FINAL
REMEDIAL INVESTIGATION / FEASIBILITY STUDY REPORT

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION / FEASIBILITY STUDY

KINGMAN RANGE MRS (AZHQ-006-R-01)
MOHAVE COUNTY, ARIZONA

CONTRACT NO. W912DR-15-D-0022
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ACRONYMS AND ABBREVIATIONS

%	percent
°F	degrees Fahrenheit
ADEQ	Arizona Department of Environmental Quality
ARAR	applicable or relevant and appropriate requirement
ARNG G9	Army National Guard G9
AZARNG	Arizona Army National Guard
bgs	below ground surface
BIP	blow-in-place
BNL	background noise lane
BSI	blind seed item
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	CWM Hazard Evaluation
CMUA	concentrated munitions use area
COPC	contaminant of potential concern
CSM	conceptual site model
CWM	chemical warfare materiel
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DL	detection limit
DMM	discarded military munitions
DoD	Department of Defense
DQO	data quality objective
DU	decision unit
DUBG	background decision unit sample
EA	EA Engineering, Science, and Technology, Inc.
EcoSSL	ecological soil screening levels
EHE	Explosive Hazard Evaluation
EM	Engineer Manual
EOD	explosive ordnance disposal
EP	Engineer Pamphlet
ERA	ecological risk assessment
ESL	ecological screening levels
FS	Feasibility Study

ACRONYMS AND ABBREVIATIONS (CONT.)

ft.	feet or foot
FUDS	Formerly Used Defense Sites
GGA	Global Positioning System Fixed Data
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSV	geophysical system verification
HE	high explosive
HHE	Health Hazard Evaluation
HHRA	human health risk assessment
HRR	Historical Records Review
ISM	incremental sampling methodology
ISO	industry standard object
IVS	instrument verification strip
J	the reported result is an estimated value.
LANL	Los Alamos National Laboratory
LOD	limit of detection
LOQ	limit of quantitation
LUC	land use controls
m	meters
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
mg/kg	milligrams per kilograms
mm	millimeter
MMRP	Military Munitions Response Program
mph	miles per hour
MPPEH	material potentially presenting an explosive hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
mV	millivolt
NCMUA	non-concentrated munitions use area
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDNODS	Non-Department of Defense Owned, Non-Operational Defense Site

ACRONYMS AND ABBREVIATIONS (CONT.)

NMEA	National Marine Electronics Association
NFA	no further action
NMRD	non-munitions-related debris
NRCS	Natural Resources Conservation Service
NV	no value
PA	Preliminary Assessment
PAL	Project Action Limit
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PP	Proposed Plan
PRG	preliminary remediation goal
Q	data qualifier
QC	quality control
RAO	remedial action objective
RI	Remedial Investigation
ROE	right-of-entry
RSL	Regional Screening Level
RTK	real time kinematic
SAA	small arms ammunition
SD	standard deviation
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SRL	soil remediation level
SUXOS	Senior Unexploded Ordnance Supervisor
TBC	to be considered
U	Analyte was not detected and is reported as less than the LOD.
UCL	upper confidence limit
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
UJ	Estimated/Not Detected above the LOD.
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

ACRONYMS AND ABBREVIATIONS (CONT.)

UU/UE	unlimited use/unrestricted exposure
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
VSP	Visual Sample Plan
WESTON	Weston Solutions, Inc.
WGS84	World Geodetic System 1984

EXECUTIVE SUMMARY

This report summarizes the work performed by Weston Solutions, Inc. and results of the remedial investigation (RI) conducted at the Non-Department of Defense (DoD) Owned, Non-Operational Defense Sites (NDNODS) Kingman Range Munitions Response Site (MRS), located in Kingman, Mohave County, Arizona. Additionally, this report includes the Feasibility Study (FS) based on the findings in the RI Report. Work was authorized under the United States (U.S.) Army Corps of Engineers (USACE) – Sacramento District, Contract W912DR-15-D-0022, Delivery Order 0001, dated 15 September 2016. Work was performed in accordance with the 4 January 2016 Performance Work Statement, and conducted in support of the U.S. Military Munitions Response Program (MMRP). NDNODS are defined as those defense sites that were exclusively used by the Army National Guard and were never owned, leased, or otherwise possessed or used by the U.S. Army or other DoD component, are a subcategory of MMRP.

The 33.43-acre Kingman Range MRS was used by the Arizona Army National Guard as a small arms firing range from 1951 to 1968 and is located approximately 150 miles west of Flagstaff, Arizona. Most of the MRS has been developed and privately owned since 1968. Approximately 75 percent (%) of the MRS is located within a residential community. The remaining 25% is undeveloped vacant land. Access is unrestricted to pedestrian and vehicular traffic.

A Site Inspection (SI) was conducted at the Kingman Range MRS in 2012. Although no MEC was identified, evidence of munitions debris (MD) was observed and the SI recommended that the MRS proceed to an RI to gather sufficient information to characterize the nature and extent of potential munitions and explosives of concern (MEC) and associated munitions constituents (MC), if present, and to assess the potential risks of MEC and MC to potential human and ecological receptors. Information collected during the RI was used to update the conceptual site model, evaluate potential human health and ecological risks, conduct an explosives hazards risk assessment, and update the Munitions Response Site Prioritization Protocol (MRSPP) rating.

RI characterization was completed during three (3) mobilizations: the first in October 2017 to collect digital geophysical mapping (DGM) survey data and to collect surface soil samples for MC analysis; the second in July 2018 to intrusively investigate select DGM anomalies and conduct analog geophysical surveys; and the third in May 2019 to investigate four (4) 100% coverage grids. Transects, spaced 42 feet (ft.) apart on centerlines, were surveyed using DGM on the flatter portion of the investigation area; while analog transects were performed to fill in where DGM equipment was not accessible. Visual Sample Plan geostatistical software was used to generate an anomaly density map to assist in the identification of potential concentrated munitions use areas (CMUAs) and associated boundaries with non-CMUAs, and to focus the intrusive investigation. The locations of four (4), 50 ft. by 50 ft. grids were selected for intrusive investigation in relation to the areas of elevated anomaly density.

Eighty-eight (88) items were identified as a result of the intrusive investigations. Twenty-one (21) MD items, forty-four (44) non-munitions related debris (NMRD) items, and twenty-three (23) small arms ammunition (SAA) items were recovered during the intrusive investigations. MD items were encountered from the ground surface to a maximum of 6 inches depth.

The recovered MD was predominantly associated with the 3.5-inch M29 Practice Rocket (i.e., tail fins, tail shroud, and nose cone) and unidentifiable fragmentation debris, but also included a spent M22 Rifle Grenade (Smoke) and debris from a 60 millimeter (mm) mortar. MEC items were not identified during RI activities at the Kingman Range MRS. A total of 0.91 acres out of the area of investigation (8.14 acres) was investigated through DGM and analog surveys as well as grid clearances. Because no MEC has been discovered and a low volume of MD items have been recovered, CMUAs were not identified; however, several areas of elevated anomaly density primarily associated with the NMRD and SAA items were identified.

A total of seven (7) pounds of MD were dual-inspected by the senior unexploded ordnance supervisor and the unexploded ordnance quality control specialist, certified as material documented as safe (MDAS), and locked in a small container for transportation and MDAS processing (i.e., destruction via shredding prior to recycling).

Based on the results of the RI, it is recommended that the Kingman Range MRS be divided into two (2) MRSs for future work: the 8.14-acre Kingman Range MRS (AZHQ-006-R-01), and the 25.29-acre Kingman Range – No Further Action (NFA) Area MRS (AZHQ-006-R-02) (**Appendix A, Figure 10**). The Kingman Range MRS corresponds with the RI area of investigation and will require further action for MEC and NFA for MC. The Kingman Range – NFA Area MRS consists of the developed residential area to the west of the target area. This area has been developed and hardscaped, and no MD or MEC has been observed in this area during the SI or the RI, and the MRS will require NFA for MEC and MC.

The methodology described in the memorandum, *Trial Period Extension for Risk Management Methodology (RMM) at Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Projects* (USACE, 2019) was used to evaluate the risks associated with potential MEC present at the Kingman Range MRS and the Kingman Range – NFA Area MRS. Based on the evaluation, the Kingman Range MRS received an "Unacceptable" rating and the Kingman Range – NFA Area MRS received an "Acceptable". Therefore, the RI results do not support the conditions for unlimited use and unrestricted exposure (UU/UE) for the Kingman Range MRS (AZHQ-006-R-01). The RI results do support the conditions for UU/UE for the Kingman Range – NFA Area MRS (AZHQ-006-R-02)

A baseline risk assessment for MC was not required as a part of this RI because a source of MC was not identified. During the prior SI field investigation, eleven (11) surface soil samples were collected and analyzed for explosive compounds and select metals. The MC samples collected during the SI were from potential "worst-case" areas associated with small arms impact berms and encountered MD. Explosive compounds were not detected while detected metals were below their respective Arizona screening levels.

Four (4) MC samples collected during the RI were from the undeveloped portion of the MRS in the location of a former target berm. The results of the RI fieldwork indicated explosives compounds were not detected above preliminary remediation goals and metals were detected above background.

While all metals exceeded ecological screening levels, the decision units, representative of the larger undeveloped portion of the MRS in the location of the former target berm, are not sufficient in size to support an ecology that can submit to ecological review. Because it was determined that MC does not pose a risk to human health or the ecology, NFA is recommended for MC.

Based on the results of the SI and findings during the RI, the Kingman Range MRS was historically used for small arms training, as well as training with the M29 3.5-inch practice rocket training, the M22 Rifle Grenade Smoke, and the 60 mm mortar. Although no MEC was identified during the SI or RI, the presence of MD from potential high explosive munitions indicates that it is possible that MEC may be present at the MRS. The MRSPP priority rating for the Kingman Range MRS remains at a ranking of "4." The MRSPP priority rating for the Kingman Range – NFA Area MRS is No Longer Required. The USACE MEC risk assessment for the Kingman Range MRS resulted in an "Unacceptable" land use rating and therefore does not support conditions for UU/UE. The USACE MEC risk assessment for the Kingman Range –NFA Area MRS resulted in an "Acceptable" land use rating and therefore conditions for UU/UE are supported. Based on the results of the RI, NFA is recommended for MC at the Kingman Range MRS. The Kingman Range MRS will move forward to an FS to evaluate remedial action alternatives with respect to unacceptable MEC hazards that remain. The FS Report is included in this report as **Appendix L**. NFA is recommended for MEC and MC at the Kingman Range – NFA Area MRS.

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1.0 INTRODUCTION

This report summarizes the work performed by Weston Solutions, Inc., (WESTON) and results of the Remedial Investigation (RI) conducted at the Non-Department of Defense (DoD), Non-Operational Defense Sites (NDNODS) Kingman Range Munitions Response Site (MRS), located in Kingman, Mohave County, Arizona.

This RI Report has been prepared under the direction of the United States (U.S.) Army Corps of Engineers (USACE) Sacramento District for the Army National Guard G9 (ARNG G9) and the Arizona Army National Guard (AZARNG). The following guidance was used for report development: U.S. Environmental Protection Agency (USEPA) October 1988 document *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (USEPA, 1988); the Army's Military Munitions Response Program (MMRP) document, *Final Munitions Response Remedial Investigation/Feasibility Study Guidance* (U.S. Army, 2009); the USACE *Engineer Manual (EM) – 200-1-15 Technical Guidance for Military Munitions Response Actions* (USACE, 2018); and, the *USACE Engineer Pamphlet (EP) – 1110-1-18 Ordnance and Explosives Response* (USACE, 2000).

1.1 PROJECT AUTHORIZATION

Work was authorized under the USACE – Sacramento District, Contract W912DR-15-D-0022, Delivery Order No. 0001, and was conducted in support of the MMRP. The DoD established the MMRP under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. The DERP, including the MMRP, follows the CERCLA and National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

A Site Inspection (SI) was previously conducted at the 33.43-acre Kingman Range MRS in December 2011. The SI recommended the MRS proceed to an RI based on the findings during the SI. The RI field effort was designed to determine the nature and extent of munitions debris (MD), MC, and munitions and explosives of concern (MEC), if present, and assess risks and hazards resulting from past military munitions-related training within the MRS.

1.2 PURPOSE

The purpose of the RI was to gather sufficient, on-site data necessary to characterize the nature and extent of MEC and MC, if present, and to assess the potential risks posed by MEC and MC to human and ecological receptors. Information collected during the RI was used to update the conceptual site model (CSM), evaluate potential human health and ecological risks, conduct an explosives risk assessment, and update the Munitions Response Site Prioritization Protocol (MRSPP).

If it is determined to be required at the completion of this RI, the MRS will proceed to a Feasibility Study (FS). The FS is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions, if such are determined to be required. In addition, a Proposed Plan (PP) describing the preferred remedial alternative based on the recommendations of the RI and FS will be completed for public review and Stakeholder concurrence. A Record of Decision will be prepared following approval of the PP to identify the remedial alternative chosen as the selected remedy, or to document no action if no remedial efforts are necessary.

1.3 PROPERTY DESCRIPTION AND PROBLEM IDENTIFICATION/SITE BACKGROUND

1.3.1 Site Location and Setting

The NDNODS Kingman Range MRS is located in Kingman, Mohave County, Arizona, approximately 150 miles west of Flagstaff (**Appendix A, Figures 1 and 2**). The NDNODS Kingman Range MRS occupies 33.43 acres and is situated between 35° 12’ 20” and 35° 12’ 28” latitude and 114° 00’ 15” and 114° 00’ 41” longitude. The western boundary of the MRS is generally coincident with the western side of Eastern Street. The northern, eastern, and southern sides of the MRS do not coincide with distinct anthropogenic features. The eastern boundary is along an exposed bedrock escarpment that increases in elevation to the east. The MRS has been developed and privately owned since 1968 and is part of a residential community (i.e., Kingman Park Estates). There are multiple residential structures within the MRS boundary. No RI activities were designed to take place within the developed areas (approximately 25.29 acres), due to hardscaping and soils being previously disturbed, resulting in an area of investigation of 8.14 acres of the MRS.

1.3.2 Site History and Previous Investigations

The NDNODS Kingman Range MRS was used by the AZARNG from 1951 until 1968. Training included small arms ammunition (SAA) (.22-caliber, .30-caliber and .45-caliber) and submachine gun practice, as well as mortar and 3.5-inch rocket target practice. The firing line was located along Eastern Street, with firing from west to east into targets with a natural bedrock escarpment backstop located 1,500 feet (ft.) away (**Appendix A, Figure 2**). The MRS was identified in 1966 based on a memo titled “Safety Inspection of Ranges” located at the National Archives and AZARNG-provided an expired lease agreement between the previous owner of the Kingman Range MRS and the AZARNG. According to the Preliminary Assessment (PA) Report, the Kingman Range MRS is located on private property (EA Engineering, Science, and Technology, Inc. [EA], 2008).

As part of the Historical Records Review (HRR) completed for the SI work plan, historical aerial photographs from 1954 and 1965 were acquired from private archives. A 1954 U.S. Geological Survey (USGS) aerial photograph depicts the NDNODS Kingman Range extending from firing points near the current location of Broudy Drive, to the target area at the western slope of the natural escarpment approximately 950 ft. to the east.

A 1965 USGS aerial photograph reflects that the range had been extended westward with a total length of 1,500 ft. from the current location of Eastern Street to the natural escarpment backstop.

Based on the 1965 aerial photograph, the location of the former firing line and former target berm (**Appendix A, Figure 2**) have been adjusted from what has been shown in the SI. The size of the original MRS boundary depicted in the PA Report was recalculated using the data from the aerial photographs. As a result, the original 25.3-acre size of the MRS stated in the PA Report was increased to 33.43 acres. Other than the acreage change, no data gaps or inconsistencies were identified during development of the HRR (WESTON, 2011).

