | | |
| | | | | 56 | 28 | | |
| | CXRM32ASS108 | 3/21/2008 | 0-6 | 59 | 19 | 23 | 17% |
| | | | | 60 | 24 | | |
| | | | | 61 | 27 | | |
| | CXRM32ASS111 | 3/21/2008 | 0-6 | 64 | 21 | 21 | 3% |
| | | | | 65 | 21 | | |
| | | | | 66 | 22 | | |
| | CXRM32ASS114 | 3/21/2008 | 0-6 | 72 | 41 | 40 | 29% |
| | | | | 73 | 28 | | |
| | | | | 75 | 51 | | |
| | CXRM32ASS117 | 3/21/2008 | 0-6 | 78 | 31 | 29 | 51% |
| | | | | 79 | 13 | | |
| | | | | 80 | 43 | | |
| | CXRM32ASS118 | 3/21/2008 | 0-6 | 82 | 45 | 45 | 3% |
| | | | | 83 | 44 | | |
| | | | | 84 | 46 | | |
| | | | | 86 | 149 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32ASS119 | 3/21/2008 | 0-6 | 87 | 112 | 125 | 16% |
| | | | | 88 | 115 | | |
| | CXRM32ASS120 | 9/10/2009 | 0-6 | 42 | 45 | 42 | 7% |
| | | | | 43 | 40 | | |
| | | | | 44 | 40 | | |
| | CXRM32ASS123 | 3/21/2008 | 0-6 | 94 | 7 | 7 | 94% |
| | | | | 95 | 14 | | |
| | | | | 96 | 1 | | |
| | CXRM32ASS124 | 3/21/2008 | 0-6 | 98 | 32 | 34 | 7% |
| | | | | 99 | 37 | | |
| | | | | 100 | 34 | | |
| | CXRM32ASS126 | 9/10/2009 | 0-6 | 62 | 85 | 85 | 7% |
| | | | | 63 | 91 | | |
| | | | | 66 | 79 | | |
| | CXRM32ASS129 | 3/21/2008 | 0-6 | 107 | 17 | 22 | 27% |
| | | | | 108 | 20 | | |
| | | | | 109 | 29 | | |
| | CXRM32ASS132 | 9/10/2009 | 0-6 | 50 | 57 | 62 | 7% |
| | | | | 51 | 65 | | |
| | | | | 52 | 64 | | |
| | CXRM32ASS135 | 3/21/2008 | 0-6 | 117 | 16 | 13 | 34% |
| | | | | 118 | 8 | | |
| | | | | 119 | 16 | | |
| | CXRM32ASS136 | 3/21/2008 | 0-6 | 121 | 213 | 189 | 11% |
| | | | | 122 | 171 | | |
| | | | | 123 | 184 | | |
| | CXRM32ASS138 | 3/21/2008 | 0-6 | 125 | 16 | 15 | 16% |
| | | | | 126 | 12 | | |
| | | | | 127 | 17 | | |
| | CXRM32ASS139 | 9/10/2009 | 0-6 | 46 | 308 | 300 | 11% |
| | | | | 47 | 265 | | |
| | | | | 48 | 328 | | |
| | CXRM32ASB139A | 9/11/2009 | 6-12 | 150 | 188 | 194 | 9% |
| | | | | 151 | 213 | | |
| | | | | 152 | 180 | | |
| | CXRM32ASS141 | 3/21/2008 | 0-6 | 133 | 9 | 15 | 35% |
| | | | | 134 | 19 | | |
| | | | | 135 | 16 | | |
| | CXRM32ASS143 | 3/21/2008 | 0-6 | 137 | 13 | 13 | 8% |
| | | | | 138 | 12 | | |
| | | | | 139 | 14 | | |
| | CXRM32ASS154 | 9/10/2009 | 0-6 | 78 | 30 | 25 | 19% |
| | | | | 82 | 21 | | |
| | | | | 83 | 24 | | |
| | CXRM32ASS155 | 3/24/2008 | 0-6 | 47 | 18 | 15 | 19% |
| | | | | 48 | 13 | | |
| | | | | 49 | 14 | | |
| | CXRM32ASS156 | 3/24/2008 | 0-6 | 50 | 8 | 6 | 28% |
| | | | | 51 | 6 | | |
| | | | | 52 | 5 | | |
| | CXRM32ASS157 | 3/24/2008 | 0-6 | 53 | 23 | 21 | 17% |
| | | | | 54 | 17 | | |
| | | | | 55 | 23 | | |
| | CXRM32ASS158 | 3/24/2008 | 0-6 | 56 | 16 | 13 | 40% |
| | | | | 57 | 7 | | |
| | | | | 58 | 16 | | |
| | CXRM32ASS159 | 3/24/2008 | 0-6 | 59 | 6 | 11 | 58% |
| | | | | 60 | 8 | | |
| | | | | 61 | 18 | | |
| | CXRM32ASS160 | 3/24/2008 | 0-6 | 62 | 13 | 15 | 27% |
| | | | | 63 | 12 | | |
| | | | | 64 | 19 | | |
| | CXRM32ASS161 | 3/24/2008 | 0-6 | 65 | 11 | 10 | 19% |
| | | | | 66 | 8 | | |
| | | | | 67 | 10 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| MU732 .50 Caliber Firing Fan Berm | CXRM32ASS162 | 3/24/2008 | 0-6 | 68 | 19 | 20 | 13% |
| | | | | 69 | 22 | | |
| | | | | 70 | 17 | | |
| | CXRM32ASS163 | 3/24/2008 | 0-6 | 71 | 21 | 28 | 45% |
| | | | | 72 | 43 | | |
| | | | | 73 | 20 | | |
| | CXRM32ASS89 | 9/10/2009 | 0-6 | 34 | 1802 | 1806 | 8% |
| | | | | 35 | 1951 | | |
| | | | | 36 | 1664 | | |
| | CXRM32ASB89A | 9/10/2009 | 6-12 | 14 | 135 | 143 | 13% |
| | | | | 15 | 164 | | |
| | | | | 16 | 131 | | |
| | CXRM32ASB89B | 9/10/2009 | 12-18 | 10 | 11 | 11 | 42% |
| | | | | 11 | < LOD | | |
| | | | | 12 | 16 | | |
| | CXRM32ASB89C | 9/10/2009 | 18-24 | 38 | 815 | 909 | 9% |
| | | | | 39 | 942 | | |
| | | | | 40 | 969 | | |
| | CXRM32ASB89D | 9/11/2009 | 24-30 | 154 | 567 | 511 | 12% |
| | | | | 155 | 445 | | |
| | | | | 156 | 521 | | |
| | CXRM32ASB89E | 9/11/2009 | 30-36 | 163 | 31 | 35 | 10% |
| | | | | 164 | 36 | | |
| | | | | 165 | 38 | | |
| | CXRM32ASS144 | 9/10/2009 | 0-6 | 18 | 65 | 65 | 13% |
| | | | | 19 | 74 | | |
| | | | | 20 | 57 | | |
| | CXRM32ASS145 | 3/24/2008 | 0-6 | 7 | 27 | 30 | 24% |
| | | | | 8 | 38 | | |
| | | | | 9 | 24 | | |
| | CXRM32ASS146 | 3/24/2008 | 0-6 | 10 | 92 | 86 | 11% |
| | | | | 11 | 90 | | |
| | | | | 12 | 75 | | |
| | CXRM32ASS147 | 3/24/2008 | 0-6 | 13 | 290 | 289 | 18% |
| | | | | 14 | 235 | | |
| | | | | 15 | 341 | | |
| | CXRM32ASB147A | 3/24/2008 | 6-12 | 16 | 237 | 248 | 11% |
| | | | | 17 | 279 | | |
| | | | | 18 | 229 | | |
| | CXRM32ASB147B | 3/24/2008 | 12-18 | 19 | 27 | 36 | 26% |
| | | | | 20 | 36 | | |
| | | | | 21 | 45 | | |
| | CXRM32ASS148 | 9/11/2009 | 0-6 | 249 | 24 | 24 | 9% |
| | | | | 250 | 22 | | |
| | | | | 251 | 26 | | |
| | CXRM32ASS149 | 9/10/2009 | 0-6 | 74 | 709 | 622 | 13% |
| | | | | 75 | 607 | | |
| | | | | 76 | 550 | | |
| | CXRM32ASB149A | 9/11/2009 | 6-12 | 204 | 41 | 43 | 4% |
| | | | | 206 | 45 | | |
| | | | | 208 | 43 | | |
| | CXRM32ASS150 | 3/24/2008 | 0-6 | 28 | 298 | 379 | 20% |
| | | | | 29 | 448 | | |
| | | | | 30 | 393 | | |
| | CXRM32ASB150A | 3/24/2008 | 6-12 | 31 | 84 | 91 | 7% |
| | | | | 32 | 97 | | |
| | | | | 33 | 91 | | |
| | CXRM32ASS151 | 3/24/2008 | 0-6 | 35 | 33 | 39 | 19% |
| | | | | 36 | 47 | | |
| | | | | 37 | 36 | | |
| | CXRM32ASS152 | 3/24/2008 | 0-6 | 38 | 61 | 65 | 5% |
| | | | | 39 | 67 | | |
| | | | | 40 | 66 | | |
| | CXRM32ASS153 | 9/10/2009 | 0-6 | 86 | 597 | 550 | 9% |
| | | | | 87 | 499 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | | | | 88 | 555 | | |
| | CXRM32ASB153A | 9/11/2009 | 6-12 | 196 | 35 | 36 | 13% |
| | | | | 197 | 41 | | |
| | | | | 198 | 32 | | |
| | CRXM32ASS164 | 9/10/2009 | 0-6 | 6 | 499 | 514 | 3% |
| | | | | 7 | 519 | | |
| | | | | 8 | 525 | | |
| | CXRM32ASB164A | 3/26/2008 | 6-12 | 8 | 134 | 122 | 9% |
| | | | | 9 | 116 | | |
| | | | | 10 | 115 | | |
| | CXRM32ASS165 | 9/10/2009 | 0-6 | 22 | 716 | 702 | 4% |
| | | | | 23 | 670 | | |
| | | | | 24 | 720 | | |
| | CXRM32ASB165A | 3/26/2008 | 6-12 | 14 | 21 | 24 | 16% |
| | | | | 15 | 22 | | |
| | | | | 16 | 29 | | |
| | CXRM32ASS166 | 3/26/2008 | 0-6 | 17 | 51 | 55 | 5% |
| | | | | 18 | 56 | | |
| | | | | 19 | 57 | | |
| | CXRM32ASS167 | 9/10/2009 | 0-6 | 26 | 1138 | 1079 | 6% |
| | | | | 27 | 1007 | | |
| | | | | 28 | 1091 | | |
| | CXRM32ASB167A | 9/11/2009 | 6-12 | 188 | 117 | 130 | 16% |
| | | | | 189 | 153 | | |
| | | | | 190 | 120 | | |
| | CXRM32ASS168 | 3/26/2008 | 0-6 | 23 | 81 | 78 | 9% |
| | | | | 24 | 70 | | |
| | | | | 25 | 82 | | |
| | CXRM32ASS169 | 9/10/2009 | 0-6 | 58 | 1499 | 1542 | 3% |
| | | | | 59 | 1532 | | |
| | | | | 60 | 1596 | | |
| | CXRM32ASB169A | 9/10/2009 | 6-12 | 30 | 889 | 836 | 6% |
| | | | | 31 | 834 | | |
| | | | | 32 | 786 | | |
| | CXRM32ASB169B | 9/11/2009 | 12-18 | 159 | 98 | 97 | 11% |
| | | | | 160 | 86 | | |
| | | | | 161 | 108 | | |
| | CXRM32ASS170 | 3/26/2008 | 0-6 | 32 | 792 | 774 | 14% |
| | | | | 33 | 871 | | |
| | | | | 34 | 659 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32ASB170A | 9/11/2009 | 6-12 | 167 | 343 | 381 | 14% |
| | | | | 168 | 360 | | |
| | | | | 169 | 439 | | |
| | CXRM32ASB170B | 9/10/2009 | 12-18 | 90 | 504 | 555 | 8% |
| | | | | 91 | 589 | | |
| | | | | 92 | 571 | | |
| | CXRM32ASB170C | 9/11/2009 | 18-24 | 171 | 129 | 120 | 9% |
| | | | | 172 | 108 | | |
| | | | | 175 | 124 | | |
| | CXRM32ASS171 | 9/10/2009 | 0-6 | 70 | 1475 | 1502 | 9% |
| | | | | 71 | 1374 | | |
| | | | | 72 | 1656 | | |
| | CXRM32ASB171A | 9/11/2009 | 6-12 | 180 | 44 | 53 | 16% |
| | | | | 182 | 54 | | |
| | | | | 184 | 60 | | |
| | CXRM32ASS172 | 9/10/2009 | 0-6 | 102 | 847 | 746 | 15% |
| | | | | 103 | 766 | | |
| | | | | 104 | 626 | | |
| | CXRM32ASB172A | 9/11/2009 | 6-12 | 192 | 27 | 27 | 12% |
| | | | | 193 | 24 | | |
| | | | | 194 | 31 | | |
| | CXRM32ASS173 | 9/10/2009 | 0-6 | 94 | 1493 | 1359 | 10% |
| | | | | 95 | 1229 | | |
| | | | | 96 | 1356 | | |
| | CXRM32ASB173A | 3/26/2008 | 6-12 | 47 | 94 | 93 | 17% |
| | | | | 48 | 77 | | |
| | | | | 49 | 109 | | |
| | CXRM32ASS174 | 3/26/2008 | 0-6 | 50 | 36 | 42 | 21% |
| | | | | 51 | 37 | | |
| | | | | 52 | 53 | | |
| | CXRM32ASS175 | 9/10/2009 | 0-6 | 98 | 1076 | 1124 | 7% |
| | | | | 99 | 1085 | | |
| | | | | 100 | 1212 | | |
| | CXRM32ASB175A | 9/11/2009 | 6-12 | 200 | 65 | 62 | 9% |
| | | | | 201 | 66 | | |
| | | | | 202 | 55 | | |
| | CXRM32ASS176 | 3/26/2008 | 0-6 | 56 | 32 | 25 | 28% |
| | | | | 57 | 26 | | |
| | | | | 58 | 18 | | |
| **MU732 Shotgun Firing Range** | CXRM32BSS02 | 3/18/2008 | 0-6 | 5 | 27 | 28 | 16% |
| | | | | 6 | 24 | | |
| | | | | 7 | 33 | | |
| | CXRM32BSS03 | 3/18/2008 | 0-6 | 10 | 111 | 116 | 4% |
| | | | | 11 | 117 | | |
| | | | | 12 | 119 | | |
| | CXRM32BSS05 | 3/18/2008 | 0-6 | 15 | 87 | 87 | 12% |
| | | | | 16 | 77 | | |
| | | | | 17 | 98 | | |
| | CXRM32BSS06 | 9/11/2009 | 0-6 | 229 | 40 | 49 | 16% |
| | | | | 230 | 54 | | |
| | | | | 231 | 53 | | |
| | CXRM32BSB06A | 9/11/2009 | 6-12 | 254 | 72 | 83 | 15% |
| | | | | 255 | 96 | | |
| | | | | 257 | 81 | | |
| | CXRM32BSS07 | 3/18/2008 | 0-6 | 27 | 44 | 43 | 8% |
| | | | | 28 | 47 | | |
| | | | | 29 | 39 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32BSS09 | 3/18/2008 | 0-6 | 34 | 102 | 103 | 8% |
| | | | | 35 | 96 | | |
| | | | | 36 | 112 | | |
| | CXRM32BSS10 | 3/18/2008 | 0-6 | 38 | 139 | 149 | 6% |
| | | | | 39 | 151 | | |
| | | | | 40 | 156 | | |
| | CXRM32BSS12 | 9/11/2009 | 0-6 | 216 | 146 | 161 | 8% |
| | | | | 217 | 170 | | |
| | | | | 218 | 167 | | |
| | CXRM32BSS13 | 3/18/2008 | 0-6 | 47 | 50 | 59 | 16% |
| | | | | 48 | 68 | | |
| | | | | 49 | 58 | | |
| | CXRM32BSS16 | 3/18/2008 | 0-6 | 52 | 48 | 43 | 12% |
| | | | | 53 | 44 | | |
| | | | | 54 | 38 | | |
| | CXRM32BSS17 | 3/18/2008 | 0-6 | 56 | 44 | 46 | 9% |
| | | | | 57 | 43 | | |
| | | | | 58 | 51 | | |
| | CXRM32BSS19 | 9/11/2009 | 0-6 | 212 | 48 | 39 | 21% |
| | | | | 213 | 36 | | |
| | | | | 214 | 33 | | |
| | CXRM32BSS21 | 3/18/2008 | 0-6 | 64 | 73 | 76 | 14% |
| | | | | 65 | 67 | | |
| | | | | 66 | 88 | | |
| | CXRM32BSS23 | 3/18/2008 | 0-6 | 68 | 175 | 164 | 8% |
| | | | | 69 | 166 | | |
| | | | | 70 | 150 | | |
| | CXRM32BSS25 | 3/18/2008 | 0-6 | 72 | 110 | 102 | 9% |
| | | | | 73 | 106 | | |
| | | | | 74 | 92 | | |
| | CXRM32BSS26 | 3/18/2008 | 0-6 | 76 | 46 | 45 | 3% |
| | | | | 77 | 43 | | |
| | | | | 78 | 46 | | |
| | CXRM32BSS29 | 3/19/2008 | 0-6 | 5 | 86 | 86 | 1% |
| | | | | 6 | 85 | | |
| | | | | 7 | 86 | | |
| | CXRM32BSS30 | 3/19/2008 | 0-6 | 9 | 96 | 90 | 5% |
| | | | | 10 | 88 | | |
| | | | | 11 | 87 | | |
| | CXRM32BSS32 | 3/19/2008 | 0-6 | 13 | 91 | 89 | 5% |
| | | | | 14 | 91 | | |
| | | | | 15 | 84 | | |
| | CXRM32BSS33 | 3/19/2008 | 0-6 | 16 | 82 | 81 | 6% |
| | | | | 17 | 76 | | |
| | | | | 18 | 86 | | |
| | CXRM32BSS34 | 3/19/2008 | 0-6 | 20 | 87 | 83 | 7% |
| | | | | 21 | 86 | | |
| | | | | 22 | 76 | | |
| | CXRM32BSS35 | 3/19/2008 | 0-6 | 25 | 112 | 108 | 4% |
| | | | | 26 | 108 | | |
| | | | | 27 | 103 | | |
| | CXRM32BSS36 | 3/19/2008 | 0-6 | 29 | 157 | 149 | 7% |
| | | | | 30 | 138 | | |
| | | | | 31 | 152 | | |
| | CXRM32BSS38 | 9/11/2009 | 0-6 | 237 | 33 | 39 | 16% |
| | | | | 238 | 41 | | |
| | | | | 239 | 45 | | |
| | CXRM32BSS39 | 3/19/2008 | 0-6 | 37 | 126 | 139 | 9% |
| | | | | 38 | 140 | | |
| | | | | 39 | 151 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32BSS41 | 3/19/2008 | 0-6 | 41 | 39 | 38 | 10% |
| | | | | 42 | 33 | | |
| | | | | 43 | 41 | | |
| | CXRM32BSS44 | 3/19/2008 | 0-6 | 46 | 24 | 23 | 16% |
| | | | | 47 | 26 | | |
| | | | | 48 | 19 | | |
| | CXRM32BSS45 | 3/19/2008 | 0-6 | 49 | 13 | 16 | 25% |
| | | | | 50 | 15 | | |
| | | | | 51 | 20 | | |
| | CXRM32BSS48 | 3/19/2008 | 0-6 | 54 | 62 | 61 | 7% |
| | | | | 55 | 57 | | |
| | | | | 56 | 65 | | |
| | CRXM32BSS49 | 9/11/2009 | 0-6 | 233 | 76 | 80 | 7% |
| | | | | 234 | 78 | | |
| | | | | 235 | 87 | | |
| | CXRM32BSS52 | 3/19/2008 | 0-6 | 62 | 26 | 26 | 9% |
| | | | | 63 | 28 | | |
| | | | | 64 | 24 | | |
| | CXRM32BSS53 | 3/19/2008 | 0-6 | 65 | 90 | 74 | 19% |
| | | | | 66 | 68 | | |
| | | | | 67 | 65 | | |
| | CXRM32BSS56 | 3/19/2008 | 0-6 | 70 | 103 | 104 | 6% |
| | | | | 71 | 111 | | |
| | | | | 72 | 98 | | |
| | CXRM32BSS57 | 3/19/2008 | 0-6 | 73 | 46 | 49 | 7% |
| | | | | 74 | 49 | | |
| | | | | 75 | 52 | | |
| **MU732 Training and Maneuver Area** | CXRM32C2SS01 | 3/20/2008 | 0-6 | 32 | 47 | 47 | 15% |
| | | | | 33 | 39 | | |
| | | | | 34 | 53 | | |
| | CXRM32C2SS02 | 3/20/2008 | 0-6 | 35 | 39 | 30 | 47% |
| | | | | 36 | 15 | | |
| | | | | 37 | 23 | | |
| | CXRM32C2SS03 | 3/20/2008 | 0-6 | 38 | 534 | 573 | 6% |
| | | | | 39 | 589 | | |
| | | | | 40 | 596 | | |
| | CXRM32C2SB03A | 9/10/2009 | 6-12 | 122 | 54 | 42 | 26% |
| | | | | 123 | 34 | | |
| | | | | 124 | 37 | | |
| | CXRM32C2SB03B | 3/20/2008 | 12-18 | 44 | 7 | 13 | 42% |
| | | | | 45 | 12 | | |
| | | | | 46 | 18 | | |
| | CXRM32C2SS04 | 3/20/2008 | 0-6 | 47 | 79 | 59 | 30% |
| | | | | 48 | 50 | | |
| | | | | 49 | 47 | | |
| | CXRM32C2SS05 | 9/10/2009 | 0-6 | 126 | 194 | 178 | 8% |
| | | | | 127 | 172 | | |
| | | | | 128 | 167 | | |
| | CXRM32C2SS06 | 3/20/2008 | 0-6 | 53 | 59 | 51 | 12% |
| | | | | 54 | 47 | | |
| | | | | 55 | 48 | | |
| | CXRM32C2SS07 | 3/20/2008 | 0-6 | 56 | 13 | 14 | 6% |
| | | | | 57 | 14 | | |
| | | | | 58 | 13 | | |
| | CXRM32C2SS08 | 3/20/2008 | 0-6 | 59 | 240 | 239 | 9% |
| | | | | 60 | 261 | | |
| | | | | 61 | 216 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32C2SB08A | 3/20/2008 | 6-12 | 62 | 95 | 93 | 4% |
| | | | | 63 | 89 | | |
| | | | | 64 | 95 | | |
| | CXRM32C2SS09 | 3/20/2008 | 0-6 | 65 | 17 | 14 | 24% |
| | | | | 66 | 11 | | |
| | | | | 67 | 12 | | |
| | CXRM32C2SS10 | 3/20/2008 | 0-6 | 68 | 32 | 47 | 62% |
| | | | | 69 | 28 | | |
| | | | | 70 | 80 | | |
| | CXRM32C2SS11 | 3/20/2008 | 0-6 | 71 | 23 | 22 | 4% |
| | | | | 72 | 21 | | |
| | | | | 73 | 23 | | |
| | CXRM32C2SS12 | 3/20/2008 | 0-6 | 74 | 37 | 43 | 27% |
| | | | | 75 | 36 | | |
| | | | | 76 | 57 | | |
| | CXRM32C2SS13 | 3/20/2008 | 0-6 | 77 | 109 | 121 | 14% |
| | | | | 78 | 113 | | |
| | | | | 79 | 141 | | |
| | CXRM32C2SS14 | 3/20/2008 | 0-6 | 80 | 21 | 17 | 19% |
| | | | | 81 | 16 | | |
| | | | | 82 | 15 | | |
| | CXRM32C2SS15 | 3/20/2008 | 0-6 | 86 | 34 | 45 | 21% |
| | | | | 87 | 51 | | |
| | | | | 88 | 49 | | |
| | CXRM32C2SS16 | 3/20/2008 | 0-6 | 89 | 16 | 19 | 25% |
| | | | | 90 | 24 | | |
| | | | | 91 | 16 | | |
| | CXRM32C2SS17 | 9/10/2009 | 0-6 | 118 | 28 | 28 | 7% |
| | | | | 119 | 30 | | |
| | | | | 120 | 26 | | |
| | CXRM32C2SS18 | 3/20/2008 | 0-6 | 95 | 65 | 55 | 17% |
| | | | | 96 | 48 | | |
| | | | | 97 | 51 | | |
| | CXRM32C2SS19 | 3/20/2008 | 0-6 | 98 | 98 | 86 | 13% |
| | | | | 99 | 84 | | |
| | | | | 100 | 76 | | |
| | CXRM32C2SS20 | 3/20/2008 | 0-6 | 101 | 8 | 16 | 49% |
| | | | | 102 | 15 | | |
| | | | | 103 | 24 | | |
| | CXRM32C2SS21 | 3/20/2008 | 0-6 | 104 | 12 | 12 | 23% |
| | | | | 105 | 10 | | |
| | | | | 106 | 16 | | |
| | CXRM32C2SS22 | 3/20/2008 | 0-6 | 107 | 104 | 108 | 3% |
| | | | | 108 | 110 | | |
| | | | | 110 | 110 | | |
| | CXRM32C1SS01 | 3/20/2008 | 0-6 | 111 | 37 | 37 | 16% |
| | | | | 112 | 42 | | |
| | | | | 113 | 30 | | |
| | CXRM32C1SS02 | 3/20/2008 | 0-6 | 114 | 32 | 27 | 17% |
| | | | | 115 | 23 | | |
| | | | | 116 | 24 | | |
| | CXRM32C1SS03 | 3/20/2008 | 0-6 | 117 | 58 | 50 | 15% |
| | | | | 118 | 51 | | |
| | | | | 119 | 42 | | |
| | CXRM32C1SS04 | 9/11/2009 | 0-6 | 241 | 76 | 75 | 8% |
| | | | | 242 | 68 | | |
| | | | | 243 | 80 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32C1SS05 | 9/11/2009 | 0-6 | 220 | 328 | 338 | 8% |
| | | | | 221 | 369 | | |
| | | | | 222 | 318 | | |
| | CXRM32C1SB05A | 9/11/2009 | 6-12 | 269 | 80 | 77 | 11% |
| | | | | 270 | 67 | | |
| | | | | 271 | 84 | | |
| | CXRM32C1SS06 | 3/20/2008 | 0-6 | 126 | 19 | 21 | 32% |
| | | | | 127 | 16 | | |
| | | | | 128 | 29 | | |
| | CXRM32C1SS07 | 3/20/2008 | 0-6 | 129 | 30 | 25 | 18% |
| | | | | 130 | 23 | | |
| | | | | 131 | 22 | | |
| | CXRM32C1SS08 | 3/20/2008 | 0-6 | 132 | 87 | 92 | 12% |
| | | | | 133 | 85 | | |
| | | | | 134 | 105 | | |
| | CXRM32C1SS09 | 3/20/2008 | 0-6 | 135 | 23 | 26 | 37% |
| | | | | 136 | 18 | | |
| | | | | 137 | 36 | | |
| | CXRM32C1SS10 | 3/20/2008 | 0-6 | 138 | 23 | 42 | 54% |
| | | | | 139 | 67 | | |
| | | | | 140 | 36 | | |
| | CXRM32C1SS11 | 3/20/2008 | 0-6 | 141 | 11 | 22 | 43% |
| | | | | 142 | 29 | | |
| | | | | 143 | 26 | | |
| | CXRM32C1SS12 | 9/11/2009 | 0-6 | 245 | 137 | 166 | 15% |
| | | | | 246 | 181 | | |
| | | | | 247 | 181 | | |
| | CXRM32C1SS13 | 3/20/2008 | 0-6 | 147 | 50 | 38 | 29% |
| | | | | 148 | 36 | | |
| | | | | 149 | 28 | | |
| | CXRM32C1SS14 | 3/20/2008 | 0-6 | 150 | 27 | 28 | 4% |
| | | | | 151 | 27 | | |
| | | | | 152 | 29 | | |
| | CXRM32C1SS16 | 3/20/2008 | 0-6 | 156 | 28 | 21 | 30% |
| | | | | 157 | 19 | | |
| | | | | 158 | 16 | | |
| **MU732 Clay Pigeon Debris Area** | CXRM32CSS02 | 3/14/2008 | 0-6 | 5 | 25 | 29 | 15% |
| | | | | 6 | 33 | | |
| | | | | 7 | 30 | | |
| | CXRM32CSS05 | 3/14/2008 | 0-6 | 10 | 35 | 29 | 18% |
| | | | | 11 | 28 | | |
| | | | | 12 | 24 | | |
| | CXRM32CSS08 | 9/10/2009 | 0-6 | 114 | 45 | 47 | 5% |
| | | | | 115 | 49 | | |
| | | | | 116 | 48 | | |
| | CXRM32CSS09 | 3/14/2008 | 0-6 | 19 | 12 | 19 | 41% |
| | | | | 20 | 18 | | |
| | | | | 21 | 28 | | |
| | CXRM32CSS11 | 3/14/2008 | 0-6 | 23 | < LOD | 13 | 45% |
| | | | | 24 | 16 | | |
| | | | | 25 | 18 | | |
| | CXRM32CSS14 | 3/14/2008 | 0-6 | 28 | 38 | 37 | 13% |
| | | | | 29 | 32 | | |
| | | | | 30 | 41 | | |
| | CXRM32CSS17 | 3/14/2008 | 0-6 | 33 | 26 | 40 | 47% |
| | | | | 34 | 34 | | |
| | | | | 35 | 62 | | |
| | CXRM32CSS18 | 3/14/2008 | 0-6 | 36 | 30 | 31 | 6% |
| | | | | 37 | 30 | | |
| | | | | 38 | 33 | | |
| | CXRM32CSS20 | 3/14/2008 | 0-6 | 40 | 35 | 37 | 5% |
| | | | | 41 | 39 | | |
| | | | | 42 | 38 | | |

Table 5-1
Ex situ XRF Field Screening Results for MU732
Nellis Air Force Base, Nevada

| Site Name | Site No. | Date | Depth (in) | Reading No. | Lead (mg/kg) | Final Lead [1] (mg/kg) | Relative Standard Deviation |
|---|---|---|---|---|---|---|---|
| | CXRM32CSS23 | 3/14/2008 | 0-6 | 45 | 14 | 16 | 17% |
| | | | | 46 | 19 | | |
| | | | | 47 | 16 | | |
| | CXRM32CSS26 | 3/14/2008 | 0-6 | 50 | 19 | 17 | 15% |
| | | | | 51 | 14 | | |
| | | | | 52 | 18 | | |
| | CXRM32CSS28 | 3/14/2008 | 0-6 | 54 | 20 | 25 | 18% |
| | | | | 55 | 25 | | |
| | | | | 56 | 29 | | |
| | CXRM32CSS29 | 3/14/2008 | 0-6 | 57 | 39 | 40 | 15% |
| | | | | 58 | 35 | | |
| | | | | 59 | 47 | | |
| | CXRM32CSS31 | 3/14/2008 | 0-6 | 61 | 60 | 55 | 20% |
| | | | | 62 | 43 | | |
| | | | | 63 | 63 | | |
| | CXRM32CSS33 | 3/14/2008 | 0-6 | 68 | 16 | 11 | 41% |
| | | | | 69 | 11 | | |
| | | | | 70 | < LOD | | |
| | CXRM32CSS35 | 3/14/2008 | 0-6 | 72 | 18 | 21 | 15% |
| | | | | 73 | 20 | | |
| | | | | 74 | 24 | | |
| | CXRM32CSS36 | 3/19/2008 | 0-6 | 81 | 10 | 11 | 8% |
| | | | | 82 | 12 | | |
| | | | | 83 | 11 | | |
| | CXRM32CSS38 | 3/19/2008 | 0-6 | 85 | 14 | 15 | 15% |
| | | | | 86 | 12 | | |
| | | | | 87 | 16 | | |
| | CXRM32CSS40 | 3/19/2008 | 0-6 | 89 | 20 | 16 | 20% |
| | | | | 90 | 14 | | |
| | | | | 91 | 14 | | |
| | CXRM32CSS42 | 3/19/2008 | 0-6 | 93 | 14 | 10 | 46% |
| | | | | 94 | 8 | | |
| | | | | 95 | 6 | | |
| | CXRM32CSS43 | 3/19/2008 | 0-6 | 96 | 15 | 14 | 5% |
| | | | | 97 | 14 | | |
| | | | | 98 | 15 | | |
| | CXRM32CSS46 | 3/19/2008 | 0-6 | 101 | 11 | 13 | 23% |
| | | | | 102 | 16 | | |
| | | | | 103 | 11 | | |
| | CXRM32CSS47 | 9/10/2009 | 0-6 | 106 | 73 | 75 | 19% |
| | | | | 107 | 61 | | |
| | | | | 108 | 89 | | |
| | CXRM32CSS50 | 9/10/2009 | 0-6 | 110 | 17 | 20 | 29% |
| | | | | 111 | 26 | | |
| | | | | 112 | 16 | | |
| | CXRM32CSS51 | 3/19/2008 | 0-6 | 112 | 31 | 26 | 19% |
| | | | | 113 | 21 | | |
| | | | | 114 | 26 | | |
| | CXRM32CSS53 | 3/19/2008 | 0-6 | 116 | 14 | 14 | 3% |
| | | | | 117 | 14 | | |
| | | | | 118 | 14 | | |
| | CXRM32CSS55 | 3/19/2008 | 0-6 | 120 | 18 | 15 | 21% |
| | | | | 121 | 16 | | |
| | | | | 122 | 12 | | |
| | CXRM32CSS57 | 3/19/2008 | 0-6 | 124 | 34 | 40 | 17% |
| | | | | 125 | 47 | | |
| | | | | 126 | 37 | | |

Notes:
LOD = Level of Detection. The LOD for sandy soils is 13 ppm, as reported by Innov-x (Innov-x, 2006).
[1] One half the LOD was used to average sample results where lead was non-detect.
NA - Not applicable as only one reading was collected.