During the SI, fieldwork was conducted on the Kingman Range MRS in December 2011. Field work consisted of 3.6 miles of meandering path instrument-aided (i.e., White's All Metal detectors) visual surveys and the collection of surface soil samples (**Appendix A, Figure 3**). The field team confirmed that the range configuration and features were consistent with the HRR conclusions. The portion of the MRS west of the target area is residential and contains multiple homes and paved streets. The target area at the eastern portion of the MRS remains undeveloped and vegetated with Mohave Desert grasses and shrubs. The field team observed an escarpment at the eastern end of the range that acted as a natural backstop for the target area. The west face of the escarpment has exposed bedrock over 30 ft. above the elevation of the residential areas to the west, and its role as a backstop was confirmed when the field team observed SAA projectiles protruding from the rocks facing the firing line. This also confirmed the direction of fire to be toward the east. The land west of the backstop escarpment gently slopes toward the west-southwest. No targets, remains of a target stand, or impact berms were found.

A range flag pole was still standing on top of the escarpment. Evidence of military activities identified by the field team in the target area included the presence of MD items consisting of SAA projectiles, a rifle clip, two (2) mortar fuze fragments and debris from a 3.5-inch rocket. The mortar fuze fragments and rocket debris were located west of the escarpment backstop, behind the location of the historical target line identified in the aerial photographs. No MEC was discovered in the sampling areas during the visual survey, but evidence of munitions use, including potential high explosive (HE) munitions, was confirmed and the possibility of MEC does exits, even though it may be low (WESTON, 2012).

A total of 11 surface soil samples (0-6 inches depth) were collected from the Kingman Range MRS. Five (5) discrete samples were collected at the backstop escarpment. Three (3) "spoke-and-hub" seven (7)-point composite samples were initially collected at the base of the backstop escarpment. Three (3) additional composite samples were collected at the location of the mortar fuze fragments and rocket fragments. Each of the initial five (5) discrete and three (3) composite samples collected from the base of the backstop were analyzed for select MC metals, including antimony, copper, lead, and zinc. The three (3) composite samples collected at the locations of the mortar fuze fragments and rocket fragments were analyzed for explosive compounds because of their association with MD in an impact area. Concentrations of the detected metals (copper, lead, and zinc) were below their respective Arizona screening levels. Antimony was not detected in any of the samples. Explosive compounds were not detected. Based on the results of the SI, it was recommended that further investigation be conducted for MEC and MC (WESTON, 2012).

1.3.3 Right-of-Entry

The Kingman Range MRS is situated on multiple privately owned properties. A depiction of ownership parcels within the Kingman Range MRS is shown in **Appendix A, Figure 4**. USACE sought and received a right-of-entry (ROE) for one (1) property, parcel 311-20-027, to conduct field investigations in the fall of 2017 and summer of 2018. The ROE was signed by the private property owner on 19 August 2016 (**Appendix B**). A second ROE for parcel 311-20-027, necessary to conduct field work in the summer of 2019, was signed on 15 March 2019 (**Appendix B**).

2.0 PROJECT REMEDIAL RESPONSE OBJECTIVES

Remedial response goals identified for the Kingman Range MRS in the Final RI Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) (WESTON, 2017) were to characterize the type (nature) and density and distribution (extent) of MEC at the MRS; to characterize the concentrations and extent of MC at the location of the former target berm, including any potential source of MC (e.g., identification of compromised MEC, areas of concentrated MEC and/or MD, or post blow-in-place [BIP] locations) identified at the MRS; and, to perform baseline risk assessment for MC and explosive hazards, if identified.

2.1 PRELIMINARY CONCEPTUAL SITE MODEL

The CSM is a description of a site and its environment that is based on existing knowledge. The CSM describes the sources of MEC and MC hazards at a site, actual or potential pathways, current or proposed use of property, and potential receptors to MC or explosives hazards. The CSM provides a planning tool to integrate site information from a variety of sources, evaluate the information with respect to project objectives and data needs, and respond through an iterative process for further data collection or action. The CSM development should be viewed as a process that reflects the progress of activities at a site from initial assessment through site closeout. Information in this CSM includes:

- Facility Profile – Describes the history, location, and man-made features at or near the site;
- Physical Profile – Describes the factors that may affect release, fate, and transport;
- Land Use and Exposure Profile – Provides the information used to identify and evaluate the applicable exposure scenarios and receptor locations;
- Ecological Profile – Describes the physical relationship between developed and undeveloped portions of the site, use of the undeveloped portions, and ecological use; and
- Release Profile – Presents the extent of contaminants or hazards in the environment.

The preliminary CSM was developed and included in the UFP-QAPP (WESTON, 2017). A summary of the preliminary CSM information is described in the following sections.

2.1.1 Facility Profile

See **Section 1.3.1**.

2.1.2 Physical Profile

2.1.2.1 Climate

The minimum and maximum monthly temperature averages range from 31.1 to 97.8 degrees Fahrenheit (°F), with an average annual temperature of 74.5° F. Average annual precipitation is 10.35 inches.; average annual snowfall is 3.7 inches; average annual wind speed is ten (10) miles per hour (mph) with average gusts of 26 mph typically from the south (Western Regional Climate Center, 2016).

2.1.2.2 Topography

Elevations across the MRS range from approximately 3,538 ft. to 3,640 ft. above mean sea level. Terrain is relatively flat with an escarpment and mesa rising in the eastern portion of the MRS.

2.1.2.3 Soils

The underlying geology at the MRS includes the House Mountains family – Calvista family – Rock outcrop complex and the Jagerson very gravelly loam. There are two (2) primary soil units found within the MRS in descending prevalence (Natural Resources Conservation Service [NRCS], 2016):

- House Mountain family – Calvista family - Rock outcrop complex (ten [10] % to thirty-five [35] % slopes); and
- Jagerson very gravelly loam, (zero [0] % to four [4] % slopes).

The House Mountains family – Calvista family – Rock outcrop complex consists of the following layers: zero (0) to two (2) inches below ground surface (bgs) of very gravelly sandy loam; two (2) to ten (10) inches bgs of cobbly loam, and ten (10) inches bgs of unweathered bedrock. The soil is classified as loamy, mixed, superactive, thermic Lithic Haplocalcids. Parent material is alluvium derived from volcanic rock. The soil is well drained consisting of approximately 45% coarse gravel with a depth of four (4) to 20 inches to bedrock. Exposures of bedrock are typically barren but may have sparse vegetation growing in cracks and crevices or in thin layers of alluvium or colluvium (NRCS, 2005).

The Jagerson very gravelly loam consists of the following layers: zero (0) to two (2) inches bgs of gravelly sandy clay loam; two (2) to nine (9) inches bgs of gravelly sandy clay loam; nine (9) to 18 inches bgs of clay loam; 18 to 42 inches bgs of very gravelly sandy loam; and 42 to 60 inches bgs of extremely gravelly loamy coarse sand. The soil is classified as fine-loamy, mixed, superactive, thermic Typic Calciargids. Parent material is alluvium derived from volcanic rock. The soil is well drained (NRCS, 2005).

2.1.2.4 Geology

Bedrock geology of the Kingman area is dominated by a sequence of Miocene volcanic rocks that fill a broad northeast-directed paleovalley that can be traced from the southernmost Black Mountains southwest of Kingman through Kingman and Peach Springs, Arizona to the southern rim of the Grand Canyon. The bedrock of the mountains that separate the valleys consists of granitic, metamorphic, sedimentary, and volcanic rocks. The older volcanics consist of mafic lavas with interbeds of sandstone, conglomerate, and thin (<3 meter [m] thick) nonwelded, felsic ash-fall tuffs. The conglomerates are dominated by Proterozoic granitic clasts derived from the walls of the valley, but in one (1) area near Gross Spring, rounded clasts of dacitic lava most likely derived from the Black Mountains to the southwest are present. Dacitic lavas of Miocene age are also present to the east of Kingman. Sparse northeasterly paleocurrents at this locality provide evidence that the paleovalley probably flowed to the northeast. In most areas, the bedrock is relatively impermeable compared to the basin fill and forms barriers to ground-water movement in the basin-fill aquifer. The Grand Wash Cliffs along the eastern margin of the Hualapai Valley consist of Paleozoic sedimentary rocks that extend eastward and mark the boundary between the Colorado Plateau and Basin and Range Physiographic Provinces (Gillespie and Bentley, 1971).

Younger Miocene rocks that fill the paleovalley consist of ignimbrites dominated by the Peach Spring Tuff which forms the prominent cliffs in the Kingman area. The ledges and cliffs are part of a single cooling unit, and clearly distinct from the underlying Cook Canyon, and overlying Bonnelli tuffs. The Cook Canyon Tuff fills a smaller, similarly oriented paleovalley inset into the broader main valley.

Structurally, Tertiary strata of the Cerbat-Hualapai Mountains change from flat-lying along the crest of the range into predominately southwest-tilted in the Sacramento Valley to the west. The change occurs through a west-vergent anticlinorium associated with down-to-the-east normal faults that are cut by down-to-the-west normal faults. Along the crest of the range, dip-slip faulting is minimal, and faults, like the one that cuts through the town of Kingman, are predominantly strike-slip with as much as two (2) kilometers of dextral displacement. Dextral motion is indicated by offset across the fault of the northwestern edge of a paleovalley filled with the Cook Canyon Tuff.

Valleys consist of gently sloping piedmonts covered by alluvial fan and terrace deposits, and nearly flat valley floors occupied by ephemeral washes, floodplains, and low terraces. Younger alluvial deposits have little to no soil development, retaining the original grey or brown color of the alluvial sediment, and no carbonate accumulation. Clasts in these deposits have no weathering rinds or surface patinas and thus appear brighter and fresher than older clasts. Young alluvial surfaces often retain original depositional characteristics such as bars and swales. Conversely, older alluvial deposits have better developed soils that appear orange or red in color, with soil horizons reflecting clay and carbonate accumulations. Clasts in older alluvial deposits often exhibit darkened weathering rinds or rock varnish, and thus appear darker.

Intermediate alluvial fan and terrace deposits near the mountain front are located at higher elevations in the landscape than Holocene alluvium but are partially buried by younger deposits farther from the mountain front where relief between Pleistocene and Holocene deposits is reduced or absent. Wide terraces are planar where preserved and exhibit remnant bar and swale microtopography which has been overprinted and smoothed by pavement formation, inflation, and churning by vegetation. Very coarse, medium to well-varnished boulder dominated bars are partially buried by moderate pavement development in surrounding swales. Clast cover is composed of vesicular basalt, mixed volcanics, and granitoids. Basalt clasts are the most varnished lithology and surface color varies depending on lithology dominance. Vegetation on surfaces consists of small shrubs, creosote, catclaw acacia, yucca, cholla, and ocotillo. Surface soil color is medium brown (Ferguson and Cook, 2014).

2.1.2.5 Hydrogeology

Groundwater from the basin-fill aquifer is the primary water supply for each of the three (3) valleys. The older basin fill is the primary water-bearing deposit because intermediate and younger basin fill are above the water table in most areas. Most groundwater withdrawals in the valleys are for municipal and industrial uses; a small percentage of withdrawals is used for agriculture. The combined annual groundwater pumpage for the three (3) valleys was about 6,600 acre-ft. in 1991; by 2000, pumpage had nearly doubled to about 11,000 acre-ft. (Tadayon, 2005). The combined annual recharge for the three (3) valleys was estimated to be about 9,000 acre-ft. (Freethey and Anderson, 1986), and groundwater storage was estimated to be about 13 million acre-ft. (Arizona Department of Water Resources, 1994). Regional groundwater movement in the basin-fill aquifer generally is from the mountain fronts towards the valley center and then along the valley axis to the Colorado River. In general, depths to groundwater are greatest in the upper parts of the valleys and decrease down-gradient to within a few feet below the land surface near the Colorado River. The greatest depths to water are about 1,200 ft. near the boundary between Detrital and Sacramental Valleys (Rascona, 1991), and about 600 ft. near Kingman in the Hualapai Valley (Remick, 1981).

Local groundwater in consolidated rocks serves as a water supply in some areas, especially where rocks are faulted, fractured, and weathered (Gillespie and Bentley, 1971). In the Kingman area, volcanic rocks are locally permeable near two (2) fault zones, and groundwater stored in the fractures has been used as part of the municipal water supply. Several springs issue from consolidated rocks and in some cases serve as water supplies for livestock and wildlife. Groundwater depth at the MRS is greater than 150 ft. bgs (WESTON, 2012).

2.1.2.6 Hydrology

No surface water exists on or nearby the MRS. Precipitation drains to the west-southwest and is absorbed by the ground or evaporates (WESTON, 2012).

Detrital, Hualapai, and Sacramento Valleys are drained by a network of streams that are intermittent or ephemeral owing to the dry climate. Detrital Wash, Hualapai wash, and Sacramento Wash are the primary streams in their valleys and drain to the Colorado River. A topographic divide separates the northern and southern parts of the Hualapai Valley. Truxton Wash, the only major stream that originates outside of the three (3) valleys, drains part of the basin east of Hualapai Valley and flows westward into the southern part of the Hualapai Valley into Red Lake Playa. Streams generally flow only in response to regionally extensive winter storms or from spatially scattered summer thunderstorms. Runoff in mountain tributaries usually does not reach the valley's primary stream, but rather infiltrates the streambed sediments or evaporates. Many stream channels become poorly defined with distance from the mountain front owing to the lack of streamflow. Although the Colorado River forms a small part of the perimeter of each valley, it generally is not a significant water supply within the valleys (Anning et al., 2006).

2.1.2.7 Cultural, Archaeological, and Historical Resources

There are no known cultural, archeological, or historical resources located within the Kingman Range MRS. According to the UFP-QAPP (WESTON, 2017), Cornerstone Environmental Consulting, a contractor to WESTON, reviewed the Arizona State Historic Preservation Office database in March 2017 for the acreage associated with the Kingman Range MRS. Cornerstone/WESTON concluded that there are no areas of cultural or archeological significance within the MRS footprint. Additionally, letters were sent to thirteen Tribes notifying them of the upcoming field work in 2017. No responses from the Tribes were received regarding known cultural or Tribal sites within the MRS.

2.1.2.8 Demographics

According to the U.S. Census Bureau, dated 1 July 2018, Mohave County, Arizona has a population of 200,182 people, and Kingman, Arizona has a population of 28,069 people. This is an increase of 4.7% and 8.0% since the last population census dated 1 April 2010. According to the last census, the population per square mile for Mohave County and Kingman, Arizona is 15.0 and 806.1, respectively (U.S. Census, 2018).

2.1.3 Ecological Profile

The NDNODS Kingman Range MRS is located on grasslands consisting predominately of Mohave Desert Scrub. Portions of the MRS are residential development with landscaping. Bird species, mammals, lizards and reptiles are likely to use the MRS.

2.1.3.1 Species of Special Concern

There are no federal or state threatened or endangered species known or suspected to exist on the MRS; however the following species are known to exist within the county (U.S. Fish and Wildlife Service, 2016):

- Mammals: Hualapai Mexican vole (endangered);

- Plants: Arizona cliffrose (endangered), Fickeisen plains cactus (endangered), Gierisch mallow (endangered), Holmgren (Paradox) milk vetch (endangered), Jones cycladenia (threatened), and Siler pincushion cactus (threatened);
- Reptiles: Mojave desert tortoise (threatened), Northern Mexican Gartersnake (threatened), and Relict leopard frog (candidate);
- Fish: Bonytail chub (endangered), Humpback chub (endangered), Razorback sucker (endangered), Roundtail chub (proposed threatened), Virgin River chub (endangered), Woundfin (endangered), and Virgin spinedace (conservation agreement); and
- Birds: California Condor (endangered), California Least Tern (endangered), Mexican spotted owl (threatened), Southwestern willow flycatcher (endangered), Yellow-billed cuckoo (threatened), and Yuma clapper rail (endangered).