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32BSB04 | | | | CM32BSS05 | | | | CM32BSS06 | | | | CM32BSS07 | | | | CM32BSS08 | | | | CM32BSS09 | | | | CM32BSS10 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | |
| | | | Sample Depth | 0.5-1 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.013 | J | 0.0063 | 0.1 | 0.0016 | U | 0.0016 | 0.025 | 0.00093 | J | 0.00063 | 0.01 | 0.021 | J | 0.0063 | 0.1 | 0.00063 | U | 0.00063 | 0.01 | 0.027 | J | 0.00063 | 0.01 | 0.00031 | U | 0.00031 | 0.005 |
| Acenaphthene | 33000 | 3400 | 29 | 0.039 | J | 0.0032 | 0.1 | 0.0037 | J | 0.00081 | 0.025 | 0.0024 | J | 0.00032 | 0.01 | 0.094 | J | 0.0033 | 0.1 | 0.0022 | J | 0.00032 | 0.01 | 0.046 | J | 0.00032 | 0.01 | 0.00026 | J | 0.00016 | 0.005 |
| Acenaphthylene | NA | NA | 29 | 0.0034 | U | 0.0034 | 0.1 | 0.00086 | U | 0.00086 | 0.025 | 0.00034 | U | 0.00034 | 0.01 | 0.0035 | U | 0.0035 | 0.1 | 0.00034 | U | 0.00034 | 0.01 | 0.0008 | J | 0.00034 | 0.01 | 0.00017 | U | 0.00017 | 0.005 |
| Anthracene | 170000 | 17000 | 29 | 0.38 | | 0.0027 | 0.1 | 0.028 | | 0.00067 | 0.025 | 0.0083 | J | 0.00027 | 0.01 | 0.41 | | 0.0027 | 0.1 | 0.011 | | 0.00027 | 0.01 | 0.1 | J | 0.00027 | 0.01 | 0.0014 | J | 0.00013 | 0.005 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **3.4** | | 0.015 | 0.51 | 0.25 | | 0.00074 | 0.025 | 0.15 | | 0.0003 | 0.01 | **4.5** | | 0.015 | 0.51 | 0.1 | | 0.0003 | 0.01 | 0.86 | J | 0.003 | 0.1 | 0.015 | | 0.00015 | 0.005 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **4.3** | | 0.014 | 0.51 | 0.39 | | 0.00072 | 0.025 | 0.24 | | 0.00029 | 0.01 | **7.2** | | 0.015 | 0.51 | 0.15 | | 0.00029 | 0.01 | **1.1** | **J** | 0.0029 | 0.1 | 0.024 | | 0.00014 | 0.005 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **8.5** | | 0.015 | 0.51 | 0.73 | | 0.00073 | 0.025 | 0.49 | | 0.00074 | 0.025 | **13** | | 0.015 | 0.51 | 0.29 | | 0.00029 | 0.01 | **2** | **J** | 0.0029 | 0.1 | 0.05 | | 0.00015 | 0.005 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **3.4** | | 0.02 | 0.51 | 0.34 | | 0.001 | 0.025 | 0.22 | | 0.0004 | 0.01 | **6.2** | | 0.02 | 0.51 | 0.12 | | 0.0004 | 0.01 | 0.61 | J | 0.004 | 0.1 | 0.025 | | 0.0002 | 0.005 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.0026 | U | 0.0026 | 0.1 | 0.00066 | U | 0.00066 | 0.025 | 0.00026 | U | 0.00026 | 0.01 | 0.0027 | U | 0.0027 | 0.1 | 0.00026 | U | 0.00026 | 0.01 | 0.00026 | UJ | 0.00026 | 0.01 | 0.00013 | U | 0.00013 | 0.005 |
| Chrysene | 210 | 15 | 1.1 | **3.3** | | 0.0039 | 0.1 | 0.27 | | 0.00097 | 0.025 | 0.17 | | 0.00039 | 0.01 | **4.9** | | 0.02 | 0.51 | 0.13 | | 0.00039 | 0.01 | **1.2** | **J** | 0.0039 | 0.1 | 0.02 | | 0.00019 | 0.005 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | **1.1** | | 0.0049 | 0.1 | 0.091 | | 0.0012 | 0.025 | 0.058 | | 0.00049 | 0.01 | **1.7** | | 0.005 | 0.1 | 0.035 | | 0.00049 | 0.01 | 0.27 | J | 0.00049 | 0.01 | 0.0065 | | 0.00025 | 0.005 |
| Fluoranthene | 22000 | 2300 | 1.1 | **5.3** | | 0.021 | 0.51 | 0.4 | | 0.0011 | 0.025 | 0.19 | | 0.00042 | 0.01 | **7.3** | | 0.021 | 0.51 | 0.18 | | 0.00042 | 0.01 | **1.5** | **J** | 0.0042 | 0.1 | 0.027 | | 0.00021 | 0.005 |
| Fluorene | 22000 | 2300 | 29 | 0.0059 | J | 0.0046 | 0.1 | 0.0012 | J | 0.0011 | 0.025 | 0.00081 | J | 0.00046 | 0.01 | 0.033 | J | 0.0046 | 0.1 | 0.00046 | U | 0.00046 | 0.01 | 0.014 | J | 0.00046 | 0.01 | 0.00023 | U | 0.00023 | 0.005 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **3.2** | | 0.025 | 0.51 | 0.32 | | 0.0012 | 0.025 | 0.2 | | 0.00049 | 0.01 | **5.5** | | 0.025 | 0.51 | 0.12 | | 0.00049 | 0.01 | 0.65 | J | 0.0049 | 0.1 | 0.021 | | 0.00025 | 0.005 |
| Naphthalene | 20 | 3.9 | 29 | 0.075 | U | 0.0066 | 0.1 | 0.0031 | U | 0.0016 | 0.025 | 0.0043 | U | 0.00066 | 0.01 | 0.075 | J | 0.0067 | 0.1 | 0.0032 | U | 0.00066 | 0.01 | 0.13 | J | 0.00066 | 0.01 | 0.00052 | J | 0.00033 | 0.005 |
| Phenanthrene | NA | NA | 29 | 1.6 | | 0.0063 | 0.1 | 0.12 | | 0.0016 | 0.025 | 0.049 | | 0.00063 | 0.01 | 2.3 | | 0.0064 | 0.1 | 0.052 | | 0.00063 | 0.01 | 0.55 | J | 0.0063 | 0.1 | 0.0088 | | 0.00032 | 0.005 |
| Pyrene | 17000 | 1700 | 1.1 | **4.7** | | 0.018 | 0.51 | 0.37 | | 0.00089 | 0.025 | 0.18 | | 0.00036 | 0.01 | **6.6** | | 0.018 | 0.51 | 0.15 | | 0.00036 | 0.01 | **1.5** | **J** | 0.0036 | 0.1 | 0.026 | | 0.00018 | 0.005 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32BSS11 | | | | CM32BSS12 | | | | CM32BSS13 | | | | CM32BSS14 | | | | CM32CSS01 | | | | CM32CSB01 | | | | CM32CSS02 | | | | CM32CSS02D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.029 | J | 0.0063 | 0.1 | 0.017 | J | 0.0063 | 0.1 | 0.016 | J | 0.0031 | 0.051 | 0.052 | J | 0.032 | 0.51 | 0.0019 | J | 0.00031 | 0.005 | 0.00099 | J | 0.00031 | 0.005 | 0.016 | J | 0.0063 | 0.1 | 0.014 | J | 0.0062 | 0.1 |
| Acenaphthene | 33000 | 3400 | 29 | 0.093 | J | 0.0032 | 0.1 | 0.054 | J | 0.0032 | 0.1 | 0.053 | | 0.0016 | 0.051 | 0.23 | J | 0.016 | 0.51 | 0.0036 | J | 0.00016 | 0.005 | 0.00097 | J | 0.00016 | 0.005 | 0.02 | J | 0.0032 | 0.1 | 0.023 | J | 0.0032 | 0.1 |
| Acenaphthylene | NA | NA | 29 | 0.0034 | U | 0.0034 | 0.1 | 0.0034 | U | 0.0034 | 0.1 | 0.0017 | U | 0.0017 | 0.051 | 0.017 | U | 0.017 | 0.51 | 0.00025 | J | 0.00017 | 0.005 | 0.00017 | U | 0.00017 | 0.005 | 0.0034 | U | 0.0034 | 0.1 | 0.0034 | U | 0.0034 | 0.1 |
| Anthracene | 170000 | 17000 | 29 | 0.7 | | 0.0027 | 0.1 | 0.28 | | 0.0027 | 0.1 | 0.14 | | 0.0013 | 0.051 | 2.5 | | 0.014 | 0.51 | 0.025 | | 0.00013 | 0.005 | 0.005 | J | 0.00013 | 0.005 | 0.26 | | 0.0027 | 0.1 | 0.19 | | 0.0027 | 0.1 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **6.8** | | 0.03 | 1 | **3.8** | | 0.015 | 0.51 | **1.6** | | 0.0015 | 0.051 | **15** | | 0.15 | 5.1 | 0.22 | | 0.00073 | 0.025 | 0.061 | | 0.00029 | 0.01 | **2.2** | | 0.003 | 0.1 | **2.3** | | 0.0029 | 0.1 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **9.4** | | 0.029 | 1 | **5.7** | | 0.014 | 0.51 | **2.7** | | 0.0072 | 0.25 | **23** | | 0.15 | 5.1 | 0.28 | | 0.00072 | 0.025 | 0.081 | | 0.00029 | 0.01 | **2.8** | | 0.0029 | 0.1 | **3.1** | | 0.0029 | 0.1 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **19** | | 0.029 | 1 | **11** | | 0.015 | 0.51 | **5.4** | | 0.0073 | 0.25 | **44** | | 0.15 | 5.1 | 0.56 | | 0.00073 | 0.025 | 0.18 | | 0.00029 | 0.01 | **4.9** | | 0.0073 | 0.25 | **6.6** | | 0.0073 | 0.25 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **7.2** | | 0.04 | 1 | **5.2** | | 0.02 | 0.51 | **2.4** | | 0.01 | 0.25 | **17** | | 0.2 | 5.1 | 0.23 | | 0.001 | 0.025 | 0.066 | | 0.0004 | 0.01 | **2.1** | | 0.004 | 0.1 | **2.6** | | 0.004 | 0.1 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.0026 | U | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 | 0.0013 | U | 0.0013 | 0.051 | 0.013 | U | 0.013 | 0.51 | 0.00065 | U | 0.00065 | 0.025 | 0.00013 | U | 0.00013 | 0.005 | 0.0026 | U | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 |
| Chrysene | 210 | 15 | 1.1 | **8.6** | | 0.039 | 1 | **4** | | 0.019 | 0.51 | **2.1** | | 0.0097 | 0.25 | **22** | | 0.2 | 5.1 | 0.26 | | 0.00097 | 0.025 | 0.091 | | 0.00039 | 0.01 | **2.3** | | 0.0039 | 0.1 | **2.5** | | 0.0039 | 0.1 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | **2.4** | | 0.0049 | 0.1 | **1.6** | | 0.0049 | 0.1 | 0.71 | | 0.0025 | 0.051 | **6.4** | | 0.025 | 0.51 | 0.095 | | 0.00024 | 0.005 | 0.021 | | 0.00049 | 0.01 | 0.71 | | 0.0049 | 0.1 | 0.84 | | 0.0049 | 0.1 |
| Fluoranthene | 22000 | 2300 | 1.1 | **12** | | 0.042 | 1 | **5.5** | | 0.021 | 0.51 | **3** | | 0.011 | 0.25 | **27** | | 0.21 | 5.1 | 0.43 | | 0.0011 | 0.025 | 0.13 | | 0.00042 | 0.01 | **3.6** | | 0.011 | 0.25 | **3.6** | | 0.011 | 0.25 |
| Fluorene | 22000 | 2300 | 29 | 0.016 | J | 0.0046 | 0.1 | 0.0066 | J | 0.0046 | 0.1 | 0.015 | J | 0.0023 | 0.051 | 0.041 | J | 0.023 | 0.51 | 0.0018 | J | 0.00023 | 0.005 | 0.00023 | U | 0.00023 | 0.005 | 0.0046 | U | 0.0046 | 0.1 | 0.0046 | U | 0.0046 | 0.1 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **7** | | 0.049 | 1 | **4.6** | | 0.025 | 0.51 | **2.1** | | 0.012 | 0.25 | **16** | | 0.25 | 5.1 | 0.23 | | 0.0012 | 0.025 | 0.063 | | 0.00049 | 0.01 | **2.1** | | 0.0049 | 0.1 | **2.6** | | 0.0049 | 0.1 |
| Naphthalene | 20 | 3.9 | 29 | 0.14 | U | 0.0066 | 0.1 | 0.075 | J | 0.0066 | 0.1 | 0.055 | | 0.0033 | 0.051 | 0.29 | U | 0.033 | 0.51 | 0.005 | | 0.00033 | 0.005 | 0.0025 | J | 0.00033 | 0.005 | 0.051 | J | 0.0066 | 0.1 | 0.057 | J | 0.0066 | 0.1 |
| Phenanthrene | NA | NA | 29 | 3.8 | | 0.063 | 1 | 1.4 | | 0.0063 | 0.1 | 0.74 | | 0.0032 | 0.051 | 8.8 | | 0.032 | 0.51 | 0.17 | | 0.0016 | 0.025 | 0.051 | J | 0.00032 | 0.005 | 1.5 | J | 0.0063 | 0.1 | 0.89 | J | 0.0063 | 0.1 |
| Pyrene | 17000 | 1700 | 1.1 | **11** | | 0.036 | 1 | **5.2** | | 0.018 | 0.51 | **2.9** | | 0.009 | 0.25 | **25** | | 0.18 | 5.1 | 0.36 | | 0.00089 | 0.025 | 0.11 | | 0.00036 | 0.01 | **3** | | 0.009 | 0.25 | **3.3** | | 0.0036 | 0.1 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32CSB02 | | | | CM32CSS03 | | | | CM32CSB03 | | | | CM32CSS04 | | | | CM32CSB04 | | | | CM32CSS05 | | | | CM32CSS06 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | |
| | | | Sample Depth | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.0082 | J | 0.0063 | 0.1 | 0.023 | J | 0.0031 | 0.051 | 0.014 | J | 0.0016 | 0.025 | 0.019 | J | 0.0062 | 0.1 | 0.0025 | J | 0.0016 | 0.025 | 0.00032 | J | 0.00031 | 0.005 | 0.0029 | J | 0.0016 | 0.025 |
| Acenaphthene | 33000 | 3400 | 29 | 0.013 | J | 0.0032 | 0.1 | 0.037 | J | 0.0016 | 0.051 | 0.023 | J | 0.00081 | 0.025 | 0.037 | J | 0.0032 | 0.1 | 0.0044 | J | 0.00081 | 0.025 | 0.00044 | J | 0.00016 | 0.005 | 0.0039 | J | 0.00081 | 0.025 |
| Acenaphthylene | NA | NA | 29 | 0.0034 | U | 0.0034 | 0.1 | 0.0021 | J | 0.0017 | 0.051 | 0.0012 | J | 0.00086 | 0.025 | 0.0034 | U | 0.0034 | 0.1 | 0.00086 | U | 0.00086 | 0.025 | 0.00017 | U | 0.00017 | 0.005 | 0.00086 | U | 0.00086 | 0.025 |
| Anthracene | 170000 | 17000 | 29 | 0.13 | | 0.0027 | 0.1 | 0.25 | | 0.0013 | 0.051 | 0.072 | | 0.00067 | 0.025 | 0.26 | J | 0.0027 | 0.1 | 0.012 | J | 0.00067 | 0.025 | 0.0029 | J | 0.00013 | 0.005 | 0.012 | J | 0.00067 | 0.025 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **1.2** | | 0.003 | 0.1 | **2.5** | | 0.015 | 0.51 | 1 | | 0.003 | 0.1 | **3.5** | **J** | 0.015 | 0.5 | 0.41 | | 0.00074 | 0.025 | 0.039 | | 0.00015 | 0.005 | 0.41 | | 0.00074 | 0.025 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **1.7** | | 0.0029 | 0.1 | **2.8** | | 0.014 | 0.51 | **1.3** | | 0.0029 | 0.1 | **4.4** | **J** | 0.014 | 0.5 | 0.6 | | 0.00072 | 0.025 | 0.048 | | 0.00014 | 0.005 | 0.73 | | 0.00072 | 0.025 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **3** | | 0.0073 | 0.25 | **5.5** | | 0.015 | 0.51 | **2.5** | | 0.0029 | 0.1 | **9.3** | **J** | 0.015 | 0.5 | **1.2** | | 0.0029 | 0.1 | 0.098 | | 0.00015 | 0.005 | **1.5** | | 0.0029 | 0.1 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **1.3** | | 0.004 | 0.1 | **2** | | 0.02 | 0.51 | 0.97 | | 0.004 | 0.1 | **3.2** | **J** | 0.02 | 0.5 | 0.42 | | 0.001 | 0.025 | 0.043 | | 0.0002 | 0.005 | 0.53 | | 0.001 | 0.025 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.0026 | U | 0.0026 | 0.1 | 0.0013 | U | 0.0013 | 0.051 | 0.00066 | U | 0.00066 | 0.025 | **2.5** | **J** | 0.0026 | 0.1 | 0.00066 | U | 0.00066 | 0.025 | 0.00013 | U | 0.00013 | 0.005 | 0.00066 | U | 0.00066 | 0.025 |
| Chrysene | 210 | 15 | 1.1 | **1.4** | | 0.0039 | 0.1 | **2.5** | | 0.019 | 0.51 | **1.2** | | 0.0039 | 0.1 | **3.7** | **J** | 0.019 | 0.5 | 0.49 | | 0.00097 | 0.025 | 0.044 | | 0.00019 | 0.005 | 0.47 | | 0.00097 | 0.025 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | 0.39 | | 0.0049 | 0.1 | 0.73 | | 0.0025 | 0.051 | 0.38 | | 0.0012 | 0.025 | **1.5** | **J** | 0.0049 | 0.1 | 0.15 | | 0.0012 | 0.025 | 0.012 | | 0.00024 | 0.005 | 0.21 | | 0.0012 | 0.025 |
| Fluoranthene | 22000 | 2300 | 1.1 | **2.1** | | 0.0042 | 0.1 | **4.7** | | 0.021 | 0.51 | **1.6** | | 0.0042 | 0.1 | **5.2** | **J** | 0.021 | 0.5 | 0.55 | | 0.0011 | 0.025 | 0.075 | | 0.00021 | 0.005 | 0.35 | | 0.0011 | 0.025 |
| Fluorene | 22000 | 2300 | 29 | 0.0046 | U | 0.0046 | 0.1 | 0.0079 | J | 0.0023 | 0.051 | 0.0046 | J | 0.0012 | 0.025 | 0.014 | J | 0.0046 | 0.1 | 0.0011 | U | 0.0011 | 0.025 | 0.00023 | U | 0.00023 | 0.005 | 0.0011 | J | 0.0011 | 0.025 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **1.3** | | 0.0049 | 0.1 | **2** | | 0.025 | 0.51 | 0.98 | | 0.005 | 0.1 | **3.2** | **J** | 0.025 | 0.5 | 0.44 | | 0.0012 | 0.025 | 0.04 | | 0.00025 | 0.005 | 0.56 | | 0.0012 | 0.025 |
| Naphthalene | 20 | 3.9 | 29 | 0.028 | J | 0.0066 | 0.1 | 0.058 | | 0.0033 | 0.051 | 0.037 | | 0.0017 | 0.025 | 0.066 | J | 0.0066 | 0.1 | 0.011 | U | 0.0016 | 0.025 | 0.00078 | J | 0.00033 | 0.005 | 0.013 | J | 0.0016 | 0.025 |
| Phenanthrene | NA | NA | 29 | 0.54 | | 0.0063 | 0.1 | 1.7 | | 0.032 | 0.51 | 0.54 | | 0.0016 | 0.025 | 1.6 | J | 0.0063 | 0.1 | 0.1 | | 0.0016 | 0.025 | 0.027 | | 0.00031 | 0.005 | 0.079 | | 0.0016 | 0.025 |
| Pyrene | 17000 | 1700 | 1.1 | **1.9** | | 0.0036 | 0.1 | **4.1** | | 0.018 | 0.51 | **1.6** | | 0.0036 | 0.1 | **4.3** | **J** | 0.018 | 0.5 | 0.49 | | 0.0009 | 0.025 | 0.061 | | 0.00018 | 0.005 | 0.33 | | 0.00089 | 0.025 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32CSS07 | | | | CM32CSS08 | | | | CM32CSS09 | | | | CM32CSS10 | | | | CM32CSS11 | | | | CM32DSS01 | | | | CM32DSS01D | | | | CM32DSB01 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0.5-1 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.00066 | J | *0.00063* | *0.01* | 0.00032 | U | *0.00032* | *0.0051* | 0.0078 | J | *0.0016* | *0.025* | 0.16 | J | *0.016* | *0.26* | 0.017 | J | *0.0031* | *0.05* | 0.011 | J | *0.0062* | *0.1* | 0.015 | J | *0.0062* | *0.1* | 0.0084 | J | *0.0016* | *0.025* |
| Acenaphthene | 33000 | 3400 | 29 | 0.00074 | J | *0.00032* | *0.01* | 0.00016 | U | *0.00016* | *0.0051* | 0.0084 | J | *0.00081* | *0.025* | 0.42 | | *0.0082* | *0.26* | 0.035 | J | *0.0016* | *0.05* | 0.034 | J | *0.0032* | *0.1* | 0.038 | J | *0.0032* | *0.1* | 0.024 | J | *0.00081* | *0.025* |
| Acenaphthylene | NA | NA | 29 | 0.00034 | U | *0.00034* | *0.01* | 0.00017 | U | *0.00017* | *0.0051* | 0.00086 | U | *0.00086* | *0.025* | 0.017 | J | *0.0087* | *0.26* | 0.0017 | U | *0.0017* | *0.05* | 0.0034 | U | *0.0034* | *0.1* | 0.0034 | U | *0.0034* | *0.1* | 0.00086 | U | *0.00086* | *0.025* |
| Anthracene | 170000 | 17000 | 29 | 0.011 | | *0.00027* | *0.01* | 0.0019 | J | *0.00014* | *0.0051* | 0.028 | | *0.00067* | *0.025* | 6.4 | | *0.0068* | *0.26* | 0.16 | | *0.0013* | *0.05* | 0.058 | J | *0.0027* | *0.1* | 0.13 | J | *0.0027* | *0.1* | 0.051 | | *0.00067* | *0.025* |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | 0.083 | | *0.0003* | *0.01* | 0.02 | | *0.00015* | *0.0051* | 0.51 | | *0.00074* | *0.025* | **49** | | *0.15* | *5.1* | **2.6** | | *0.015* | *0.5* | **1.5** | | *0.003* | *0.1* | **1.4** | | *0.0029* | *0.1* | 1 | | *0.003* | *0.1* |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | 0.083 | | *0.00029* | *0.01* | 0.042 | | *0.00015* | *0.0051* | 0.68 | | *0.00073* | *0.025* | **38** | | *0.15* | *5.1* | **3.4** | | *0.014* | *0.5* | **2.4** | | *0.0029* | *0.1* | **2.1** | | *0.0029* | *0.1* | **1.6** | | *0.0029* | *0.1* |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | 0.17 | | *0.00029* | *0.01* | 0.095 | | *0.00015* | *0.0051* | **1.4** | | *0.0029* | *0.1* | **88** | | *0.15* | *5.1* | **6.7** | | *0.015* | *0.5* | **4.4** | | *0.0073* | *0.25* | **3.7** | | *0.0073* | *0.25* | **2.8** | | *0.0029* | *0.1* |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | 0.058 | | *0.0004* | *0.01* | 0.041 | | *0.0002* | *0.0051* | 0.47 | | *0.001* | *0.025* | **29** | | *0.2* | *5.1* | **2.5** | | *0.02* | *0.5* | **1.9** | | *0.004* | *0.1* | **1.5** | | *0.004* | *0.1* | **1.2** | | *0.004* | *0.1* |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.00026 | U | *0.00026* | *0.01* | 0.00013 | U | *0.00013* | *0.0051* | 0.00066 | U | *0.00066* | *0.025* | 0.13 | U | *0.13* | *5.1* | 0.013 | U | *0.013* | *0.5* | 0.0026 | U | *0.0026* | *0.1* | 0.0026 | U | *0.0026* | *0.1* | 0.00066 | U | *0.00066* | *0.025* |
| Chrysene | 210 | 15 | 1.1 | 0.078 | | *0.00039* | *0.01* | 0.036 | | *0.0002* | *0.0051* | 0.66 | | *0.00097* | *0.025* | **46** | | *0.2* | *5.1* | **2.8** | | *0.019* | *0.5* | **1.7** | | *0.0039* | *0.1* | **1.6** | | *0.0039* | *0.1* | **1.2** | | *0.0039* | *0.1* |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | 0.019 | | *0.00049* | *0.01* | 0.01 | | *0.00025* | *0.0051* | 0.17 | | *0.0012* | *0.025* | **8.7** | | *0.25* | *5.1* | **1.1** | | *0.0024* | *0.05* | 0.59 | | *0.0049* | *0.1* | 0.45 | | *0.0049* | *0.1* | 0.32 | | *0.0012* | *0.025* |
| Fluoranthene | 22000 | 2300 | 1.1 | 0.19 | | *0.00042* | *0.01* | 0.048 | | *0.00021* | *0.0051* | 0.86 | | *0.0011* | *0.025* | **120** | | *0.21* | *5.1* | **3.7** | | *0.021* | *0.5* | **2.1** | | *0.0042* | *0.1* | **2.4** | | *0.0042* | *0.1* | **1.7** | | *0.0042* | *0.1* |
| Fluorene | 22000 | 2300 | 29 | 0.00046 | U | *0.00046* | *0.01* | 0.00023 | U | *0.00023* | *0.0051* | 0.0012 | U | *0.0012* | *0.025* | 0.19 | J | *0.012* | *0.26* | 0.0092 | J | *0.0023* | *0.05* | 0.0053 | J | *0.0046* | *0.1* | 0.0063 | J | *0.0046* | *0.1* | 0.0053 | J | *0.0011* | *0.025* |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | 0.059 | | *0.00049* | *0.01* | 0.038 | | *0.00025* | *0.0051* | 0.5 | | *0.0012* | *0.025* | **28** | | *0.25* | *5.1* | **2.5** | | *0.025* | *0.5* | **1.8** | | *0.0049* | *0.1* | **1.4** | | *0.0049* | *0.1* | **1.1** | | *0.0049* | *0.1* |
| Naphthalene | 20 | 3.9 | 29 | 0.0014 | U | *0.00066* | *0.01* | 0.00064 | U | *0.00033* | *0.0051* | 0.02 | J | *0.0017* | *0.025* | 0.39 | | *0.017* | *0.26* | 0.066 | | *0.0033* | *0.05* | 0.044 | J | *0.0066* | *0.1* | 0.077 | J | *0.0066* | *0.1* | 0.039 | | *0.0017* | *0.025* |
| Phenanthrene | NA | NA | 29 | 0.098 | | *0.00063* | *0.01* | 0.013 | | *0.00032* | *0.0051* | 0.28 | | *0.0016* | *0.025* | **42** | | *0.32* | *5.1* | 0.96 | | *0.0031* | *0.05* | 0.5 | | *0.0063* | *0.1* | 0.58 | | *0.0063* | *0.1* | 0.38 | | *0.0016* | *0.025* |
| Pyrene | 17000 | 1700 | 1.1 | 0.15 | | *0.00036* | *0.01* | 0.041 | | *0.00018* | *0.0051* | 0.88 | | *0.0009* | *0.025* | **92** | | *0.18* | *5.1* | **3.2** | | *0.018* | *0.5* | **1.9** | | *0.0036* | *0.1* | **2.2** | | *0.0036* | *0.1* | **1.6** | | *0.0036* | *0.1* |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32DSS02 | | | | CM32DSB02 | | | | CM32DSS03 | | | | CM32DSB03 | | | | CM32DSS04 | | | | CM32DSB04 | | | | CM32DSS05 | | | | CM32DSB05 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/28/08 | | | | 3/28/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.052 | J | 0.0063 | 0.1 | 0.021 | J | 0.0031 | 0.051 | 0.052 | J | 0.016 | 0.25 | 0.023 | J | 0.016 | 0.25 | 0.26 | J | 0.031 | 0.51 | 0.024 | J | 0.0063 | 0.1 | 0.21 | J | 0.016 | 0.25 | 0.009 | J | 0.00063 | 0.01 |
| Acenaphthene | 33000 | 3400 | 29 | 0.15 | | 0.0033 | 0.1 | 0.065 | | 0.0016 | 0.051 | 0.36 | J | 0.0081 | 0.25 | 0.21 | J | 0.0081 | 0.25 | 1.3 | | 0.016 | 0.51 | 0.13 | | 0.0033 | 0.1 | 0.4 | | 0.008 | 0.25 | 0.021 | | 0.00033 | 0.01 |
| Acenaphthylene | NA | NA | 29 | 0.0042 | J | 0.0035 | 0.1 | 0.0017 | U | 0.0017 | 0.051 | 0.0086 | UJ | 0.0086 | 0.25 | 0.0086 | U | 0.0086 | 0.25 | 0.017 | J | 0.017 | 0.51 | 0.0035 | U | 0.0035 | 0.1 | 0.0085 | U | 0.0085 | 0.25 | 0.00075 | J | 0.00035 | 0.01 |
| Anthracene | 170000 | 17000 | 29 | 0.63 | | 0.0027 | 0.1 | 0.31 | | 0.0014 | 0.051 | 2.3 | J | 0.0067 | 0.25 | 1.5 | | 0.0067 | 0.25 | 2.4 | | 0.014 | 0.51 | 0.28 | | 0.0027 | 0.1 | 1.8 | | 0.0067 | 0.25 | 0.086 | | 0.00027 | 0.01 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **6.2** | | 0.015 | 0.51 | **3.2** | | 0.0074 | 0.25 | **18** | **J** | 0.074 | 2.5 | **9** | | 0.03 | 1 | **46** | | 0.15 | 5.1 | **4.7** | | 0.015 | 0.51 | **9.8** | | 0.029 | 1 | 0.87 | | 0.003 | 0.1 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **8.2** | | 0.015 | 0.51 | **3.8** | | 0.0073 | 0.25 | **21** | **J** | 0.072 | 2.5 | **11** | | 0.029 | 1 | **65** | | 0.15 | 5.1 | **6.5** | | 0.015 | 0.51 | **11** | | 0.029 | 1 | 0.92 | | 0.0029 | 0.1 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **16** | | 0.015 | 0.51 | **7.3** | | 0.0074 | 0.25 | **41** | **J** | 0.073 | 2.5 | **21** | | 0.029 | 1 | **120** | | 0.15 | 5.1 | **12** | | 0.015 | 0.51 | **23** | | 0.029 | 1 | **1.9** | | 0.0029 | 0.1 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **6.1** | | 0.02 | 0.51 | **2.7** | | 0.01 | 0.25 | **15** | **J** | 0.1 | 2.5 | **6.7** | | 0.04 | 1 | **50** | | 0.2 | 5.1 | **4.8** | | 0.02 | 0.51 | **7.9** | | 0.01 | 0.25 | 0.59 | | 0.004 | 0.1 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.0027 | U | 0.0027 | 0.1 | 0.0013 | U | 0.0013 | 0.051 | 0.0066 | UJ | 0.0066 | 0.25 | 0.0066 | U | 0.0066 | 0.25 | 0.013 | U | 0.013 | 0.51 | 0.0027 | U | 0.0027 | 0.1 | 0.0065 | U | 0.0065 | 0.25 | 0.00026 | U | 0.00026 | 0.01 |
| Chrysene | 210 | 15 | 1.1 | **7.2** | | 0.02 | 0.51 | **3.2** | | 0.0098 | 0.25 | **19** | **J** | 0.097 | 2.5 | **11** | | 0.039 | 1 | **49** | | 0.2 | 5.1 | **4.8** | | 0.02 | 0.51 | **10** | | 0.039 | 1 | 1 | | 0.0039 | 0.1 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | **1.9** | | 0.005 | 0.1 | 0.86 | | 0.0025 | 0.051 | **5.6** | **J** | 0.012 | 0.25 | **2.9** | | 0.012 | 0.25 | **15** | | 0.025 | 0.51 | **1.5** | | 0.005 | 0.1 | **2.5** | | 0.012 | 0.25 | 0.27 | | 0.00049 | 0.01 |
| Fluoranthene | 22000 | 2300 | 1.1 | **12** | | 0.021 | 0.51 | **5.4** | | 0.011 | 0.25 | **28** | **J** | 0.11 | 2.5 | **16** | | 0.042 | 1 | **61** | | 0.21 | 5.1 | **6.1** | | 0.021 | 0.51 | **17** | | 0.042 | 1 | **1.8** | | 0.0042 | 0.1 |
| Fluorene | 22000 | 2300 | 29 | 0.034 | J | 0.0046 | 0.1 | 0.015 | J | 0.0023 | 0.051 | 0.11 | J | 0.011 | 0.25 | 0.089 | J | 0.012 | 0.25 | 0.28 | J | 0.023 | 0.51 | 0.032 | J | 0.0047 | 0.1 | 0.12 | J | 0.011 | 0.25 | 0.0037 | J | 0.00046 | 0.01 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **6** | | 0.025 | 0.51 | **2.7** | | 0.012 | 0.25 | **14** | **J** | 0.12 | 2.5 | **6.7** | | 0.049 | 1 | **47** | | 0.25 | 5.1 | **4.6** | | 0.025 | 0.51 | **7.5** | | 0.012 | 0.25 | 0.56 | | 0.005 | 0.1 |
| Naphthalene | 20 | 3.9 | 29 | 0.24 | | 0.0067 | 0.1 | 0.096 | U | 0.0033 | 0.051 | 0.47 | J | 0.016 | 0.25 | 0.27 | | 0.017 | 0.25 | 1.1 | | 0.033 | 0.51 | 0.11 | U | 0.0067 | 0.1 | 1 | | 0.016 | 0.25 | 0.043 | | 0.00066 | 0.01 |
| Phenanthrene | NA | NA | 29 | 3.8 | | 0.032 | 0.51 | 1.8 | | 0.016 | 0.25 | 10 | J | 0.16 | 2.5 | 6.5 | | 0.016 | 0.25 | 13 | | 0.032 | 0.51 | 1.3 | | 0.0064 | 0.1 | 7.1 | | 0.016 | 0.25 | 0.55 | | 0.0063 | 0.1 |
| Pyrene | 17000 | 1700 | 1.1 | **10** | | 0.018 | 0.51 | **4.8** | | 0.009 | 0.25 | **25** | **J** | 0.089 | 2.5 | **14** | | 0.036 | 1 | **58** | | 0.18 | 5.1 | **5.9** | | 0.018 | 0.51 | **16** | | 0.036 | 1 | **1.5** | | 0.0036 | 0.1 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32DSS06 | | | | CM32DSB06 | | | | CM32DSS07 | | | | CM32DSS08 | | | | CM32DSS09 | | | | CM32DSS10 | | | | CM32DSS10D | | | | CM32DSS11 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.019 | J | 0.0062 | 0.1 | 0.005 | J | 0.0016 | 0.025 | 0.12 | | 0.0063 | 0.1 | 0.0047 | J | 0.0016 | 0.025 | 0.019 | J | 0.0062 | 0.1 | 0.0092 | J | 0.00062 | 0.01 | 0.0033 | J | 0.00031 | 0.005 | 0.00076 | J | 0.00062 | 0.01 |
| Acenaphthene | 33000 | 3400 | 29 | 0.032 | J | 0.0032 | 0.1 | 0.0098 | J | 0.00081 | 0.025 | 0.39 | | 0.0032 | 0.1 | 0.013 | J | 0.00081 | 0.025 | 0.043 | J | 0.0032 | 0.1 | 0.012 | J | 0.00032 | 0.01 | 0.0045 | J | 0.00016 | 0.005 | 0.0011 | J | 0.00032 | 0.01 |
| Acenaphthylene | NA | NA | 29 | 0.0034 | U | 0.0034 | 0.1 | 0.00086 | U | 0.00086 | 0.025 | 0.0052 | J | 0.0034 | 0.1 | 0.00086 | U | 0.00086 | 0.025 | 0.0034 | U | 0.0034 | 0.1 | 0.00073 | J | 0.00034 | 0.01 | 0.00028 | J | 0.00017 | 0.005 | 0.00034 | U | 0.00034 | 0.01 |
| Anthracene | 170000 | 17000 | 29 | 0.45 | | 0.0027 | 0.1 | 0.11 | | 0.00067 | 0.025 | 0.8 | | 0.0027 | 0.1 | 0.096 | | 0.00067 | 0.025 | 0.21 | | 0.0027 | 0.1 | 0.046 | J | 0.00027 | 0.01 | 0.027 | J | 0.00013 | 0.005 | 0.014 | | 0.00027 | 0.01 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **3.4** | | 0.0029 | 0.1 | 0.88 | | 0.00074 | 0.025 | **6.9** | | 0.015 | 0.51 | 0.66 | | 0.00074 | 0.025 | **2.4** | | 0.0029 | 0.1 | 0.5 | | 0.0029 | 0.1 | 0.38 | | 0.0015 | 0.05 | 0.095 | | 0.00029 | 0.01 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **3.3** | | 0.014 | 0.5 | 0.89 | | 0.0029 | 0.1 | **8.7** | | 0.014 | 0.51 | 0.72 | | 0.00072 | 0.025 | **3.3** | | 0.0029 | 0.1 | 0.76 | J | 0.0029 | 0.1 | 0.43 | J | 0.0014 | 0.05 | 0.12 | | 0.00029 | 0.01 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **7.1** | | 0.015 | 0.5 | **1.9** | | 0.0029 | 0.1 | **14** | | 0.015 | 0.51 | **1.5** | | 0.0029 | 0.1 | **5.6** | | 0.0073 | 0.25 | **1.5** | | 0.0029 | 0.1 | 0.91 | | 0.0015 | 0.05 | 0.24 | | 0.00029 | 0.01 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **2.2** | | 0.004 | 0.1 | 0.72 | | 0.001 | 0.025 | **5.4** | | 0.02 | 0.51 | 0.49 | | 0.001 | 0.025 | **2.2** | | 0.004 | 0.1 | 0.56 | J | 0.004 | 0.1 | 0.29 | J | 0.002 | 0.05 | 0.087 | | 0.0004 | 0.01 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.0026 | U | 0.0026 | 0.1 | 0.00066 | U | 0.00066 | 0.025 | 0.0026 | U | 0.0026 | 0.1 | 0.00066 | U | 0.00066 | 0.025 | 0.0026 | U | 0.0026 | 0.1 | 0.00026 | U | 0.00026 | 0.01 | 0.00013 | U | 0.00013 | 0.005 | 0.00026 | U | 0.00026 | 0.01 |
| Chrysene | 210 | 15 | 1.1 | **3.4** | | 0.0039 | 0.1 | 0.86 | | 0.00097 | 0.025 | **6.9** | | 0.019 | 0.51 | 0.66 | | 0.00097 | 0.025 | **2.6** | | 0.0039 | 0.1 | 0.83 | J | 0.0039 | 0.1 | 0.45 | J | 0.0019 | 0.05 | 0.12 | | 0.00039 | 0.01 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | 0.86 | | 0.0049 | 0.1 | 0.27 | | 0.0012 | 0.025 | **1.8** | | 0.0049 | 0.1 | 0.16 | | 0.0012 | 0.025 | 0.85 | | 0.0049 | 0.1 | 0.24 | J | 0.00049 | 0.01 | 0.14 | J | 0.00024 | 0.005 | 0.026 | | 0.00049 | 0.01 |
| Fluoranthene | 22000 | 2300 | 1.1 | **5.3** | | 0.021 | 0.5 | **1.5** | | 0.0042 | 0.1 | **12** | | 0.021 | 0.51 | **1.6** | | 0.0042 | 0.1 | **3.5** | | 0.0042 | 0.1 | **1.1** | | 0.0042 | 0.1 | 0.74 | | 0.0021 | 0.05 | 0.2 | | 0.00042 | 0.01 |
| Fluorene | 22000 | 2300 | 29 | 0.0059 | J | 0.0046 | 0.1 | 0.0032 | J | 0.0012 | 0.025 | 0.084 | J | 0.0046 | 0.1 | 0.0079 | J | 0.0011 | 0.025 | 0.013 | J | 0.0046 | 0.1 | 0.0016 | J | 0.00046 | 0.01 | 0.00067 | J | 0.00023 | 0.005 | 0.00046 | U | 0.00046 | 0.01 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **2.4** | | 0.0049 | 0.1 | 0.76 | | 0.0012 | 0.025 | **5.6** | | 0.025 | 0.51 | 0.51 | | 0.0012 | 0.025 | **2.3** | | 0.0049 | 0.1 | 0.51 | J | 0.0049 | 0.1 | 0.27 | J | 0.0025 | 0.05 | 0.079 | | 0.00049 | 0.01 |
| Naphthalene | 20 | 3.9 | 29 | 0.077 | J | 0.0066 | 0.1 | 0.015 | J | 0.0017 | 0.025 | 0.38 | | 0.0066 | 0.1 | 0.014 | J | 0.0016 | 0.025 | 0.076 | J | 0.0066 | 0.1 | 0.027 | J | 0.00066 | 0.01 | 0.0093 | J | 0.00033 | 0.005 | 0.002 | J | 0.00066 | 0.01 |
| Phenanthrene | NA | NA | 29 | 1.9 | | 0.0063 | 0.1 | 0.73 | | 0.0016 | 0.025 | 3.9 | | 0.032 | 0.51 | 0.61 | | 0.0016 | 0.025 | 0.74 | | 0.0063 | 0.1 | 0.33 | J | 0.0063 | 0.1 | 0.19 | J | 0.0031 | 0.05 | 0.076 | | 0.00063 | 0.01 |
| Pyrene | 17000 | 1700 | 1.1 | **4.3** | | 0.018 | 0.5 | **1.2** | | 0.0036 | 0.1 | **11** | | 0.018 | 0.51 | **1.3** | | 0.0036 | 0.1 | **3** | | 0.0036 | 0.1 | **1.1** | **J** | 0.0036 | 0.1 | 0.65 | J | 0.0018 | 0.05 | 0.17 | | 0.00036 | 0.01 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

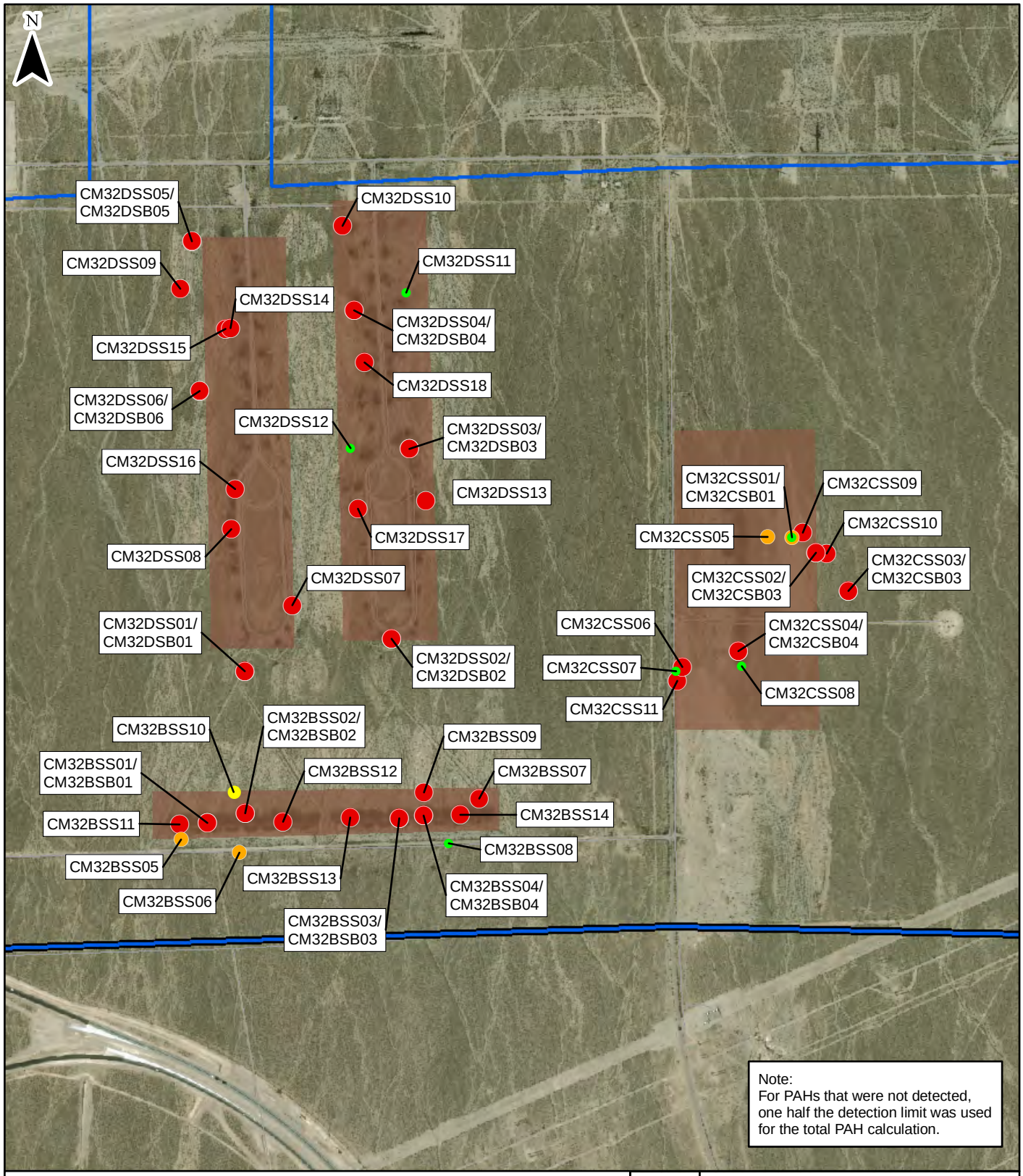
| Analyte | | | Sample ID | CM32BSS01 | | | | CM32BSB01 | | | | CM32BSS02 | | | | CM32BSB02 | | | | CM32BSS03 | | | | CM32BSB03 | | | | CM32BSS04 | | | | CM32BSS04D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0.5-1 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.2 | J | 0.031 | 0.51 | 0.008 | J | 0.0032 | 0.051 | 0.23 | J | 0.016 | 0.25 | 0.016 | J | 0.0063 | 0.1 | 0.019 | J | 0.0063 | 0.1 | 0.01 | J | 0.0032 | 0.051 | 0.016 | J | 0.0062 | 0.1 | 0.023 | J | 0.0063 | 0.1 |
| Acenaphthene | 33000 | 3400 | 29 | 0.8 | | 0.016 | 0.51 | 0.05 | J | 0.0016 | 0.051 | 0.73 | | 0.0081 | 0.25 | 0.099 | J | 0.0032 | 0.1 | 0.11 | | 0.0033 | 0.1 | 0.059 | | 0.0016 | 0.051 | 0.061 | J | 0.0032 | 0.1 | 0.064 | J | 0.0032 | 0.1 |
| Acenaphthylene | NA | NA | 29 | 0.017 | U | 0.017 | 0.51 | 0.0017 | U | 0.0017 | 0.051 | 0.016 | J | 0.0086 | 0.25 | 0.0035 | U | 0.0035 | 0.1 | 0.0035 | U | 0.0035 | 0.1 | 0.0017 | U | 0.0017 | 0.051 | 0.0034 | U | 0.0034 | 0.1 | 0.0034 | U | 0.0034 | 0.1 |
| Anthracene | 170000 | 17000 | 29 | 2 | | 0.014 | 0.51 | 0.093 | | 0.0014 | 0.051 | 3.9 | | 0.0068 | 0.25 | 0.45 | | 0.0027 | 0.1 | 0.39 | | 0.0027 | 0.1 | 0.15 | | 0.0014 | 0.051 | 0.63 | | 0.0027 | 0.1 | 0.63 | | 0.0027 | 0.1 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | **33** | | 0.15 | 5.1 | **1.9** | | 0.0075 | 0.26 | **32** | | 0.074 | 2.5 | **4.5** | | 0.015 | 0.51 | **6.1** | | 0.015 | 0.51 | **2.8** | | 0.0075 | 0.26 | **4.9** | | 0.015 | 0.5 | **5.2** | | 0.015 | 0.51 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | **48** | | 0.15 | 5.1 | **2.6** | | 0.0073 | 0.26 | **41** | | 0.073 | 2.5 | **5.7** | | 0.015 | 0.51 | **8.5** | | 0.015 | 0.51 | **3.9** | | 0.0073 | 0.26 | **6.3** | | 0.014 | 0.5 | **6.6** | | 0.014 | 0.51 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | **91** | | 0.15 | 5.1 | **4.8** | | 0.0074 | 0.26 | **76** | | 0.074 | 2.5 | **11** | | 0.015 | 0.51 | **16** | | 0.015 | 0.51 | **7.5** | | 0.0074 | 0.26 | **13** | | 0.015 | 0.5 | **13** | | 0.015 | 0.51 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | **37** | | 0.2 | 5.1 | **2** | | 0.01 | 0.26 | **26** | | 0.1 | 2.5 | **4.3** | | 0.02 | 0.51 | **6.7** | | 0.02 | 0.51 | **3.1** | | 0.01 | 0.26 | **4.6** | | 0.02 | 0.5 | **4.8** | | 0.02 | 0.51 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.013 | U | 0.013 | 0.51 | 0.0013 | U | 0.0013 | 0.051 | 0.0066 | U | 0.0066 | 0.25 | 0.0026 | U | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 | 0.0013 | U | 0.0013 | 0.051 | 0.0026 | U | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 |
| Chrysene | 210 | 15 | 1.1 | **41** | | 0.19 | 5.1 | **2** | | 0.0099 | 0.26 | **37** | | 0.098 | 2.5 | **4.5** | | 0.019 | 0.51 | **7** | | 0.02 | 0.51 | **3.1** | | 0.0098 | 0.26 | **5.9** | | 0.019 | 0.5 | **5.9** | | 0.019 | 0.51 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | **11** | | 0.025 | 0.51 | 0.6 | | 0.0025 | 0.051 | **8.3** | | 0.12 | 2.5 | **1.5** | | 0.0049 | 0.1 | **1.9** | | 0.005 | 0.1 | 0.91 | | 0.0025 | 0.051 | **1.8** | | 0.0049 | 0.1 | **1.8** | | 0.0049 | 0.1 |
| Fluoranthene | 22000 | 2300 | 1.1 | **46** | | 0.21 | 5.1 | **2.2** | | 0.011 | 0.26 | **55** | | 0.11 | 2.5 | **6.9** | | 0.021 | 0.51 | **9.2** | | 0.021 | 0.51 | **3.9** | | 0.011 | 0.26 | **8.5** | | 0.021 | 0.5 | **8.4** | | 0.021 | 0.51 |
| Fluorene | 22000 | 2300 | 29 | 0.15 | J | 0.023 | 0.51 | 0.0064 | J | 0.0023 | 0.051 | 0.16 | J | 0.012 | 0.25 | 0.018 | J | 0.0046 | 0.1 | 0.015 | J | 0.0046 | 0.1 | 0.0072 | J | 0.0023 | 0.051 | 0.0098 | J | 0.0046 | 0.1 | 0.011 | J | 0.0046 | 0.1 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | **34** | | 0.25 | 5.1 | **1.8** | | 0.013 | 0.26 | **26** | | 0.12 | 2.5 | **4** | | 0.025 | 0.51 | **6.5** | | 0.025 | 0.51 | **3** | | 0.012 | 0.26 | **4.6** | | 0.025 | 0.5 | **4.8** | | 0.025 | 0.51 |
| Naphthalene | 20 | 3.9 | 29 | 1 | | 0.033 | 0.51 | 0.049 | U | 0.0033 | 0.051 | 0.83 | | 0.017 | 0.25 | 0.12 | | 0.0066 | 0.1 | 0.082 | U | 0.0066 | 0.1 | 0.052 | U | 0.0033 | 0.051 | 0.072 | U | 0.0066 | 0.1 | 0.13 | U | 0.0066 | 0.1 |
| Phenanthrene | NA | NA | 29 | 13 | | 0.032 | 0.51 | 0.42 | | 0.0032 | 0.051 | 18 | | 0.16 | 2.5 | 2.3 | | 0.0063 | 0.1 | 2.4 | | 0.0064 | 0.1 | 0.91 | | 0.0032 | 0.051 | 3 | | 0.0063 | 0.1 | 3.1 | | 0.0063 | 0.1 |
| Pyrene | 17000 | 1700 | 1.1 | **44** | | 0.18 | 5.1 | **2.1** | | 0.0091 | 0.26 | **50** | | 0.09 | 2.5 | **6.7** | | 0.018 | 0.51 | **8.6** | | 0.018 | 0.51 | **3.6** | | 0.0091 | 0.26 | **7.5** | | 0.018 | 0.5 | **7.5** | | 0.018 | 0.51 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |

Table 5-2
MU732 – Clay Pigeon Debris Areas – PAH Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM32DSS12 | | | | CM32DSS13 | | | | CM32DSS13D | | | | CM32DSS14 | | | | CM32DSS15 | | | | CM32DSS16 | | | | CM32DSS17 | | | | CM32DSS18 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | | 3/31/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/28/08 | | | | 3/31/08 | | | | 3/31/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | | 0-0.5 | | | |
| | i-RBC | r-RBC | Eco SV | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL | Result | Val Q | MDL | MRL |
| **PAHs (mg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 4100 | 310 | 29 | 0.00037 | J | 0.00031 | 0.005 | 0.0049 | J | 0.0016 | 0.025 | 0.0016 | U | 0.0016 | 0.025 | 0.014 | J | 0.0062 | 0.1 | 0.17 | | 0.0064 | 0.1 | 0.0071 | J | 0.0063 | 0.1 | 0.028 | J | 0.0063 | 0.1 | 0.028 | J | 0.0062 | 0.1 |
| Acenaphthene | 33000 | 3400 | 29 | 0.00049 | J | 0.00016 | 0.005 | 0.013 | J | 0.0008 | 0.025 | 0.0019 | J | 0.0008 | 0.025 | 0.042 | J | 0.0032 | 0.1 | 0.26 | | 0.0033 | 0.1 | 0.015 | J | 0.0032 | 0.1 | 0.08 | J | 0.0032 | 0.1 | 0.068 | J | 0.0032 | 0.1 |
| Acenaphthylene | NA | NA | 29 | 0.00017 | U | 0.00017 | 0.005 | 0.00085 | U | 0.00085 | 0.025 | 0.00085 | U | 0.00085 | 0.025 | 0.0034 | U | 0.0034 | 0.1 | 0.0063 | J | 0.0035 | 0.1 | 0.0034 | U | 0.0034 | 0.1 | 0.0034 | U | 0.0034 | 0.1 | 0.0034 | U | 0.0034 | 0.1 |
| Anthracene | 170000 | 17000 | 29 | 0.0045 | J | 0.00013 | 0.005 | 0.12 | J | 0.00067 | 0.025 | 0.028 | J | 0.00067 | 0.025 | 0.38 | | 0.0027 | 0.1 | 0.55 | | 0.0028 | 0.1 | 0.25 | J | 0.0027 | 0.1 | 0.71 | | 0.0027 | 0.1 | 0.5 | | 0.0027 | 0.1 |
| Benzo(a)anthracene | 2.1 | 0.15 | 1.1 | 0.047 | | 0.00015 | 0.005 | **1.4** | **J** | 0.0029 | 0.1 | 0.19 | J | 0.00073 | 0.025 | **2.2** | | 0.003 | 0.1 | **5.2** | | 0.015 | 0.52 | **1.6** | **J** | 0.003 | 0.1 | **4.7** | | 0.015 | 0.51 | **5** | | 0.015 | 0.5 |
| Benzo(a)pyrene | 0.21 | 0.015 | 1.1 | 0.066 | | 0.00014 | 0.005 | **1.4** | **J** | 0.0029 | 0.1 | 0.25 | J | 0.00072 | 0.025 | **2.3** | | 0.0029 | 0.1 | **6.6** | | 0.015 | 0.52 | **2.3** | **J** | 0.0029 | 0.1 | **5.1** | | 0.014 | 0.51 | **5.7** | | 0.014 | 0.5 |
| Benzo(b)fluoranthene | 2.1 | 0.15 | 1.1 | 0.14 | | 0.00015 | 0.005 | **3.2** | **J** | 0.0029 | 0.1 | 0.54 | J | 0.00073 | 0.025 | **4.2** | | 0.0073 | 0.25 | **11** | | 0.015 | 0.52 | **3.7** | **J** | 0.0073 | 0.25 | **9.7** | | 0.015 | 0.51 | **12** | | 0.015 | 0.5 |
| Benzo(g,h,i)perylene | NA | NA | 1.1 | 0.059 | | 0.0002 | 0.005 | **1.1** | **J** | 0.004 | 0.1 | 0.22 | J | 0.001 | 0.025 | **1.4** | | 0.004 | 0.1 | **4.1** | | 0.021 | 0.52 | **1.7** | **J** | 0.004 | 0.1 | **3.4** | | 0.02 | 0.51 | **4.2** | | 0.02 | 0.5 |
| Benzo(k)fluoranthene | 21 | 1.5 | 1.1 | 0.00013 | U | 0.00013 | 0.005 | 0.00065 | U | 0.00065 | 0.025 | 0.00065 | U | 0.00065 | 0.025 | 0.0026 | U | 0.0026 | 0.1 | 0.0027 | U | 0.0027 | 0.1 | 0.0026 | UJ | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 | 0.0026 | U | 0.0026 | 0.1 |
| Chrysene | 210 | 15 | 1.1 | 0.054 | | 0.00019 | 0.005 | **1.4** | **J** | 0.0039 | 0.1 | 0.22 | J | 0.00097 | 0.025 | **2** | | 0.0039 | 0.1 | **6.2** | | 0.02 | 0.52 | **1.7** | **J** | 0.0039 | 0.1 | **4.5** | | 0.019 | 0.51 | **4.7** | | 0.019 | 0.5 |
| Dibenzo(a,h)anthracene | 0.21 | 0.015 | 1.1 | 0.016 | | 0.00025 | 0.005 | 0.44 | J | 0.0012 | 0.025 | 0.06 | J | 0.0012 | 0.025 | 0.5 | | 0.0049 | 0.1 | **1.8** | | 0.005 | 0.1 | 0.52 | J | 0.0049 | 0.1 | **1.1** | | 0.0049 | 0.1 | **1.5** | | 0.0049 | 0.1 |
| Fluoranthene | 22000 | 2300 | 1.1 | 0.087 | | 0.00021 | 0.005 | **2.3** | **J** | 0.0042 | 0.1 | 0.4 | J | 0.0011 | 0.025 | **4.1** | | 0.011 | 0.25 | **9.7** | | 0.022 | 0.52 | **3.1** | **J** | 0.0042 | 0.1 | **8.5** | | 0.021 | 0.51 | **7.2** | | 0.021 | 0.5 |
| Fluorene | 22000 | 2300 | 29 | 0.00023 | U | 0.00023 | 0.005 | 0.0015 | J | 0.0011 | 0.025 | 0.0011 | U | 0.0011 | 0.025 | 0.0071 | J | 0.0046 | 0.1 | 0.045 | J | 0.0047 | 0.1 | 0.0046 | U | 0.0046 | 0.1 | 0.021 | J | 0.0046 | 0.1 | 0.013 | J | 0.0046 | 0.1 |
| Indeno(1,2,3-cd)pyrene | 2.1 | 0.15 | 1.1 | 0.055 | | 0.00025 | 0.005 | **1.1** | **J** | 0.0049 | 0.1 | 0.21 | J | 0.0012 | 0.025 | **1.5** | | 0.0049 | 0.1 | **4.2** | | 0.025 | 0.52 | **1.7** | **J** | 0.0049 | 0.1 | **3.4** | | 0.025 | 0.51 | **4.1** | | 0.025 | 0.5 |
| Naphthalene | 20 | 3.9 | 29 | 0.00091 | U | 0.00033 | 0.005 | 0.014 | J | 0.0016 | 0.025 | 0.0025 | J | 0.0016 | 0.025 | 0.03 | J | 0.0066 | 0.1 | 0.71 | | 0.0067 | 0.1 | 0.031 | J | 0.0066 | 0.1 | 0.11 | U | 0.0066 | 0.1 | 0.1 | U | 0.0066 | 0.1 |
| Phenanthrene | NA | NA | 29 | 0.03 | | 0.00031 | 0.005 | 0.74 | J | 0.0016 | 0.025 | 0.14 | J | 0.0016 | 0.025 | 2 | | 0.0063 | 0.1 | 3.3 | | 0.032 | 0.52 | 0.97 | J | 0.0063 | 0.1 | 3.1 | | 0.032 | 0.51 | 2.3 | | 0.0063 | 0.1 |
| Pyrene | 17000 | 1700 | 1.1 | 0.079 | | 0.00018 | 0.005 | **1.9** | **J** | 0.0036 | 0.1 | 0.35 | J | 0.00089 | 0.025 | **3.4** | | 0.0036 | 0.1 | **9.5** | | 0.018 | 0.52 | **2.6** | **J** | 0.0036 | 0.1 | **7.4** | | 0.018 | 0.51 | **6.5** | | 0.018 | 0.5 |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| | r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) |
| | i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) |
| | Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) |
| | Qual | Combination of laboratory and USEPA validation qualifiers |
| | MDL | Method Detection Limit |
| | MRL | Method Reporting Limit |
| | **Qualifiers** | |
| | No Code | Confirmed identification. |
| | U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. |
| | J | The positive result is an estimated quantity. The associated numerical value is the appropriate concentration of the analyte in the sample. |
| | UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. |




LEGEND

- PAH Above Eco, Residential, and Industrial Screening Levels
- PAH Above Residential and Industrial Screening Levels
- PAH Above Eco and Residential Screening Levels
- PAH Above Residential Only Screening Levels
- Munitions Response Area
- Clay Pigeon Debris Area

0 500 1,000 2,000 Feet

Projection : NAD_1983_StatePlane_Nevada_East_FIPS_2701_Feet

**U.S. ARMY CORPS OF ENGINEERS**
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER** 5-7

**MU732 PAH LABORATORY SAMPLE RESULTS NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West

**Shotgun Firing Range**

A total of 35 samples were collected from the Shotgun Firing Range. Lead was below screening levels for all samples at the Shotgun Firing Range (see **Figure 5-5** and **Table 5-1**).

Fourteen surface soil samples and four subsurface soil samples were collected from the Shotgun Firing Range for PAH analysis.

- Nine PAHs were detected above the human health and/or ecological screening levels as follows:
  - Benzo(a)anthracene was detected at concentrations ranging from 0.015 to 33 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(a)pyrene was detected at concentrations ranging from 0.024 to 48 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(b)fluoranthene was detected at concentrations ranging from 0.05 to 91 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(g,h,i)perylene was detected at concentrations ranging from 0.025 to 37 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. No screening levels for human health are available for this analyte.
  - Chrysene was detected at concentrations ranging from 0.02 to 41 mg/kg and exceeded the residential screening level of 15 mg/kg and the ecological screening level of 1.1 mg/kg. This concentration is below the industrial screening level of 210 mg/kg.
  - Dibenzo(a,h)anthracene was detected at concentrations ranging from 0.0065 to 11 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Fluoranthene was detected at concentrations ranging from 0.027 to 55 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 2,300 mg/kg and industrial screening level of 22,000 mg/kg.
  - Indeno(1,2,3-cd)pyrene was detected at concentrations ranging from 0.021 to 34 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Pyrene was detected at concentrations ranging from 0.026 to 50 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 1,700 mg/kg and industrial screening level of 17,000 mg/kg.

**Training and Maneuver Area**

A total of 41 samples were collected at the Training and Maneuver Area. Lead was detected in one soil sample (CXRM32C2SS03) above the residential screening level at a concentration of

573 mg/kg in the 0-0.5 feet bgs interval (see **Figures 5-4** through **5-6** and **Table 5-1**). Please note that samples were biased to the northern portion of the clay pigeon debris lanes in the Training and Maneuver Area as the result of discussion and agreement with Project Team that samples in this area would be focused in areas where clay pigeon debris appeared most concentrated, which was the northern half of the area. It was assumed that the XRF lead results from this area were representative for the southern half of the area as agreed to by the Project Team and further that the PAHs, which were sampled in the areas of heaviest debris in the northern half as well as the southern half (to evaluate areas down-gradient from the primary area where debris was observed), are the remedial driver for follow-on actions.

Eighteen surface soil samples and six subsurface soil samples were collected from the Training and Maneuver Area for PAH analysis.

- Nine PAHs were detected above the human health and/or ecological screening levels as follows:
  - Benzo(a)anthracene was detected at concentrations ranging from 0.047 to 46 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(a)pyrene was detected at concentrations ranging from 0.066 to 65 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(b)fluoranthene was detected at concentrations ranging from 0.14 to 120 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(g,h,i)perylene was detected at concentrations ranging from 0.059 to 50 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. No screening levels for human health are available for this analyte.
  - Chrysene was detected at concentrations ranging from 0.054 to 49 mg/kg and exceeded the residential screening level of 15 mg/kg and the ecological screening level of 1.1 mg/kg. This concentration is below the industrial screening level of 210 mg/kg.
  - Dibenzo(a,h)anthracene was detected at concentrations ranging from 0.016 to 15 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Fluoranthene was detected at concentrations ranging from 0.087 to 61 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 2,300 mg/kg and industrial screening level of 22,000 mg/kg.
  - Indeno(1,2,3-cd)pyrene was detected at concentrations ranging from 0.055 to 47 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.

Pyrene was detected at concentrations ranging from 0.079 to 58 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 1,700 mg/kg and industrial screening level of 17,000 mg/kg.

**Clay Pigeon Debris Area**

A total of 28 samples were collected at the Clay Pigeon Debris Area. Lead was below the screening levels of 400 mg/kg at the Clay Pigeon Debris Area (**Figure 5-6** and **Table 5-1**). Sampling in the remainder of MU732 was not warranted as no evidence of additional military munitions activities or MEC were observed during the visual surveys and no other records of military munitions use of this property have been identified.