2.1.4 Release Profile

The release profile for the Kingman Range MRS includes the sources and types of MEC and MC, their inferred mechanisms for release, and potential influences from natural features or events that could affect distribution. The profile is based upon the historical, physical, and ecological information presented in the preceding sections and is used to revise the CSM data input from the SI.

2.1.4.1 MEC Sources

The Kingman Range MRS was used historically by the AZARNG from 1951 until 1968. Training included SAA (.22-caliber, .30-caliber and .45-caliber) and submachine gun practice, as well as mortar and 3.5-inch rocket target practice. Historical photographs from 1954 and 1965 confirmed the orientation of the range and direction of fire towards the east using the natural escarpment as a backstop. During the SI, mortar fuzes and 3.5-inch rocket debris were encountered and characterized as MD items. Although limited, there is evidence that potential HE munitions were used for live-fire training at the MRS, and thus the potential for MEC does exist.

2.1.4.2 MEC Release Mechanisms

The mechanism for release of MEC at the Kingman Range MRS is firing of munitions during training exercises that occurred from 1951 through 1968 or from DMM or UXO. The depth of impact for these items is anticipated to be minimal, less than 12 inches, because of the types of ordnance expected to have been used and geologic conditions at the MRS (i.e., hard substrate and shallow bedrock). Based on the dig data from the RI, the greatest depth of MD was recovered at 6 inches bgs.

2.1.4.3 MC Primary Sources

The source of potential MC at the Kingman Range MRS are from SAA usage and the potential MEC items used at the MRS. Sampling for small arms constituents (i.e., antimony, copper, lead, and zinc) was performed during the SI in addition to explosive compounds (WESTON, 2012).

Further investigation of MC was recommended during the SI based on historic information and the results of the SI field work. Therefore, the RI was designed to evaluate MC from the undeveloped portion of the MRS in the location of the former target berm and if a potential new MC source is discovered (e.g., identification of compromised MEC, areas of concentrated MEC and/or MD, or post BIP locations) at the MRS. No MEC items have been identified at the MRS.

2.1.4.4 Secondary Source Media

Secondary source media is considered to be subsurface soil should MC migrate to these media. MC was not identified in surface soil during the SI; therefore, no secondary source media are present at the Kingman Range MRS.

2.1.4.5 Interaction with MEC or MC

When MEC or MC are present on the ground surface, the likelihood of movement by human activity and/or human redistribution is greatly increased. While MEC or MC in the subsurface may also be encountered by human activity resulting in their movement and/or redistribution, such contact is less likely due to the level of effort and deliberate nature of intrusive activities.

During the SI, UXO technicians performed an instrument-aided (i.e., White's All Metals detectors) visual survey along meandering paths through accessible portions of the MRS. No evidence of MEC was observed on the ground surface but MD was encountered resulting in a potentially complete pathway for MEC at the surface and subsurface. MC sampling during the SI and risk evaluations did not identify a potential risk to any receptors at the MRS. Therefore, the potential level of interaction between humans with regard to MEC was considered to be low, although the potential for MEC and MC related to MEC exists at the site, as there is evidence of potential HE munitions use at the MRS. Based on previous MRS findings, the MEC exposure pathways for human receptors at the MRS were considered to be potentially complete and depicted on **Appendix A, Figure 5**. While the previous MRS findings indicated no MC risk, the RI was designed to evaluate MC in the location of the former target berm and if a potential new MC source is discovered at the MRS. Therefore, the MC exposure pathways for human and ecological receptors at the MRS were considered to be potentially complete for surface soil and depicted on **Appendix A, Figure 5**.

2.2 PRELIMINARY REMEDIATION GOALS

A set of preliminary remediation goals (PRGs) were established for use in determining whether further actions would be recommended as a result of the RI.

2.2.1 Assessment of Land Use

The majority of the Kingman Range MRS (western portion, about 75%) is developed and consists of a multi-parcel residential community (**Appendix A, Figure 4**). The eastern portion of the MRS (remaining 25%) is undeveloped vacant land. A portion of this area contains the former target area, the RI area of investigation, and is zoned for residential land use.

Future land use is anticipated to be consistent with current use. The area within two (2) miles of the MRS is used for both residential and commercial purposes.

2.2.2 Preliminary Remediation Goals for Munitions and Explosives of Concern

There are no established PRGs for MEC, particularly UXO and DMM (U.S. Army, 2009). In general, the remediation goals for MEC focus on removing or limiting the exposure pathways. Two (2) types of PRGs were applicable to MEC during the RI:

1. Determination of whether MEC was present as an explosive or imminent safety hazard; and
2. Determination of the extent of potential MEC using analog and digital geophysical mapping (DGM) surveys combined with intrusive investigation of anomalies.

The basis for the PRGs was the current and anticipated land use and associated receptors at the MRS, based upon the preliminary CSM (**Section 2.1**). Data obtained by fulfillment of the PRGs, specifically the presence or absence of MEC, drive future munitions responses. Actions taken as a result of the PRGs during the RI were a direct result of whether MEC was present as an explosive hazard.

2.2.3 Preliminary Remediation Goals for Munitions Constituents

PRGs for MC were developed from Project Action Limits (PALs) in the UFP-QAPP, Worksheet #15 (WESTON, 2017). PALs are established in the UFP-QAPP to ensure the selected analytical laboratory and method can provide accurate data to achieve the reference limits (e.g. regulatory limits or risk-based limits) on which action limits are based. A set of project risk-based limits (or PRGs) for MC in soil were selected based on the most conservative human health or ecological screening value from the following sources:

- USEPA Regional Screening Levels (RSLs), Residential Soil (target hazard quotient=0.1; target cancer risk=1E-06); (updated May 2019).
- Arizona Department of Environmental Quality (ADEQ) Soil Remediation Levels (SRL), Residential Soil Remediation Levels (10-6 Risk or most stringent value, updated March 31, 2009).
- USEPA Ecological Soil Screening Levels (EcoSSLs) (2016). Minimum of values for plants, soil invertebrates, birds and mammals.
- Los Alamos National Laboratory (LANL) EcoRisk Database. Version 4.1. September 2017. Minimum no effect ecological screening level (ESL) for soil.

Quantitative risk-based limits for MC are used in the screening-level human health risk assessment (HHRA) and screening-level ecological risk assessment (ERA) evaluations provided in **Section 6.0**.

2.3 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND "TO-BE-CONSIDERED" INFORMATION

CERCLA response actions are exempted by law from the requirement to obtain federal, state, or local permits related to activities conducted completely on-site. It is the policy of the USEPA and the Army to assure activities conducted on-site are protective of human health and the environment. However, this policy does not eliminate the requirement to meet (or waive) the substantive provisions of permitting regulations that are applicable or relevant and appropriate requirements (ARARs), as defined in CERCLA Section 121(d). These ARARs can be chemical-specific, action-specific, and location-specific environmental or siting law. For instance, regulations promulgated under the Resource Conservation and Recovery Act, Clean Air Act, Clean Water Act, and the Safe Drinking Water Act frequently affect removal and remedial actions. Laws and requirements enforced by agencies other than the USEPA may also be applicable or relevant and appropriate at a site. Other examples of potential environmental laws include, Endangered Species Act, National Historic Preservation Act, Solid Waste Disposal Act, and Archeological Resources Protection Act. The evaluation of the ARARs is an iterative process to be performed throughout the life of the project. ARARs specific to the MRS have been developed for the FS (**Appendix L**).

To-be-considered (TBC) requirements are non-promulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. TBCs are not potential ARARs because they are neither promulgated nor enforceable; however, in many circumstances TBCs are considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health or the environment (USEPA, 1988). Compliance with TBCs is not mandatory, as it is for ARARs.

2.4 SUMMARY OF INSTITUTIONAL ANALYSIS

Typical strategies for addressing the presence of MEC on a site are physical removals and land use controls (LUCs). Although physical removals may be conducted to reduce the amount of MEC at a site, current technologies are not adequate to provide for the detection and removal of all MEC items. Therefore, even if physical removals are performed, LUCs are often implemented to manage any residual MEC risk at a site. LUCs are also sometimes put into place as a stand-alone response without a physical removal. Landowners provide critical input into the development of a viable LUC program at a site located on their property. If a LUC program is selected for a site on a property not under the control of the DoD, it is the property owner and/or appropriate state and local governments that have the authority to maintain compliance with the provisions of the LUCs and maintain the effectiveness of the LUCs.

LUCs consist of various legal mechanisms, educational and engineering control measures, and construction support used to minimize the potential for hazards to human receptors from a property impacted with MEC or other hazards. Types of LUCs are described in more detail in **Appendix C**.

Instead of direct elimination of MEC, LUC components to remedial actions rely on behavior modification and access control strategies to reduce or eliminate risk. The objectives of an institutional analysis are to illustrate the opportunities that exist to implement a LUC program at a specific site; identify landowners and government agencies having jurisdiction over the site; and assess the appropriateness, capability and willingness of landowners and government agencies to assert their control over the site. The government agencies/institutions that would have a role in a LUC program includes the AZARNG and ARNG G9.

2.4.1 Land Use and Existing Controls

The Kingman Range MRS is used primarily for residential purposes with some illegal recreational use occurring in the undeveloped vacant portion to the eastern side. The parcel containing the former target area and RI area of investigation is zoned for residential use; however, no residential structures are present within this portion of the MRS.

Future land use is anticipated to be consistent with current use. Current human receptors within the MRS include residents (adults and children), recreational users (trespassers), site visitors, and site workers.

Access at the MRS is unrestricted. The current and adjacent property owners have reported seeing evidence of military munitions in the undeveloped portion of the MRS.

No evidence of military munitions has been reported in the residential area. Prior to the SI field work conducted in December 2011 (WESTON, 2012), ROEs were requested for 16 properties; however, only 4 property owners granted access. An inspection was conducted east of Darren Drive near the impact area. Significant development and hardscaping in the residential area was present and the residential parcels were not considered critical. During the RI, prior to field work, interviews were conducted with the Mayor, Deputy Police Chief, and Deputy Fire Chief of Kingman on 31 May 2018. None of those interviewed were aware of any munitions being encountered or explosive ordnance disposal (EOD) responses in the residential portion of the MRS.

2.4.2 Recommendations for Additional Land Use Controls

Recommended institutional control alternatives identified in the Institutional Analysis (**Appendix C**) to be evaluated during the FS include:

- Engineering Controls:
  - Fencing; and
  - Warning signs.
- Educational Controls:
  - Public notices; and
  - Fact sheets.

Fencing would serve as an engineering control that would restrict public access, thereby limiting exposure to potential MEC on the MRS. Fencing would be required surrounding the entire 8.14-acre MRS in order to be effective. Fencing would require inspection, maintenance, and repair in order to remain effective.

Warning signs would serve as engineering controls for educating those accessing the MRS property (both with and without landowner permission) of the potential MEC hazards at the Kingman Range MRS. Warning signs would also serve as educational controls for educating the public of the potential MEC hazards at the MRS.

Fact sheets are recommended for distribution at key times during any MRS remediation activities. In addition, fact sheets notifying land users of potential MEC are recommended for distribution to public officials, emergency management agencies, and the private landowner.

The roles, responsibilities, and authorities that each organization would have in implementing, maintaining, monitoring, and enforcing institutional controls are provided in **Appendix C, Table 4-1**. Long-term implementation of institutional controls would be the responsibility of the AZARNG/ARNG G9.

2.5 DATA NEEDS AND DATA QUALITY OBJECTIVES

Data needs and data quality objectives (DQOs) were developed in the UFP-QAPP (WESTON, 2017), with specific aspects of MEC/MC DQOs described in the UFP-QAPP. The following seven (7) steps of the DQO process summarize the general objectives for the Kingman Range MRS.

1. **State the problem:** The nature and extent of MEC and MC at the Kingman Range MRS related to historical training were unknown. An MMRP RI, as recommended by the SI, was performed to meet Army obligations under CERCLA and the NCP to address potential residual hazards and risks to human health, welfare, and the environment. The CSM, based on data and information collected through the SI, indicated that potentially complete exposure pathways for MEC exist related to former munitions firing and small arms training conducted by AZARNG. The risk posed to current and future potential human and ecological receptors from incomplete exposure pathways identified for MC in soil were unknown and required additional data to assess baseline risks.
2. **Identify the goals of the study:** The goals of the MMRP RI were the following:
   - Determine the nature and extent of MEC within the MRS.
   - Traverse, detect and characterize concentrated munitions use areas (CMUAs) and perform a MEC hazard assessment to determine “acceptable vs. unacceptable” land use.
   - Traverse and characterize non-CMUAs (NCMUAs) and perform a MEC hazard assessment to determine “acceptable vs. unacceptable” land use.
   - Intrusively investigate target anomalies identified along DGM and analog geophysical transects and within the CMUAs, if identified, and NCMUAs.

- Determine whether concentrations of detected contaminants present an unacceptable human health or ecological risk by conducting a baseline HHRA and Screening-Level ERA (SLERA).
- Further investigate if MC poses an unacceptable risk for current and anticipated future land use, based on intrusive investigation findings.

3. **Identify information inputs:** Additional data collection was performed based on historical information, current MRS conditions, and the results from the SI. These data were used to develop the CSM and exposure pathway assessment needs to focus MEC and MC characterization during the development of the UFP-QAPP. Additional data was collected during the RI, which included DGM surveys with intrusive investigations of selected subsurface anomalies as well as analog geophysical surveys with intrusive investigations of all anomalies. The RI soil sampling results included assessment of MC in soil.
4. **Define study boundaries:** The study boundary included all of the MRS acreage encompassing 33.43 acres. The extent of potential MEC was delineated using DGM and analog geophysical surveys in the undeveloped area in the eastern portion of the MRS only. Based on the type of MD observed during the SI, the maximum anticipated penetration depth was less than one (1) ft. bgs.
5. **Develop the analytical approach:** The analytical approach for the Kingman Range MRS included the following:
   - Conduct DGM and analog transect surveys across the MRS at a spacing of 39 ft. based off a 3.5 rocket, (42 ft. on centers) to achieve 95% probability of traversing and detecting potential MEC target area/CMUAs.
   - Reacquire DGM survey anomalies using a real-time kinematic (RTK) global positioning system (GPS) and investigate analog survey anomalies to determine the nature of the anomaly. Document location, size, depth, description, and orientation of each item.
   - Assess anomaly locations using Visual Sample Plan (VSP) software and prepare a spatial anomaly density map to identify locations requiring further investigation.
   - If CMUA(s) are identified, then place full coverage grids and investigate all anomalies.
   - If additional coverage is required, then survey additional full coverage grids in the CMUA(s) and interrogate the targets identified. Document the location, size, depth, description, and orientation of each item.
   - Collect an incremental surface soil sample in the location of the former target berm. Collect a single background incremental sample with two (2) replicates with a size and number of aliquots consistent with the incremental sample collected from the former target berm.
   - If areas are identified as CMUAs, perform incremental sampling.

- If MEC/MD is identified and the item is displaying evidence of leakage of MC into the environment and/or where visible contamination is distributed around the item, then collection of surface soil samples would occur for MC at the location of the MEC/MD item. Conduct sampling in accordance with the appropriate related sampling scenario and type of munitions as discussed in the UFP-QAPP, Worksheet #17.
- If a demolition occurs, then collect a post-demolition, seven (7)-point wheel composite sample, centered at the blast point.