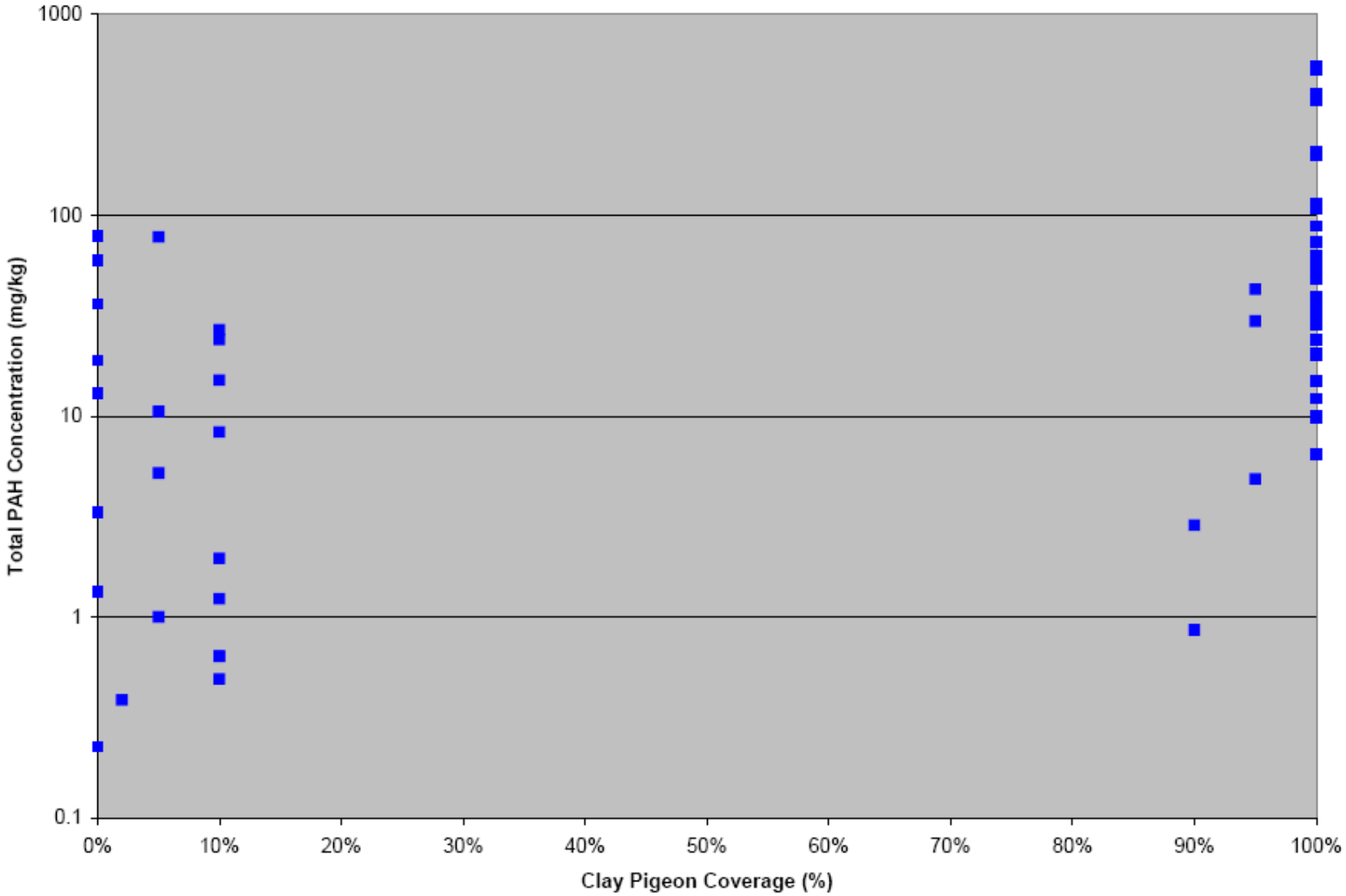
Eleven surface soil and four subsurface soil samples were collected from the Clay Pigeon Debris Area for PAH analysis.

- Ten PAHs were detected above the human health and/or ecological screening levels as follows:
  - Benzo(a)anthracene was detected at concentrations ranging from 0.02 to 49 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(a)pyrene was detected at concentrations ranging from 0.042 to 38 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(b)fluoranthene was detected at concentrations ranging from 0.095 to 88 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Benzo(g,h,i)perylene was detected at concentrations ranging from 0.041 to 29 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. No screening levels for human health are available for this analyte.
  - Benzo(k)fluoranthene was detected in one sample at a concentration of 2.5 mg/kg which exceeds the ecological screening level of 1.1 mg/kg and is equal to the residential screening level of 2.5 mg/kg. This concentration is below the industrial screening level of 21 mg/kg.
  - Chrysene was detected at concentrations ranging from 0.036 to 46 mg/kg and exceeded the residential screening level of 15 mg/kg and the ecological screening level of 1.1 mg/kg. This concentration is below the industrial screening level of 210 mg/kg.
  - Dibenzo(a,h)anthracene was detected at concentrations ranging from 0.01 to 8.7 mg/kg and exceeded the residential screening level of 0.015 mg/kg, the industrial screening level of 0.21 mg/kg, and the ecological screening level of 1.1 mg/kg.
  - Fluoranthene was detected at concentrations ranging from 0.048 to 120 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 2,300 mg/kg and industrial screening level of 22,000 mg/kg.
  - Indeno(1,2,3-cd)pyrene was detected at concentrations ranging from 0.038 to 28 mg/kg and exceeded the residential screening level of 0.15 mg/kg, the industrial screening level of 2.1 mg/kg, and the ecological screening level of 1.1 mg/kg.

- Pyrene was detected at concentrations ranging from 0.041 to 92 mg/kg and exceeded the ecological screening level of 1.1 mg/kg. The concentrations are below the residential screening level of 1,700 mg/kg and industrial screening level of 17,000 mg/kg.

The PAH concentrations were evaluated against the observed clay pigeon coverage observed over the soil samples that were collected to determine if the clay pigeons could be used as a guide to estimate the area and volume of contamination. By plotting the concentrations of total PAHs detected in the samples against the clay pigeon coverage observed (see **Figure 5-8** and field notes in **Appendix E**), it was determined that the areas within significant clay pigeon debris contained the highest concentration of total PAHs, confirming that the clay pigeons are the source of the PAHs. However, areas with no clay pigeons still contained PAHs, sometimes in high concentrations. This is attributed to migration of the PAHs through overland transport, primarily during rain events. However, the PAHs extended radially outward from the clay pigeon source, and were not biased to the topographically downslope areas, as was anticipated. Therefore, some mechanical distribution of the PAHs may have occurred as well. PAHs above screening levels extended as far as 200 feet from the areas where clay pigeons were observed. However, vertical migration of the PAHs through the soil column only occurred to a limited extent. On average, there was a 65.8% reduction in the concentration of total PAHs from the surface soil samples to the subsurface soil samples, which were collected at 0.5-1.0 feet bgs (i.e., directly under the surface soil samples). Based on these results, it is anticipated that the PAHs are limited to the top 1.5-2 feet bgs.

**Figure 5-8 PAH Concentrations vs. Clay Pigeon Coverage**



#### *5.1.6.4 Background Determination*

Background screening values (BSV) have been established for lead in surface soil and subsurface soil at Nellis AFB (JMM, 1989). The first step in the evaluation of the lead data was a comparison of the site data to these established BSVs to identify potential localized contamination. Lead was detected above the BSV (12 mg/kg) in the majority of samples at MU732.

### 5.1.7 Identification of Potential Receptors

Current human receptors at MU732 may include base personnel such as those performing ground maintenance, ecological surveys/studies, or security forces. Occasionally, unauthorized persons have been observed trespassing onto MU732. Evidence of illegal dumping of trash and civilian arms target practice also was observed.

In addition, rare, threatened, or endangered species have been identified on MU732. Evidence that the desert tortoise is present at MU732 was observed during the CSE Phase II. Therefore, consideration of ecological receptors is also required.

#### *5.1.7.1 Buildings Near/Within MRA*

Numerous buildings, including portions of the Las Vegas Motor Speedway, a youth detention center, and a residential development are located within two miles of MU732. These buildings are located within two miles of the Training and Maneuver Area, Clay Pigeon Debris Areas, and Shotgun Firing Range. However, no buildings are located within two miles of the .50 Caliber Firing Fan or Mountainous Areas.

#### *5.1.7.2 Utilities On/Near MRA*

The Southern Nevada Water Authority has constructed facilities associated with the Grand Teton Reservoir project, including a covered potable water storage reservoir, a pumping station, two underground pipelines, and a stormwater diversion structure that transverses in a northeast-southwest direction through the narrowest part of the western portion of MU732 property. Presumably, in addition to the underground pipelines, there are other buried utilities associated with these facilities; however, no aboveground utilities were observed. Overhead power lines cross the southeast corner of the western portion of MU732, also in a northeast-southwest direction. No other utilities are known to be in the area of MU732.

### 5.1.8 Natural Resources

#### *5.1.8.1 Wetlands*

No wetlands have been identified at MU732.

#### *5.1.8.2 Rare, Threatened, or Endangered Species*

According to the Nellis AFB Plan 126-4 – Integrated Natural Resources Management Plan (99 CES/CEV 2001), the Las Vegas bearpoppy and the burrowing owl are known to be present on the main portion of the base. The desert tortoise is present on the main base and on MU732 in low densities. The phainopepla and the common chuckwalla (*Sauromalus obesus*), which is on the state watch list, are found on the base and MU732. The banded gila monster is known to be present on the base and possibly on MU732.

#### *5.1.8.3 Cultural Resources*

The Integrated Cultural Resources Management Plan (CRMP) for Nellis AFB noted that 100 percent of all undeveloped Las Vegas Valley USAF land was inventoried for archaeology sites and the results were subjected to consultation. The inventoried area included the main base, Areas II and III, and the Small Arms Range Annex, (Nellis AFB 2006). Eighty-five sites were identified, but only one of these, a quarry site, was determined to be eligible for nomination to the National Register of Historic Places in compliance with Section 112 of the National Historic Preservation Act.

No WWII-era structures and just a few Cold War-era structures, the Threat Facility, the Red Flag Air Combat Training Center, the Weapons School Facility, the Thunderbirds Maintenance Hangar, and the Command Center, have been recommended for additional research. Neither the quarry site nor any of the Cold War-era structures are located in the vicinity of the Nellis AFB MU732.

## 5.2 XU741: Area III Magazines

### 5.2.1 Site Description

XU741, Area III Magazines, is a 23.4-acre site located in the northwestern portion of the site (**Figure 1-1**). The boundaries of the MRA were based on the 1943 map of Nellis AFB.

### 5.2.2 History of MEC Activities

Based on the 1943 base map of Nellis AFB, XU741 included a pyrotechnics magazine, a chemical bomb magazine, and a small arms ammunition building. According to the CARSI Phase II (Mitretek 1999), "The sources consulted at Nellis AFB do not believe that CAIS or CWM were stored in the Chemical Bomb Magazine." Only two of the original buildings (now referred to as Buildings 1039 and 1047) remain. Five additional igloos have been constructed at the western end of this MRA. The munitions types associated with these additional igloos are unknown as the specific types of munitions stored here are not documented.

MEC anticipated to be present at XU741 are as follows:

- Pyrotechnics
- Chemical bombs potentially containing white phosphorus

In addition, there is a history of small arms ammunition storage at the MRA.

A removal action was performed for the HP Project, which was adjacent to XU741 in 2007, as described in Section 2.6.9. This removal action consisted of excavation and screening of a burial pit/trench containing additional MD. Approximately 9.2 tons of scrap metal and MD were removed from the project clean-up footprint. A total of 86 suspect items needed probing to ensure no smoke signal or spotting charge remained. Of these, 36 items could not be verified and were handled by the Base Explosive Ordnance Disposal Unit (EODU) for disposal. These items included 23 – MK106 practice bombs, 11 – BDU33 practice bombs, and 2 – MB2 practice bombs. The ordnance dumped in the burial pit/trench is indicative of ordnance stored in the igloos, which were located 1,000 feet away.

### 5.2.3 Current Land Use

XU741 is the responsibility of base Defense Reutilization and Marketing Office (DRMO). The western portion of this MRA is also used as the base recreational vehicle (RV) storage/parking area.

### 5.2.4 Access Controls

XU741 is located on the northwest portion of Area III on Nellis AFB and completely contained within the Nellis AFB Area III perimeter security fence. In addition, the five newer igloos are contained within a barbed-wire-topped, chain link fence. No other site specific controls were identified during the CSE Phase II.

### 5.2.5 Restrictions

Access to XU741 is restricted and controlled by DRMO.

### 5.2.6 Field Investigation Results

#### *5.2.6.1 Site Reconnaissance Observations*

The Bay West Team visually surveyed 23.4 acres (2.44 linear miles, with transects spaced 25 feet apart). The eastern portion of the MRA was covered with asphalt and used for recreational vehicle storage. As such visual survey was not warranted. With the exception of an old railway which appeared to be abandoned, the site was level, flat, and appeared to potentially have been graded. The site was primarily used for large item storage. A few scattered small arms (empty 5.56mm blank cartridges) were observed. Metallic construction debris was also observed throughout the site. All of the magazines, with the exception of Magazine 1047, had a concrete or asphalt apron the width of the building covering the area in front of the door; therefore no soil samples were collected for laboratory analysis for explosives from these locations. The area outside of Magazine 1047 only had a small asphalt pad in front of the door; therefore, a soil sample was collected for laboratory analysis for explosives from this area. No MEC or MD items were observed in this area (see **Figure 5-9**).

#### *5.2.6.2 Geophysical Survey Results*

A geophysical survey was not performed at XU741 as it was not warranted to achieve the DQOs for this MRA.

#### *5.2.6.3 Media Sampling Results*

One surface soil sample and a duplicate sample were collected using discrete sampling techniques from XU741 during the CSE Phase II (**Figure 5-10**). These samples were analyzed for select explosives (hexahydro-1,3,5-trinitro-1,3,5-triazine [RDX], pentaerythritol tetranitrate [PETN], nitroglycerin, 2,4,6-trinitrotoluene [TNT], 2,4-dinitrotoluene [DNT], 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl). Laboratory analytical results were compared to the screening levels presented in **Table 4-3**. The analytical results for the XU741 samples are presented in **Table 5-3**. Explosives were not detected in the soil samples collected from XU741.

LEGEND

Munitions Response Area

Magazine Location

Completed CSE Phase II Transect

0 250 500 Feet

Projection : NAD83 State Plane Nevada East

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**MILITARY MUNITIONS RESPONSE PROGRAM**

| FIGURE NUMBER | |
|---|---|
| 5-9 | XU741<br>VISUAL SURVEY OBSERVATIONS<br>NELLIS AIR FORCE BASE |

Shaw Environmental, Inc.

Bay West

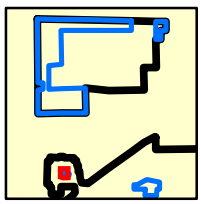
LEGEND

Munitions Response Area

Magazine Location

Analytical Sample Locations

Surface Soil



0 100 200 Feet

Projection : NAD83 State Plane Nevada East

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 5-10

XU741
ANALYTICAL RESULTS
NELLIS AIR FORCE BASE

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Table 5-3
XU741 Soil Analytical Results
Nellis Air Force Base, Nevada

| Analyte | | | Sample ID | CM41SS01 | | | | CM41SS01D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Sample Date | 3/31/08 | | | | 3/31/08 | | | |
| | | | Sample Depth | 0-0.5 | | | | 0-0.5 | | | |
| | **i-RBC** | **r-RBC** | **Eco SV** | Result | Qual | MDL | MRL | Result | Qual | MDL | MRL |
| **Explosives (mg/kg)** | | | | | | | | | | | |
| 1,3,5-Trinitrobenzene | 18000 | 1800 | 0.99 | 0.076 | U | *0.076* | *0.27* | 0.076 | U | *0.076* | *0.27* |
| 1,3-Dinitrobenzene | 62 | 6.1 | 7.5 | 0.065 | U | *0.065* | *0.27* | 0.065 | U | *0.065* | *0.27* |
| 2,4,6-Trinitrotoluene | 57 | 16 | 71 | 0.062 | U | *0.062* | *0.27* | 0.062 | U | *0.062* | *0.27* |
| 2,4-Dinitrotoluene | 1200 | 120 | 6.4 | 0.053 | U | *0.053* | *0.27* | 0.053 | U | *0.053* | *0.27* |
| 2,6-Dinitrotoluene | 620 | 61 | 0.52 | 0.058 | U | *0.058* | *0.27* | 0.058 | U | *0.058* | *0.27* |
| 2-amino-4,6-Dinitrotoluene | 1200 | 120 | 0.37 | 0.048 | U | *0.048* | *0.27* | 0.049 | U | *0.049* | *0.27* |
| 2-Nitrotoluene | 10000 | 780 | 0.73 | 0.09 | U | *0.09* | *0.27* | 0.09 | U | *0.09* | *0.27* |
| 3-Nitrotoluene | NA | NA | 6.6 | 0.058 | U | *0.058* | *0.53* | 0.059 | U | *0.059* | *0.53* |
| 4-amino-2,6-Dinitrotoluene | 1200 | 120 | 2.1 | 0.042 | UJ | *0.042* | *0.27* | 0.042 | U | *0.042* | *0.27* |
| 4-Nitrotoluene | 110 | 30 | 0.073 | 0.12 | U | *0.12* | *0.43* | 0.12 | U | *0.12* | *0.43* |
| HMX | 31000 | 3100 | 2 | 0.083 | U | *0.083* | *0.27* | 0.083 | U | *0.083* | *0.27* |
| Nitrobenzene | 280 | 31 | 2.4 | 0.065 | U | *0.065* | *0.27* | 0.066 | U | *0.066* | *0.27* |
| RDX | 16 | 4.4 | 4.4 | 0.091 | U | *0.091* | *0.27* | 0.091 | U | *0.091* | *0.27* |
| Tetryl | 2500 | 240 | 27 | 0.058 | U | *0.058* | *0.53* | 0.059 | U | *0.059* | *0.53* |
| Nitroglycerin | 62 | 6.1 | 8600 | 1.8 | U | *1.8* | *5.3* | 1.8 | U | *1.8* | *5.3* |
| PETN | NA | NA | 2.2 | 1.4 | U | *1.4* | *4.3* | 1.4 | U | *1.4* | *4.3* |

| | | |
|---|---|---|
| 12 | J | Shading and black font indicates a i-RBC exceedance. |
| 12 | J | Bold outline indicates a r-RBC exceedance. |
| **12** | **J** | Bold, underlined font indicates an Eco SV exceedance. |
| *12* | *12* | Shading in the MDL/MRL columns indicates the MDL exceeds a criterion. |
| r-RBC | Residential USEPA National Screening Levels (ORNL, 7 July 2008) | |
| i-RBC | Industrial USEPA National Screening Levels (ORNL, 7 July 2008) | |
| 12 | Bold outline indicates an ecological screening level exceedance. | |
| Eco SV | Recommended Ecological Screening Value (see **Table 4-3**) | |
| Qual | Combination of laboratory and USEPA validation qualifiers | |
| MDL | Method Detection Limit | |
| MRL | Method Reporting Limit | |
| **Qualifiers** | | |
| No Code | Confirmed identification. | |
| U | Undetected at the limit of detection: The associated data value is the limit of detection or reported sample quantitation limit, adjusted by any dilution factor used in the analysis. | |
| UJ | The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may be inaccurate or imprecise. | |

#### *5.2.6.4 Background Determination*

XU741 soil sample was analyzed for explosives (RDX, PETN, nitroglycerin, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl). BSVs are not appropriate for explosives. Further, all explosives were non-detect. Therefore, a background determination is not warranted.

### 5.2.7 Identification of Potential Receptors

Current human receptors at XU741 may include base personnel such as grounds maintenance personnel or security forces. Potential future receptors may include recreational users, construction workers performing intrusive activities, and possibly residents, given the Military Family Housing Project planned near this MRA.

In addition, rare, threatened, or endangered species have been identified on the main base. Therefore, consideration of ecological receptors is also required.

#### *5.2.7.1 Nearby Population*

Nellis AFB is located in Clark County, Nevada, on the northeast side of Las Vegas. The U.S. Census treated it as a census-designated place for statistical purposes, so specific demographic information about residents of the base is compiled. As of 2000, Nellis AFB had a population of 8,896. According to the U.S. Census, Clark County, Nevada has a population of 1,375,765, with a population density of 217 persons per square mile (U.S. Census Bureau [USCB] 2001).

#### *5.2.7.2 Buildings Near/Within MRA*

Seven aboveground, earth-covered magazines along with several other buildings that are currently operated by the base DRMO are present in the MRA. Numerous buildings, including Nellis AFB-related structures and an off-base residential development, are located within a two mile radius of XU741.

#### *5.2.7.3 Utilities On/Near MRA*

Electric, natural gas, and wastewater utilities are present in the vicinity of XU741, according to the Nellis AFB GIS files. No other utilities are known to be in the area of XU741.

### 5.2.8 Natural Resources

#### *5.2.8.1 Wetlands*

No wetlands have been identified at XU741.

#### *5.2.8.2 Rare, Threatened, or Endangered Species*

According to the *Integrated Natural Resources Management Plan* (99 CES/CEV 2001), the Las Vegas bearpoppy and the burrowing owl are known to be present on the main portion of the base. The desert tortoise is present on the main base in low densities. The phainopepla and the common chuckwalla (*Sauromalus obesus*), which is on the state watch list, are also found on Nellis AFB. The banded gila monster is known to be present on the base as well.

#### *5.2.8.3 Cultural Resources*

The Integrated CRMP for Nellis AFB noted that 100 percent of all undeveloped Las Vegas Valley USAF land, which included the main base, Areas II and III, and the Small Arms Range was inventoried for archaeology sites and the results subjected to consultation (Nellis AFB 2006). Eighty-five sites were identified, but only one of these, a quarry site, was determined to be eligible for nomination to the National Register of Historic Places in compliance with Section 112 of the National Historic Preservation Act.

No WWII-era structures and just a few Cold War-era structures, the Threat Facility, the Red Flag Air Combat Training Center, the Weapons School Facility, the Thunderbirds Maintenance Hangar, and the Command Center, have been recommended for additional research. Neither the quarry site nor any of the Cold War-era structures are located in the vicinity of XU741.

## 5.3 TM742: Former Navy Training Area

### 5.3.1 Site Description

TM742, Former Navy Training Area, is a 310.3-acre MRA located in the central portion of Nellis AFB. According to the *Range Inventory Report* (URS 2001), TM742 was historically used by the U.S. Navy to conduct mock assaults on an ammunition supply point. TM742 also includes a former wastewater treatment plant. The lagoons for the former wastewater treatment plant have since been converted into a "wildlife habitat pond." Immediately northeast of the MRA boundary is an active small arms range.

### 5.3.2 History of MEC Activities

According to the *Range Inventory Report* (URS 2001), TM742 was historically used by the U.S. Navy to conduct mock assaults on the ammunition supply point located in what is now referred to as Area II of Nellis Air Force Base. This report indicated that the suspected munitions likely included blank ammunition, pyrotechnics, and practice munitions; however, specific munitions types used at the MRA were unknown. Historical evidence indicates that this area was used from the 1950s until 1969.

### 5.3.3 Current Land Use

TM742 includes a former wastewater treatment plant. The lagoons for the former wastewater treatment plant have been converted into a "wildlife habitat pond."

### 5.3.4 Access Controls

TM742 is located in the southwest portion of Area II on Nellis AFB and is completely contained within the Nellis AFB Area II perimeter security fence. No site-specific controls were identified.

### 5.3.5 Restrictions

Access to this area is restricted and controlled by Nellis AFB Operations.

### 5.3.6 Field Investigation Results

#### *5.3.6.1 Site Reconnaissance Observations*

The Bay West Team visually surveyed the 310.3 acres (10.4 linear miles with transects spaced on 250-foot centers) within TM742. A road by which munitions are currently transported to and

from the flight line was present through the site. The team recorded one munitions debris item (smoke grenade) and a small arms item (one belt of 5.56mm blanks) at this MRA (see **Figure 5-11**).

#### *5.3.6.2 Geophysical Survey Results*

A geophysical survey was not performed at TM742 as it was not warranted to achieve the DQOs for this MRA.

#### *5.3.6.3 Media Sampling Results*

Sampling for MC was not required at TM742 as there were no areas of concentrated MEC/MD observed. Therefore, it was concluded that environmental impacts from military munitions activities could not have occurred.

#### *5.3.6.4 Background Determination*

As sampling for MC was not performed at TM742, no assessment of the results against background concentrations was required.

### 5.3.7 Identification of Potential Receptors

Current human receptors at TM742 include base personnel performing grounds maintenance, ecological surveys/studies, or security. Potential future receptors are expected to be similar to current receptors.

In addition, rare, threatened, or endangered species have been identified on the main base. Therefore, consideration of ecological receptors is also required.

#### *5.3.7.1 Nearby Population*

Nellis AFB is located in Clark County, Nevada, on the northeast side of Las Vegas. The U.S. Census treated it as a census-designated place for statistical purposes, so specific demographic information about residents of the base is compiled. As of 2000, Nellis AFB had a population of 8,896. According to the U.S. Census, Clark County, Nevada has a population of 1,375,765, with a population density of 217 persons per square mile (USCB 2001).

#### *5.3.7.2 Buildings Near/Within MRA*

Numerous buildings, including portions of the Las Vegas Motor Speedway, a Federal Prison Facility, and Nellis AFB-related structures are located within a two-mile radius of TM742.

#### *5.3.7.3 Utilities On/Near MRA*

Wastewater utilities are present in the vicinity of TM742, according to the Nellis AFB GIS files. No other utilities are known to be in the area of TM742.

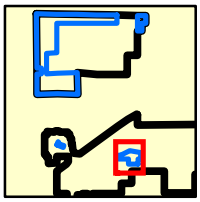
### 5.3.8 Natural Resources

#### *5.3.8.1 Wetlands*

No wetlands have been identified at TM742.

LEGEND

- Munitions Response Area
- Completed CSE Phase II Transect
- MD - Smoke Grenade
- Small Arms



0 100 200
Feet

Projection : NAD83 State Plane Nevada East

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**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER**
5-11

**TM742**
**VISUAL SURVEY OBSERVATIONS**
**NELLIS AIR FORCE BASE**

Shaw Environmental, Inc.

Bay West

#### *5.3.8.2 Rare, Threatened, or Endangered Species*

According to the *Integrated Natural Resources Management Plan* (99 CES/CEV 2001), the Las Vegas bearpoppy and the burrowing owl are known to be present on the main portion of the base. The desert tortoise is present on the main base in low densities. The phainopepla and the common chuckwalla (*Sauromalus obesus*), which is on the state watch list, are also found on Nellis AFB. The banded gila monster is known to be present on the base as well.

#### *5.3.8.3 Cultural Resources*

The Integrated CRMP for Nellis AFB noted that 100 percent of all undeveloped Las Vegas Valley USAF land, which included the main base, Areas II and III, and the Small Arms Range was inventoried for archaeology sites and the results subjected to consultation (Nellis AFB 2006). Eighty-five sites were identified, but only one of these, a quarry site, was determined to be eligible for nomination to the National Register of Historic Places in compliance with Section 112 of the National Historic Preservation Act.

No WWII-era structures and just a few Cold War-era structures, the Threat Facility, the Red Flag Air Combat Training Center, the Weapons School Facility, the Thunderbirds Maintenance Hangar, and the Command Center, have been recommended for additional research. Neither the quarry site nor any of the Cold War-era structures are located in the vicinity of TM742.

# 6.0 EVALUATION OF KNOWN/SUSPECTED MEC

## 6.1 MEC Technical Data

The following summarizes the ordnance items with a history of use at Nellis AFB. It should be noted that evidence of each of these items was not observed during the CSE Phase II.

MEC anticipated to be present at MU732 are as follows:

- Bomb, practice, with MK 4 signal: BDU-33/B MK 5, MK 23, MK 43, MK 106, MK 76;
- Bomb, practice, with signal, M38A2;
- Bomb, practice, MK 82 Mod 0;
- Bomb, practice 750-lb;
- Bomb, M117 inert;
- Napalm bomb (no nomenclature provided);
- BLU-27;
- 2.75-inch Rocket, M229 HE warhead;
- Rocket motor, MK40 Mod 1;
- 5-inch Rocket, MK 1 Mod 0 HE;
- Grenade, AN-M14 incendiary;
- Demolition block, M3 and M5;
- 20mm projectile, TP, AP-T, and HEI; and
- 37mm projectile, HE.

MEC anticipated to be present at XU741 are as follows:

- MK106 practice bombs;
- BDU33 practice bombs;
- MB2 practice bombs;
- Pyrotechnics; and
- Chemical Bombs potentially containing white phosphorous.

MEC anticipated to be present at TM742 are as follows:

- Smoke grenades.

The technical data sheets for these items are presented as **Appendix F**.

In addition, small arms (.30 caliber cartridge, M2 ball, M2 AP, and M1 tracer, .45 caliber cartridge, M1911 ball, .50 caliber cartridge, M2 ball, and M2 AP, and 12-gauge cartridge) were used at the MU732 MRA.

## 6.2 Primary Sources and Release Mechanisms

MU732, WWII Gunnery Range @ Range Road (Excess), was the location of small arms gunnery practice, air-to-ground gunnery, ground-to-air gunnery, air-to-air gunnery, bombing, rocketry, and demolition/burning operations. XU741, the Area III Magazines, included a pyrotechnic

magazine; a chemical bomb magazine; and a small arms magazine. According to the *Range Inventory Report*, TM742, the Former Navy Training Area, was used historically by the U.S. Navy to conduct mock assaults on the ammunition supply point located in what is now referred to as Area II of Nellis AFB.

Sources are those areas where MEC/MC has entered (or may enter) the physical system. The munitions-related activities that have occurred at Nellis AFB are the primary source of MEC. These activities resulted in MEC being present in the soil and on the ground surface of Nellis AFB.

## 6.3 MEC Locations (Secondary Sources)

Secondary sources are the media to which MEC and MC have been released. Potentially impacted media at Nellis AFB include soils and near-surface groundwater. Following the initial release of MEC, its detonation, damage on impact, or degradation may release MC to the environment. Leaching and other transport mechanisms may transfer released MC between two or more media. No secondary sources of MEC were identified during the CSE Phase II for Nellis AFB.

## 6.4 MEC Penetration Estimates

The depth at which MEC is located is a primary determinant of both potential human exposure and the cost of investigation and cleanup. In addition, the *Ammunition and Explosives Safety Standards* (DoD 1997) require that an estimate of expected depth of MEC be included in the site-specific analysis for determining response depth. A wide variety of factors may affect the depth at which military munitions are found, including penetration depth – a function of munition size, shape, propellant charge used, soil characteristics, angle of entry, and other factors – as well as movement of MEC through human interaction.

**Table 6-1** provides examples of the potential effects that different soil characteristics can have on penetration depth. These depths do not reflect the variety of other factors (e.g., different striking velocities and angles) that affect the actual depth at which the munition may be found. The depths provided in **Table 6-1** are taken from a controlled study to determine munition penetration into earth. They are presented here to give the reader an understanding of the wide variability in the depths at which individual munitions may be found, based on soil characteristics alone.

While **Table 6-1** provides a few examples of penetration depths, it does not illustrate the dramatic differences possible within ordnance categories. For example, rockets can penetrate sand to depths of between 0-4.0 feet, and silty sands and clays to depths of between 0-1.5 feet, depending on the type of rocket and a host of site-specific conditions.

**Table 6-1 Examples of Ordnance Penetration Depths into Soil**

| Type of Munition | Ordnance Item | Depth of Penetration (in feet) | | |
|---|---|---|---|---|
| | | Sand | Silty Sand and Clay | Loam |
| Rocket | 2.36-inch Rocket | 0-4.0 | 0-1.5 | NA |
| Projectile | 75mm | 0-2.0 | 0.5-4.0 | 0-0.7 |
| Projectile | 105mm | 0.3-3.0 | NA | NA |

*Sources: Adams, J.B., "Ordnance and Explosives Recovery Depth," UXO Forum 99, Atlanta, GA, May 1999. Based on database of recovered MEC from 13 FUDS sites nationwide.*

## 6.5 Special Consideration MEC (e.g., Depleted Uranium, Chemical Warfare Materiel)

No evidence indicating the potential use of radioactive weapons at USAF MMRP-eligible properties associated with Nellis AFB was found during the CSE Phase II activities. However, a 1943 base map shows a "chemical bomb magazine" and a "gas instruction building" within the XU741. Both buildings have been razed and replaced by newer buildings, and no indications of their former use were identified during the site reconnaissance. The CARSI Phase II Report (Mitretek 1999) notes that "CAIS appears to have been present at Nellis AFB for training in 1945," but the report did not identify the location or disposition of this material. However, according to the CARSI Phase II, "The sources consulted at Nellis AFB do not believe that CAIS or CWM were stored in the Chemical Bomb Magazine." In addition, "There was no evidence that any chemical agents were used in the gas chambers [i.e., gas instruction building] at Nellis AFB."

## 6.6 Known/Suspected MC

Details of MEC used at Nellis AFB are located on **Table 6-2**. This table lists the size/type, nomenclature, net explosive weight (NEW), MC, and fuzes associated with each of the items. It should be noted that records on individual MEC items used at Nellis AFB were not located and EOD records generally only indicated the generic classification of the item removed (e.g., 20mm TP). Therefore, a comprehensive review of all items used during the time period when the activities occurred at Nellis AFB within each of the generic classifications was performed. A listing of the MC associated with each of the MEC types follows:

- Demolition Materials: Metals (primarily lead) and explosives and explosives constituents (RDX, TNT, PETN, potassium chlorate, lead azide, lead styphnate and barium chromate);
- Bombs and Bomb Fuzes: Metals (aluminum, antimony, chromium, iron, copper, lead, and zinc), explosives and explosives constituents (RDX, TNT, PETN, tetryl, nitroglycerin, nitrocellulose, potassium nitrate, potassium chlorate, red phosphorous, lead sulfocyanate and lead azide), and other organic compounds (titanium tetrachloride, polyisobutylene, motor oil, and gasoline);
- Rockets and Rocket Fuzes: Metals (aluminum, antimony, chromium, iron, copper, lead, and zinc), explosives and explosives constituents (RDX, TNT, tetryl, lead azide, potassium chlorate, and nitrocellulose), and other organic compounds (ethylcellulose and diazodinitrophenol);

**Table 6-2**
**Composition of Munitions Potentially Used at Nellis AFB**

| Size/Type | Nomenclature | Net Explosive Weight (LBS) | Munitions Constituent(s) | MC Ref Pub(s) | Fuzes |
|---|---|---|---|---|---|
| **DEMOLITION MATERIALS** | | | | | |
| Fuse, Time, Blasting | M700 | Unknown | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) | TM 43-0001-38 | N/A |
| Igniter, Time Blasting Fuse | M60/T2 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 43-0001-38 | N/A |
| Charge, Demolition Block | M3 | 2.25 pounds | Composition C-3 is 77% RDX, 3% tetryl, 4% TNT, 1% NC, 5% MNT (mononitrotoluol), and 10% DNT (dinitrotoluol). Composition C-2 is 80% RDX, 4% TNT, 1% NC, 5% MNT (mononitrotoluol), and 10% DNT (dinitrotoluol). | TM 43-0001-38 | N/A |
| Charge, Demolition, C-4 | M112 | 1.25 pounds | RDX 91%, Non-explosive plasticizers 9% | TM 43-0001-38 | N/A |
| Charge, Demolition, TNT Block | None | 1 pound | TNT | TM 43-0001-38 | N/A |
| Cap, Blasting, Nonelectric | M7 | 13.5 grains | PETN or RDX in base charge | TM 43-0001-38 | N/A |
| | | <1 gram | Lead Azide in ignition charge | | |
| Cap, Blasting, Electric | M60/T2 | <1 gram | PETN or RDX in base charge | TM 43-0001-38 | N/A |
| | | <1 gram | Lead Azide in intermediate charge | | |
| | | <1 gram | Lead Styphnate and Barium Chromate in ignition charge | | |
| | | <1 gram | Sulfur | | |
| Cord, Detonating | Lightweight | 25 grains per foot | PETN | TM 43-0001-38 | N/A |
| | Wirebound | 42 grains per foot | | | |
| | Reinforce Pliofilm | 42 grains per foot | | | |
| | Primacord | 50 grains per foot | | | |
| **BOMBS** | | | | | |
| Bomb, Practice, 5-lb | MK 106 Mod 0, 1, 2, 3, 4 or 5 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 | Integral or M173 Modified |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Bomb, Practice, 100-lb | M38A2 | 3 pounds | Black Powder: Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) | TM 9-1980, TM 9-1904 and OP 1280 | Intergral |
| Bomb, Practice (Low Drag), Concrete or Sand Filled, 500-lb, with Spotting Charge | MK 82 | 6.25 pounds | Composition C-4 (in Spotting Charge): RDX (91%), di(2-ethylhexyl) (5.3%), polyisobutylene (2.1%), motor oil (1.6%) | OP 1280 | FMU-26 series,FMU-54 series AN-M190, AN-M905, ANM906, AN-M990 Series, MK 344 and MK 376 |
| Bomb, Practice (Low Drag), Concrete or Sand Filled, 500-lb, with Signal Cartridge | MK 82 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | OP 1280 | Intergral with Signal Cartridge |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Bomb, Practice, 25 pound | MK 76 Series | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 and OP 1280 | Integral with Signal Cartridge |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |

**Table 6-2**
**Composition of Munitions Potentially Used at Nellis AFB**

| Size/Type | Nomenclature | Net Explosive Weight (LBS) | Munitions Constituent(s) | MC Ref Pub(s) | Fuzes |
|---|---|---|---|---|---|
| Bomb, Dummy Unit, Simulated, 25 pound | BDU-33 Series | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 | MK 1 Mod 0 Firing Pin Assembly |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Bomb, Practice, 3 pound | MK 23 and MK 5 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 and OP 1280 | Integral with Signal Cartridge |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Bomb, Practice, 4.5 pound | MK 43 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 and OP 1280 | Integral with Signal Cartridge |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Bomb, Practice, 750 pound, inert | M117 | 4 or 6.25 pounds | Black Powder (4 pounds) or Composition C-4 (6.25 pounds) in Spotting Charge | OP 1280 | FMU-26 series,FMU-54 series AN-M190, AN-M905, ANM906, AN-M990 Series, MK 344 and MK 376 |
| Bomb, Fire, Napalm | BLU-27 | 873 pounds | Napalm B (gasoline and thickening agent) and M23 igniter | OP 1280 | FMU-7 Series |
| **BOMB FUZES** | | | | | |
| Fuze, Impact, All-ways | M173 | 12 grams | Tetryl Booster | TM 9-1325-200 | N/A |
| | | <1 gram | Lead Azide and Tetryl Detonator | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate Primer | | |
| Fuze, Nose and Tail, Multipurpose | FMU-26/B and FMU-26B/B | <1 gram | Unknown MC in two Battery Firing Devices (BFD's) | OP 1280 | N/A |
| | | <1 gram | Lead Azide and PETN in electric detonator | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate in percussion primer | | |
| | | 5 or 45 grams | Propellant (5 grams) or RDX (45 grams) in booster | | |
| Fuze, Tail, Inertial | FMU-54A/B | <1 gram | Lead Azide and RDX in percussion detonator | OP 1280 | N/A |
| | | <1 gram | Lead Azide and PETN in electric detonator | | |
| | | <1 gram | Tetryl in short explosive lead | | |
| | | <1 gram | Tetryl in long explosive lead | | |
| | | 159 grams | Tetryl in booster pellet | | |
| Fuze, Tail, Inertial | FMU- 54/B | <1 gram | Lead Azide and PETN in Primer | OP 1280 | N/A |
| | | <1 gram | Lead Azide and RDX in percussion detonator | | |
| | | <1 gram | Tetryl in short explosive lead | | |
| | | <1 gram | Tetryl in long explosive lead | | |
| | | 153 grams | Tetryl in booster pellet | | |
| Fuze, Tail, Impact Inertia | AN-M190 | <1 gram | Lead Azide and PETN in Primer | TM 9-1325-200 | N/A |
| | | <1 gram | Black Powder Ignition and Delay Element | | |
| | | <1 gram | RDX Detonator | | |

**Table 6-2**
**Composition of Munitions Potentially Used at Nellis AFB**

| Size/Type | Nomenclature | Net Explosive Weight (LBS) | Munitions Constituent(s) | MC Ref Pub(s) | Fuzes |
|---|---|---|---|---|---|
| Fuze, Tail, Impact, Short Delay | AN-M905 | <1 gram | Lead Styphnate Percussion Primer, Lead Azide Explosive Primary Delay, and Pyrotechnic Relay in the M9 Delay Element | TM 9-1325-200 | N/A |
| | | <1 gram | Lead Azide Explosive Secondary Relay | | |
| | | <1 gram | Lead Azide and Tetryl in M35 Detonator | | |
| Fuze, Tail, Impact | AN-M906 | <1 gram | Lead Styphnate Percussion Primer and Lead Azide Explosive Primary Relay | TM 9-1325-200 | N/A |
| | | 7 grams | Manganese, Lead Chromate, and Barium Chromate in Pyrotechnic Delay | | |
| | | <1 gram | Lead Azide Explosive Secondary Relay | | |
| | | <1 gram | Lead Azide and Tetryl in M35 Detonator | | |
| Fuze, Tail, Impact, Electric | AN-M990 | <1 gram | Two Explosive Bellows | OP 1280 | N/A |
| | | <1 gram | Lead Azide and PETN in electric detonator | | |
| | | 116 grams | Tetryl Booster | | |
| Fuze, Tail, Electric | MK 344 Mod 0 and MK 376 Mod 0 | <1 gram | Unknown MC in two Explosive Bellows | OP 1280 | N/A |
| | | <1 gram | Lead Azide and PETN in MK 100 electric detonator | | |
| | | 113 grams | Tetryl Booster | | |
| Fuze Sets, Electric | FMU-7 Series | <1 gram | Lead Azide in M26 Percussion Primer | TM 9-1325-200 | N/A |
| | | <1 gram | Lead Azide and Tetryl in M31A1 Detonator | | |
| | | 12 grams | Tetryl Burster | | |
| **ROCKETS** | | | | | |
| Rocket, 2.75 inch, Warhead, HE | M229 | 4.8 pounds | Compositon B4 | TM 43-0001-30 | M423, M427, M429 and M433 |
| Rocket, 5 inch, Warhead, HE, Aircraft | MK 1 Mod 0 | 8.6 pounds | TNT | OP 1664 and OP 1157 | MK 148 and MK 149 |
| Rocket, 2.75 inch, Motor, LSFFAR | MK40 Mods 0, 1, and 3 | 5.9 pounds | Double-Base Propellant | TM 43-0001-30 and TM 9-1340-222-20 | N/A |
| | | 10 grams | Black Powder (80%) and Coated Magnesium Powder (20%) in MK125 Mod 4 or 5 Igniter Charge | | |
| | | <1 gram | Potassium chlorate (60%), Diazodinitrophenol (20%), Charcoal (15%), Nitrostarch (5%) in MK1 Mod 0 Electric Squib | | |
| Rocket, 2.75 inch, Motor, SSFFAR | MK66 Mod 2 | 7.21 pounds | Extruded Double-Base, Ethylcellulose Inhibited Propellant | TM 43-0001-30 and TM 9-1340-222-20 | N/A |
| | | 10 grams | Black Powder (80%) and Coated Magnesium Powder (20%) in MK125 Mod 4 or 5 Igniter Charge | | |
| | | <1 gram | Potassium chlorate (60%), Diazodinitrophenol (20%), Charcoal (15%), Nitrostarch (5%) in MK1 Mod 0 Electric Squib | | |
| Rocket, 3.25 inch, Motor, A.R. | MK 7 | Unknown | MK 9 Mod 0 Black Powder Igniter | OP 1664 and OP 1157 | N/A |
| | | <1 gram | Potassium chlorate (60%), Diazodinitrophenol (20%), Charcoal (15%), Nitrostarch (5%) in MK1 Mod 0 Electric Squib | | |
| | | 6.5 pounds | MK 13 Mod 0 Single grain Ballistite Propellant | | |
| **ROCKET FUZES** | | | | | |
| Fuze, 2.75 inch, Rocket, PDSQ | M423 and M427 | <1 gram | Lead Azide in Primer | TM 43-0001-30 | N/A |
| | | <1 gram | Lead Azide and RDX in M59 Detonator | | |
| | | <1 gram | Tetryl in explosive lead | | |
| | | 9 grams | Tetryl Booster | | |
| Fuze, 2.75 inch, Rocket, Proximity | M429 | <1 gram | Lead Azide and RDX in Electric Stab Detonator | TM 43-0001-30 | N/A |
| | | 9 grams | Tetryl Booster | | |
| Fuze, 2.75 inch, Rocket, Electric Time | M433 | <1 gram | Lead Azide and RDX in Electric Stab Detonator | TM 43-0001-30 | N/A |
| | | 9 grams | Tetryl Booster | | |

**Table 6-2**
**Composition of Munitions Potentially Used at Nellis AFB**

| Size/Type | Nomenclature | Net Explosive Weight (LBS) | Munitions Constituent(s) | MC Ref Pub(s) | Fuzes |
|---|---|---|---|---|---|
| Fuze, Nose, Impact, 5 inch, Rocket | MK 148 | <1 gram | Lead Azide and RDX in Shutter Detonator | OP 1664 and OP 1157 | N/A |
| | | <1 gram | Tetryl Explosive Lead | | |
| | | 9 grams | Tetryl Booster | | |
| Fuze, Nose, Impact, 5 inch, Rocket | MK 149 | <1 gram | Lead Azide and RDX in Shutter Detonator | OP 1664 and OP 1157 | N/A |
| | | <1 gram | Tetryl Explosive Lead | | |
| | | 9 grams | Tetryl Booster | | |
| **PROJECTILES** | | | | | |
| Cartridge, 20mm, HEI | M97A2 | 120 grains | RDX | TM 43-0001-27 | M505A3 |
| | | Unknown | Incendiary Pellet | | |
| | | 470 grains | Black Powder in M12 propellant | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate Electric Primer | | |
| Cartridge, 20mm, HEI | M56A3 | 165 grains | H761 Propellant | TM 43-0001-27 | M505A3 |
| | | 20 grains | I136 Incendiary Pellet | | |
| | | 585 grains | WC870 Propellant | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate Electric M52A3B1 Primer | | |
| Cartridge, 20mm, Anti-Aircraft, HE-T | MK 4 | 0.01 pound | Tetryl or PETN | OP 1212 | MK 26 Mod 0 or 2 |
| | | <1 gram | Lead Azide and Tetryl Detonator | | |
| | | <1 gram | Lead Azide in Percussion Primer | | |
| Cartridge, 20mm, Target Practice (TP) | M99A1 | 500 grains | Black Powder Propellant | TM 43-0001-27 | N/A |
| | | <1 gram | Pyrotechnic Tracer Composition | | |
| | | 500 grains | Black Powder Propelling Charge | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate Electric Primer | | |
| Cartridge, 37mm, HE | M54 | 0.1 pound | Tetryl | TM 9-1901 | M56 |
| | | 0.25 pound | Pyrotechnic Tracer Composition | | |
| | | <1 gram | Lead Azide and Tetryl M23A2 Primer | | |
| | | .38 lb or .15 lb | Flashless Non-hygroscopic powder | | |
| | | 20 grain | Ingiter | | |
| | | Unknown | Tetryl Booster | | |
| **OTHER MUNITIONS** | | | | | |
| Igniter, Bomb, WP | M23 | 1.25 lb | White Phosphorous | TM 9-1325-200 | M173 |
| Cartridge, Signal | MK 5 | <1 gram | Potassium Chlorate and Lead Sulfocyanate Percussion Primer | TM 9-1325-200 | Integral with Signal Cartridge |
| | | 3 grams | Black Powder; Potassium nitrate (74%), Charcoal (15.6%), Sulfur (10.4%) or Smokeless Powder; Nitrocellulose (55%), Nitroglycerin (40%), Stabilizer (5%) | | |
| | | 10 or 43 grams | Signal: Red Phosphorus (10g), Zinc Oxide (10g), Unknown Composition (10g), or Titanium Tetrachloride (43g) | | |
| Grenade, Hand, Smoke | M8 | 19.0 oz | HC-C Smoke Mixture, Aluminum, Zinc Oxide, and Hexachlorethane | TM 43-0001-29 | M201A1 |
| | | <1 gram | Starter Mixture, Barium nitrate, Strontium nitrate, Potassium nitrate, Magnesium, Dechlorane and Black Powder | | |
| Grenade, Hand, Smoke | M18 | 11.5 ounces | Smoke Mixture, Potassium chlorate, Lactose, Colored dye | TM 43-0001-29 | M201A1 |
| | | <1 gram | Starter Mixture, Barium nitrate, Strontium nitrate, Potassium nitrate, Magnesium, Dechlorane and Black Powder | | |

**Table 6-2**
**Composition of Munitions Potentially Used at Nellis AFB**

| Size/Type | Nomenclature | Net Explosive Weight (LBS) | Munitions Constituent(s) | MC Ref Pub(s) | Fuzes |
|---|---|---|---|---|---|
| Grenade, Hand, Incendiary, TH3 | AN-M14 | 26.5 ounces | Thermite TH3 and Thermite (plain) | TM 43-0001-29 | M201A1 |
| | | <1 gram | Iron Oxide, Titanium, and Zirconium in Ignition Mixture | | |
| | | <1 gram | Titanium Powder, Potassium Perchlorate and Zirconium Nickel Alloy Pyrotechnic Delay | | |
| | | <1 gram | Potassium Chlorate and Lead Sulfocyanate M39A1 Percussion Primer | | |
| Grenade, Hand, Fuze | M201A1 | < 1 gram | Primer, Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide | TM 43-0001-29 | N/A |
| | | < 1 gram | Delay Element, Black Powder | | |
| | | < 1 gram | Ignition Mixture, Iron Oxide, Titanium, Zircronium- | | |

**REFERENCES**


TM 9-1325-200, Army Technical Manual, Bombs and Bomb Components, 1966
TM 9-1901, Army Technical Manual, Artillery Ammunition, 1950
TM 9-1904, Army Technical Manual, Ammunition Inspection Guide, 1944
TM 9-1980, Army Technical Manual, Bombs for Aircraft, 1944
TM 43-0001-29, Army Ammunition Data Sheets, Grenades, 1994
TM 43-0001-30, Army Ammunition Data Sheets, Rockets, 1981
TM 43-0001-38, Army Ammunition Data Sheets, Demolition Materials, 1994
OP 1157, Ordnance Pamphlet, Rocket Ammunition, 3.5 and 5 inch, 1945
OP 1212, Ordnance Pamphlet, Projectile Fuzes, 1945
OP 1280, Ordnance Pamphlet, Aircraft Bombs, 1957
OP 1664 Volume II, Ordnance Pamphlet, U.S. Explosive Ordnance, 1969

- Projectiles: Metals (aluminum, antimony, chromium, iron, copper, lead, and zinc), and explosives and explosives constituents (RDX, tetryl, PETN, potassium chlorate, lead azide, and lead sulfocyanate);
- Other Munitions: Metals (aluminum, antimony, chromium, iron, copper, lead, and zinc), explosives (white phosphorous, nitrocellulose, tetryl, nitroglycerin, lead azide, potassium chlorate), and other organics (tetrachloride and potassium perchlorate); and
- Small Arms - Metals (antimony, iron, copper, lead, and zinc).

MC associated with the MEC (metals, explosives, etc.) dissipate through the soil through infiltration and percolation. In addition to being transported, contaminants in the environment may also transfer from one medium to another, such as from soil to groundwater or surface water, or from one surface water body to another. The propensity of a chemical to react to equilibrium conditions in the environment and transfer between media is an important factor determining the mobility of a compound.

The physical properties of the primary MC associated with the items used at Nellis AFB (metals, explosives) tend to bind to organic matter (metals) or biodegrade (explosives). Based on the physical properties of the MC and the dry climate at Nellis, vertical migration will be very limited.

## 6.7 Explosive Safety Submission Information

An ESS is used to provide munitions response action safety criteria for approval by an appropriate DoD element and is completed per Data Item Description MR-060, which incorporates requirements from Engineer Pamphlet (EP) 385-1-95b.

An ESS must be done for all response actions, even if the recommended response action is either No DoD Action Indicated (NDAI) or Institutional/Engineering Controls. Typically, the ESS will be completed during the remedial design phase. An ESS currently is not required for the purpose of investigation. The purpose of the ESS is to ensure that all applicable DoD and Department of the Army explosive safety standards are applied during a munitions response action. The ESS design elements that pertain to Nellis AFB are described in this section.

### 6.7.1 Munitions with the Greatest Fragmentation Distance

For Quantity-Distance purposes, munitions with the greatest fragmentation distance (MGFD) were established for each MRA based on TP 16, Rev 1. The MGFD is the round with the greatest fragment distance that can reasonably be expected to exist in any particular MRS. The MGFD can be selected from historical or site investigation data; however, site investigation data is best. For Nellis AFB, only historical data and the Phase I and Phase II CSE visual survey findings were available for the MGFD calculation. The MGFDs for the Nellis AFB MRA follow (note that these distances do not include a safety buffer):

- MU732: The MGFD is a 5-inch Rocket, MK 1 Mod 0 HE warhead; 1,650 feet.
- XU741: No evidence of MEC was identified during the CSE Phase II; therefore, an MGFD is not associated with this MRA.
- TM742: No evidence of MEC was identified during the CSE Phase II; therefore, an MGFD is not associated with this MRA.

### 6.7.2 Maximum Credible Event

For explosives-contaminated soil, a Maximum Credible Event (MCE) was established. For soil, the MCE is the concentration of explosives times the weight of the mix. When the concentration varies within the area, weighted averages or any other valid mathematical technique can be used, as long as the technique is explained and technically supported in the ESS.

For all of the MRAs at Nellis AFB, a MCE does not apply as significant quantities of explosives were not identified in the soil.

### 6.7.3 Frost Line

Nellis AFB has a frost line of 7 inches (DoD, 2005). The frost line depth is considered to be the depth at which a significant number of frost cycles are expected, there is frost susceptibility, and moisture is available. All three of these parameters are required to produce frost-related migration of MEC. Specific properties of soils on Nellis AFB are discussed in Section 3.4.1.

# 7.0 EVALUATION OF HAZARDOUS WASTE/SUBSTANCES

The following information has been extracted from the CSE Phase I Report (URS 2007). Research to evaluate the completeness of this information was not performed as part of the CSE Phase II activities, which were tailored towards MMRP data gathering only.

## 7.1 Hazardous Waste Activities

Waste disposal activities are known to have occurred at several IRP sites located, at least partially, within the boundaries of MU732 (refer to Section 7.2 for details). In addition, several ammunition and target material (i.e., 12-gauge shells and clay pigeons) burn pits have been identified within the boundaries of MU732. These burn pits were investigated as IRP site OT-36, as discussed in Section 7.2.3. Environmental sampling completed at these disposal areas has not identified the presence of any hazardous waste.

No evidence of any other waste-related activities was identified at any of the other Nellis AFB MRAs during the CSE Phase II activities. However, it is possible that the MC associated with the potential MEC that may be present at the MRA could have released hazardous constituents to the environment.

## 7.2 Hazardous Waste Characteristics

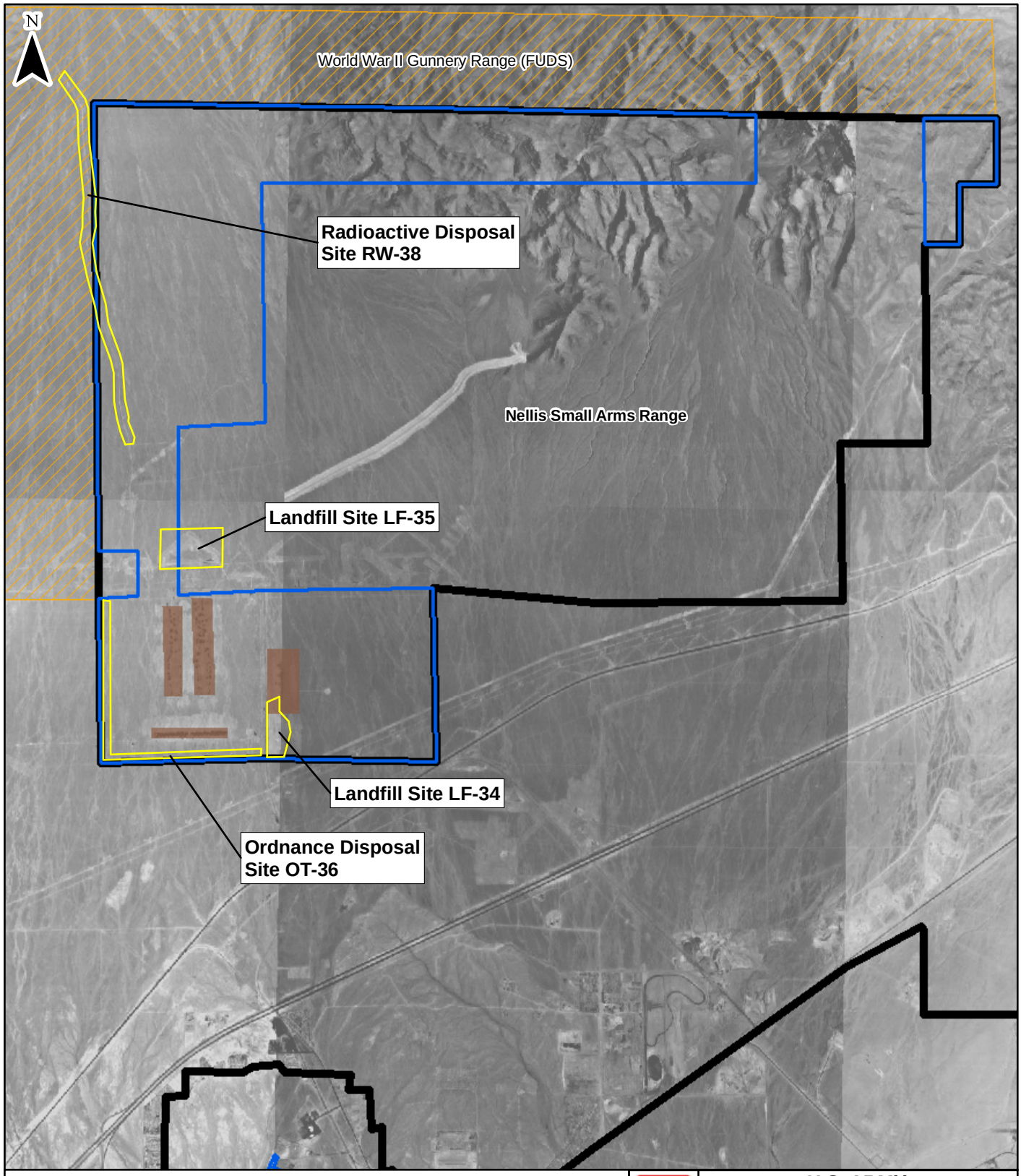
Four closed IRP sites are located wholly or partially within the boundaries of MU732 as shown on **Figure 7-1**. Environmental sampling completed at all four sites has not identified hazardous waste at any of the sites. NFA determinations have been issued by NDEP for all four sites. Previous investigation results are discussed in Section 2.6 and summarized below.

### 7.2.1 Landfill Site LF-34

Landfill Site LF-34 was reportedly a disposal site for waste generated from all of Nellis AFB during the late 1960s. The landfill has been inactive and largely covered over for many years. Eight rounds of groundwater sampling from three monitoring wells were completed at the site. Low levels of TCE and dissolved metals were historically present, but all VOCs, including TCE, were non-detect during the last round of sampling. The decision document concluded that there is no evidence to indicate that Site LF-34 is adversely affecting human health or the environment, and NDEP concurred.

### 7.2.2 Landfill Site LF-35

Landfill Site LF-35 was reportedly used as the Nellis AFB landfill during the early 1970s. Wastes including solvents, paints, and lubricants may have been disposed of in this landfill. Only a small area of buried debris was identified near the suspected location of this site, but the material found appeared to be Nellis AFB waste. No VOCs, polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), or dissolved metals were detected in groundwater samples collected from a groundwater monitoring well located immediately downgradient of this site. The decision document recommended no further investigation for Site LF-35, and NDEP concurred.




LEGEND

- Installation Boundary
- Munitions Response Area
- FUDS Property
- IRP Site
- Clay Pigeon Debris Area

0 4,000 8,000 Feet

Projection : NAD83 State Plane Nevada East

**U.S. ARMY CORPS OF ENGINEERS**
**OMAHA DISTRICT**

**MILITARY MUNITIONS RESPONSE PROGRAM**

**FIGURE NUMBER** 7-1

**IRP SITE LOCATIONS IN MU732**
**NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West

#### 7.2.3 Ordnance Disposal site OT-36

Ordnance Disposal Site OT-36 is an L-shaped disposal area located in the southwest corner of MU732 that was used for small arms residue burning and munitions residue disposal. Miscellaneous skeet range target debris is also scattered throughout the site area. A USAF IRP Phase I study determined that contaminant migration from ordnance waste was not anticipated because of the physical character of the ordnance and the relative lack of transport mechanisms. The site did not warrant examination during the IRP Phase II studies. A 1992 EOD sweep found no ordnance or explosive hazards at the site. The decision document recommended no further investigation for Site OT-36, and NDEP concurred.

#### 7.2.4 Radioactive Disposal Site RW-38

The Radioactive Disposal Site RW-38 was reportedly a radioactive waste disposal site; however, the actual location of the site could not be verified in the field. The entire area of the suspected site location was surveyed, but no radioactivity above background levels was measured. Therefore, no further investigation or remediation was recommended for the site, and NDEP concurred.

### 7.3 Identification of Source Areas

The only potential source areas positively identified during the CSE Phase II site reconnaissance are the burn pits located outside the four IRP sites at MU732. Other potential source areas associated with the Nellis AFB MRAs include firing points and target areas, as well as the bomb jettison area at MU732.

### 7.4 Potential Contaminants of Concern Known/Suspected Releases

The CSE Phase II investigation did not identify any contaminants of concern or known or suspected releases within the MRAs associated with Nellis AFB.

# 8.0 CONCEPTUAL SITE MODEL

The CSM was developed to address MEC and/or MC environmental contamination. The CSM is a description of the site and its environment based on existing knowledge. It describes contamination sources and possible receptors, and the interactions that link them. It is intended to assist in planning, interpreting data, and communicating. The CSM is used as a planning tool to integrate information from a variety of resources, to evaluate the information with respect to project objectives and data needs, and to evolve through an iterative process of further data collection or action. The information provided was refined through the CSE Phase II process.

## 8.1 MEC

Munitions-related activities that have occurred at Nellis AFB are the primary source of MEC. Based on review of the archival records and available documentation, the principal sources of MEC anticipated at Nellis AFB are:

- MU732: Small arms, projectiles, rockets, bombs, and incendiary items being fired, as well as demolition materials;
- XU741: Pyrotechnics and chemical bombs left or abandoned at the magazine area; and
- TM742: Pyrotechnics and practice munitions being fired.

These activities potentially resulted in MEC being present in the soil and on the ground surface of Nellis AFB. A summary list of MEC items (i.e., bombs, rockets, other munitions) encountered and reported at Nellis AFB is presented in Section 6.1 and detailed in **Appendix F**. The results from the visual surveys performed during the CSE Phase II at the Nellis AFB MRA are presented as **Figures 5-1, 5-9,** and **5-11**.

### 8.1.1 MEC Exposure Pathway Analysis

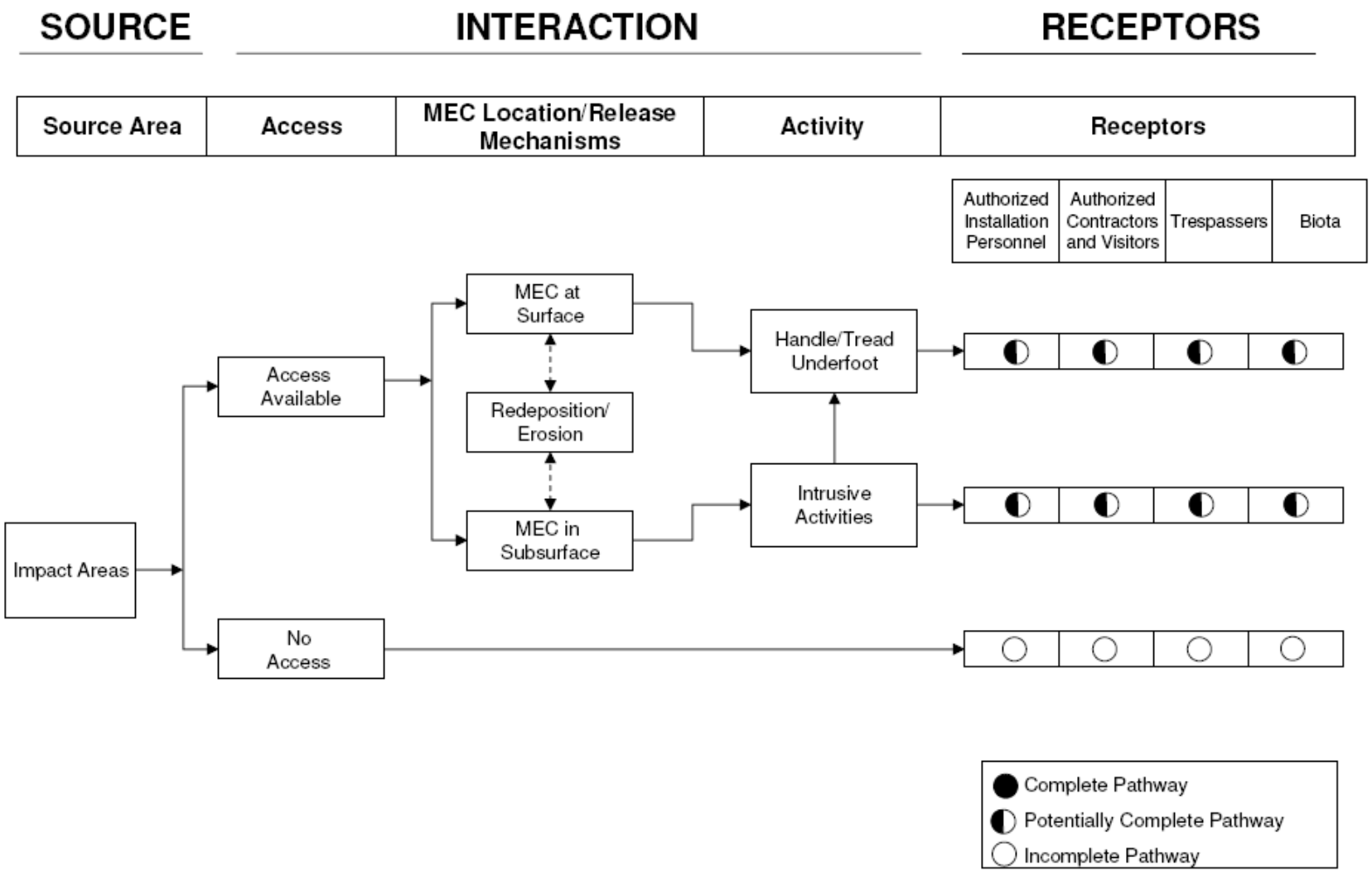
The information presented in the CSM was used to identify all actual, potentially complete, or incomplete source–receptor interactions for the site, for both current and reasonably anticipated future land uses. An exposure pathway is the course a chemical or physical agent takes from a source to a receptor. Each MEC pathway includes a source, access, activity, and a receptor. Each MC pathway includes a source, an exposure medium, an exposure route, and a receptor. The MC pathways may also include a release mechanism (i.e., volatilization) and a transport medium (i.e., air) if the point of exposure is not at the same location as the source. The exposure pathway analysis for the Nellis AFB MRAs is presented as **Figures 8-1** through **8-3**. Note that for XU741, no MEC was identified and is not anticipated based on the results of the CSE Phase II. Therefore, all exposure pathways at this MRA were considered incomplete.