6. **Specify performance or acceptance criteria:** Performance or acceptance criteria included the following:
   - If MC are detected in soil, prepare an MC baseline risk assessment that includes a HHRA and SLERA in accordance with the CERCLA/NCP process. Initially, perform a contaminant of potential concern (COPC) determination by comparing concentrations of MC against human health and ecological screening criteria. If detected concentrations exceed screening criteria, complete the remaining steps of a baseline risk assessment were to determine risks and hazards.
   - If concentrations of detected contaminants present an unacceptable human health or ecological risk as determined in a baseline HHRA and SLERA, evaluate remedial alternatives in an FS. If concentrations of contaminants do not indicate a risk, recommend no action for MC.
   - If the geophysical equipment is verified to be functioning correctly as outlined in the geophysical system verification process (WESTON, 2017; Worksheet #17), then assume the geophysical data to be valid.
   - If the MC characterization sample collection and analytical data processing results are within the performance and acceptance criteria outlined (WESTON, 2017; Worksheet #36), then assume the data to be valid. WESTON provided a staged electronic data deliverables deliverable to USACE at the completion of the project.
7. **Develop the plan for obtaining data:**
   - A geophysical parallel transect survey approach was developed using VSP to traverse and detect CMUAs at an especially high degree of confidence (95%). Transects 3.28 ft. wide were spaced at 42 ft. on centers across the MRS, resulting in 1.14 miles (0.51 acres) of coverage (may have been adjusted based on accessibility).
   - Transects were traversed using DGM equipment (i.e., Geonics EM61-MK2) and analog geophysical instrumentation (White's All Metal Detectors) to detect subsurface anomalies.
   - Transect survey results were used to generate a spatial density map (variogram/kriging analysis) using VSP to determine the CMUA(s), if present.
   - Anomalies detected along transects were intrusively investigated to determine if the anomaly source is munitions related or non-munitions related debris (NMRD).

- The DGM results were analyzed to determine where to place grids (if required), to expand or tighten areas of interests, delineate presence or lack of anomalies and determine pick lists within potential CMUA(s).
- Material potentially presenting an explosive hazard (MPPEH)/MEC and MD were subject to a dual inspection and verification onsite to identify suspected munitions and any associated hazard to determine proper handling and disposal requirements.
- Incremental sampling methodology (ISM) was employed to collect MC soil samples from the former target berm where accessible and at potential CMUAs, if identified.
- Composite sampling would have been performed if detonations were required to collect post-demolition samples.
- Discrete sample collection was taken into consideration if compromised MEC was found or low-ordered/damaged MEC was discovered.
- Background samples were collected in non-munitions-impacted areas of a type consistent with primary MC samples collected.
- MC parameters (i.e., explosive compounds and select metals [antimony, copper, lead and zinc]) were selected based on known or suspected munitions. Verification and validation of analytical MC data was performed in accordance with DoD Quality Systems Manual and federal guidelines and communicated to ARNG G9, AZARNG, and USACE prior to data incorporation into data evaluation/risk screening activities to make project decisions.

3.0 CHARACTERIZATION OF MUNITIONS AND EXPLOSIVES OF CONCERN AND MUNITIONS CONSTITUENTS

The UFP-QAPP (WESTON, 2017) detailed the approach used to develop investigation area coverage, operating procedures, and quality control (QC) protocols, as well as identify appropriate equipment that was used for the investigations that were performed during the RI. The overall RI approach and DQOs are presented in **Section 2.5**. The MEC and MC characterization approach at the Kingman Range MRS included the following primary elements:

- DGM and analog geophysical transect surveys to traverse and detect potential CMUAs and NCMUAs;
- Intrusive investigations at select DGM and all analog anomaly locations to determine the nature, type, density, and distribution of MEC and MD within potential CMUAs and NCMUAs; and
- Further investigation if MC poses an unacceptable risk within the MRS based on accessible MRS features (i.e., former target area), CMUA, and NCMUA characterization findings for current and anticipated future land use.

Field characterization of MEC and MC was conducted at the Kingman Range MRS during three (3) mobilizations: Mobilization 1 from 11 October 2017 through 19 October 2017; mobilization 2 from 15 July 2018 through 19 July 2018; and, Mobilization 3 on 21 May 2019. **Table 3-1** summarizes the work conducted at the Kingman Range MRS. This section presents the data results from the RI field work that are used to define the nature and extent of hazards at the Kingman Range MRS.

3.1 MUNITIONS AND EXPLOSIVES OF CONCERN CHARACTERIZATION

The geophysical survey design for the characterization of MEC at the Kingman Range MRS included parallel DGM and analog transect surveys across the MRS and intrusive investigation of anomalies within the transects. Daily Reports including photo documentation of site activities for the duration of the fieldwork are provided in **Appendix D.**

3.1.1 Vegetation Reduction

No vegetation reduction or clearance activities were required to conduct RI field activities.

Table 3-1
Kingman Range MRS Fieldwork Timeline Summary

Mobilization 1 – 11 October 2017 through 19 October 2017
Meet with professional land surveyor to install a survey monument and QC point.
Established the instrument verification strip (IVS) to verify geophysical instrument is operating within required specifications and to determine a target selection threshold.
Seeded DGM transects with small industry standard objects (ISOs) in accordance with the blind seed program using anomaly avoidance.
Conducted DGM surveys along transects to detect anomalies.
Identify and set up a background sampling decision unit (DU) for surface soil sampling using ISM. A background DU was sampled in triplicate using ISM consisting of 30 increments. Assess MRS features to determine locations of two (2) DUs at the former target area for MC sampling. Each DU was sampled using ISM consisting of 30 increments. One (1) of the DUs was sampled in triplicate.
Mobilization 2 – 15 July 2018 through 19 July 2018
Confirm installation of IVS and analog geophysical instrumentation is operating.
Set up RTK GPS equipment at professionally installed survey monument, perform QC using control point, and reacquire the fifty-eight (58) selected DGM targets for intrusive investigation.
Seed analog transects with small ISOs in accordance with the blind seed program.
Perform intrusive investigations along analog transects and at reacquired DGM targets.
Certify MD, approximately six (6) pounds, as material documented as safe (MDAS) for transportation and final disposition. Dispose of NMRD as scrap metal for recycling.
Mobilization 3 – 21 May 2019
Establish the IVS/instrument test strip to verify geophysical instruments are operating within required specification.
Geospatially locate four (4), 50 ft. by 50 ft. grids within identified areas with elevated anomaly densities, install QC seeds per the UFP-QAPP.
Perform intrusive investigation, 100% clearance, of the four (4), 50 ft. by 50 ft. grids, approximately 0.23 acres, using analog geophysical equipment.
Certify MD, approximately 1 pound, as MDAS for transportation and final disposition.

3.1.2 Geophysical Mapping Activities

Geophysical mapping activities included DGM and analog geophysical surveys along transects, and full analog coverage grids. DGM data along eight (8) transects was collected using a single coil Geonics EM61-MK2A time domain electromagnetic induction metals detector supported by RTK GPS instrumentation. Due to terrain at the MRS, analog geophysical transects and grids were also collected using White's All Metal detectors. During analog geophysical transect data collection, handheld metal detectors were supported by a Trimble Geo7x GPS unit equipped with UXO Respond Fast for data input and management. The DGM and analog survey transect track paths are presented in **Appendix A, Figure 6.** Full coverage grids are discussed in **Section 3.1.3**. A summary of the geophysical mapping activities conducted during the RI are presented in **Table 3-2**.

Table 3-2
Geophysical Mapping Coverage Summary

Geophysical Survey Type	UFP-QAPP Proposed		RI Field Activities - Actual	
	Line Miles (miles)	Area Coverage (acres)[2]	Line Miles (miles)	Area Coverage (acres)
DGM	0.90	0.36	0.98	0.39
Analog	0.25	0.15	0.49	0.29
Grids[1]	To Be Determined		N/A	0.23
TOTAL:	**1.15**	**0.51**	**1.47**	**0.91**

Notes:
[1]Four (4), 50 ft. by 50 ft. grids were fully investigated.
[2]Area coverage based on an instrumentation coverage swath width of 3.28 ft. for DGM and 5 ft. for analog.

3.1.2.1 Survey Control

Survey control points were established by professional licensed surveyor from the state of Arizona, Shephard Wesnitzer, Inc., in two (2) locations outside of the MRS (**Appendix A, Figure 6**) and **Table 3-3**. The geographic coordinates were converted into World Geodetic System 1984 (WGS84), Universal Transverse Mercator (UTM) Zone 11 North, in m.

Table 3-3
Survey Control Points Location Summary

Point Name	Northing (m)	Easting (m)	Elevation (m)	Completion Details
KING BASE	3900241.584	772465.756	1087.28	Spindle in rock, aluminum tag stamped RLS 27253.
KING CHK	3900191.011	772434.078	1082.01	½" rebar with aluminum cap stamped RLS 27253.

A copy of the survey report provided by the registered land surveyor is provided in **Appendix E**.

3.1.2.2 Geophysical Survey and Navigational Equipment

A Geonics EM61-MK2A on a wheel-mounted cart coupled with an RTK GPS was hand-pulled during all DGM surveys. A handheld White's MXT all-metals detector was used for analog surveys with geospatial data collected at targets using a Trimble Geo 7X GPS. The following sections describe the geophysical and geospatial equipment utilized during the RI.

3.1.2.2.1 EM-MK2 Geophysical Instrumentation

The EM61-MK2 sensor is a time-domain metal detector system manufactured by Geonics that identifies ferrous and non-ferrous objects. The EM61-MK2 is battery-powered, consists of air-cored coincident transmitter and receiver coils (1.0 x 0.5 m coils), and operates at a maximum output of 10,000 millivolts (mV).

The transmitter generates a time varying magnetic field that induces eddy currents in conductive objects within the subsurface. The receiver measures the amplitude of these eddy currents at 216, 366, 660, and 1260 micro-second intervals during the decay period.

A single EM61-MK2 sensor DGM system was deployed as a standard-height (i.e., lower coil was 1.3 ft. above the ground surface) wheel-mounted cart and hand-pulled during DGM surveying. An RTK GPS antenna/receiver was mounted over the center of the sensor. The receiver captured the real-time differential corrections from the fixed local base station and output a spatially corrected National Marine Electronics Association (NMEA) Global Positioning System Fixed Data (GGA) message (a code used by NMEA that provided 3D location and accuracy data from the GPS unit) directly into the Allegro Data Logger® at one (1)-second intervals. Direct interfacing between the GPS and EM61-MK2 used a single clock and streams position information directly into the raw MK2 data file. A sampling frequency was set at no less than ten (10) hertz, resulting in an average sampling rate of between three (3) and four (4) measurements per linear ft. Measurements of the four (4) time gates of the bottom coil were digitally recorded and stored in memory using the Allegro Data Logger®.

3.1.2.2.2 Analog All-Metals Detectors

White's MXT All Metal detectors were selected to conduct analog surveys due to potential MEC composition (non-ferrous materials) and MRS conditions such as variable terrain, including cliffs east of the target area, and the ability to investigate anomalies in real time. White's All Metals detectors were checked and tested for functionality at the IVS each day they were used. Details of the IVS are discussed in **Section 3.1.2.3**.

White's MXT All Metals detectors consist of a hand-held, two (2) coil design that utilizes the electromagnetic method to detect ferrous and non-ferrous metals. An audible signal sounds when the sensors are swept over a conductive material. The volume and frequency of the signal changes as the sensor pinpoints the center of the source body. The instrument sensitivity is adjustable to increase or decrease the capability to detect small, metallic materials.

3.1.2.2.3 Navigation and Positioning Equipment

A Trimble Model R10 Global Navigation Satellite System (GNSS) RTK GPS was used to position the data collected during the DGM surveys. The Trimble R10 GNSS RTK system is an integrated parallel channel GPS receiver with a built-in radio-modem communication system. A dedicated base station broadcasts RTK corrections to the rover unit being used by the field crew. Positional data in the NMEA GPS Fixed Data (i.e., GGA) format was output to the logging computer at one (1)-second intervals using a serial cable. The GPS antenna was placed on a tripod directly above the bottom coil center for accurate location of data.

In addition to providing positioning data for the geophysical sensor measurements, the RTK GPS was used for DGM anomaly reacquire and to map the bounds of the MC sampling DUs. Coordinates for each interpreted DGM anomaly identified for intrusive investigation was uploaded to the RTK GPS rover and the "stakeout" mode of operations was used to reacquire each location.

A Trimble Geo7X handheld GNSS GPS was used to support analog survey navigation and geospatial data point collection.

3.1.2.3 Geophysical System Verification

The geophysical system verification (GSV) approach was used to monitor and verify geophysical equipment functionality during the DGM and analog surveys. The GSV approach included an IVS, background noise lane (BNL), and a production area seeding program to monitor sensor detection performance throughout the duration of the DGM and analog survey efforts. IVS specific data results are provided in **Appendix F**.

3.1.2.3.1 Instrument Verification Strip Background Survey

The IVS was located near the MRS and chosen based on its accessibility, proximity to the MRS, and similarity in terrain and geology to the surrounding production environment. Prior to the burial of seed items, a background survey was conducted to determine the suitability of the location. The survey was conducted on 16 October 2018. This survey determined if large anomalies existed, and allowed refinement of the final placement of the seed items in the IVS. No anomalies were identified. The background data represents MRS conditions expected to be encountered within the MRS boundary.

3.1.2.3.2 Instrument Verification Strip Construction

An IVS was constructed to provide a means to verify, on an ongoing basis, that the geophysical equipment was operating properly and that the project QC metrics were being met. The IVS and BNL were located near the laydown area, north of the MRS. Three (3) Schedule 80 steel pipe ISO's and one (1) survey nail were placed in a line running approximately northeast-southwest, with a ten (10) ft. spacing between items. Non-metallic pin flags were placed at the start and end of the IVS lane to identify endpoints. Flagging tape was used to mark the locations of each of the items.

Table 3-4 shows the types, depths, orientations, and the coordinates of the IVS ISO items. The objectives of the IVS are to verify the geophysical detection system is operating as designed, to capture levels of background noise due to MRS conditions (thus establish a target selection threshold), and to verify that geophysics personnel are qualified to perform the survey work. These objectives were met by the present IVS design.

The IVS and BNL lines were marked with pin flags and the seed items and end points were recorded with RTK GPS in WGS84, UTM Zone 11 North in m. Standard USACE QC tests were run, including the cable shake, personnel test, static/standard/static, IVS, and IVS background.

Table 3-4
IVS Seed Information

Identification	Northing (m)	Easting (m)	Description	Orientation	Depth (inches bgs)
Seed-01	3900210.05	772412.82	Small ISO Item	Horizontal, Across-Track (East-West)	4
Seed-02	3900207.83	772410.78	Small ISO Item	Horizontal, Across-Track (East-West)	6
Seed-03	3900205.53	772408.72	Small ISO Item	Horizontal, Across-Track (East-West)	8
Seed-04	3900203.35	772406.82	Survey Nail	Vertical	Surface

3.1.2.3.3 Data Acquisition

The EM61-MK2A data were collected by the field geophysicist pulling the wheeled cart back and forth across the IVS at a normal walking speed. Data were collected directly over the IVS, and also offset by 0.5-m on each side of the IVS to ascertain the horizontal extent of detection. During this time, the operator was responsible for monitoring the displays on the Allegro Data Logger®; no other input was required from the operator once data logging had started.

A variety of tests were conducted to verify that the instruments were operating properly at the start and end of the daily surveying. Data were recorded from the system while it was stationary and subjected to a cable shake, personnel, and static/standard/static. The tests were performed at a known location with the standard item, a small ISO, placed horizontal/parallel directly under the front of the EM61-MK2A coil. The tests verified that the instrument was consistently responding to a test item, and ensured that the sensor was connected to the correct serial ports on the computer so that the data could be positioned accurately.

A latency test was performed in the IVS lane using the start and end points of the lane. The latency correction was determined by applying different values to the data collected over the end points until the peaks recorded in opposite directions overlaid one another. The latency correction value (0.5 seconds) was applied to the rest of the dataset.