TM742 (Former Navy Training Area) was identified as a potential training and maneuver area. As discussed in Section 5.3.3, TM742 is currently classified as a closed range and access to this area is restricted and controlled by Nellis AFB Operations. Site reconnaissance was performed during the CSE Phase II and no evidence of MEC was observed at the site. One MD item, a smoke grenade, was identified.

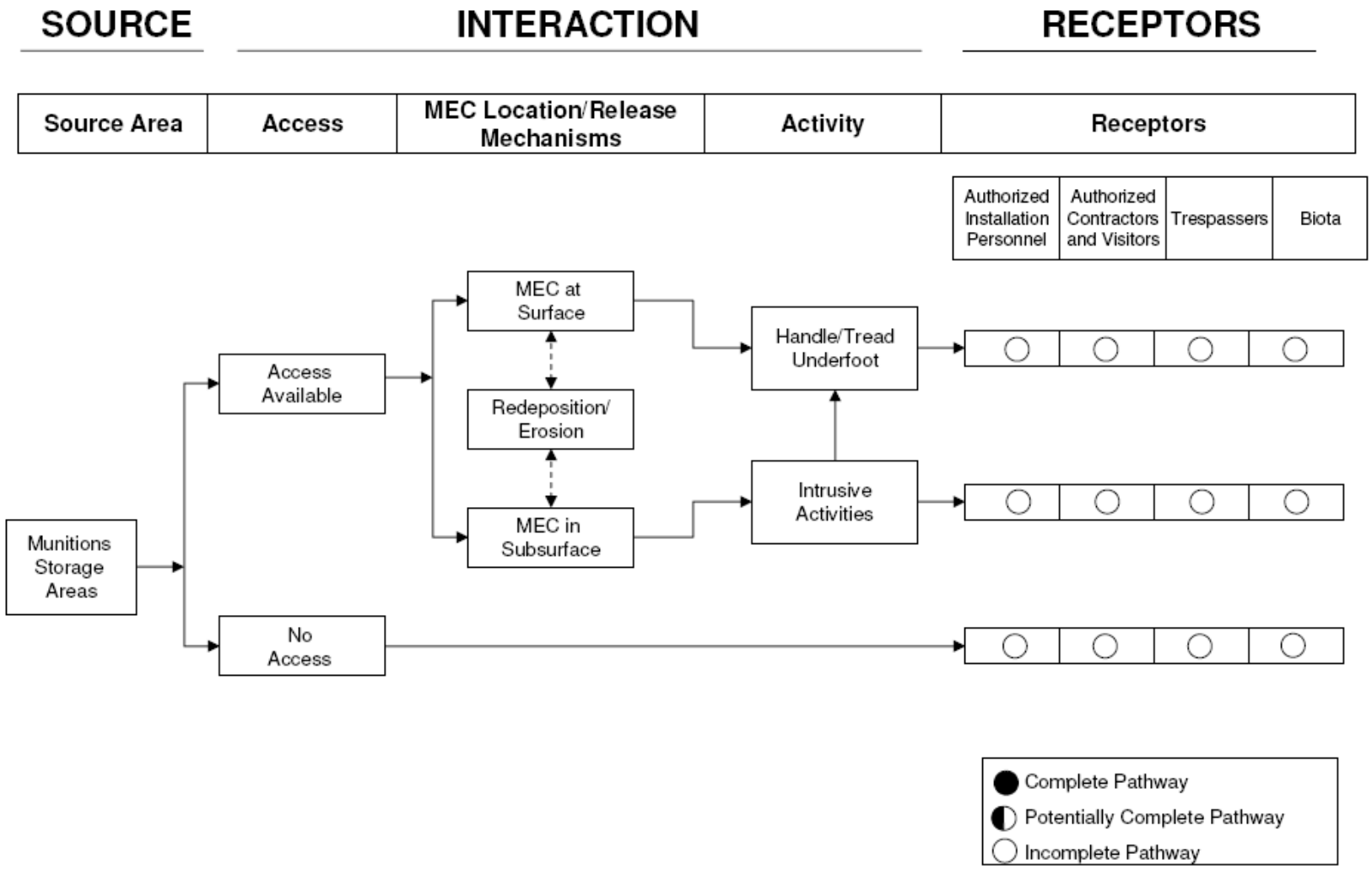
### 8.1.2 Transport Processes

Source areas at Nellis AFB include target areas where MEC was distributed. At the time of the MEC release into the environment, the medium receiving the item was surface soil and subsurface soil.

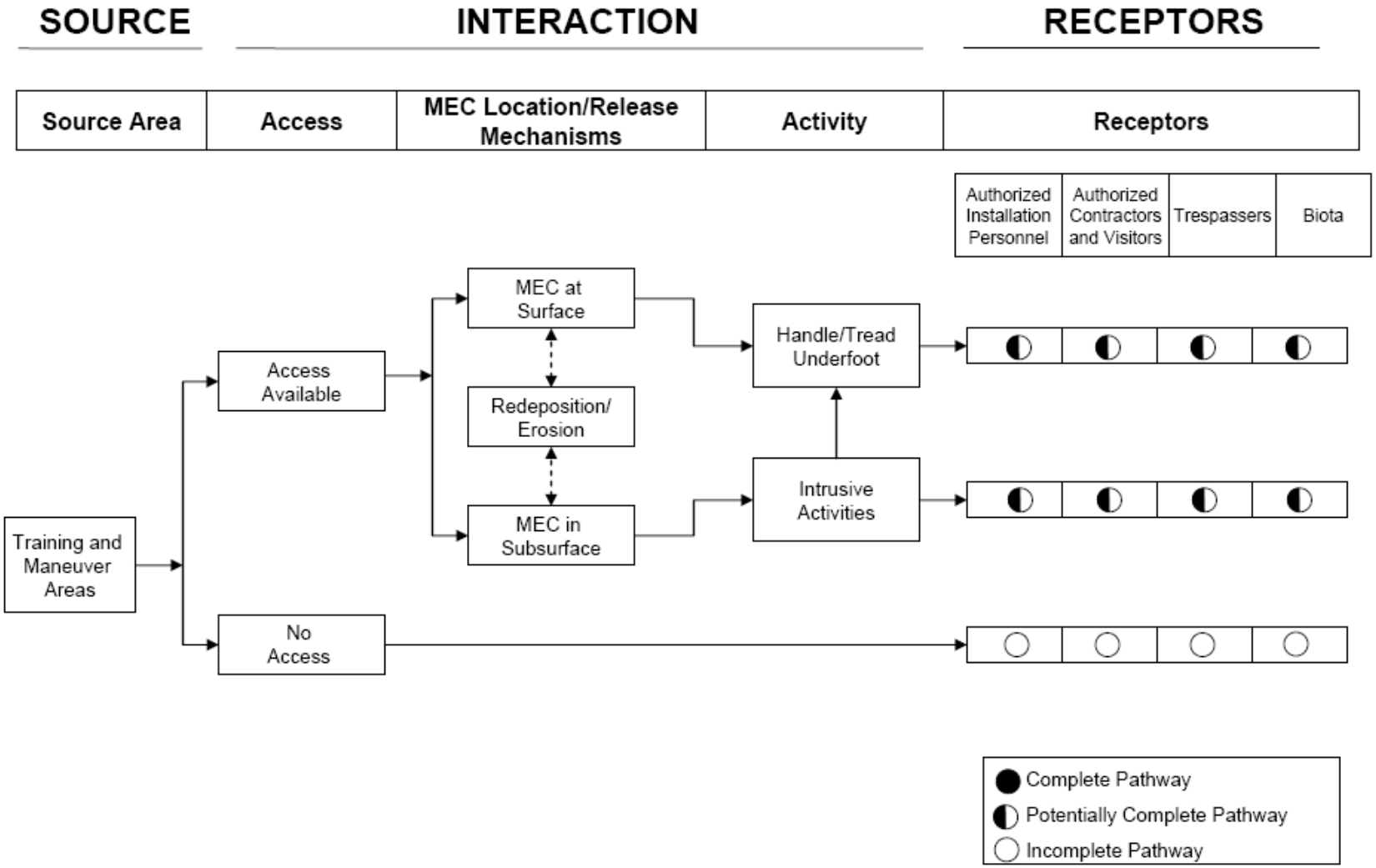
## Figure 8-1
## MEC Exposure Pathway Analysis – WWII Gunnery Range @ Range Road (Excess) MU732



## Figure 8-2
## MEC Exposure Pathway Analysis – Area III Magazines
## XU741



## Figure 8-3
## MEC Exposure Pathway Analysis – Former Navy Training Area TM742



A variety of naturally-occurring processes may alter the condition of the land at Nellis AFB resulting in a potentially explosive subsurface item being exposed at the surface and becoming more accessible to contact with people or the environment. An example of these processes includes erosion of the covering soil and frost heave. Flooding also results in changes to the amount of water in the ponds and streams at Nellis AFB. Flooding may increase the water cover over some additional acreage and MEC items, but also may cause MEC items to be dislodged and transported to other locations by the flood-induced runoff flow.

A variety of intrusive activities by people also may alter the condition of the land at Nellis AFB in a manner that a subsurface MEC item may become exposed at the surface. On land, these may include construction activities that involve excavation or re-contouring land; recreational activities; camping; timber harvesting; fire fighting; or continued military training activities.

One principle activity in evidence at Nellis AFB is the mechanical redistribution of soil as part of past construction or clearance activities. Any clearance and re-grading activities could have resulted in soil at various depths being mixed and potentially moved to different locations at Nellis AFB to be used as fill. The result of the action of these mechanisms and processes is a potentially different distribution of MEC than the one that may have existed at the time of original release. These locations become the points of potential direct contact exposure to people engaged in various activities.

### 8.1.3 Exposure Media and Accessibility

Interaction describes ways that receptors come into contact with a source. Movement of MEC is not anticipated to be significant and interaction will occur only at the source area, limited by access and activity. However, there can be some movement through natural processes, such as erosion (primarily vertical movement in the soil) or from human activity. Environmental contaminants, such as MC, often undergo various processes (e.g., migration), such that media other than the source area can become contaminated. Therefore, all potentially contaminated media (exposure media) were considered at the site.

### 8.1.4 MEC Exposure Receptors

Nellis AFB includes active operations and military training areas. Sixty-two percent of the main base is undeveloped, while the remaining area is either paved or contains structures. The total land area occupied by Nellis AFB and its restricted ranges is more than 5,000 square miles. An additional 7,700 square miles of airspace north and east of the restricted ranges are also available for military flight operations.

Therefore, the receptors considered for MEC at Nellis AFB MRAs were: authorized installation personnel, authorized contractors and visitors, and trespassers. In addition, as rare, threatened, and endangered species have been identified at the MRA, an evaluation of biota was also performed. All potential access and activities were considered in evaluating the source–receptor interactions at the site. The impacted media considered for Nellis AFB were surface and subsurface soil.

### 8.1.5 MEC Exposure Conclusions

Confirmed sensitive munitions were observed on the ground surface in MU732 (WWII Gunnery Range @ Range Road (Excess). As discussed in Section 5.1.3, MU732 is currently inactive and considered a closed range but is accessed by authorized installation personnel, authorized

contractors and visitors, and trespassers. Given the confirmation of sensitive munitions in this area, exposure pathways are considered potentially complete for this MRA.

No evidence of MEC was identified at XU741 (Area III Magazines) during the CSE Phase II. Therefore, the MEC exposure pathways for this MRA are incomplete for all receptors.

TM742 (Former Navy Training Area) was identified as a potential training and maneuver area. As discussed in Section 5.3.3, TM742 is currently classified as a closed range and access to this area is restricted and controlled by Nellis AFB Operations. Site reconnaissance was performed during the CSE Phase II and there was no evidence of MEC at the site (one MD item, a smoke grenade, was identified). Therefore, exposure pathways are considered incomplete for this MRA.

## 8.2 MC, Hazardous Substances, Pollutants/Contaminants, and Other Constituents

**Figure 1-1** shows the approximate locations of these exposure areas. The details on the MEC used at Nellis AFB (discussed in Section 6.6) are located in **Table 6-2**. This table lists the size/type, nomenclature, NEW, MC, and fuzes associated with each of the items. It should be noted that records on individual MEC items used at Nellis AFB were not located and EOD records generally only indicated the generic classification of the item removed (e.g., 3.5-inch rocket). Therefore, a comprehensive review of all items used during the time period when the activities occurred at Nellis AFB within each of the generic classifications was performed.

The fate and transport of the MC are dependent on a wide variety of factors. Contaminant fate refers to the expected final state that an element, compound, or group of compounds will achieve following release to the environment. Contaminant transport refers to migration mechanisms and rates of contaminants away from the source area. Migration pathways often include air, water, soil, and the interfaces between the phases of the contaminant (i.e., solid, liquid, or gas). The fate and transport of contaminants at Nellis AFB occurs in one of the three environmental media: terrestrial (i.e., not aquatic or atmospheric). Terrestrial environments are comprised of soil and groundwater; aquatic environments include surface water, marsh, and sediment; and air is the only component of the atmospheric environment.

In the terrestrial environment, if the contaminant is released to soil, the contaminant may volatilize, adhere to the soil by sorption, leach into the groundwater, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized, the compound may be released to the atmosphere, or if volatilization occurs in the subsurface, the contaminated vapor may migrate and sorb to previously uncontaminated soil or dissolve in groundwater. Constituents that are dissolved eventually may be transported to an aquatic environment. However, an aquatic environment is not presented within or near the Nellis AFB MRAs; therefore, this pathway is considered to be incomplete for this installation.

The terrestrial environment was evaluated during the CSE Phase II for all of the Nellis AFB MRAs.

The fate and transport of contaminants at Nellis AFB are strongly influenced by physical and chemical properties, as well as by environmental factors such as soil characteristics and groundwater flow. For example, the Henry's Law Constants, a measure of the volatility of a compound is related to other physical properties of the compound, the most important of which are vapor pressure and water solubility. Compounds exhibiting high vapor pressures and low

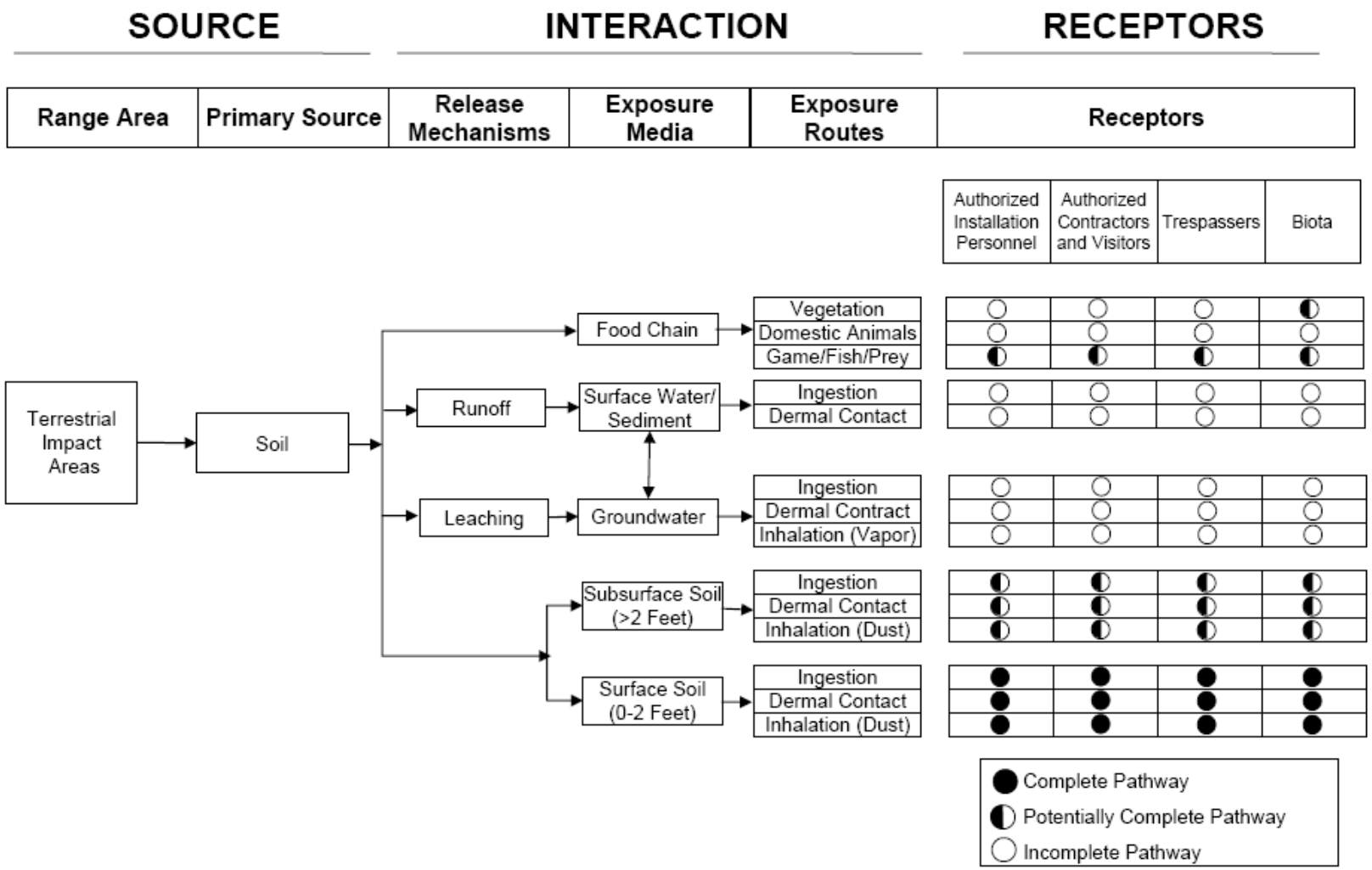
water solubilities tend to have high volatilization rates (and therefore, high Henry's Law Constants). The organic carbon/water partition coefficient ($K_{oc}$) value is a measure of the tendency of a chemical to be sorbed to the organic fraction of soil. The higher the value, the greater the sorption potential of the compound. The octanol/water partition coefficient ($K_{ow}$) value is an indication of whether a compound will dissolve in a solvent (i.e., n-octanol) or water. The properties of the compounds selected for further evaluation in the human health and ecological risk screening evaluations (lead and PAHs) are as follows:

**Lead (Pb)**: Lead is a naturally-occurring metal found in small amounts in the earth's crust. The most common form of lead found in nature is $Pb^{+2}$, although lead also exists to a lesser extent as $Pb^{+4}$ and in the organic form with up to four Pb-carbon bonds. Most lead deposited on surface soil is retained and eventually becomes mixed into the surface layer. The migration of lead in the subsurface environment is controlled by the solubility of lead complexes and adsorption to aquifer materials. Adsorption to soil greatly limits the mobility of lead in the environment. Lead may be immobilized by ion exchange with hydrous oxides or clays or by chelation with humic or fulvic acids in the soil (USEPA 1997a). Adsorption of Pb increases with increasing pH with most lead precipitating out at a pH greater than 6 (USEPA 1990). Adsorption of lead also increases as the amount of total organic carbon in the soil increases, thereby decreasing its mobility.

**PAHs:** The movement of PAHs in the environment depends on properties such as how easily they dissolve in water, and how easily they evaporate into the air. PAHs in general do not easily dissolve in water. They are present in air as vapors or stuck to the surfaces of small solid particles. They can travel long distances before they return to earth in rainfall or particle settling. Some PAHs evaporate into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms of rivers or lakes. In soils, PAHs are most likely to stick tightly to particles. Some PAHs evaporate from surface soils to air. Certain PAHs in soils also contaminate underground water. The PAH content of plants and animals living on the land or in water can be many times higher than the content of PAHs in soil or water. PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks to months and is caused primarily by the actions of microorganisms (ATSDR 1995).

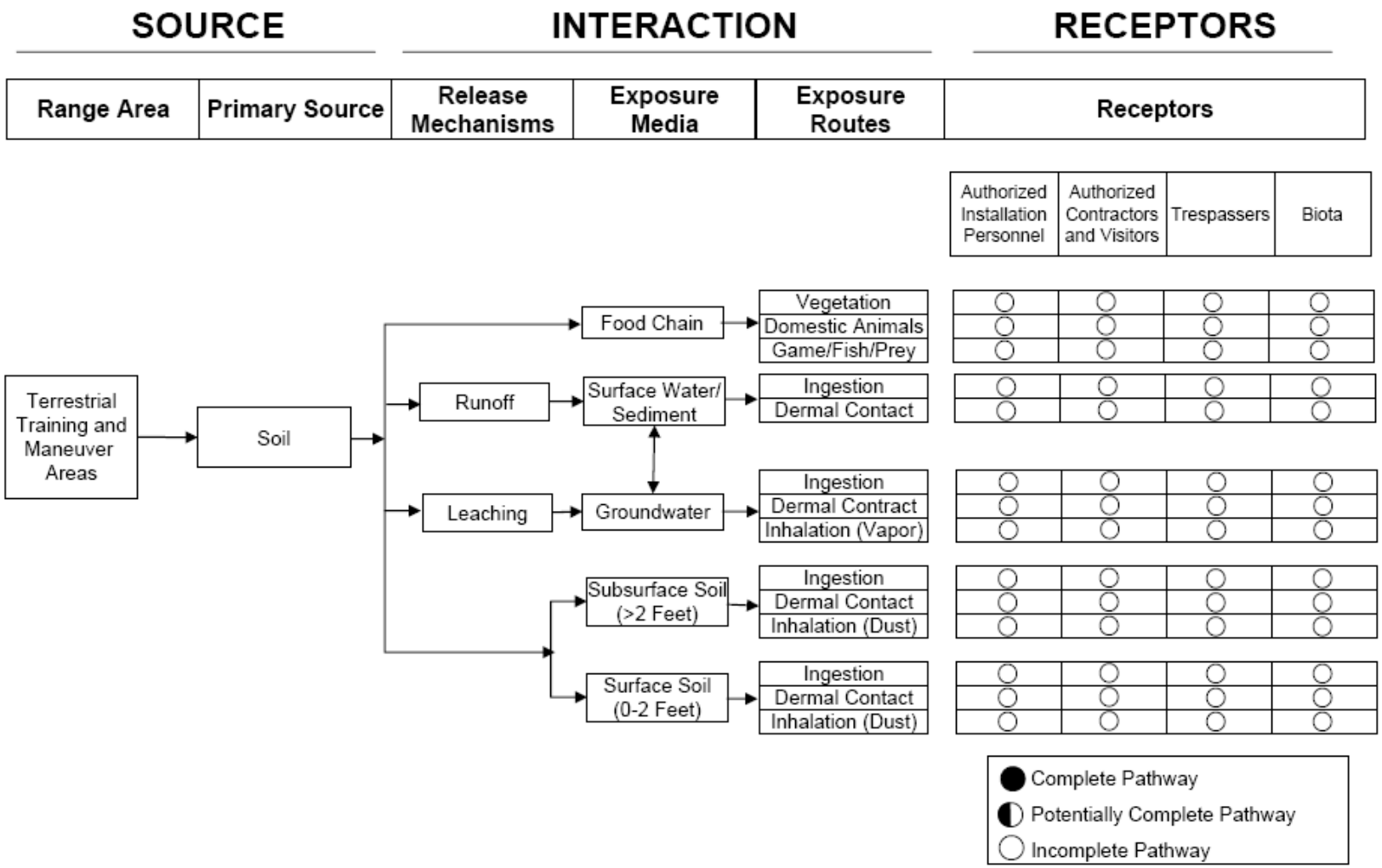
The CSMs for MC exposure areas are presented as **Figures 8-4** through **8-6**. Note that for XU741 and TM742, no environmental impacts associated with historical military munitions use were identified. Therefore, all exposure pathways were considered to be incomplete for these MRA.

# Figure 8-4
# MC Exposure Pathway Analysis – MU732
# Terrestrial



# Figure 8-5
# MC Exposure Pathway Analysis – XU741
# Terrestrial

# Figure 8-6
# MC Exposure Pathway Analysis – TM742
# Terrestrial



### 8.2.1 Soil Exposure Pathway Analysis

#### *8.2.1.1 Soil Exposure Receptors*

Appropriate human and ecological receptors to soil (surface and subsurface) were selected for Nellis AFB based on site-specific conditions. Human receptor subcategories considered for this evaluation include: authorized installation personnel, authorized contractors and visitors, and trespassers. Ecological receptors (plant and animal) also are considered given the viable habitat that exists and the number of rare, threatened, or endangered species identified at the base.

#### *8.2.1.2 Soil Exposure Conclusions*

Soil sampling was performed for MU732 and XU741 during the CSE Phase II. Based on the results of the soil sampling, the only impacts to soil were due to lead and PAHs (associated with clay pigeons) at MU732. However, evaluation of the burn pit identified in the northern portion of MU732 was not performed during the CSE Phase II. Evaluation of whether residual MC or other contaminants is associated with activities performed at the burn pits is warranted. MC was below residential screening levels and/or background concentrations at XU741. Soil samples were not collected at TM742 during the CSE Phase II as no MEC was observed. Therefore, an evaluation of MC impacts was not required. Based on the CSE Phase II sampling results, it was concluded that soil exposure is only considered to be associated with limited areas within MU732. Additional soil sampling in the remainder of Nellis AFB is not warranted.

### 8.2.2 Surface Water/Sediment Migration Pathway Analysis

#### *8.2.2.1 Surface Water/Sediment Receptors*

Appropriate human and ecological receptors to surface water were selected for Nellis AFB based on site-specific conditions. Human receptor subcategories considered for this evaluation included: authorized installation personnel, authorized contractors and visitors, and trespassers. Ecological receptors (plant and animal) also were considered given the viable habitat that exists and the number of rare, threatened, or endangered species identified at the base.

#### *8.2.2.2 Surface Water/Sediment Conclusions*

Surface water and sediment sampling was not performed for the CSE Phase II at Nellis AFB. During the scoping phase of the project, it was determined that the media most likely impacted by the MC associated with MEC used at Nellis AFB was soil. No significant surface water features were present at the Nellis MRAs; therefore, it is concluded that surface water and sediment does not have a complete pathway for migration of MC from Nellis AFB MRAs.

### 8.2.3 Groundwater Migration Pathway Analysis

#### *8.2.3.1 Groundwater Receptors*

A receptor is an organism (human or ecological) that contacts a chemical or physical agent. This pathway evaluation considers both current and reasonably anticipated future land uses, and receptors were determined on that basis. Only human receptors were selected for the groundwater migration pathway analysis, as ecological receptors are not likely to come into contact with the groundwater medium at Nellis AFB. Human receptor subcategories that are considered for this evaluation include: authorized installation personnel, authorized contractors and visitors, and trespassers.

#### *8.2.3.2 Groundwater Conclusions*

Groundwater sampling was not performed for the CSE Phase II at Nellis AFB. During the scoping phase of the project, it was determined that the media most likely impacted by the MC associated with MEC used at Nellis AFB was soil. This is based on the properties of the MC associated with military munitions activities at Nellis (i.e., metals, PAHs, and explosives) which bind to soil and the depth to groundwater. Nearly all of the groundwater supply in the Valley comes from a zone of confined and semi-confined principal aquifers at depths of 650-970 feet bgs. Depth to groundwater varies from site to site at Nellis AFB. Depths to the shallow aquifer (nonpotable and generally not suitable for irrigation) range from 40-90 feet bgs. Further, as vertical migration of MC was not apparent and MC impacts are limited to the upper 1.5-2 feet of soil, groundwater impacts associated with MC were concluded to not have occurred and a groundwater investigation is not warranted.

Based on results from the CSE Phase II soil sampling which demonstrated that MC are not present at levels that indicate migration to groundwater is occurring, it is concluded that groundwater does not have a complete pathway for migration of MC from the Nellis AFB MRAs.

# 9.0 SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT

## 9.1 General Approach

A screening-level human health risk assessment (HHRA) was performed for two MRAs at Nellis AFB. The first MRA, MU732, is located north of the main base. The other, XU741, is located on the northwest portion of the base itself. An HHRA was not performed for TM742 as MC sampling was not required since no areas of concentrated MEC/MD were observed. As discussed in Section 8.0, a CSM was developed to address MEC and/or MC environmental contamination. The CSM describes sources of contamination, possible receptors, and possible exposure pathways. Potential current and future human exposure pathways were reviewed to determine whether the pathways associated with each of the MRAs were complete. The pathways and receptors for each MRA are summarized in Section 9.2.

To evaluate potential human health risks, the measured concentrations in environmental media (surface and subsurface soil) were compared with human health screening concentrations on a site-by-site basis. All exceedances were reported. Screening levels for the environmental media investigated for the CSE Phase II were discussed previously in Section 4.3 and presented in **Table 4-3**. These screening levels also are briefly discussed below.

Both surface and subsurface soil data were evaluated for the HHRA. For samples analyzed by XRF, surface soil was collected at a depth of 0-0.5 feet bgs. The majority of subsurface samples were collected at depths between 0.5-1.0 feet bgs. Samples were also collected at intervals of 1.5-2.0 feet, 2.0-2.5 feet, and 2.5-3.0 feet bgs at selected locations. For laboratory analyses, surface soil samples were collected at a depth of 0-0.5 feet bgs and subsurface soil was represented by samples collected at depths between 0.5-1.0 feet bgs. Potential future receptors were evaluated for exposures to total soil (surface and subsurface soil) because it was assumed that surface and subsurface soil would mix as a result of soil disturbance due to digging or excavation.

MU732 is currently inactive and classified as a closed range. Current receptors include base personnel, security, authorized visitors, and possible trespassers. Land use is expected to be returned to the BLM upon completion of the munitions assessment and clearance. Future receptors would include BLM personnel and trespassers. However, the residential scenario will be used to evaluate “unrestricted use” at the MRA and to support the decision-making process for NFA.

XU741 included pyrotechnic and chemical magazine areas and igloos and a small arms ammunition building. These igloos are currently not used for storage of military munitions items and are the responsibility of the DRMO. The western portion of this MRA also is used as the RV storage/parking area for the base. Current human receptors include base personnel. Future human receptors include recreational users, construction workers, and residents, as a Military Family Housing Project is planned nearby. The exposure assumptions for the residential scenario are conservative because the frequency and duration of exposure to a resident would be much greater than that of the recreational visitor to the MRAs. Therefore, the residential screening criteria were considered to be protective of recreational receptors.

Surface and subsurface soil sample results were screened against the Regional SLs for Chemical Contaminants at Superfund Sites for industrial and residential exposures to soil per an

Interagency Agreement dated May 20, 2008 between the EPA and ORNL. The SLs are concentrations of analytes in soil that the EPA considers to be below thresholds of concern for risks to human health. Direct-contact exposure pathways, specifically ingestion, dermal absorption, and inhalation of particulates and volatiles, are assumed in the development of these values. The SLs for industrial soil are based on routine outdoor workers with an exposure period of 250 days per year for a total of 25 years. The SLs for residential soil are based on exposures to residents during typical daily activities. Residential SLs for carcinogens were based on combined childhood and adult exposure over a 30-year period. Residential SLs for non-carcinogens are based on childhood exposure from 1 to 6 years of age.

The sampling data and screening results for each MRA have been presented by medium in Section 5.0. The results and conclusions of the HHRA screening are discussed in Sections 9.3 and 9.4 below.

## 9.2 Pathways and Receptors

Nellis AFB encompasses over 11,000 acres and is located eight miles to the northeast of Las Vegas in Clark County, Nevada. Numerous buildings and residential developments are located within a few miles of the base. Current land uses immediately adjacent to Nellis AFB include industrial, commercial, and residential.

A chain link fence runs along the southern and western boundaries of MU732. The northern boundary is mountainous and inaccessible by vehicle, while the eastern boundary is shared with the active Nellis Small Arms Range. Public access to MU732 is currently restricted. Although trespassing is not a common occurrence at Nellis AFB, there is evidence of illegal dumping in the area. XU741 is completely contained within the Nellis AFB security fence. Some of the newer magazines are contained within barbed-wire topped fences as well. Therefore, public access to this area is restricted as well.

Land use varies within these MRAs at Nellis AFB. MU732 is inactive and classified as a closed range. However, the Southern Nevada Water Authority has constructed facilities associated with the Grand Teton reservoir on this part of the base. XU741 is located in a restricted area of the base which is controlled by DRMO. The pathway analysis for MC is discussed in Section 8.2 and illustrated in the CSM for the MC exposure areas in **Figures 8-4** through **8-6**. Site-specific pathways and receptors for each MRA are summarized below.

<u>WWII Gunnery Range @ Range Road (Excess) (MU732).</u> MU732 was originally reported as a 5,590-acre MRA in AFRIMS. However, during the CSE Phase I, it was determined that the MRA footprint was actually 3,982 acres, which was confirmed during the CSE Phase II. The delta of 1,608 acres will be administratively closed following this CSE Phase II as it represents a miscalculation in AFRIMS from the actual footprint of the MRA. The MRA is located north of the main base at Nellis AFB. Various types of ordnances were used at the Small Arms Range from 1941 to 1965. The area is patrolled and is not open to the general public. Currently, no human receptors are permitted to access this MRA and "No Trespassing" signs are posted. Potential receptors include authorized Nellis AFB personnel, security, as well as trespassers (**Figure 8-4**). Potential exposure routes to surface and subsurface soil include incidental ingestion, dermal contact, and inhalation of dusts.

<u>Area III Magazines (XU741).</u> This MRA is a 23.4-acre site located on the northwestern portion of the main base at Nellis AFB. It consists of several bomb magazines, new igloos, and a small

arms ammunition building. This area also serves as the base RV storage/parking area. As shown in **Figure 8-5**, potential future receptors include residents from nearby base housing, recreational users, authorized Nellis AFB personnel, workers and possible trespassers. Potential exposure routes to surface and subsurface soil include incidental ingestion, dermal contact, and inhalation of dusts.

## 9.3 WWII Gunnery Range @ Range Road (Excess)

This section presents results of the HHRA screening for soil at five areas within the WWII Gunnery Range @ Range Road (Excess) (MU732).

### 9.3.1 MU732 - .50 Caliber Firing Fan

#### *9.3.1.1 Soil*

As shown in **Table 5-1,** a total of 60 ex-situ samples from this MRA were analyzed by XRF. Fifty-nine of these samples represented surface soil and one sample represented subsurface soil. There were no detections of lead in surface or subsurface soil samples at concentrations greater than the residential PRG (400 mg/kg). No other compounds were analyzed for this MRA.

#### *9.3.1.2 HHRA Conclusions and Recommendations*

Based on results of the human health screening assessment, no further evaluation action is required for lead in surface and subsurface soil at the .50 Caliber Firing Fan area of MU732.

### 9.3.2 MU732 - .50 Caliber Firing Fan Berm

#### *9.3.2.1 Soil*

As shown in **Table 5-1,** a total of 53 ex-situ samples from this MRA were analyzed by XRF. Thirty-one of these samples represented surface soil and 22 samples represented subsurface soil. Lead was detected in surface soil samples at concentrations greater than the residential PRG (400 mg/kg) in 16 samples from the .50 Caliber Firing Fan Berm. Eight samples also exceeded the industrial PRG (800 mg/kg). In subsurface soil, lead concentrations in four samples were greater than the residential PRG, and two of those samples also exceeded the industrial PRG. Three exceedances were noted at different depths for one sample location (CXRM32ASS89), two of them located within subsurface soil. No other compounds were analyzed for this MRA.

#### *9.3.2.2 HHRA Conclusions and Recommendations*

Based on results of the human health screening assessment, further evaluation of lead is recommended for surface and subsurface soil at the .50 Caliber Firing Fan Berm area of MU732.

### 9.3.3 MU732 – Shotgun Firing Range

#### *9.3.3.1 Soil*

As shown in **Table 5-1,** a total of 35 ex-situ samples from this MRA were analyzed by XRF. Thirty-four of these samples represented surface soil and one sample represented subsurface soil. There were no detections of lead in surface or subsurface soil samples at concentrations greater than the residential PRG (400 mg/kg).

As shown in **Table 5-2**, fourteen surface soil samples including one duplicate (0-0.5 feet bgs) and four subsurface soil samples (0.5-1.0 feet bgs) were collected from the MRA for PAH

analysis. For the human health assessment, potential exposures to total soil (surface and subsurface soil) were evaluated. Five PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene and Indeno(1,2,3-cd)pyrene) were detected at concentrations greater than their residential and industrial soil screening values in the majority of the samples. Chrysene was also detected at concentrations greater than the residential screening values in three surface soil samples.

#### *9.3.3.2 HHRA Conclusions and Recommendations*

Based on results of the human health screening assessment, further evaluation of PAHs in surface and subsurface soil is recommended for the Shotgun Firing Range area of MU732.

### 9.3.4 MU732 – Training and Maneuver Area

#### *9.3.4.1 Soil*

As shown in **Table 5-1,** a total of 41 ex-situ samples from this MRA were analyzed by XRF. Thirty-eight of these samples represented surface soil and three samples represented subsurface soil. Lead was detected in one surface soil sample (CXRM32C2SS03) at a concentration of 573 mg/kg, which is greater than the residential PRG (400 mg/kg) and less than the industrial PRG (800 mg/kg). In subsurface soil, lead concentrations in three samples were less than the residential PRG.

As shown in **Table 5-2**, eighteen surface soil samples including three duplicates (0-0.5 feet bgs) and six subsurface soil samples (0.5-1.0 feet bgs) were collected from the MRA for PAH analysis. For the human health assessment, potential exposures to total soil (surface and subsurface soil) were evaluated. Five PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene and Indeno(1,2,3-cd)pyrene) were detected at concentrations greater than their residential and industrial soil screening values in the majority of the samples. Chrysene was also detected at concentrations greater than the residential screening values in two surface soil samples.

#### *9.3.4.2 HHRA Conclusions and Recommendations*

Based on results of the human health screening assessment, further evaluation of lead in surface soil and PAHs in surface and subsurface soil is recommended for the Training and Maneuver Area of MU732.

### 9.3.5 MU732 – Clay Pigeon Debris Area

#### *9.3.5.1 Soil*

As shown in **Table 5-1,** a total of 28 ex-situ samples from this MRA were analyzed by XRF. All twenty-eight samples represented surface soil. There were no detections of lead in these surface soil samples at concentrations greater than the residential PRG (400 mg/kg).

As shown in **Table 5-2**, eleven surface soil samples including one duplicate (0-0.5 feet bgs) and four subsurface soil samples (0.5-1.0 feet bgs) were collected from the MRA for PAH analysis. For the human health assessment, potential exposures to total soil (surface and subsurface soil) were evaluated. Five PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene and Indeno(1,2,3-cd)pyrene) were detected at concentrations greater than their residential and industrial soil screening values in the majority of the samples.

Benzo(k)fluoranthene and Chrysene were also detected at concentrations greater than the residential screening values in one surface soil sample each.

#### *9.3.5.2 HHRA Conclusions and Recommendations*

Based on results of the human health screening assessment, further evaluation of PAHs in surface and subsurface soil is recommended for the Clay Pigeon Debris Area of MU732.

## 9.4 Area III Magazines

This section presents results of the HHRA screening for soil at the Area III Magazines (XU741).

### 9.4.1 Soil

As shown in **Table 5-3**, one surface soil sample and one duplicate sample (0-0.5 feet bgs) were collected from XU741. The samples were analyzed for explosives (RDX, PETN, nitroglycerin, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl). Laboratory analytical results were compared to the Regional SL values. None of the explosives analyzed exceeded the residential or industrial screening values.

### 9.4.2 HHRA Conclusions and Recommendations

Based on results of human health screening, no further evaluation of explosives in surface soil is recommended for XU741.

# 10.0 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

## 10.1 General Approach

A Screening-Level Ecological Risk Assessment (SLERA) was performed for the CSE Phase II. Measured concentrations from both laboratory and XRF samples in environmental media (surface soil and subsurface soil) were compared with ecological screening concentrations, on a site-by-site basis. The SLERA utilized both surface and subsurface soil data, as the depth of the subsurface soils was to a maximum of 2 feet bgs, so was considered an exposure media for ecological receptors. MC that exceeded ESVs and were not background related (see background evaluation in Section 5.1.6.4) were evaluated further. It should be noted that ecological screening criteria and benchmarks were previously presented in Section 5.0. Where both XRF and laboratory samples were collected for a single location, the XRF results were utilized in the risk assessment. The XRF provided a more comprehensive dataset and the results were determined to be definitive and valid for risk assessment purposes as discussed in Section 4.4.1. Nellis AFB encompasses approximately 11,300 acres and includes three MRAs evaluated as part of the CSE Phase II effort. Due to the size of the facility, the MRAs vary greatly in size and character; therefore, the MRAs were evaluated individually (on a site-by-site basis). MRAs that were evaluated were MRA MU732, which was further divided into five assessment areas: .50 Caliber Firing Fan, .50 Caliber Firing Fan Berm, Shotgun Firing Range, Clay Pigeon Debris Area, Training and Maneuver Area; MRA XU741 – Area III Magazines; and MRA TM742 – Former Navy Training Area.

## 10.2 Habitat and Receptors

As part of an annual review, an assessment of the functional biotic communities at Nellis AFB was completed in 2001 and provided in the *Integrated Natural Resources Management Plan* (99 CES/CEV 2001). The following section summarizes those findings.

The Nellis AFB is approximately 11,300 acres with 38 percent of the area being paved or containing structures. The base is an expansive area consisting mainly of vegetation associated with the Great Basin Desert in the northern regions and Mojave Desert in southern regions. Landscaped areas are predominantly turf grasses and mixed deciduous trees.

There are no wetlands located within the study boundary at Nellis AFB. Therefore, assessment of this habitat type was not performed.

Wildlife species that may be found on the base include:

Reptiles:

- Side-blotched lizard (*Uta stansburiana*)
- Zebra-tailed lizard (*Callisaurus draconoides*)
- Western whiptail (*Cnemidophorous tigris*)
- Common kingsnake (*Lampropeltis getulus*)
- Sidewinder (*Crotalus cerastes*)

Birds:

- Great-tailed grackle (*Quiscalus major*)

- Common rock dove (*Columba livia*)
- House sparrow (*Passer domesticus*)
- Costa's hummingbird (*Calypte costae*)
- Roadrunner (*Geococcyx californica*)
- Phainopepla (*Phainopepla nitens*)
- Mourning dove (*Zenaida macroura*)

Mammals:

- Pocket mouse species (*Chaetodipus sp.*)
- Kangaroo rat species (*Dipodomys sp.*)
- Jackrabbit (*Lepus californicus*)
- Western cottontail (*Sylvilagus audubonii*)
- Coyote (*Canis latrans*)
- Kit fox (*Vulpes macrotis*)
- Mule deer (*Odocoileus hemionus*)
- Desert bighorn sheep (*Ovis canadensis nelsoni*)
- Pronghorn (*Antilocapra americana*) (99 CES/CEV 2001).

### 10.2.1 Threatened, Endangered, or Rare Species

In addition to the species listed above, the following Federal and state protected species are known to occur or could potentially occur on Nellis AFB (99 CES/CEV 2001).

The Las Vegas bearpoppy (*Arctomecon californica*) and the burrowing owl (*Athene cunicularia*) are known to be present on the main portion of the base. The desert tortoise (*Gopherus agassizii*) is present on the main base in low densities and on MU732. The phainopepla (*Phainopepla nitens*), and the common chuckwalla (*Sauromalus obesus*), which are on the state watch list, are found on the base and MU732. The banded gila monster (*Heloderma suspectum cinctum*) is known to be present on the base and possibly on MU732.

## 10.3 MU732: WWII Gunnery Range @ Range Road (Excess)

This section presents results of the ecological screening assessment for soil at five areas within the WWII Gunnery Range @ Range Road (Excess) (MU732).

### 10.3.1 MU732: .50 Caliber Firing Fan

#### *10.3.1.1 Soil*

Sixty soil samples were collected for XRF lead analysis from the .50 Caliber Firing Fan from depths of 0-0.5 and 0.5-1 feet bgs. Results of the screening assessment are presented in **Table 5-1**. Detected concentrations of lead in the XRF samples were above ESVs and found not to be background related.

#### *10.3.1.2 SLERA Conclusions and Recommendations*

Based on results of the screening assessment, lead in soil was further evaluated in Section 10.6. The additional evaluation includes some or all of the following steps: calculation of a 95 % UCL, determination if the site meets the criteria as an "Important Ecological Place" (IEP), and review of the ESVs.

### 10.3.2 MU732: .50 Caliber Firing Fan Berm

#### *10.3.2.1 Soil*

Fifty-three soil samples were collected for XRF lead analysis from the .50 Caliber Firing Fan from depths of 0-0.5, 0.5-1, 1-1.5, 1.5-2, 2-2.5, and 2.5-3 feet bgs. Results of the screening assessment are presented in **Table 5-1**. Detected concentrations of lead in the XRF samples were above ESVs and found not to be background related.

#### *10.3.2.2 SLERA Conclusions and Recommendations*

Based on results of the screening assessment, lead in soil was further evaluated in Section 10.6. The additional evaluation includes some or all of the following steps: calculation of a 95% UCL, determination if the site meets the criteria as an IEP, and review of the ESVs.

### 10.3.3 MU732: Shotgun Firing Range

#### *10.3.3.1 Soil*

Thirty-five soil samples were collected for XRF lead analysis from the Shotgun Firing Range from depths of 0-0.5 and 0.5-1 feet bgs. Eighteen samples and one duplicate were collected from depths of 0-0.5 and 0.5-1 feet bgs for laboratory PAH analysis. Results of the screening assessment are presented in **Table 5-1** and **Table 5-2**. MC 1-methlynaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, phenanthrene, and naphthalene were either not detected or found to have detectable concentrations below ESVs, so no additional evaluation was necessary for these MCs. Detected concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene were above ESVs and not background related.

#### *10.3.3.2 SLERA Conclusions and Recommendations*

Based on results of the screening assessment, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene in soil were further evaluated in Section 10.6. The additional evaluation includes some or all of the following steps: calculation of a 95% UCL, determination if the site meets the criteria as an IEP, and review of the ESVs.

### 10.3.4 MU732: Clay Pigeon Debris Area

#### *10.3.4.1 Soil*

Twenty-eight soil samples were collected for XRF lead analysis from the Clay Pigeon Debris Area from depths of 0-0.5 feet bgs. Fifteen samples and one duplicate were collected from depths of 0-0.5 and 0.5-1 feet bgs for laboratory PAH analysis. Results of the screening

assessment are presented in **Table 5-1** and **Table 5-2**. MC 1-methlynaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, and naphthalene were either not detected or found to have detectable concentrations below ESVs, so no additional evaluation was necessary for these MCs. Detected concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene were above ESVs and not background related.

#### *10.3.4.2 SLERA Conclusions and Recommendations*

Based on results of the screening assessment, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene in soil were further evaluated in Section 10.6. The additional evaluation includes some or all of the following steps: calculation of a 95% UCL, determination if the site meets the criteria as an IEP, and review of the ESVs.

### 10.3.5 MU732: Training and Maneuver Area

#### *10.3.5.1 Soil*

Forty-one soil samples were collected for XRF lead analysis from the Training and Maneuver Area from depths of 0-0.5 and 0.5-1 feet bgs. Twenty-four samples and three duplicates were collected from depths of 0-0.5 and 0.5-1 feet bgs for laboratory PAH analysis. Results of the screening assessment are presented in **Table 5-1** and **Table 5-2**. MC 1-methlynaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, phenanthrene, and naphthalene were either not detected or found to have detectable concentrations below ESVs, so no additional evaluation was necessary for these MCs. Detected concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene were above ESVs and not background related.

#### *10.3.5.2 SLERA Conclusions and Recommendations*

Based on results of the screening assessment, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene in soil were further evaluated in Section 10.6. The additional evaluation includes some or all of the following steps: calculation of a 95% UCL, determination if the site meets the criteria as an IEP, and review of the ESVs.

## 10.4 XU741: Area III Magazines

This section presents results of the ecological screening assessment for soil at the 23.4 acre Area III Magazines (XU741).

### 10.4.1 Soil

One soil sample and a duplicate were collected for laboratory analysis from XU741 and analyzed for RDX, PETN, nitroglycerin, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, 2-amino-4,6-DNT, 4-amino-2,6-DNT, and tetryl. Results of the screening assessment are presented in **Table 5-3**. These analytes were not detected in the sample so further analysis was not necessary.

#### 10.4.2 SLERA Conclusions and Recommendations

MC were not detected in surface soil at XU741; therefore, no further ecological evaluation is recommended.

### 10.5 TM742: Former Navy Training Area

This section presents results of the ecological screening assessment for soil at the 310.3 acre Former Navy Training Area (TM742).

#### 10.5.1 Soil

Sampling for MC was not required at TM742 as there were no areas of concentrated MEC observed.

#### 10.5.2 SLERA Conclusions and Recommendations

Sampling for MC was not required at TM742; therefore, no further ecological evaluation is recommended.

### 10.6 Additional Ecological Screening Assessment

This section summarizes several steps taken to further evaluate chemicals that exceeded ESVs. This includes: calculating of a 95% UCL, determining if the site meets the criteria as an IEP, and reviewing the basis and applicability of ESVs. The following sites, media, and constituents (see **Table 10-1**) were evaluated in this section.

**Table 10-1 Summary of Additional Ecological Assessment Steps at Each Site**

| Site | Parameters | Assessment Type |
|---|---|---|
| MU732 – .50 Caliber Firing Fan | lead | *95%UCL; IEP; ESV* |
| MU732 – .50 Caliber Firing Fan Berm | lead | *95%UCL; IEP; ESV* |
| MU732 – Shotgun Firing Range | Lead, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, and Pyrene | *95%UCL; IEP; ESV* |
| MU732 – Clay Pigeon Debris Area | Lead, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene | *95%UCL; IEP; ESV* |
| MU732 – Training and Maneuver Area | Lead, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, and Pyrene | *95%UCL; IEP; ESV* |
| XU741 | --- | --- |
| TM742 | --- | --- |
| *Assessment Types: 95%UCL – calculation of a 95% UCL; IEP - site evaluated for IEP criteria; ESV – review of ESVs. --- indicates not evaluated.* | | |

### 10.6.1 95% UCL Calculation

To evaluate the potential ecological exposure at MU732, the concentration of MC in the exposure medium (soil) relevant to potentially exposed ecological receptors must be known or estimated. This concentration is referred to as an exposure point concentration (EPC). EPCs were calculated for MC that exceeded available ESVs and were not background related. The approach used to estimate EPCs in the media sampled at MU732 follows USEPA (1989) guidance. According to this guidance, the most appropriate measurement of central tendency for exposure to environmental chemical concentrations is the arithmetic mean. To account for uncertainty associated with this value, USEPA guidance recommends the use of the 95% UCL of the arithmetic mean concentration. The 95% UCL of each constituent in each medium (soil) was calculated using the USEPA ProUCL (v4.0) statistical software. The calculated values are assumed to represent the concentration to which receptors could be exposed at this site. The results of the 95% UCL calculations are presented in **Table 10-2**. The calculation of 95% UCLs resulted in EPC values lower than maximum detected concentrations, however, all of the EPCs, except benzo(k)fluoranthene at the MU732 - Shotgun Firing Range and benzo(k)fluoranthene at the MU732 - Training and Maneuver Area, still exceeded available ESVs. Therefore, all of the MC listed in **Table 10-2**, with the exception of benzo(k)fluoranthene at the two aforementioned sites, need to be evaluated further.

**Table 10-2 Summary of ProUCL 95% UCL Calculations for Soil (mg/kg)**

| Site | Parameter | BTV [1] | ESV [2] | 95% UCL Statistic & (Distribution) [3] | Recommended UCL [4] |
|---|---|---|---|---|---|
| MU732 – .50 Caliber Firing Fan | Lead | 12 | 11 | 95% Chebyshev (U) | 55 |
| MU732 – .50 Caliber Firing Fan Berm | Lead | 12 | 11 | 99% Chebyshev (U) | 1096 |
| MU732 – Shotgun Firing Range | Lead | 12 | 11 | 95% Student's-t (N) | 90 |
| | Benzo(a) anthracene | --- | 1.1 | 95% Approximate Gamma (G) | 13 |
| | Benzo(a)pyrene | --- | 1.1 | 95% Approximate Gamma (G) | 18 |
| | Benzo(b) fluoranthene | --- | 1.1 | 95% Approximate Gamma (G) | 35 |
| | Benzo(g,h,i) perylene | --- | 1.1 | 95% Approximate Gamma (G) | 13 |
| | Benzo(k) fluoranthene | --- | 1.1 | 95% KM Chebyshev (U) | **0.007** |
| | Chrysene | --- | 1.1 | 95% Approximate Gamma (G) | 41 |
| | Dibenz(a,h) anthracene | --- | 1.1 | 95% Approximate Gamma (G) | 4.3 |
| | Fluoranthene | --- | 1.1 | 95% Approximate Gamma (G) | 21 |
| | Indeno(1,2,3-cd) pyrene | --- | 1.1 | 95% Approximate Gamma (G) | 13 |
| | Pyrene | --- | 1.1 | 95% Adjusted Gamma UCL (G) | 20 |
| MU732 – Clay Pigeon Debris Area | Lead | 12 | 11 | 95% Approximate Gamma (G) | 32 |
| | Benzo(a) anthracene | --- | 1.1 | 99% Chebyshev (L) | 36 |
| | Benzo(a)pyrene | --- | 1.1 | 95% Adjusted Gamma (G) | 10 |
| | Benzo(b) fluoranthene | --- | 1.1 | 95% Adjusted Gamma (G) | 23 |
| | Benzo(g,h,i) perylene | --- | 1.1 | 95% Adjusted Gamma (G) | 7.7 |
| | Benzo(k) fluoranthene | --- | 1.1 | 99% Chebyshev (U) | 1.8 |

**Table 10-2 Summary of ProUCL 95% UCL Calculations for Soil (mg/kg)**

| Site | Parameter | BTV [1] | ESV [2] | 95% UCL Statistic & (Distribution) [3] | Recommended UCL [4] |
|---|---|---|---|---|---|
| MU732 – Clay Pigeon Debris Area (continued) | Chrysene | --- | 1.1 | 99% Chebyshev (L) | 34 |
| | Dibenz(a,h) anthracene | --- | 1.1 | 95% Adjusted Gamma (G) | 2.5 |
| | Fluoranthene | --- | 1.1 | 99% Chebyshev (L) | 88 |
| | Indeno(1,2,3-cd) pyrene | --- | 1.1 | 95% Adjusted Gamma (G) | 7.5 |
| | Phenanthrene | --- | 29 | 99% Chebyshev (L) | 31 |
| | Pyrene | --- | 1.1 | 99% Chebyshev (L) | 68 |
| MU732 – Training and Maneuver Area | Lead | 12 | 11 | 95% H-UCL (L) | 96 |
| | Benzo(a) anthracene | --- | 1.1 | 95% Approximate Gamma (G) | 9.2 |
| | Benzo(a)pyrene | --- | 1.1 | 95% Approximate Gamma (G) | 12 |
| | Benzo(b) fluoranthene | --- | 1.1 | 95% Approximate Gamma (G) | 22 |
| | Benzo(g,h,i) perylene | --- | 1.1 | 95% Approximate Gamma (G) | 8.6 |
| | Benzo(k) fluoranthene | --- | 1.1 | 97.5% KM Chebyshev (U) | **0.006** |
| | Chrysene | --- | 1.1 | 95% Approximate Gamma (G) | 9.7 |
| | Dibenz(a,h) anthracene | --- | 1.1 | 95% Approximate Gamma (G) | 2.8 |
| | Fluoranthene | --- | 1.1 | 95% Approximate Gamma (G) | 14 |
| | Indeno(1,2,3-cd) pyrene | --- | 1.1 | 95% Approximate Gamma (G) | 8.2 |
| | Pyrene | --- | 1.1 | 95% Adjusted Gamma UCL (G) | 13 |
| XU741 | --- | --- | --- | --- | --- |
| TM742 | --- | --- | --- | --- | --- |

*All units are mg/kg. **Shaded** values indicate UCL does not exceed ESV. --- indicates not evaluated or not applicable.*
*1) BTV = Background Threshold Value.*
*2) ESV = Ecological Screening Value, see Table 4-3 (Screening Level Table).*
*3) Statistical test and distribution from ProUCL (v4.0): G = Gamma Dist., L = Lognormal Dist., N = Normal Dist., U = Undefined Dist.*
*4) 95% UCL recommended by ProUCL (v4.0).*

### 10.6.2 Important Ecological Place

The USACE MMRP SI process has developed a protocol for conducting a screening-level risk assessment for ecological receptors at FUDS. The purpose of the risk screening is to conservatively evaluate the potential for adverse effects due to site contamination. One of the first steps in FUDS program is to determine whether IEPs are present on-site, then identify valuable biological resources within each IEP as the focus for management goal development. If the site does not contain important ecological places, assessment is made as to whether the site is managed for ecological purposes. Areas which do not meet the IEP criteria should not be considered further for ecological assessment. Instead, a management goal should be established that protects resources from widespread impacts to flora and fauna, such as dead animals or large areas lacking vegetation.

There are two types of land categories that potentially meet IEP criteria at Nellis AFB: 1) habitat known to be used by state-designated endangered or threatened species, and 2) habitat known to be used by Federal endangered or threatened species.

The following federally or state-listed endangered, threatened, or special-concern species are known to occur at Nellis AFB: Las Vegas bearpoppy (*Arctomecon californica*), burrowing owl (*Athene cunicularia*), desert tortoise (*Gopherus agassizii*), phainopepla (*Phainopepla nitens*), common chuckwalla (*Sauromalus obesus*),and banded gila monster (*Heloderma suspectum cinctum*). Due to the potential presence of Federally and/or state-listed species at MU732 further evaluation for ecological impacts is needed for soil at this site.

### 10.6.3 Ecological Screening Value Review

The sources of soil screening values were reviewed to determine if the basis of the screening value and the test species used are appropriate for screening values at Nellis AFB. The literature reviewed for the screening values included the following: *Ecological Soil Screening Levels* (EcoSSLs) (USEPA 2008); *Toxicological Benchmarks for Wildlife (*ORNL 1996); and Eco Risk Database, Release 2.2. (LANL, 2005). **Table 4-3** provides more details on the screening value sources and selection process.

The ecological soil screening value for lead is based on avian studies in the EcoSSL guidance. Therefore, the soil screening value used for lead is appropriate for use at Nellis AFB as appropriate habitat exists on base for this class of ecological receptor.

The ecological soil screening values for high molecular weight PAHs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene; are based on mammalian studies in the EcoSSL guidance. Therefore, the soil screening value used for these PAHs is appropriate for use at Nellis AFB as appropriate habitat exists on base for this class of ecological receptor.

Based on this assessment, the soil screening values for lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene are appropriate for use at Nellis AFB.

## 10.7 Final SLERA Conclusions and Recommendations

Based on results of the screening assessment, the following actions are recommended for the MRAs:

MU732 – .50 Caliber Firing Fan. Concentrations of lead that are potentially site-related were detected above the ESV for lead in soil. Therefore, lead was further evaluated in this section. After the additional evaluation presented in Section 10.6, it was determined that lead still need to be evaluated further for soil.

MU732 – .50 Caliber Firing Fan Berm. Concentrations of lead that are potentially site-related were detected above the ESV for lead in soil. Therefore, lead was further evaluated in this section. After the additional evaluation presented in Section 10.6, it was determined that lead still need to be evaluated further for soil.

MU732 – Shotgun Firing Range. Concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene, that are potentially site-related, were detected above ESVs in soil. Therefore, these constituents were further evaluated in this section. After the additional evaluation presented in Section 10.6, it was determined that lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene still need to be evaluated further for soil.

MU732 – Clay Pigeon Debris Area. Concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene, that are potentially site-related, were detected above ESVs in soil. Therefore, these constituents were further evaluated in this section. After the additional evaluation presented in Section 10.6, it was determined that lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene still need to be evaluated further for soil.

MU732 – Training and Maneuver Area. Concentrations of lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene, that are potentially site-related, were detected above ESVs in soil. Therefore, these constituents were further evaluated in this section. After the additional evaluation presented in Section 10.6, it was determined that lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene still need to be evaluated further for soil.

XU741 – Area III Magazines. MC were not detected in surface soil XU741; therefore, no further ecological evaluation is recommended.

TM742 – Former Navy Training Area. Sampling for MC was not required at TM742 as there were no areas of concentrated MEC observed; therefore, no further ecological evaluation is recommended.

# 11.0 MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL

DoD proposed the MRSPP (32 CFR Part 179) to assign a relative risk priority to each defense site in the MMRP Inventory for response activities. These response activities are to be based on the overall conditions at each location and taking into consideration various factors related to explosive safety and environmental hazards (68 FR 50900). The application of the MRSPP applies to all locations:

- That are or were, owned, leased to, or otherwise possessed or used by DoD;
- That are known to or are suspected of containing MEC or MC; and,
- That are included in the MMRP Inventory.

In assigning a relative priority for response activities, DoD generally considers MRSs posing the greatest hazard as being the highest priority. In the USAF program, the MRS priority will be one factor in determining the sequence in which munitions response actions are funded. The following sections are a brief summary of the working modules of the MRSPP. A DoD training manual is under preparation to assist in the application of the MRSPP.

## 11.1 Explosive Hazard Evaluation Module

The Explosive Hazard Evaluation (EHE) module assesses the presence of known or suspected explosive hazards. The EHE module is composed of three factors, each of which has two to four data elements that are intended to assess the specific conditions at an MRS. These factors are as follows:

1. **Explosive Hazard**, which has the data elements *Munitions Type and Source of Hazard*;

2. **Accessibility**, which has the data elements *Location of Munitions, Ease of Access, and Status of Property*; and

3. **Receptors**, which has the data elements *Population Density, Population Near Hazard, Types of Activities/Structures, and Ecological and/or Cultural Resources*.

Based on site-specific information, each data element is assigned a numeric value, and the sum of these values is the EHE module score. The EHE module score results in an MRS receiving a rating. The MRSPP tables for Nellis AFB are presented as **Appendix K**. The scores for each specific data element for the EHE module of the MRSPP above are compiled in **Appendix K** and presented in **Table 11-1**.

It should be noted that each MRS defined for Nellis AFB (defined in Section 14.3) were scored in the EHE module. There were ten MRS identified for the WWII Gunnery Range @ Range Road (Excess) (MU732, MU732a, MU732b, MU732c, MU732d, MU732e, MU732f, MU732g, MU732h, and MU732i). The reader is referred to Section 14.3 for a detailed discussion of the rationale for this division.

**Table 11-1 Summary and Total of the EHE Data Element Scores**

| Specific Data Element | MU732 | MU732a | MU732b | MU732c | MU732d | MU732e | MU732f | MU732g | MU732h | MU732i | XU741 | TM742 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Explosive Hazard | | | | | | | | | | | | |
| Munitions Type | 30 | 2 | 20 | 30 | 0 | 2 | 20 | 5 | 20 | NA | 0 | 20 |
| Source of Hazard | 10 | 1 | 10 | 10 | 0 | 5 | 10 | 10 | 10 | NA | 2 | 5 |
| Accessibility | | | | | | | | | | | | |
| Information on the Location of Munitions | 10 | 1 | 25 | 5 | 0 | 1 | 25 | 10 | 10 | NA | 5 | 10 |
| Ease of Access | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | NA | 10 | 10 |
| Status of Property | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | NA | 0 | 0 |
| Receptors | | | | | | | | | | | | |
| Population Density | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | NA | 3 | 3 |
| Population Near Hazard | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | NA | 5 | 5 |
| Types of Activities/ Structures | 5 | 1 | 5 | 1 | 1 | 5 | 1 | 1 | 5 | NA | 5 | 5 |
| Ecological and/or Cultural Resources | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | NA | 3 | 3 |
| **TOTAL EHE MODULE SCORE** | **77** | **22** | **82** | **63** | **18** | **35** | **73** | **43** | **67** | **NA** | **33** | **61** |
| **TOTAL EHE MODULE RATING** | **C** | **G** | **B** | **D** | **G** | **G** | **C** | **F** | **D** | **NA** | **G** | **D** |

*NA – No known or suspected explosive hazard.*

## 11.2 Chemical Warfare Materiel Hazard Evaluation Module

The CHE module provides an evaluation of the chemical hazards associated with the physiological effects of CWM. The CHE module is used only when CWM in the form of MEC or MC, are known or suspected of being present at an MRA. Like the EHE module, the CHE module has three factors, each of which has two to four data elements that are intended to assess the conditions at an MRA. These factors are as follows:

1. **CWM Hazard**, which has the data elements, CWM Configuration and Sources of CWM;

2. **Accessibility**, which focuses on the potential for receptors to encounter the CWM known or suspected to be present on an MRA. This factor consists of three data elements, Location of CWM, Ease of Access, and Status of Property; and

3. **Receptor**, which focuses on the human and ecological populations that may be impacted by the presence of CWM. It has the data elements Population Density, Population Near Hazard, Types of Activities/Structures, and Ecological and/or Cultural Resources.

Similar to the EHE module, each data element is assigned a numeric value, and the sum of these values (i.e., the CHE module score) is used to determine the CHE rating. There is no history of CWM use at MU732 or TM742, nor did the CSE Phase II visual survey of XU741 identify any evidence of CWM. Therefore the CHE module does not apply to these MRAs. All MRSs at Nellis AFB receive the alternative module rating of "No Known or Suspected CWM Hazard."

## 11.3 Health Hazard Evaluation Module

The HHE module provides a consistent DoD-wide approach for evaluating the relative risk to human health and the environment posed by contaminants (i.e., MC) present at an MRA. The module has three factors that are as follows:

1. **Contamination Hazard Factor (CHF)**, which indicates contaminants present. This factor contributes a level of *High (H), Middle (M), or Low (L)* based on *Significant, Moderate, or Minimal* contaminants present, respectively;

2. **Receptor Factor (RF)**, which indicates the receptors. This factor contributes a level of *H, M, or L* based on *Identified, Potential, or Limited* receptors, respectively; and

3. **Migration Pathway Factor (MPF)**, which indicates environmental migration pathways, and contributes a level of *H, M, or L* based on *Evident, Potential or Confined* pathways, respectively.