3.1.2.3.4 Instrument Verification Strip Results

IVS result details are provided in the Kingman Range MRS IVS Report in **Appendix F**. WESTON determined that the sum of channels 1, 2, 3, and 4 (Stack), provides the best choice for target selection based on the signal-to-noise ratio channel assessment and because random noise tends to cancel. The standard deviation (SD) background noise of 0.88-mV was determined by averaging ten (10) BNL data sets. A common criterion for establishing a picking threshold based on background noise is four (4) to seven (7) SDs of the background noise. Using seven (7) SDs,

WESTON determined that 6.16-mV picking threshold provided a sufficient value above background so as to minimize the picking of noise peaks.

3.1.2.3.5 Production Area Seeding

A seeding program was instituted in the production DGM and analog survey areas to provide ongoing monitoring of the geophysical instrumentation detection performance. The GSV approach included the placement of blind seed items (BSI) within the geophysical survey areas. The BSIs were blind to the geophysical data collection and processing teams as well as the intrusive team. Seed items, each consisting of one (1) small ISO (1.0-inch by 4.0-inch black iron pipes), were placed at a frequency such that one (1) BSI would be encountered for each day of operation. One (1) BSI was placed in each of the four (4) full coverage grids.

The ISO location were recorded by QC staff using the RTK GPS for DGM transects and Trimble Geo7x GPS for analog transects, and kept confidential from DGM personnel and UXO teams. The seeds were recovered by the UXO dig team during intrusive investigations. **Table 3-5** lists the emplacement and transect identified location, geophysical response, and offset of the seed items placed within the production survey areas.

Table 3-5
GSV Seed Items and Descriptions

Geophysics Target Information						
Seed ID	**Seed Type**	**Target ID**	**Easting**	**Northing**	**Offset (m)**	**Response (mV)**
BS-01	Small	T03-43-1	772501.54	3900131.19	0.0	38.724
AT-01	Small	AT-01-202	772513.37	3900157.2	N/A	N/A
AT-02	Small	AT-02-201	772573.14	3900079.49	N/A	N/A
ISO-17	Small	ISO-17	Grid No. 1*		N/A	N/A
ISO-24	Small	ISO-24	Grid No. 2*		N/A	N/A
ISO-40	Small	ISO-40	Grid No. 3*		N/A	N/A
ISO-10	Small	ISO-10	Grid No. 4*		N/A	N/A

*See Grid sheets in **Appendix D** (Daily Reports)

The blind seed items placed within the DGM survey areas were observed in the geophysical data with a signal consistent with the sensor response curves developed for the EM61-MK2A and within the offset metric established in the UFP-QAPP (WESTON, 2017). DGM seed responses are above 75% of the minimum response of 21.14 mV for small ISOs.

3.1.2.4 Digital Geophysical Mapping Survey Procedures

DGM surveys were conducted using an EM61-MK2A electromagnetic induction sensor coupled with RTK GPS as the navigation method with survey control established by a licensed surveyor from the state of Arizona. For the grid process, the full coverage survey line spacing of 2.5-ft. was employed to identify the item of interest, a rocket with the smallest hazardous fragment distance.

DGM survey lane control was monitored with the assistance of an on-site field technician measuring perpendicular spacing and marking the path location.

3.1.2.5 Analog Geophysical Mapping Survey Procedures

Analog surveys were performed using a White's All Metal detector and a Trimble Geo7X GPS as the survey instrument and data collection device. The three (3) person UXO dig team followed pre-planned analog transects in a manner to ensure complete coverage within a five (5)-ft. wide lane for each instrument operator. All anomalies detected along each transect were intrusively investigated.

3.1.2.6 Data Management

All data related to DGM surveys were managed using Geosoft Oasis Montaj® software. All DGM data were provided electronically to the USACE Geophysicist. Data were backed up on an internal network and project workstation. All DGM and QC data is provided in **Appendix G** (CD Only).

Data collected at anomalies intrusively investigated along the analog transects were input into the UXO Respond Fast program, which was installed on the Trimble Geo7X GPS unit. Data recorded at anomaly locations are provided on the RI intrusive investigation results dig list (**Appendix H**).

3.1.2.7 Digital Data Processing

The EM61-MK2A data were downloaded from the Allegro Data Logger® and imported into Geonics® DAT61MK2 software for pre-processing. DAT61MK2 is used to sync the GPS data with the EM61 data to create a Geosoft-compatible .XYZ data file. Each .XYZ file contains data for each of the four (4) time gates recorded, the position, GPS quality indicators, and collection times. The survey data were processed using Geosoft Oasis Montaj® software. Data were checked for navigational accuracy, line distribution, and coverage.

Latency corrections of 0.5 seconds obtained during the pre- and post-survey QC tests were applied to the data, correcting for any temporal lags observed in the data. A Geosoft script was run to automatically progress through the processing steps for each of the datasets. A non-linear drift correction filter was used to remove any drift associated with each data channel occurring throughout the survey period. Velocity and sample separation were calculated for each dataset. Background noise was evaluated for each dataset by windowing a section of the data and generating statistics using the UX-Process QC module. Anomalies were selected from the filtered and gridded Stack (sum of Channels 1, 2, 3, and 4) data using a peak-picking algorithm in Oasis Montaj. Decay analysis was performed to remove targets that had atypical decays by applying a filter of CH1-CH2, CH2-CH3, and CH3-CH4Targets were reviewed and verified by the processing geophysicist and QC geophysicist. Each of the data processing steps were documented to ensure all data were processed in a consistent manner. **Table 3-6** presents processing parameters.

Table 3-6
EM61-MK Data Processing Parameters

Process	Parameter
Drift – Median Drift Correction Filter (UCEDRIFT.GX)	Window Length: 100 % lowest values ignored: 0% % highest values ignored: 40%
Statistical Evaluation of Background Noise	Windowed section of backgrounding/using UX-Process quality assurance/QC module to evaluate standard deviation and menu noise values.
Grid	All data channels were processed using the same parameters. A grid cell size of 0.0762 m and blanking distance of 0.549 m was used for transects.
Pick Peaks along Profile Algorithm	Pick peaks along profile used for transects. Anomalies were selected on Stack channel with a pick threshold of 6.16 mV.

3.1.2.7.1 Geophysical Quality Control Testing

Data processing QC metrics were tracked daily throughout the duration of the project. The Project Geophysicist performed QC measures not only on the QC instrument function tests, but also on the production data collected by the EM61-MK2A. The following parameters were analyzed:

- Coverage,
- Velocity,
- Sample separation,
- Background Noise statistics, and
- QC seed detection.

Instrument functionality tests were conducted before and after production DGM surveying at the IVS. The Static Test and Static Response Test involved collecting non-dynamic data for a period of three (3) minutes over background, three (3) minutes with a small ISO item, and one (1) minute over background. All results were within ±10 % for the duration of the project.

A Cable Shake Test was performed daily and no random spikes were identified indicating a loose/bad cable connection. A Personnel Test was performed daily and no spikes were identified indicating a spike related to onsite personnel. IVS repeatability and amplitude tests were conducted daily with no adverse responses. Static/Standard/Static [whatever this is...a test, I presume] were performed daily and were within ±10% for the duration of the project.

The production data passed the QC metrics: 95% of the daily DGM velocities were below 3.5 mph, 98% of the data separations were below 0.25 m, and the across-line transect coverages exceeded 95% of the survey design spacing.

Details of the RI QC metrics and daily results are located in the attached Access Database Table Performance Requirements Defaults Table (**Appendix G**).

3.1.3 Anomaly Selection

3.1.3.1 Digital Geophysical Mapping Anomaly Selection

Anomalies were selected from the Stack channel (sum of channel 1, 2, 3, and 4) gridded data using the peak-picking selection algorithm in Oasis montaj. A target threshold value of 6.16 mV on the Stack channel, as approved by the USACE Geophysicist, was used to select the initial target list (see IVS Report in **Appendix F**). This threshold was based on the background response as determined in the IVS and reflects a relatively low noise level relative for most project areas. After initial target selection, targets were merged and obvious cultural targets were removed, identifying fifty-eight (58) targets on the transects (**Appendix A, Figure 6**).

3.2 REACQUISITION AND INTRUSIVE INVESTIGATION OF ANOMALIES

Reacquisition and intrusive investigation of DGM survey anomalies began on 16 July 2018 and was completed on 18 July 2018. All of the DGM targets (58) identified in the analysis of DGM data were reacquired using RTK GPS and intrusively investigated by qualified UXO personnel. The UXO intrusive team investigated the anomalies using hand tools and recorded the target ID, operator, item category, item type, depth, weight, etc., on dig sheets. In total, seventy-five (75) items were intrusively investigated. The dig sheets were reviewed by the Senior UXO Supervisor (SUXOS) and UXO Quality Control Specialist (UXOQCS) daily and any discrepancies were resolved at the end of the day.

All anomalies detected during the analog geophysical surveys were intrusively investigated by the UXO dig team. Six (6) targets were intrusively investigated in this manner.

WESTON performed a geostatistical spatial density analysis using VSP (**Appendix G**). This analysis determines a functional relationship amongst neighboring transect targets allowing projection of target density in the void area between transects. Thus, transect information is used to generate a spatial target density plot in units of targets per acre. It should be noted that this method demarcates areas of high concentrations of metallic targets, which can be ordnance related or non-ordnance related in origin. Only investigation and identification of the target items can define/refine the boundaries of true CMUAs.

Based on the DGM survey collection data, no CMUAs were identified at the MRS. However, several areas of elevated anomaly density were identified, primarily within the southeastern portion of the MRS. The areas of elevated anomaly densities are skewed higher as a result of SAA debris (recent) and NMRD.

Further investigation of the areas of elevated anomaly density was performed during the complete investigation (i.e., 100% coverage) of four (4), 50 ft. by 50 ft. grids using analog geophysical investigative methodology on 21 May 2019. The investigation of the four (4) grids resulted in the recovery of seven (7) pieces of MD and nineteen (19) pieces of NMRD.

Table 3-7 summarizes the results of the DGM transect survey and the intrusive investigations and **Appendix A, Figure 7** presents the locations of the anomaly locations and items. **Appendix A, Figure 8** identifies the areas of elevated anomaly density. Photographs of daily activities including intrusive results are presented in the daily reports (**Appendix D**).

Table 3-7
Intrusive Results

Type Category	Item Type	Quantity	Description
MEC	None	0	N/A
MD	Grenade, Rifle	1	M22 Smoke, empty.
	Projectile	5	3.5-inch M29 Practice Rocket debris, including tail fins, tail shroud, nose cone.
	Mortar	1	60 millimeter (mm) tail boom.
	Fragmentation	14	Unidentifiable frag and 60mm mortar fragmentation debris.
SAA	Small arms debris (projectiles and/or casings)	23	Projectiles and Cartridge case.
NMRD	NMRD	44	Aluminum cans, scrap metal, wire, foil, and nails.
TOTAL ITEMS RECOVERED:		**88**	

3.2.1 Munitions and Explosives of Concern

No MEC items were identified during intrusive activities at the Kingman Range MRS and no demolition operations were performed.

3.2.2 Munitions Debris Items

A total of twenty-one (21) MD items were recovered during all intrusive investigations (**Table 3-7 and Appendix A, Figure 7**). MD items were encountered from the surface to a maximum of six (6) inches bgs. MD was predominantly 3.5-inch M29 Practice Rocket debris (i.e., tail fins, tail shroud, and nose cone) and unidentifiable fragmentation debris, but also included a spent M22 Rifle Grenade Smoke and debris from a 60mm mortar. The intrusive dig list record is presented in **Appendix H**.

3.2.3 Non-Munitions Related Debris

Forty-four (44) NMRD items were found during intrusive investigations (**Appendix A, Figure 7)**. NMRD were encountered at the surface to maximum depths of 12 inches bgs. These items included aluminum cans, scrap metal, wire, foil, and nails.

3.2.4 Intentional Detonation

No MEC or MPPEH were identified during intrusive activities at the Kingman Range MRS. As such, no intentional detonation operations were required.

3.2.5 Disposition of Material Documented as Safe

In July 2018, approximately six (6) pounds of MD were dually-inspected by the SUXOS and UXOQCS and certified as MDAS. The MDAS was locked in a tool box and sealed with a serial numbered tamper-evident seal (#B-433273) at the conclusion of RI field activities. Demil Metals, Inc. was contracted to provide destruction via shredding prior to recycling of MDAS.

In May 2019, approximately one (1) pound of MD was dually-inspected by the SUXOS and UXOQCS and certified as MDAS. The MDAS was locked in a tool box sealed with a serial numbered tamper-evident seal (#1528345) at the conclusion of RI field activities. Demil Metals, Inc. performed destruction via shredding prior to recycling. The MDAS turn-in form (DD Form 1348-1A) and the certificate of destruction are presented in **Appendix I**.

3.2.6 Intrusive Investigation Summary

The geostatistical spatial density analysis of DGM data indicated multiple areas with elevated concentrations of metallic objects, which could be ordnance-related or non-ordnance-related in origin. Intrusive investigation results of the MRS revealed that the anomalies were primarily NMRD and SAA debris (76%). MD (24%) relating to 3.5-inch M29 Practice Rocket debris, unidentifiable fragmentation debris, a M22 Rifle Grenade Smoke, and debris from a 60mm mortar were recovered. The maximum penetration depth of munitions-related items is less than one (1) ft. based on the intrusive investigations. The area between the former target area and the western slope of the escarpment had a higher metallic density of SAA debris and MD. The escarpment served to render all identified practice rockets, mortars, and smoke rifle grenade components inert.

The nature and extent of MD has been defined in accordance with project DQOs. All anomalies on the DGM and analog transects, as well as the full coverage grids, were investigated and no MEC was identified; however, components of potential HE munitions were identified during the RI fieldwork. A total of 0.91 acres of coverage from of the area of investigation (8.14 acres) was completed through the geophysical surveys and grid clearances.

3.3 MUNITIONS CONSTITUENT CHARACTERIZATION

The MC sampling program was designed to determine the nature and extent of MC associated with the Kingman Range MRS. As described in the UFP-QAPP, the MC sampling approach was based on historical information and the results of the intrusive investigation. In general, MC sampling was to be performed at the undeveloped portion of the MRS in the location of the former target berm, at MEC locations showing signs of a release, at areas of concentrated MEC/MD, and post-BIP locations.

Because no MEC/MPPEH was identified, MC sampling was focused at the former target berm. Two (2) DUs within the study area were identified to characterize the undeveloped area of the former target berm. Background sampling was conducted at a DU located outside of the MRS to distinguish site-related contamination from naturally-occurring or other non-site related levels of chemicals. MC characterization via ISM was executed during the first mobilization of field work.

The locations of MC sampling and background DUs were spatially acquired using a Trimble RTK GPS unit.

ISM, in accordance with the Interstate Technology Regulatory Council (2012), was utilized as the primary method of soil sampling to delineate the lateral extent of MC. All ISM samples were collected in accordance with the methods, and QC frequency designated in the UFP-QAPP (WESTON, 2017). Analytical results were validated and detailed in a laboratory-provided analytical report presented in **Appendix J**.

Table 3-8 summarizes the sampling locations, quantity, and field QC.

Table 3-8
MC Sampling Summary

Date	DUs	DU Incremental Sample Types and Quantity		Sample Location Notes
		Normal	Replicates	
16 October 2017	DUBG, DUBGR1, DUBGR2	1	2	Background DU samples (DUBG) were collected upslope and north of the MRS, with each DU sample comprised of 30 increments.
17 October 2017	DU01, DU01R1, DU01R2, DU02	2	2	DU01 and DU02 are located in the undeveloped portion of the former target area. DU01 was comprised of native soil while DU02 was non-native soil. Each DU sample was comprised of 30 increments.

3.3.1 Munitions Constituents Sampling Rationale and Analysis

DU samples (DU01, including QC samples, and DU02) were collected from the former target berm (**Appendix A, Figure 9**) in order to evaluate MC concentrations at the undeveloped portion of the MRS. Based on field observations of construction debris, non-native, and native soil, it was decided to adjust the proposed MC sampling design based on soil type to include two (2) DUs, one (1) comprised of native soil (DU01) and non-native soil (DU02). The DU MC normal samples were labeled KR-DU01-101717 and KR-DU02-101717, respectively; while, the replicate QC samples collected from DU01 were labeled KR-DU01R1-101717 and KR-DU01R2-101717, respectively.

Each DU sample was collected using ISM, comprised of 30 increments collected from ground surface to six (6) inches bgs, and analyzed for munitions-related metals (i.e., antimony, copper, lead, and zinc) via USEPA Method SW-846 6020A and explosive compounds (nitroaromatics and nitramines) via USEPA Method SW-846 8321B, in accordance with the UFP-QAPP (WESTON, 2017). A summary of the analytical results is as follows:

- No explosive compounds were detected, with the exception of laboratory-estimated concentrations of nitroglycerin and 2,4-dinitrotoluene. Nitroglycerin was detected in the sample and its field replicate from DU01 (0.011 J milligrams per kilogram [mg/kg] and 0.034 J mg/kg, respectively); 2,4-dinitrotoluene was detected at 0.022 J mg/kg at DU02.
- Antimony concentrations ranged from 0.73 mg/kg to 0.96 mg/kg.

- Copper concentrations ranged from 9.5 mg/kg to 18 J mg/kg.
- Lead concentrations ranged from 42 mg/kg to 85 mg/kg.
- Zinc concentrations ranged from 29 mg/kg to 45 mg/kg.

Analytical results are presented in **Table 3-9**. The laboratory analytical results and data validation reports are presented in **Appendix J**.

Table 3-9
U Analytical Sample Results

		Sample ID:	KR-DU01-101717					KR-DU01R1-101717					KR-DU01R2-101717					KR-DU02-101717				
		Depth (inches bgs):	0 - 6					0 - 6					0 - 6					0 - 6				
		Sample Date:	10/17/2017					10/17/2017					10/17/2017					10/17/2017				
Compound	**PRG[1]**	**Units**	**Result**	**Q**	**LOQ**	**LOD**	**DL**	**Result**	**Q**	**LOQ**	**LOD**	**DL**	**Result**	**Q**	**LOQ**	**LOD**	**DL**	**Result**	**Q**	**LOQ**	**LOD**	**DL**
USEPA Method SW-846 8321B - Explosive Compounds (nitroaromatics and nitramines)																						
1,3,5-Trinitrobenzene	10 d	mg/kg	0.029	U	0.096	0.029	0.012	0.028	U	0.093	0.028	0.012	0.029	U	0.097	0.029	0.012	0.029	U	0.097	0.029	0.012
2,4,6-Trinitrotoluene	3.6 a	mg/kg	0.015	U	0.096	0.015	0.0048	0.014	U	0.093	0.014	0.0047	0.015	U	0.097	0.015	0.0049	0.015	U	0.097	0.015	0.0049
2,4-Dinitrotoluene	1.7 a	mg/kg	0.029	U	0.096	0.029	0.0079	0.028	U	0.093	0.028	0.0076	0.029	U	0.097	0.029	0.0079	**0.022**	**J**	0.097	0.029	0.008
2-Amino-4,6-dinitrotoluene	14 d	mg/kg	0.029	U	0.096	0.029	0.012	0.028	U	0.093	0.028	0.011	0.029	U	0.097	0.029	0.012	0.029	U	0.097	0.029	0.012
4-Amino-2,6-dinitrotoluene	12 d	mg/kg	0.015	U	0.096	0.015	0.0049	0.014	U	0.093	0.014	0.0048	0.015	U	0.097	0.015	0.0049	0.015	U	0.097	0.015	0.005
HMX	16 d	mg/kg	0.015	U	0.096	0.015	0.0056	0.014	U	0.093	0.014	0.0054	0.015	U	0.097	0.015	0.0056	0.015	U	0.097	0.015	0.0057
m-Nitrotoluene	0.63 a	mg/kg	0.029	U	0.096	0.029	0.012	0.028	U	0.093	0.028	0.012	0.029	U	0.097	0.029	0.012	0.029	U	0.097	0.029	0.012
Nitrobenzene	2.2 d	mg/kg	0.029	U	0.096	0.029	0.01	0.028	U	0.093	0.028	0.01	0.029	U	0.097	0.029	0.01	0.029	U	0.097	0.029	0.011
Nitroglycerin	0.63 a	mg/kg	**0.011**	**J**	0.096	0.029	0.01	**0.034**	**J**	0.093	0.028	0.0098	0.029	U	0.097	0.029	0.01	0.029	U	0.097	0.029	0.01
o-Nitrotoluene	0.93 b	mg/kg	0.015	U	0.096	0.015	0.0055	0.014	U	0.093	0.014	0.0054	0.015	U	0.097	0.015	0.0056	0.015	U	0.097	0.015	0.0056
PETN	13 a	mg/kg	0.015	U	0.096	0.015	0.005	0.014	U	0.093	0.014	0.0048	0.015	U	0.097	0.015	0.005	0.015	U	0.097	0.015	0.005
p-Nitrotoluene	13 b	mg/kg	0.029	U	0.096	0.029	0.011	0.028	U	0.093	0.028	0.01	0.029	U	0.097	0.029	0.011	0.029	U	0.097	0.029	0.011
RDX	2.3 d	mg/kg	0.015	U	0.096	0.015	0.0042	0.014	U	0.093	0.014	0.004	0.015	U	0.097	0.015	0.0042	0.015	U	0.097	0.015	0.0042
Tetryl	1.5 d	mg/kg	0.015	UJ	0.096	0.015	0.0073	0.014	UJ	0.093	0.014	0.0071	0.015	UJ	0.097	0.015	0.0073	0.015	UJ	0.097	0.015	0.0074
USEPA Method SW-846 6020A - Metals																						
Antimony	0.27 c	mg/kg	**0.96**		0.2	0.10	0.029	**0.73**		0.2	0.10	0.029	**0.81**		0.2	0.099	0.029	**0.84**		0.19	0.095	0.028
Copper	14 c	mg/kg	**18**	J	2.5	0.20	0.071	**12**		2.3	0.19	0.067	**12**		2.5	0.20	0.07	**9.5**		2.5	0.20	0.071
Lead	11 c	mg/kg	**58**		0.39	0.069	0.018	**42**		0.37	0.066	0.017	**85**		0.4	0.069	0.018	**73**		0.4	0.070	0.018
Zinc	46 c	mg/kg	**45**		2.5	0.95	0.32	**40**		2.3	0.89	0.3	**42**		2.5	0.94	0.31	**29**		2.5	0.95	0.32

Notes:
[1] – The PRGs are based on PALs developed in the UFP-QAPP (WESTON, 2017) and are used for comparison to RI field data and are the lowest of the following Human Health or Ecological Criteria (WESTON, 2017):
a. USEPA RSL = USEPA 2019, Residential Soil (target hazard quotient=0.1; target cancer risk=1E-06) (updated May 2019 at https://www.epa.gov/risk/regional-screening-levels-rsls).
b. ADEQ SRL = ADEQ 2009, Residential Soil Remediation Levels (10^{-6} Risk or most conservative value). (Updated March 31, 2009 at http://apps.azsos.gov/public_services/Title_18/18-07.pdf).
c. EcoSSL = USEPA EcoSSL (https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents).
d. LANL = LANL EcoRisk Database. Version 4.1. September 2017. (https://lanl.gov/environment/protection/eco-risk-assessment.php). Minimum no effect ESL for soil.

BOLD and shaded – Result exceeds the stated PRG.
DL – detection limit
J – The reported result is an estimated value.
LOD – limit of detection
LOQ – limit of quantitation
Q – data qualifier
U – Analyte was not detected and is reported as less than the LOD.
UJ – Estimated/Not Detected above the LOD.

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3.3.2 Background Sampling Rationale and Analysis

Background sampling was conducted to distinguish site-related contamination from naturally-occurring or other non-site related levels of chemicals. A background DU, approximately 50 ft. by 200 ft. (**Appendix A, Figure 9**) was established to the north outside of the MRS boundary in an area known not to have been impacted by munitions use and located within the parcel with the approved ROE. The background DU sample was labeled KR-DUBG-101617; while, the replicate QC samples were labeled KR-DUBGR1-101617 and KR-DUBGR2-101617.

Each background sample was collected using ISM, comprised of 30 increments collected from ground surface to six (6) inches bgs, and analyzed for munitions-related metals (i.e., antimony, copper, lead, and zinc) via USEPA Method SW-846 6020A, in accordance with the UFP-QAPP (WESTON, 2017).

The analytical results of the background samples collected were used to calculate a 95% upper confidence limit (UCL) (i.e., 95% Student's-t UCL) using ProUCL version 5.1. Only those metals that exceed background are evaluated in the risk assessment in **Section 6**. A summary of the background sample analytical results and calculated 95% UCL is provided in **Table 3-10**.

Table 3-10
Background Sample Results and Calculated 95% UCL

Analyte	Background DU Sample Results (mg/kg)			Calculated 95% UCL	RI 95% UCL Concentration
	KR-DUBG-101617 Normal Sample	KR-DUBGR1-101617 Replicate Sample	KR-DUBGR2-101617 Replicate Sample		
Antimony	0.39	0.36	0.29	0.43	1.03
Copper	15	13	14	16	20
Lead	15	16	16	17	98
Zinc	54	51	51	55	47

3.3.3 Sample Data Validation

All laboratory analytical data were validated by a WESTON chemist in accordance with the UFP-QAPP (WESTON, 2017). The validator performed Stage IV validation of the sample delivery group received for each analytical parameter from TestAmerica, Inc. This full validation included a review of the raw data and logbook sheets and recalculation of at least 10% of the sample and QC sample results.

Data qualifiers assigned by the laboratory based on their data quality review were evaluated for appropriateness in the context of the DQOs outlined in the UFP-QAPP (WESTON, 2017). Sample condition, holding times, laboratory control samples, matrix spikes, matrix spike duplicates, surrogate recoveries (where applicable), and field triplicate results (percent relative standard deviation) were evaluated to assess the overall precision, accuracy, and completeness of the data. Qualifiers assigned to the data are shown in **Table 3-9**.

Seventy-two (72) results from four (4) samples, ISM surface DU samples and QC replicates, were evaluated for data quality. Except for laboratory estimated concentrations of nitroglycerin from DU01 and 2,4-dinitrotoluene at DU02, all analytical results for nitroaromatics and nitramines (fifty-six [56]) were qualified "U" or "UJ", not detected or not detected estimated, and reported as less than the LOD. One (1) analytical result for copper (KR-DU01-101717) was qualified "J", estimated. No other results were qualified.

Data were evaluated with regards to the PARCCS parameters (Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity) and qualified as appropriate based on that evaluation. The overall quality of the data were acceptable, and these data are considered usable for decision-making purposes. The laboratory analytical results and data validation reports are presented in **Appendix J**.

3.4 RESIDENTIAL SURVEY

At the conclusion of the RI field work, ADEQ requested that ARNG G9 conduct a survey of residents in the residential area within the MRS to ensure that no residents had found munitions on their property or had heard of anyone finding munitions in their neighborhood. ADEQ made this request because no transects were conducted in the residential area during the SI or RI. As agreed upon between ADEQ, AZARNG, ARNG G9, and USACE, no work was conducted in the residential area during the SI or RI because there were no known reports of munitions or munitions debris and it was assumed the construction development activities would have already identified any items.

A questionnaire was sent out to residents within the MRS on 10 December via certified mail and included a self-addressed stamped envelope to return the questionnaire. A copy of the questionnaire is provided in Appendix M. The questionnaire asked if residents had dug on their property (yes or no), if they had found any metal objects or munitions objects (yes or no; if yes, describe), and if they had heard of anyone in their community finding a munitions-related object (yes or no; if yes, describe). A total of 46 letters/questionnaires were sent out for 41 properties, as some properties listed that the property owner lived at another address; therefore, a letter was sent to the owner's address and the property address. Fourteen responses were received and are included in Appendix M. Twelve of the responses indicated that they had not found metal objects or munitions objects on their property nor had they heard of anyone in the community finding these objects. One response indicated they had found a single 50-caliber bullet on their property and one response indicated they found three bullet casings on top of their grass.

ADEQ hosted a public meeting on 05 January 2021 for residents to learn more about the project and ask questions. The meeting was conducted virtually. Only one resident attended the meeting. The meeting notice, presentation, and minutes are provided in Appendix M.

3.5 SUCCESS OF RI MEC AND MC CHARACTERIZATION

The achievement of MEC and MC characterization can be evaluated by comparison to the PRGs identified in **Section 2.2**. Results of the intrusive investigation satisfied the PRGs of determining the nature and extent of MEC and MC and the potential risk posed to human health and the environment. The extent of potential MEC was determined using DGM transects and intrusive investigation of select anomalies. No MEC items were found during the Kingman Range MRS RI. However, components of potential HE munitions were identified during the RI fieldwork.

The usability of the MC data, and the frequency and location of soil samples collected within the MRS have satisfied DQOs for Decision Inputs based upon the criteria in the UFP-QAPP (WESTON, 2017). The data are also considered acceptable for use in evaluating potential human health risks in **Section 6.0**. Significant deviations from the proposed scope of data collection that would compromise data usability or representativeness were not encountered.

Detailed descriptions of the field activities and data collection are presented in **Section 3**. Daily reports for field activities are provided in **Appendix D**.

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4.0 REVISED CONCEPTUAL SITE MODEL

The CSM presented in **Section 2.1** has been updated using data collected from the RI. Specifically, the updates include refinement of the types of munitions present at the MRS and the potential for the presence of associated MC. All other aspects of the original CSM remain valid.

4.1.1 Revised Munitions and Explosives of Concern and Munitions Constituents Conceptual Site Model

The types of MD found at the MRS during the RI are consistent with those presented in the original CSM and the known historical use of the MRS as a small arms training range (WESTON, 2012). No MEC was observed during the field efforts. However, munitions-related debris (fragments from M29 3.5-inch rockets, M22 Rifle Grenade Smoke, and 60mm mortars) and small arms projectiles and casings were identified during the SI and RI. MD items were removed from the MRS and properly destroyed and recycled (**Section 3.2.5**).

4.1.2 Munitions and Explosives of Concern Types Identified

During the SI and RI, 3.5-inch practice rockets and 60mm mortar MD components were identified. The debris from the M29 3.5-inch practice rockets consists of a tail fins, tail shroud, and nose cone. The M29 practice rocket is considered HE. The rocket motor contains propellant, which is expended upon firing, and produces fragmentation upon impact (e.g., impacting the natural escarpment present at the MRS). The M29 3.5-inch practice rocket is a surface launched munition with a maximum range of approximately 500 ft. MD components (fuze, tail boom, and unidentified fragmentation debris) from 60mm mortars were also identified; however, model type(s) was indeterminate. The MD associated with the 60mm mortars may have been associated with target practice rounds.

During the RI, an expended M22 Rifle Grenade Smoke was identified. The M22 (Smoke) Rifle Grenade is used for signaling and consists of three (3) basic parts, a steel stabilizer assembly, an integral fuze, and a body. The body is filled with a burning-type smoke charge which contains a dye to color the smoke. The M22 Rifle Grenade is a surface launched munition with a maximum range of approximately 650 ft.

At the completion of the RI, there is physical evidence of potential HE munitions use at the Kingman Range MRS. Therefore, the MEC pathway is considered “potentially complete” on the revised CSM diagram. (**Appendix A, Figure 11**).

4.1.3 Munitions and Explosives of Concern Distribution

The MD items identified during the SI and RI were located within the original scoped MRS boundary and concentrated behind the former target area but not beyond the natural backstop escarpment (**Appendix A, Figure 7**). All MD items encountered ranged in depth from the ground surface to a maximum of six (6) inches bgs.