The HHE builds on the Relative Risk Site Evaluation (RRSE) framework that is used in the IRP. The CHF, RF, and MPF are based on a quantitative evaluation of MC and/or CERCLA hazardous substances, and a qualitative evaluation of pathways and human and ecological receptors in groundwater, surface water, sediment, and surface soils. Please note that the HHE does not address subsurface soils. However, as the depth appropriate for evaluation is 0-2 feet and the soil samples collected from Nellis AFB were 0-0.5 feet, 0.5-1.0 feet, 1.0-1.5 feet, and 1.5-2.0 feet, all soil results obtained from Nellis AFB were utilized in the HHE module. In

addition, the HHE does not consider air as a pathway, because the risk through this medium from DoD MMRP sites with soil contamination generally is minimal.

The H, M, and L levels for the CHF, RF, and MPF are combined in a matrix to obtain composite three-letter combination levels that integrate considerations of all three factors. The three-letter combination levels are organized by frequency, and the resulting frequencies result in an HHE rating. The ratings for each of the HHE modules of the MRSPP for these four MRS are compiled in **Appendix K** and summarized in **Table 11-2**.

## 11.4 MRSPP Score

Each MRA or discrete MRS is assigned a MRS priority ranging from 1 to 8. Priority 1 indicates the highest potential hazard and priority 8 indicates the lowest potential hazard. Only a site with a chemical warfare hazard can receive a MRS priority of 1. The MRS priority is determined by selecting the highest rating from amongst the EHE, CHE, and HHE modules. For example, if the EHE rating is 2, the CHE rating is 5, and the HHE rating is 4, the MRS priority assigned would be 2. The MRS priority will be used to determine the future funding sequence of MRAs and/or MRSs for further munitions response action. The MRS Priorities for the Nellis AFB MRSs are presented in **Table 11-3**. For reference, the MRS Priorities prior to the CSE Phase II are also presented.

**Table 11-2 Summary of the HHE Data Element Scores**

| Specific Data Element | MU732 | MU732a | MU732b | MU732c | MU732d | MU732e | MU732f | MU732g | MU732h | MU732i | XU741 | TM742 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contaminant Hazard Factor | M | M | M | NA | L | NA | L | NA | NA | NA | NA | NA |
| Receptor Factor | M | M | M | NA | M | NA | M | NA | NA | NA | NA | NA |
| Migration Pathway Factor | M | L | M | NA | L | NA | L | NA | NA | NA | NA | NA |
| HHE COMBINATION LEVEL | MMM | MML | MMM | NA | MLL | NA | MLL | NA | NA | NA | NA | NA |
| TOTAL HHE MODULE RATING | **D** | **E** | **D** | **NA** | **F** | **NA** | **F** | **NA** | **NA** | **NA** | **NA** | **NA** |
| *NA – No known or suspected MC hazard.* | | | | | | | | | | | | |

**Table 11-3 Priority Rating for Nellis AFB MRS**

| Specific Data Element | MU732 | MU732a | MU732b | MU732c | MU732d | MU732e | MU732f | MU732g | MU732h | MU732i | XU741 | TM742 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EHE Module Rating | C (4) | G (8) | B (3) | D (5) | G (8) | G (8) | C (4) | F (7) | D (5) | NA | G (8) | D (5) |
| CHE Module Rating | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| HHE Module Rating | D (5) | E (6) | D (5) | NA | F (7) | NA | F (7) | NA | NA | NA | NA | NA |
| **Priority** | **4** | **6** | **3** | **5** | **7** | **8** | **4** | **7** | **5** | **NA** | **8** | **5** |
| Priority Prior to CSE Phase II | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **6** | **6** |
| *NA – No known or suspected hazard.* | | | | | | | | | | | | |

# 12.0 PERCHLORATE REPORTING

Perchlorate sampling has not been performed at Nellis AFB to date. Based on an assessment of the MEC types identified and/or historically used, perchlorate is not associated with the MEC used at Nellis AFB. Therefore, smpling for perchlorate was not warranted and is not proposed to be completed in the future

# 13.0 SUMMARY AND CONCLUSIONS

This section summarizes the significant results obtained and conclusions reached as a result of CSE Phase II activities conducted at Nellis AFB. Only the most significant findings are presented in this section and are reproduced directly or abstracted from information contained in this report. The conclusions provide general and comparative interpretations of the findings, in terms of the general objectives of the CSE Phase II.

## 13.1 Summary of CSE Phase II Activities

The CSE Phase II activity compiled and evaluated information on Nellis AFB relating to the possible presence of MEC and associated contamination of environmental media from MC. The sources of this information were observations during detailed visual surveys and environmental media sampling. This information was reviewed and used to develop and refine the CSMs of potential exposures to MEC and MC. The CSMs related the indicated sources of explosive items to potential direct-contact exposures to people at the Nellis AFB in consideration of both the current and projected future land uses. These relationships, or potentially complete exposure pathways, also considered the possible transport or migration of MEC items from place to place as the result of natural processes or the activities of people, as well as impacts associated with migration of contaminants associated with the MEC. These land use scenarios were evaluated with respect to how people would interact with the land at Nellis AFB. The compiled information was then used to conduct an assessment of the potential explosive and environmental hazards at each MRA.

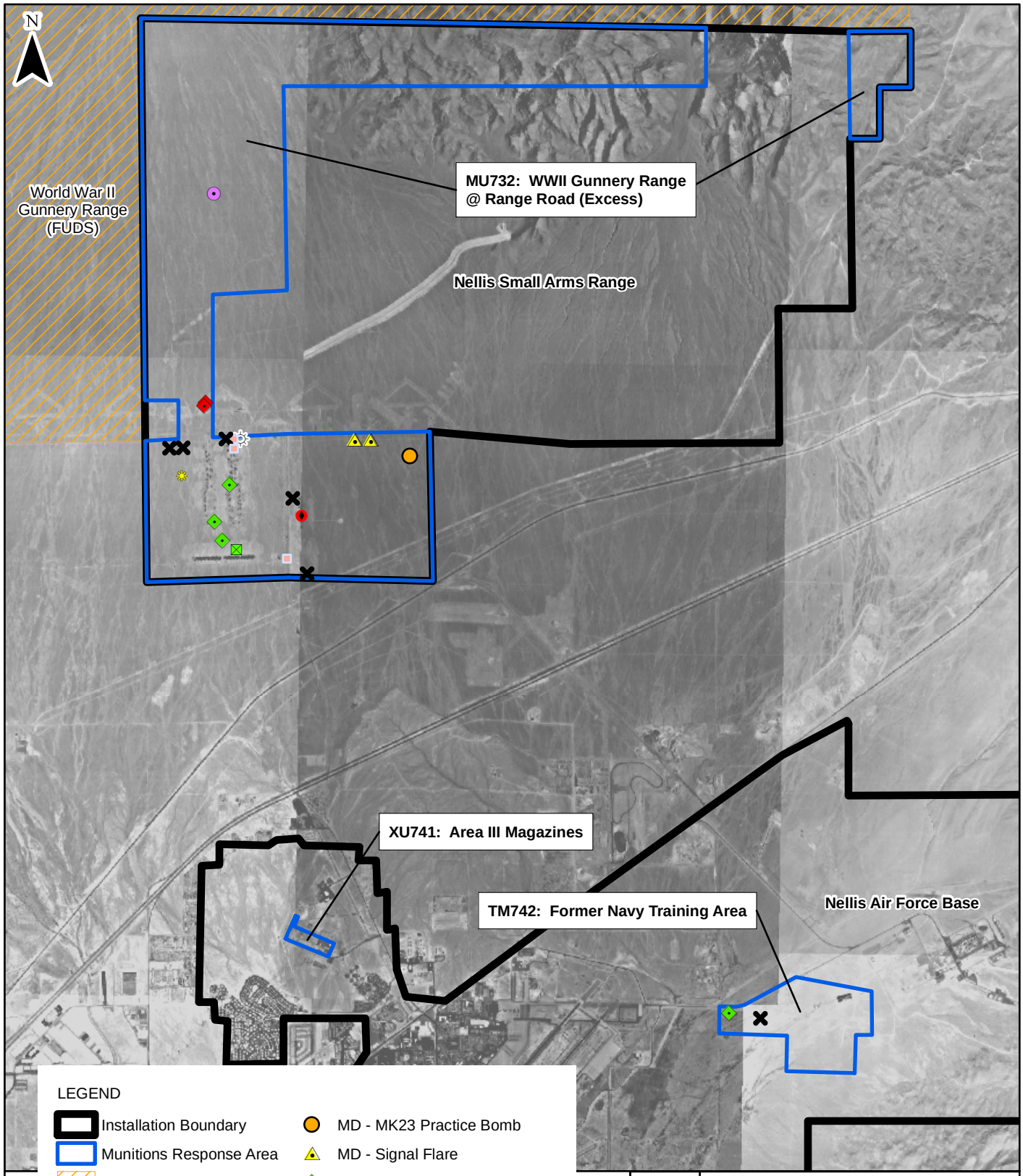
## 13.2 Summary of the CSE Phase II Findings

The CSE Phase II has resulted in the collection, evaluation, and synthesis of a large amount of information regarding past ordnance-related activities at Nellis AFB, current conditions on-site with respect to the presence of MEC and MC, physical setting of the land, and plans for the future use of the property. A summary of the findings for each of the MRAs, based on data collected during the CSE Phase II is provided in this section. A summary of the MEC data collected during the CSE Phase II is presented as **Figure 13-1**.

### 13.2.1 MU732: WWII Gunnery Range @ Range Road (Excess)

MU732, WWII Gunnery Range @ Range Road (Excess), was used for small arms gunnery practice, air-to-ground gunnery, ground-to-air gunnery, air-to-air gunnery, bombing (practice), rocketry, and demolition/burning operations. Historical evidence indicates that ordnance was used at this area from 1941 to 1965.

MEC potentially used at MU732 include small arms; practice bombs; grenades; 2.75-inch and 5-inch rockets; .30 caliber, .45 caliber, .50 caliber, and 12-guage cartridges; and 20mm, 37mm, and 75mm projectiles. However, visual survey of the MRA found only three UXO items (two hand grenade simulators and one MK 4 signal cartridge). Additionally, multiple burned surface areas containing burned small arms munitions were observed in the southwest corner of the MRA. These burned areas were previously investigated and evaluated as IRP site OT-36 (see Section 7.2.3).




LEGEND

- Installation Boundary
- Munitions Response Area
- FUDS Property
- Burn Pit
- Clay Pigeon Debris
- MD - 750 lb Practice Bomb
- MD - Fire Bomb Igniter
- MD - MK23 Practice Bomb
- MD - Signal Flare
- MD - Smoke Grenade
- MD- Frag
- Small Arms
- UXO - Hand Grenade Simulator
- UXO - MK 4 Signal Cartridge

0 1 2 Miles

Projection : NAD83 State Plane Nevada East

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**FIGURE NUMBER 13-1**

**CSE PHASE II RESULTS NELLIS AIR FORCE BASE**

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MD identified during the CSE Phase II included: one 750-lb practice bomb (concrete filled); one fire bomb igniter; one MK23 practice bomb; three smoke grenades; two signal flares; and one piece of MD. The MRA footprint was determined to be approximately 3,982 acres in size during the CSE Phase I.

Surface and subsurface soil sampling was performed in MU732 to evaluate whether lead or PAHs associated with the military munitions training activities that occurred in this MRA has impacted the environmental media. Based on the results of the sampling performed for the CSE Phase II, lead and PAHs were determined to be above screening levels and/or background concentrations. PAHs were detected above residential and industrial human health and ecological screening levels in the Training and Maneuver Area, Shotgun Firing Range, and Clay Pigeon Debris Area, which are located in the southern portion of the MRA. Lead was detected above residential and industrial human health and ecological screening levels at the .50 Caliber Firing Fan Berm, which is located next to the active range area in the central portion of the MRA. Lead was also detected in one location above residential human health and ecological screening levels in the Training and Maneuver Area.

### 13.2.2 XU741: Area III Magazines

XU741, Area III Magazines, is located in the northwestern portion of Nellis AFB. The MRA includes a pyrotechnics magazine; chemical bomb magazine; and a small arms magazine. Historical evidence indicates that use of this area began in the 1940s.

MEC anticipated to be present at XU741 based on historical records are as follows: pyrotechnics; chemical bombs potentially containing white phosphorus; and small arms ammunition. A visual survey of this MRA was performed to verify the type of munitions present and determine the extent of the MRA; however, no evidence of MEC was observed. The MRA was determined to be approximately 23.4 acres in size.

Surface sampling was performed in XU741 to evaluate whether residual MC associated with explosives storage is present in the environmental media. Based on the results of the sampling performed for the CSE Phase II, MC (explosives) was determined to be below screening levels.

### 13.2.3 TM742: Former Navy Training Area

TM742, Former Navy Training Area, was historically used by the U.S. Navy to conduct mock assaults on the ammunition supply point located in what is now referred to as Area II of Nellis AFB. Historical evidence indicates that this area was used from the 1950s until 1969.

MEC anticipated to be present at TM742 include blank ammunition, pyrotechnics, and practice munitions. The visual survey of this MRA was performed to verify the type of munitions present as well as determine the extent of the MRA. Small arms (one belt of 5.56mm blanks) and debris from a smoke grenade were identified during the effort. As no areas of concentrated MEC/MD were observed, sampling for MC was not appropriate. It was concluded that no environmental impacts are associated with this MRA.

## 13.3 Assessment of Potential Munitions Constituent Releases

Results of the environmental medium sampling indicate that impacts to soil at MU732, only, have occurred. The screening level HHRA and SLERA concluded that further evaluation is warranted for lead and PAHs at MU732.

Further, the HHRA and SLERA concluded that NFA is recommended for XU741 and TM742. For XU741, no evidence of MEC was identified and laboratory analytical results indicated that explosives were non-detect at the MRA. In addition, it was concluded that impacts have not occurred at TM742 as MEC were not observed and only minimal MD was encountered. Because no source MEC materials were observed, MC sampling was not warranted at TM742.

# 14.0 RECOMMENDATIONS (FUTURE INVESTIGATION AND/OR ACTION)

## 14.1 Cohort Assignment

To comply with USAF Knowledge Driven/Performance-based Management initiative, the MRAs are subdivided into seven "cohorts." The assignment of MRA to different cohorts supports the streamlining of the restoration process, including the development and implementation of munitions response actions for specific cohort types. The cohort type will be reflected in the site description in AFRIMS. The seven USAF MMRP cohorts are shown in **Table 14-1**.

**Table 14-1 Air Force MMRP Cohort Assignments**

| Cohort | Description |
|---|---|
| A | Small Arms Ranges |
| B | Bore-sight Ranges |
| C | Explosive Ordnance Disposal (EOD) Ranges and Open Burn/Open Detonation (OB/OD) Sites |
| D | Chemical Warfare Materiel (CWM) Sites |
| E | Pyrotechnic/Practice Sites |
| F | All Other Sites |
| G | Munitions Constituents |

As the USAF MMRP evolves, the cohort assignments may be expanded or consolidated to reflect what has been learned about the MRA. In implementation of the CSE Phase II, the cohort type was defined by the range-type as designated in documentation. The cohort assignment will be further refined based on field investigation in future phases. Any MRA with a site description of "multi-use" in AFRIMS shall be assigned a site description that reflects a specific cohort. The site description shall be revised to the range-type designated in documentation. Reassignments of cohort or site descriptions may be required in the future and will be based on the types of munitions found during future fieldwork.

### 14.1.1 Nellis AFB Cohort Assignment

The cohort type assigned to the Nellis AFB MRS is as follows:

- MU732 WWII Gunnery Range @ Range Road (Excess): F (all other sites);
- MU732a KD Range Berm: A (small arms ranges);
- MU732b Clay Pigeon Debris Area: A (small arms ranges);
- MU732c Multi-Use Range Mountainous Area: F (all other sites);
- MU732d .50 Caliber Firing Fan: A (small arms ranges);
- MU732e Remaining Areas of Sections 16 & 17: F (all other sites);

- MU732f Hand Grenade Simulator Area: F (all other sites);
- MU732g 750 Pound Practice Bomb Area: F (all other sites);
- MU732h MD Area: F (all other sites);
- MU732i Administrative Close Out Area: F (all other sites);
- XU741 Area III Magazines: F (all other sites); and
- TM742 Former Navy Training Area: E (pyrotechnic/practice sites).

## 14.2 Process Streamlining Opportunities

It is recommended that a future military munitions response action be performed at portions of MU732. For the areas in MU732 where MC was above screening levels (MU732, MU732a, and MU732b), a soil removal action is recommended. For the area where two UXO hand grenade simulators (MU732f) or MD (MU732g and MU732h) was identified, a MEC removal or remedial action is warranted.

No additional field investigation is warranted for MU732c where extremely mountainous conditions exist. This area can be managed through institutional controls on digging activities and routine maintenance to evaluate whether natural processes have exposed previously buried items.

Administrative close out is warranted for MU732i as this MRS represents an overestimation of the MRA acreage that was included in AFRIMS. NFA is recommended for the MRS.

For XU741, where impacts from MEC/MC were not observed, and MU732d, MU732e, and TM742, where no areas of concentrated MEC/MD were observed, NFA is indicated. Further, the CSE Phase II field effort demonstrated that the concentration of MEC is very low at these sites and remedial action to address MEC is not warranted.

## 14.3 Additional MRS (splitting the MRA)

Based on information gathered during the CSE Phase II and depending on site-specific factors, each MRA may be designated as a single MRS, or it may be subdivided for the purposes of evaluation and response into multiple MRSs. Subdividing MRAs into multiple MRSs allows for more efficient characterization so that munitions responses specific to local conditions can be conducted.

An MRA must be comprised of at least one MRS, but may contain multiple MRSs. The total area of all MRSs contained within an MRA must, however, equal the area of the MRA. This will ensure that the total acreage within an MRA was investigated during the CSE Phases I and II. Typical site-specific factors that may be considered during subdivision of MRAs into MRSs include:

- The prevalence of MEC or the extent of MC-contaminated media present within different areas of the MRA;
- The type of MEC or MC present within the MRA;
- Physical features (vegetation, topography, land areas versus water bodies, accessibility, and location of receptors that may be potentially exposed to MEC, etc.); and
- Geological and hydrogeological characteristics.

Areas within the MRA where the presence of MEC is not suspected or has not been confirmed during the CSE Phase II can be aggregated into a single MRS.

Based on the results of the CSE Phase II, it is recommended that MU732 be divided into ten MRSs. Three of the MRSs (MU732, MU732a, and MU732b) reflect the portions of the MRA where MC was identified at concentrations exceeding the industrial and residential screening levels. Three MRSs (MU732c, MU732d, MU732e) would consist of sections with different physical features. MU732c, referred to as the Multi-Use Range Mountainous Area, has extremely mountainous conditions. MU732d, which has flat terrain and low vegetation, was part of the .50 Caliber Firing Fan. MU732e, which also has flat terrain and low vegetation, is the remaining portion of the MRA. MU732f would consist of the area where two UXO hand grenade simulators were identified during the CSE Phase II. MU732g and MU732h would consist of areas where MD was identified during the CSE Phase II. The last MRS, MU732i, would consist of the administrative closeout area due to the AFRIMS miscalculation. The names and acreages for each of the MU732 MRS follow:

- MU732: WWII Gunnery Range @ Range Road (Excess), 419.3 acres;
- MU732a: KD Range Berm, 0.2 acres;
- MU732b: Clay Pigeon Debris Area, 84.8 acres;
- MU732c: Multi-Use Range Mountainous Area, 1039.7 acres;
- MU732d: .50 Caliber Firing Fan, 1523.3 acres;
- MU732e: Remaining Areas of Sections 16 & 17, 780.5 acres;
- MU732f: Hand Grenade Simulator Area, 49.5 acres;
- MU732g: 750 Pound Practice Bomb Area, 3.7 acres;
- MU732h: MD Area, 81.3 acres; and
- MU732i: Administrative Close Out Area, 1607.7 acres.

The locations of these MRS are presented as **Figure 14-1**. This is based on the complete MEC database for the Nellis AFB MRA (see **Figure 14-2**).

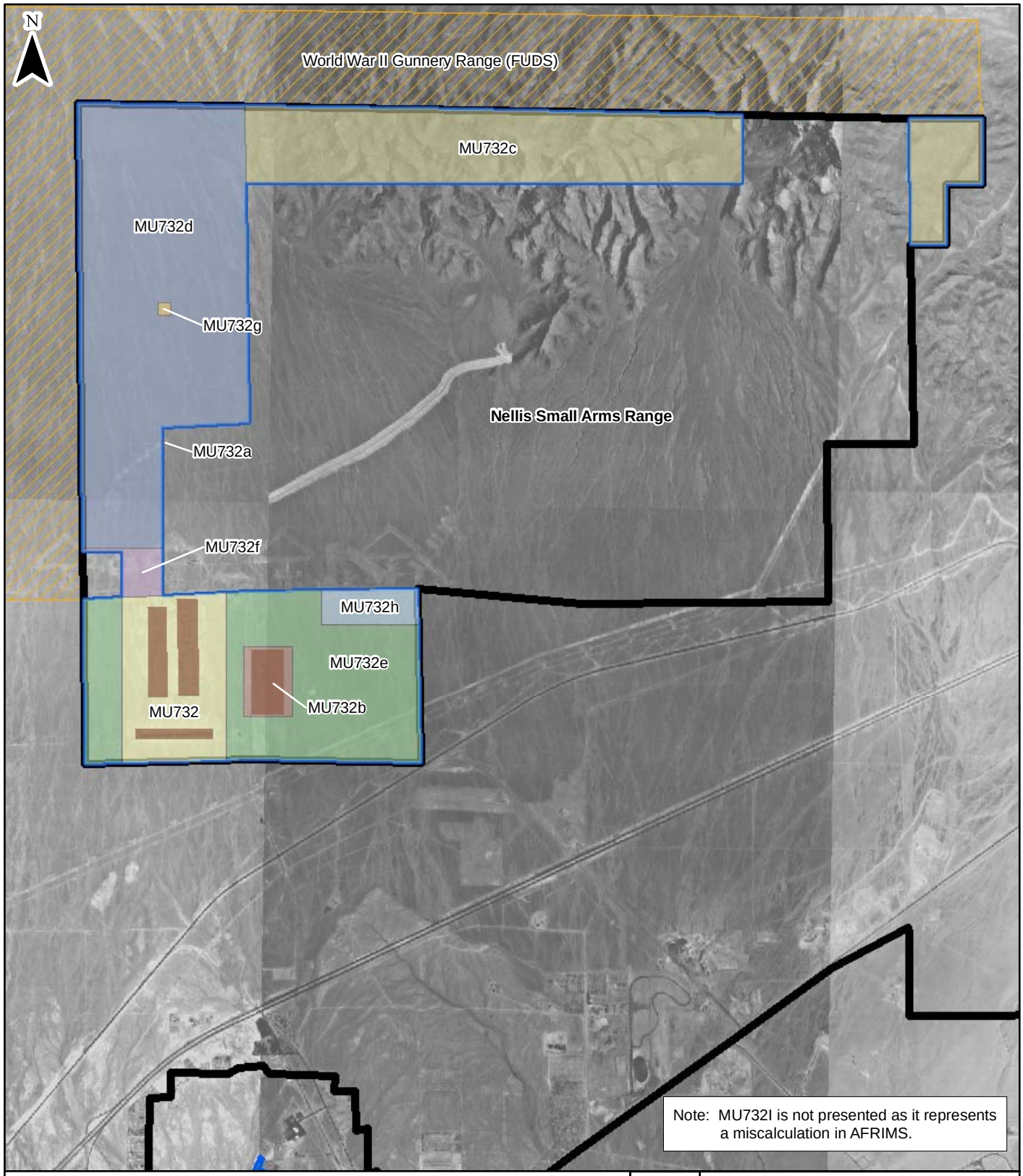
For the remaining MRAs (XU741 and TM742), splitting of the MRA into MRSs is not warranted. Each MRA is considered to be one MRS, equal in acreage to the total MRA.

## 14.4 Change to MRA/MRS Footprint

No change to the footprint of MU732, XU741, or TM742 is recommended based on the results from the CSE Phase II.

## 14.5 Future Response Actions and Objectives

A summary of the results and recommendations for the Nellis AFB MRS from the CSE Phase II is presented as **Table 14-2**.




Note: MU732I is not presented as it represents a miscalculation in AFRIMS.

LEGEND

- Installation Boundary
- Munitions Response Area
- FUDS Property
- Clay Pigeon Debris Area

MRS

- MU732
- MU732A
- MU732B
- MU732C
- MU732D
- MU732E
- MU732F
- MU732G
- MU732H

0 4,000 8,000 Feet

Projection : NAD83 State Plane Nevada East

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**FIGURE NUMBER** 14-1

**RECOMMENDED MRSS NELLIS AIR FORCE BASE**

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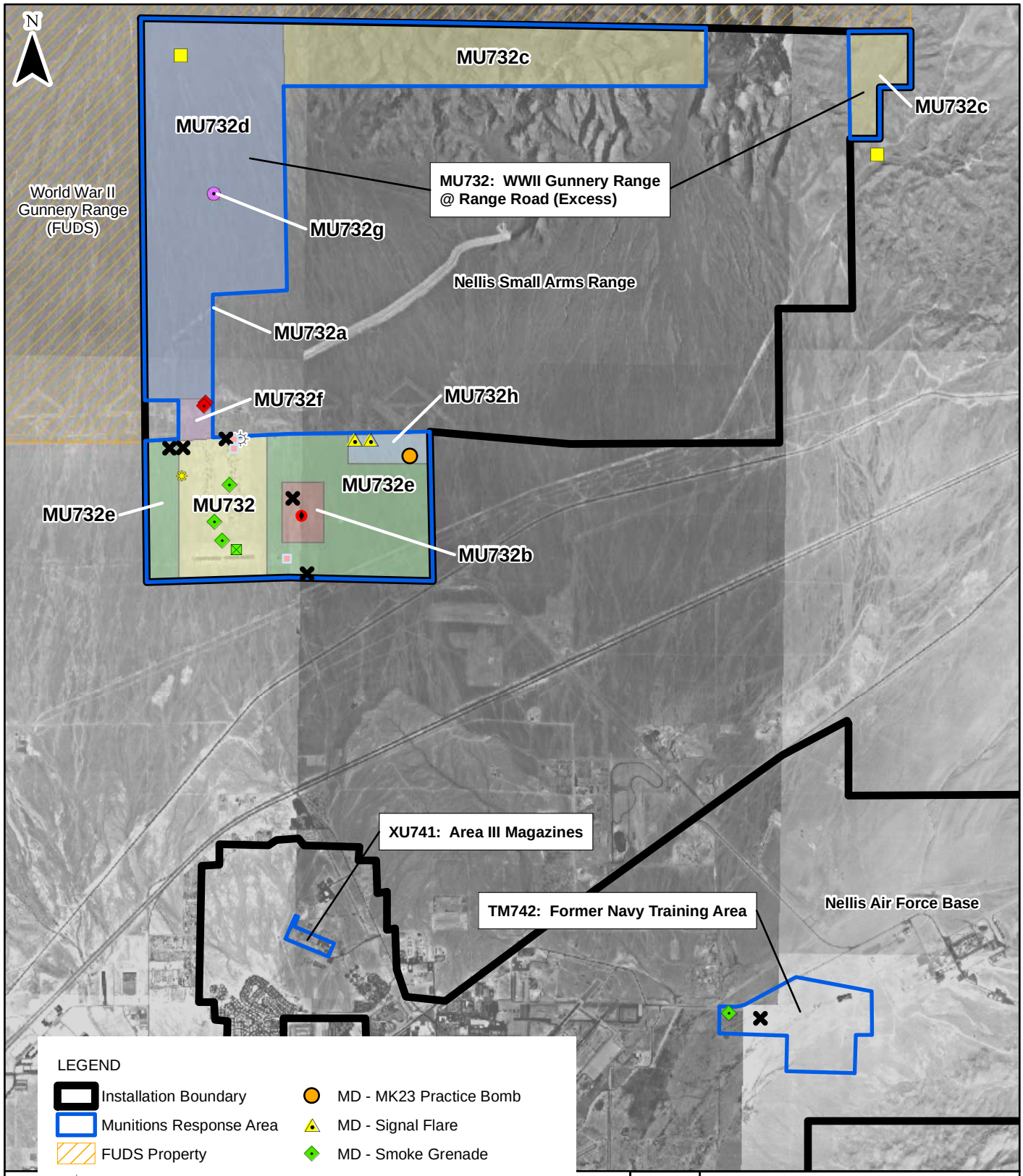


LEGEND

- Installation Boundary
- Munitions Response Area
- FUDS Property
- Burn Pit
- Clay Pigeon Debris
- MD - 750 lb Practice Bomb
- MD - Fire Bomb Igniter
- MD - MK23 Practice Bomb
- MD - Signal Flare
- MD - Smoke Grenade
- MD- Frag
- Small Arms
- UXO - Hand Grenade Simulator
- UXO - MK 4 Signal Cartridge
- Aluminum Target Material

0 1 2 Miles

Projection : NAD83 State Plane Nevada East

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**FIGURE NUMBER** 14-2

**COMPLETE MEC SUMMARY**
**NELLIS AIR FORCE BASE**

Shaw Environmental, Inc. Bay West

**Table 14-2 Conclusions and Recommendations for Nellis AFB MRSs**

| MRS | CSE Phase II Conclusions | Recommendations |
|---|---|---|
| MU732 | MEC Results: MD (smoke grenades and fire bomb igniter) identified. In addition, a burn pit was located in this MRS.<br>Environmental Sampling Results: PAH concentrations observed above industrial screening levels. Lead observed above ecological and residential screening levels in one sample.<br>Human Health Risk Screening Results: Additional evaluation of soil for PAHs and lead.<br>Ecological Screening Results: Additional evaluation of soil for PAHs. | Proceed to next phase |
| MU732a | MEC Results: No evidence of MEC observed.<br>Environmental Sampling Results: XRF and laboratory lead results were above background and screening levels.<br>Human Health Risk Screening Results: Additional evaluation of soil for lead.<br>Ecological Screening Results: Additional evaluation of soil for lead. | Proceed to next phase |
| MU732b | MEC Results: One UXO (MK 4 Practice Bomb Signal) was identified.<br>Environmental Sampling Results: PAH concentrations observed above industrial screening levels.<br>Human Health Risk Screening Results: Additional evaluation of soil for PAHs.<br>Ecological Screening Results: Additional evaluation of soil for PAHs and lead. | Proceed to next phase |
| MU732c | MEC Results: Visual surveys were not performed during the CSE Phase II due to extremely mountainous conditions.<br>Environmental Sampling Results: Sampling not performed due to extremely mountainous conditions.<br>Human Health Risk Screening Results: Not Applicable<br>Ecological Screening Results: Not Applicable | Proceed to next phase - Evaluate Institutional Controls |
| MU732d | MEC Results: No evidence of MEC was identified.<br>Environmental Sampling Results: No analytes were detected above human health screening levels. Lead was detected above background and ecological screening levels.<br>Human Health Risk Screening Results: No Further Action.<br>Ecological Screening Results: Additional evaluation of soil for lead. | No Further Action |
| MU732e | MEC Results: No evidence of MEC was identified.<br>Environmental Sampling Results: Sampling not performed due to | No Further Action |

**Table 14-2 Conclusions and Recommendations for Nellis AFB MRSs**

| MRS | CSE Phase II Conclusions | Recommendations |
|---|---|---|
| | as only a few expended small arms were observed in the MRS.<br>Human Health Risk Screening Results: Not Applicable<br>Ecological Screening Results: Not Applicable | |
| MU732f | MEC Results: Two UXO (Hand Grenade Simulators) were identified.<br>Environmental Sampling Results: No analytes were detected above human health screening levels. Lead was detected above background and ecological screening levels.<br>Human Health Risk Screening Results: No Further Action.<br>Ecological Screening Results: Additional evaluation of soil for lead. | Proceed to next phase |
| MU732g | MEC Results: MD from one 750 pound practice bomb was identified.<br>Environmental Sampling Results: Sampling not performed as only one MD item was observed.<br>Human Health Risk Screening Results: Not Applicable<br>Ecological Screening Results: Not Applicable | Proceed to next phase |
| MU732h | MEC Results: MD from two signal flares and one MK23 practice bomb was identified.<br>Environmental Sampling Results: Sampling not performed as only three MD items were observed.<br>Human Health Risk Screening Results: Not Applicable<br>Ecological Screening Results: Not Applicable | Proceed to next phase |
| MU732i | Acreage miscalculation in AFRIMS from actual footprint. Investigation is not applicable. | Administratively Close |
| XU741 | MEC Results: No evidence of MEC observed.<br>Environmental Sampling Results: One surface sample analyzed for select explosives. All explosives were non-detect.<br>Human Health Risk Screening Results: No Further Action<br>Ecological Screening Results: No Further Action | No Further Action |
| TM742 | MEC Results: One smoke grenade MD observed and small arms<br>Environmental Sampling Results: Sampling not required as no concentrated areas of MEC/MD were identified.<br>Human Health Risk Screening Results: No Further Action.<br>Ecological Screening Results: No Further Action | No Further Action |

## 14.6 Identify Gaps in CSM

The CSM for the Nellis AFB MRA is well defined. No gaps in the CSM were identified.

## 14.7 DOD MRSPP Priority

The DoD MRSPP Priorities for the Nellis AFB MRAs/MRSs are presented in **Table 14-2**.

## 14.8 Site Sequencing Considerations

There are no unusual considerations for site sequencing at Nellis AFB.