4.1.4 Munitions Constituents Sources

The primary potential MC sources at the MRS consist of the residues of munitions and their filler materials that may remain in the environment as a result of military munitions training activities. Concentrations of nitroglycerin and 2,4-dinitrotoluene were detected in three (3) soil samples below their respective PRGs (i.e., the most stringent human health and ESLs). Antimony, copper, and lead were detected in soil samples above background concentrations and PRGs. However, while all metals exceeded ESLs, the DUs, representative of the larger undeveloped portion of the MRS in the location of the former target berm, are not sufficient in size to support an ecology that can submit to ecological review. Therefore, the exposure pathways for explosive compounds and metals are considered "incomplete" on the revised CSM diagram (**Appendix A, Figure 11**).

4.1.5 Recommended Division of the Kingman Range Munitions Response Site

Based on the results of the RI, WESTON recommends that the Kingman Range MRS be divided into two (2) MRSs for future work, the 8.14-acre Kingman Range MRS (AZHQ-006-R-01), and the 25.29-acre Kingman Range – NFA Area MRS (AZHQ-006-R-02) (**Appendix A, Figure 10**). The Kingman Range MRS corresponds with the RI area of investigation and will require further action for MEC and no further action (NFA) for MC. The Kingman Range – NFA Area MRS consists of the developed residential area to the west of the target area. This area has been developed and hardscaped, and no MD or MEC has been observed in this area during the SI or the RI. The initial CSM for the Kingman Range – NFA Area MRS shows that the MEC and MC pathways are considered incomplete (**Appendix A, Figure 12**), and the MRS will require NFA for MEC and MC. ADEQ concurred with NFA for the Kingman Range – NFA Area MRS in a letter provided in Appendix M.

5.0 CONTAMINANT FATE AND TRANSPORT

The intent of this section is to describe the fate of contaminants in the environment and the potential transport mechanisms for MEC/MC at the Kingman Range MRS. No UXO or DMM were found; therefore, only the fate and transport of the chemical component of the hazard is evaluated. 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 away from the source area.

5.1 MUNITIONS AND EXPLOSIVES OF CONCERN

A potential source for MEC at this MRS was the result of releases from military munitions used in the historical military training activities, involving the M29 3.5-inch practice rockets, M22 Rifle Grenade Smoke, and 60mm mortars. Mechanisms for MEC releases included deliberate or unintentional functioning of potential MEC items. The MEC characterization activities clarified the potential types of MEC present (**Section 4.1.1**).

5.1.1 Potential Routes of Exposure

Results from the SI and RI indicate that the M29 3.5-inch practice rockets, M22 Rifle Grenades Smoke, and 60mm mortars were the sole munitions used at the Kingman Range MRS. No MEC was identified during the SI and RI field activities, however the presence of MD from potential HE munitions is present at the MRS. Therefore the revised CSM indicates that the MEC pathway is still "potentially complete" (**Appendix A, Figure 11**).

5.1.2 Munitions and Explosives of Concern Persistence

The majority of MEC contains a high proportion of metallic components that are generally resistant to physical or chemical breakdown. Although MC may degrade at variable rates, casings, fuzes, or undefined MD may remain for long periods of time in relatively unaltered states at the surface. Burial of MEC may cause enhanced chemical weathering due to the interaction with moisture and minerals in soil.

5.1.3 Munitions and Explosives of Concern Migration

Several factors influence the possible transport of MEC/MD from the MRS. The greatest potential for transport of MEC/MD by humans is the redistribution by farming, ranching, or recreational activities. The influence of natural factors such as erosion (wind or surface water), runoff (surface water) transport at the MRS due to topography and soil (predominantly silty fine sands) may also affect MEC/MD at or near the ground surface.

5.2 MUNITIONS CONSTITUENTS

Although concentrations of two (2) explosive compounds (nitroglycerin and 2,4-dinitrotoluene) and three (3) metals (antimony, copper and lead) were detected in soil samples collected from the former target area, no sources of MC were identified by the SI or RI. MC could adhere to soil particles through sorption and be entrained in the wind, transported to a surface water body by overland flow, or leach to the groundwater. However, because the nearest surface water body is greater than 30 miles to the east and groundwater is deeper than 150 ft. bgs, it is unlikely that MC would be transported to a surface water body or into the groundwater.

6.0 RISK ASSESSMENT

6.1 MUNITIONS CONSTITUENTS SCREENING LEVEL/BASELINE RISK ASSESSMENT

A SLERA is prepared as part of the RI to provide an evaluation of risks associated with exposure to MC. In accordance with the CERCLA, NCP and the site-specific UFP-QAPP, risk is assessed for MC that exceeds applicable screening levels (i.e., PRGs) or background concentrations. The most stringent screening levels for soil at the MRS are the lower of the USEPA residential direct contact RSLs and the ADEQ residential SRLs. These screening levels are chemical-specific concentrations for individual contaminants in soil that are considered by the Agency to be protective for humans (including sensitive groups) over a lifetime.

The applicable screening levels for soil are USEPA EcoSSLs and ESLs for soil from the LANL EcoRisk Database. The EcoSSLs and ESLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil (USEPA, 2005). Screening levels are also based on no effect toxicity values to ensure risks are not underestimated and to provide a defensible conclusion that negligible ecological risk exists or that certain contaminants and exposure pathways can be eliminated from consideration (USEPA, 1997).

During field activities, no damaged, corroded or potentially leaking UXO, DMM, or MPPEH items were observed; however, MD from M29 3.5-inch practice rockets, M22 Rifle Grenade Smoke, and 60mm mortars was recovered. Soil samples were collected from three (3) DUs using ISM and analyzed for explosives and munitions-related metals using ISM. The analytical results were used to calculate the 95% UCL on the mean in accordance with the UFP-QAPP (WESTON, 2017).

All concentrations of explosive compounds were below their respective human health and ESLs (**Table 6-1**). Concentrations of metals were below their respective human health screening levels (**Table 6-1**). However, some concentrations of antimony, copper, and lead exceeded ESLs. Only one (1) copper concentration exceeded its ESL, but was below its EcoSSLs (**Table 6-1**). Therefore, copper was eliminated from further evaluation. Concentrations of antimony and lead exceeded both their ESLs and EcoSSLs and were carried forward in the assessment.

Table 6-1
COPC Evaluation

Analyte	ESL		Human Health Values		PRG[2]	Background (95% UCL)[3]	RI 95% UCL Concentration[4]
	LANL ESL	EcoSSL[1]	USEPA RSL	ADEQ SRL			
	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)	Soil (mg/kg)
Antimony	2.3	0.27 B	3.1	3.1	0.27	0.43	1.03
Copper	14	28 A	310	3,100	14	16	20
Lead	11	11 A	400	400	11	17	98
Zinc	47	46 A	2,300	23,000	46	55	47

Notes:
1. The primary source for the ESL is the USEPA EcoSSL (Avian) (A). If an USEPA EcoSSL (Avian) value was not available, the lowest of the USEPA EcoSSL for Mammalian (B), plant (C) and soil invertebrate (D) value is presented.
2. The PRG used for comparison to RI field data is the lowest of the following human health or ecological criteria:
   a. USEPA RSL = USEPA 2019, Residential Soil (target hazard quotient=0.1; target cancer risk=1E-06) (updated November 2019)
   b. ADEQ SRL = ADEQ 2009, Residential Soil Remediation Levels (10^{-6} Risk or most conservative value) (updated March 31, 2009).
   c. EcoSSL = USEPA (2016) EcoSSL.
   d. LANL ESL = LANL EcoRisk Database. Version 4.1 ESL. October 2017.
3. Background (95% UCL) = 95 % UCL on the mean of replicate background results.
4. RI 95% UCL concentration = 95 % UCL on the mean of replicate RI results.

The antimony and lead concentrations were compared to receptor-specific EcoSSLs to evaluate the potential risk to plants, soil invertebrates and a range of trophic levels and feeding guilds for birds and mammals from these metals in the soil (**Table 6-2**). Antimony concentrations exceeded the screening level protective of small mammals. Lead concentrations exceeded the screening levels for protection of small mammals, herbivorous birds, and insectivorous birds (**Table 6-2**). Due to its small size (less than 0.3 acres), the former target area is not capable of providing quality habitat or food that would support wildlife populations Therefore, it is unlikely that wildlife (including sensitive species) is exposed to soil impacted by MC and the risk posed to ecological receptors is correspondingly low.

Table 6-2
Comparison to Receptor-Specific ESLs

RI 95% UCL Concentration:	Metal Analyte	
	Antimony	Lead
	1.03 mg/kg	98 mg/kg
EcoSSL[1]		
Plant	NV	120
Soil Invertebrate	78	1700
Herbivorous bird	NV	**46**
Insectivorous bird	NV	**11**
Carnivorous bird	NV	510
Herbivorous mammal	10	1200
Insectivorous mammal	**0.27**	**56**
Carnivorous mammal	4.9	460

Notes
[1]USEPA EcoSSL
(https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents).
NV no value

6.1.1 Munitions Constituents Risk Summary

A SLERA was not performed for MC concentrations as no MC concentrations were above human health screening levels. Antimony and lead concentrations exceeded the screening level for some ecological receptors; however, the assessment determined that the former target area would not support wildlife populations based on its small size. Therefore, MC at the MRS does not pose a threat to human health or the ecology.

6.2 MUNITIONS AND EXPLOSIVES OF CONCERN RISK ASSESSMENT

6.2.1 Background

In accordance with 40 Code of Federal Regulations (CFR) Part 300.175(d)(4), "...the Lead Agency shall conduct a site-specific baseline risk assessment to characterize the current and potential threats to human health and the environment." For unacceptable risks, and in accordance with 40 CFR Part 300.430(e)(i), the Lead Agency shall "Establish Remedial Action Objectives (RAOs) specifying contaminants and media of concern, potential exposure pathways, and remediation goals." The methodology described in the memorandum, *Trial Period Extension for Risk Management Methodology (RMM) at Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Projects* (USACE, 2019), which establishes a one (1) year extension of the process described in *Study Paper: Decision Logic to Assess Risks Associated with Explosive Hazards, and to Develop Remedial Action Objectives (RAOs) for Munitions Response Sites (MRS)*, dated 3 January 2017, is intended to satisfy the requirement for a risk assessment for FUDS MMRP projects. Because of the similar non-DoD owned nature of FUDS and NDNODS, this same methodology is being applied to the Kingman Range MRS.

The baseline risk assessment for explosive hazards is performed in the RI and is intended to support risk management decisions, development of RAOs, and determining if RAOs have been met.

A baseline risk assessment, based on site-specific characterization data and land use, is used to evaluate explosive hazards, identify human health risks, and establish RAOs. The data used in the assessment is processed in a manner similar to that presented in the Department of Army Pamphlet for Risk Management (DA Pam 385-30).

The risk assessment utilizes the three (3) components – severity, accessibility, and sensitivity – to assess site-specific conditions and determine if conditions at a MRS are "acceptable" or "unacceptable."

1. **Severity:** This component evaluates the energetic material type present in the MEC item found at the MRS (e.g., HE, incendiary, etc.), and the location of human receptors relative to the MEC item (i.e., if the MEC item detonates, how many receptors would be impacted in addition to the individual initiating the detonation).

2. **Accessibility:** This component addresses the likelihood of an individual to be exposed to MEC. It includes an evaluation of MRS accessibility (e.g., presence of anthropogenic or natural barriers that would restrict access, etc.), potential contact hours with receptors, amount of MEC remaining at the MRS, minimum depth of MEC relative to potential receptor activities, (e.g., construction activities would increase the potential for receptors to encounter MEC at depth, etc.), and migration potential of MEC (e.g., frost heave, erosion, etc.).
3. **Sensitivity:** This component evaluates the detonation potential of MEC at the MRS and combines the MEC classification (e.g., UXO, fuzed or unfuzed DMM, bulk explosives, etc.) with the MEC size to evaluate the likelihood of a human-receptor encounter that would result in an unintentional detonation.

When the risk assessment determines that "unacceptable" conditions exist at an MRS, RAOs are developed to mitigate the risk. Three (3) "acceptable" risk scenarios can exist for an MRS: A) acceptable, where unlimited use and unrestricted exposure (UU/UE) is supported, B) acceptable without LUCs, where UU/UE may not be supported, and C) acceptable with LUCs, where UU/UE is not supported.

6.2.2 Assessment of Risk

Matrices are used to assess the site-specific explosive risk at MRSs.

- Matrix 1, Likelihood of Encounter, relates the amount of MEC present based on site-specific characterization data to access conditions (i.e., frequency of use) at the MRS.
- Matrix 2, Severity of Incident, relates the likelihood of an encounter (Matrix 1) to the severity as associated with specific munitions items.
- Matrix 3, Likelihood of Detonation, relates the susceptibility of MEC to detonate to the likelihood for energy to be imparted during an encounter.
- Matrix 4, Acceptable and Unacceptable Site Conditions, relates the results of the severity of detonation (Matrix 2) with the likelihood of detonation (Matrix 3).

6.2.2.1 Matrix 1: Likelihood of Encounter

In Matrix 1, shown in **Table 6-3**, the "Likelihood of Encounter" is dependent on two (2) factors, the amount of MEC items known or suspected to exist, and access conditions (e.g., accessibility and frequency of use). Either or both of these factors can be modified as a result of a selected remedial action to reduce or eliminate the likelihood of encounter.

"Amount of MEC" is determined using site-specific characterization data, or anticipated or completed results of a remedial action. "Access Conditions" are selected based on considerations of the access and frequency of use for the MRS.

"Accessibility" is a factor of the amount of MEC present, ease of site access, potential contact hours, minimum MEC depth relative to the maximum receptor intrusive depth, and migration potential; but also considers other relevant conditions, such as topography, terrain, land use, and potential receptors.

For the Kingman Range MRS, the "Likelihood of Encounter" scored by Matrix 1 is "Seldom" based on historical evidence of munitions use, and the findings of the SI and RI of HE munition debris. The Access Condition is considered "Regular" as the site has no access controls and is known to be used for recreational activities (with or without landowner permission).

For the Kingman Range – NFA Area MRS, the "Likelihood of Encounter" scored by Matrix 1 is "Unlikely" based on the fact that no MD or MEC has been observed in the area throughout development and hardscaping activities. Additionally, prior to the RI, interviews with the Mayor, Deputy Police Chief, and Deputy Fire Chief for Kingman were conducted. None were aware of any reports of munitions being found in the residential area. The Access Condition is considered "Regular" as residents reside within the MRS.

Table 6-3
Matrix 1, Likelihood of Encounter

Likelihood of Encounter, Matrix 1: Amount of MEC vs. Access Conditions		Access Conditions (frequency of use)			
		Regular (e.g., daily use, open access)	**Often** (e.g., less regular or periodic use, some access)	**Intermittent** (e.g., some irregular use, or access limited)	**Rare** (e.g., very limited use, access prevented)
Amount of MEC	• MEC is visible on the surface and detected in the subsurface.	Frequent	Frequent	Likely	Occasional
	• The area is identified as a Concentrated Munitions Use Area (CMUA) where • MEC is known or suspected (e.g., MD indicative of MEC is identified) to be present in surface and subsurface.	Frequent	Likely	Occasional	Seldom
	• MEC presence based on physical evidence (e.g., MD indicative of MEC), although the area is not a CMUA, or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/acre at 95% confidence).	Likely	Occasional	Seldom	Unlikely
	• MEC presence is based on isolated historical discoveries (e.g., EOD report) prior to investigation, or • A response action has been conducted to physically remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/acre at 95% confidence).	Occasional	Seldom	Unlikely	Unlikely
	• MEC presence is suspected based on historical evidence of munitions use only, or • A response action has been conducted to physically remove surface and subsurface MEC (evidence that some residual hazard remains to support this selection), or • The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/acre at 95% confidence).	**Seldom**[1]	Seldom	Unlikely	Unlikely
	• Investigation of the MRS did not identify evidence of MEC presence, or • A response action has been conducted that will achieve UU/UE.	**Unlikely**[2]	Unlikely	Unlikely	Unlikely

[1]The score applies to the Kingman Range MRS
[2]The score applies to the Kingman Range – NFA Area MRS.

6.2.2.2 Matrix 2: The Severity of Incident

Matrix 2 (**Table 6-4)**, relates "Likelihood of Encounter" (Matrix 1) to the potential severity of an unintentional detonation. Unlike the two (2) factors in Matrix 1, "Severity" is a static characteristic derived from the known or suspected munitions present at the MRS. To decrease the severity of an incident, MEC must be treated and/or removed (reducing the amount of MEC), land use or conditions must be altered, or both.

Table 6-4
Matrix 2, Severity of Incident

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		**Likelihood of Encounter (from Matrix 1)**				
		Frequent: Regular, or inevitable occurrences	**Likely: Several or numerous occurrences**	**Occasional: Sporadic or intermittent occurrences**	**Seldom: Infrequent, rare occurrences**	**Unlikely: Not probable**
Severity Associated with Specific Munitions Items	Catastrophic/Critical: May result in 1 or more deaths, permanent total or partial disability, or hospitalization	A	A	B	**B**[1]	D
	Modest: May result in 1 (or more) injury resulting in emergency medical treatment, without hospitalization	B	B	B	C	D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C	D
	Improbable: No injury is anticipated	D	D	D	D	**D**[2]

Notes
"A" indicates conditions most likely to result in determination of an unacceptable risk.
"B" indicates the presence of site munitions with a specific explosive nature and site-specific receptor exposure pathway may lead to a determination of unacceptable risk.
"C" indicates unacceptable explosive risk is determined if the CSM indicates presence of munitions having a specific explosives nature, as well as the accessibility supported by the specific land use, such that likelihood of encounter, sensitivity of munitions items, and severity of potential incident are collectively unacceptable.
"D" indicates conditions most likely to result in determination of an acceptable risk.

[1]The score applies to the Kingman Range MRS
[2]The score applies to the Kingman Range – NFA Area MRS.

For the Kingman Range MRS, the "Severity of Incident" (Matrix 2) results in a "B." This is based on a "Seldom" encounter from Matrix 1 and the "Catastrophic/Critical" severity of an explosive incident. For the Kingman Range – NFA Area MRS, the "Severity of Incident" (Matrix 2) results in a "D." This is based on an "Unlikely" encounter from Matrix 1 and the "Improbable" severity of an explosive incident.

6.2.2.3 Matrix 3: The Likelihood of Detonation

Matrix 3 (**Table 6-5)** relates the likelihood of detonation (sensitivity of the MEC) to the likelihood to impart energy (potential for the MEC to be disturbed). To decrease the likelihood of detonation, land use and access to the MRS must be altered.

Table 6-5
Matrix 3, Likelihood of Detonation

Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		**Likelihood to Impart Energy on an Item**		
		High e.g., areas planned for development, or seasonally tilled	**Modest** e.g., undeveloped, wildlife refuge, parks	**Inconsequential** (e.g., not anticipated, prevented, mitigated)
Sensitivity: Susceptibility to Detonation	High (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., HE or pyrotechnics)	**1**[1]	2	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	**3**[2]

[1]The score applies to the Kingman Range MRS
[2]The score applies to the Kingman Range – NFA Area MRS.

The "likelihood to impart energy" can be affected by behavioral modifications or by altering land use, specifically to prevent accessibility or particular activities to reduce the likelihood or ability of imparting energy on a munitions item.

For the Kingman Range MRS, the "Likelihood of Detonation" (Matrix 3) results in "1." This is based on the "Moderate" sensitivity of known or suspected MEC and the "High" likelihood that energy would be imparted from the MEC if disturbed. The area of investigation for the RI is zoned residential and could be developed in the future.

For the Kingman Range – NFA Area MRS, the "Likelihood of Detonation" (Matrix 3) results in a "3." This is based on the "Inconsequential" likelihood to impart energy and the "Not Sensitive" likelihood of detonation (i.e., no MEC present).

6.2.2.4 Matrix 4: Acceptable and Unacceptable Site Conditions

The acceptability of site conditions, shown in Matrix 4 (**Table 6-6**) is a summation of the previous three (3) matrices and it differentiates between "acceptable" and "unacceptable" conditions at an MRS. The acceptability (or unacceptability) of conditions at an MRS is based on the likelihood of an encounter (Matrix 1), potential severity of an incidents (Matrix 2), and the likelihood of an interaction that could result in a detonation (Matrix 3). The resulting element of the matrix could be used to assist in the identification of viable remedial actions and to determine if an implemented remedy has effectively improved the acceptability of site conditions.

Table 6-6
Matrix 4, Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result from Matrix 2			
		A	B	C	D
Results from Matrix 3	1	Unacceptable	**Unacceptable**[1]	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	**Acceptable**[2]

[1]The score applies to the Kingman Range MRS
[2]The score applies to the Kingman Range – NFA Area MRS.

Site conditions for the Kingman Range MRS are considered "Unacceptable" based on the element "1" from Matrix 3 and the element "C" from Matrix 2. The "Unacceptable" site conditions for Kingman Range MRS do not support UU/UE.

Site conditions for the Kingman Range – NFA Area MRS are considered "Acceptable" based on the element "3" from Matrix 3 and the element "D" from Matrix 2. The "Acceptable" site conditions for the Kingman Range – NFA Area MRS support UU/UE.

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7.0 SUMMARY OF REMEDIAL INVESTIGATION RESULTS

Characterization of the Kingman Range MRS was performed to determine the nature and extent of MEC and MC. Data has been generated in accordance with the methods and DQOs documented in the UFP-QAPP (WESTON, 2017), and summarized in **Section 2.5**.

Based on the results of the RI, it is recommended that the MRS be split into two (2) MRSs: The 8.14-acre Kingman Range MRS (AZHQ-006-R-01) and the 25.29-acre Kingman Range – NFA Area MRS (AZHQ-006-R-02). A summary of the RI activities, nature and extent of the MEC and MC, and how the decision rules were met is provided in the following subsections.

7.1 NATURE AND EXTENT OF MUNITIONS AND EXPLOSIVES OF CONCERN CONTAMINATION

The nature and extent of MEC and MD at the Kingman Range MRS was determined through geophysical surveys (both DGM and analog transects) and intrusive investigation. Statistical analysis (including geostatistical analysis using VSP) of the DGM data did not identify any CMUAs; however, several areas of elevated anomaly density were identified. These areas of elevated anomaly densities were primarily the result of NMRD and debris from recent SAA firing. Results of the intrusive investigation were recorded on the Dig List (**Section 3.2 and Appendix H**), and included item type, location, and disposition. Similar to the SI, no MEC was discovered during the RI; however, MD items relating to the M29 3.5-inch practice rocket, unidentified fragmentation debris, a M22 Rifle Grenade Smoke, and debris from a 60mm mortar were identified.

MD items recovered during the SI and RI were primarily located to the east of the former target area but not beyond the western slope of the natural escarpment backstop (**Appendix A, Figure 7**). All MD items were encountered at less than six (6) inches bgs. The Kingman Range – NFA Area MRS was not investigated during the RI because the area is developed and hardscaped, and no evidence of MEC or MD has been observed. Following the RI, no data gaps remain in the area that was investigated; however, the potential for MEC still exists at the MRS.

7.2 NATURE AND EXTENT OF MUNITIONS CONSTITUENTS CONTAMINATION

The primary sources of potential MC to the environment at the Kingman Range MRS are the residue of munitions and their filler materials remaining in the environment as a result of training activities. MC sampling analytical results from worst-case areas during the SI and RI confirmed that no explosive compounds were detected above screening levels. Levels of antimony, copper, and lead are present in DU1 above screening levels down to six (6) inches bgs, and antimony and lead are present in DU2 above screening levels down to six (6) inches bgs (**Appendix A, Figure 9**). No MC investigation occurred at the Kingman Range – NFA Area MRS as no source of MC has been observed.

7.3 RISK ASSESSMENT SUMMARY

7.3.1 Munitions Constituents

A baseline risk assessment for MC was not required in this RI because a source of MC was not identified. During the prior SI field investigation, 11 surface soil samples were collected at the backstop escarpment and analyzed for select metals and surface soil samples were collected at the locations of the mortar fuze and rocket fragments and analyzed for explosive compounds. The MC samples collected during the SI were from potential "worst-case" areas associated with SAA impact berms and encountered MD. Explosive compounds were not detected while detected metals were below their respective Arizona screening levels. The results of the RI fieldwork, which included the collection of four (4) ISM MC surface soil samples, indicated explosive compounds were not detected above PRGs and metals were detected above background. While all metals exceeded ESLs, the DUs, representative of the larger undeveloped portion of the MRS in the location of the former target berm, are not sufficient in size to support an ecology that can submit to ecological review. NFA is recommended for MC at the Kingman Range MRS as no MC in soil are identified as being potential human health or ecological concerns. NFA is recommended for MC at the Kingman Range – NFA Area MRS, as well, as no source of MC has been observed.

7.3.2 Munitions and Explosives of Concern Risk Assessment

The methodology described in the memorandum, *Trial Period Extension for Risk Management Methodology (RMM) at Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Projects* (USACE, 2019) was used to evaluate the risks associated with potential MEC present at the Kingman Range MRS, which was historically used for small arms training, as well as training with the M29 3.5-inch practice rocket, the M22 Rifle Grenade Smoke, and the 60 mm mortar.

Based on the evaluation, the Kingman Range received an "Unacceptable" rating, meaning the MRS does not meet the conditions for UU/UE and further action is recommended for MEC. Based on the evaluation, the Kingman Range – NFA Area MRS received an "Acceptable" rating, meaning the MRS does meet the conditions for UU/UE and NFA is recommended for MEC. The MEC risk assessment is presented in **Section 6.2**.

7.4 MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL

The MRSPP is established by 32 CFR Part 179 to assign a relative priority for munitions responses to each MRS in the DoD inventory. The MRSPP evaluates the potential explosive, chemical warfare materiel (CWM), and environmental hazards at an MRS derived from MEC and MC data. The MRSPP uses three (3) modules: 1) Explosive Hazard Evaluation (EHE), 2) CWM Hazard Evaluation (CHE), and 3) Health Hazard Evaluation (HHE). Each module evaluates the source, the exposure pathway, and the receptors for each hazard using weighted factors. A full description of the MRSPP process is provided in the MRSPP Primer (DoD, 2007). The initial MRSPP scoring for the Kingman Range MRS was developed in 2012 during the SI phase. Data from the RI was incorporated into the protocol to update the MRSPP.

Based on the results of the RI, it is recommended that the MRS be split into two (2) MRSs: The 8.14-acre Kingman Range MRS (AZHQ-006-R-01) and the 25.29-acre Kingman Range – NFA Area MRS (AZHQ-006-R-02). MRSPP scoring was developed for each of the two (2) new MRSs.

The Kingman Range MRS was scored with an EHE module total of 75, which is equivalent to a rating of "C," or Priority "4." There is no history of CWM use at the Kingman Range MRS and this was supported further by the results of the SI and RI. Therefore, the CHE module does not apply and the Kingman Range MRS receives the alternative module rating of "No Known or Suspected CWM Hazard." Based on the maximum surface soil concentrations of MC analytes from the SI and RI, the HHE module for the Kingman Range MRS resulted in an HHE alternative module rating of "No Known or Suspected MC Hazard." A summary of the MRSPP Module Ratings is provided in **Table 7-1**.

The Kingman Range – NFA Area MRS was scored with an EHE module total of "No Longer Required." There is no history of CWM use at the Kingman Range – NFA Area MRS. Therefore, the CHE module does not apply and the MRS receives the alternative module rating of "No Known or Suspected CWM Hazard." Based on the lack of a source of MC at the Kingman Range – NFA Area MRS, the HHE module resulted in an HHE alternative module rating of "No Known or Suspected MC Hazard." A summary of the MRSPP Module Ratings is provided in **Table 7-1**.

Table 7-1
Priority Rating for the Kingman Range MRS and Kingman Range – NFA Area MRS

Specific Data Element	AZHQ-006-R-01	AZHQ-006-R-02
EHE Module Rating	C (4)	No Longer Required
CHE Module Rating	No Known or Suspected CWM Hazard	No Known or Suspected CWM Hazard
HHE Module Rating	E (6)	No Known or Suspected MC Hazard
Priority	**4**	**No Longer Required**

The MRS Priority is determined by selecting the highest rating from amongst the EHE, CHE, and HHE modules. Priority 1 indicates the highest potential hazard and Priority 8 indicates the lowest potential hazard. Whereas, MRSPP alternative module ratings from highest to lowest ratings include "Evaluation Pending", "No Longer Required," and "No Known or Suspected (Explosive, CWM, or MC) Hazard." The MRSPP will be used to determine the future funding sequence of MRSs for further munitions response action. The MRSPP score for the Kingman Range MRS remains 4. The MRSPP score for the Kingman Range – NFA Area MRS is "No Longer Required." The MRSPP tables for the Kingman Range MRS and Kingman Range – NFA Area MRS are presented in **Appendix K**.

7.5 CONCLUSIONS

Information generated during the RI was input into the project's decision rules, with the results of risk assessment evaluations for MEC and MC as further inputs to assess the decision objectives for the MRSs. **Table 7-2** presents the decision objectives as applicable for the MRSs.

The 8.14-acre Kingman Range MRS (AZHQ-006-R-01) is recommended for further evaluation in an FS for MEC, because of the identification of potential HE munitions use at the MRS. The FS Report is included as **Appendix L** of this report. NFA is recommended for Kingman Range MRS (AZHQ-006-R-01) with regards to MC because no risks associated with MC were identified during the RI. NFA is recommended for the 25.29-acre Kingman Range – NFA Area MRS (AZHQ-006-R-02) with regards to MEC and MC.

Table 7-2
Status of Decision Objectives for Characterization

Decision Objective	Kingman Range MRS (AZHQ-006-R-01)	Kingman Range – NFA Area MRS (AZHQ-006-R-02)
Characterization of potential MEC/explosive hazards on the ground surface and in the subsurface.	Complete – MEC/explosive hazards on the surface and in the subsurface were characterized during the RI. No MEC was identified at the MRS. However, twenty-one (21) MD items were identified, including 3.5-inch M29 Practice Rocket debris (i.e., tail fins, tail shroud, and nose cone), unidentifiable fragmentation debris, a spent M22 Rifle Grenade (Smoke), and debris from a practice 60mm mortar.	Complete – The MRS is developed and hardscaped. No MEC or MD has been identified at the MRS.
Characterization of MC contamination in soil at the MRS.	Complete – No source of MC was identified.	Complete – No source of MC was identified.
Document MEC risks at the MRS.	Complete – The MEC risk assessment indicates “Unacceptable” site conditions for the Kingman Range MRS.	Complete – The MEC risk assessment indicates “Acceptable” site conditions for the Kingman Range – NFA Area MRS.
Document baseline risk assessment for MC at each area.	Complete – No source of MC was identified. Unacceptable risks to human health or the environment are not present at the MRS.	Complete – No source of MC was identified. Unacceptable risks to human health or the environment are not present at the MRS.
Update CSM.	Complete – Pathways for MEC and MC are considered to be potentially complete and incomplete, respectively, for the surface and subsurface.	Complete – Pathways for MEC and MC are considered to be incomplete for the surface and subsurface.
Determine whether no action is warranted or whether a remedial action is required at the MRS.	Complete – The MRS will move forward to an FS for MEC and NFA is required for MC.	Complete – The MRS requires NFA for MEC and MC.

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APPENDIX A

FIGURES

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Date: 13 Dec 2018 Last Edited by: PB E:\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\Figure 1_Site Location Map.mxd

N

0 0.25 0.5 1
Miles

SITE LOCATION MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01
Army National Guard
Kingman, Mohave County, Arizona

Figure
1

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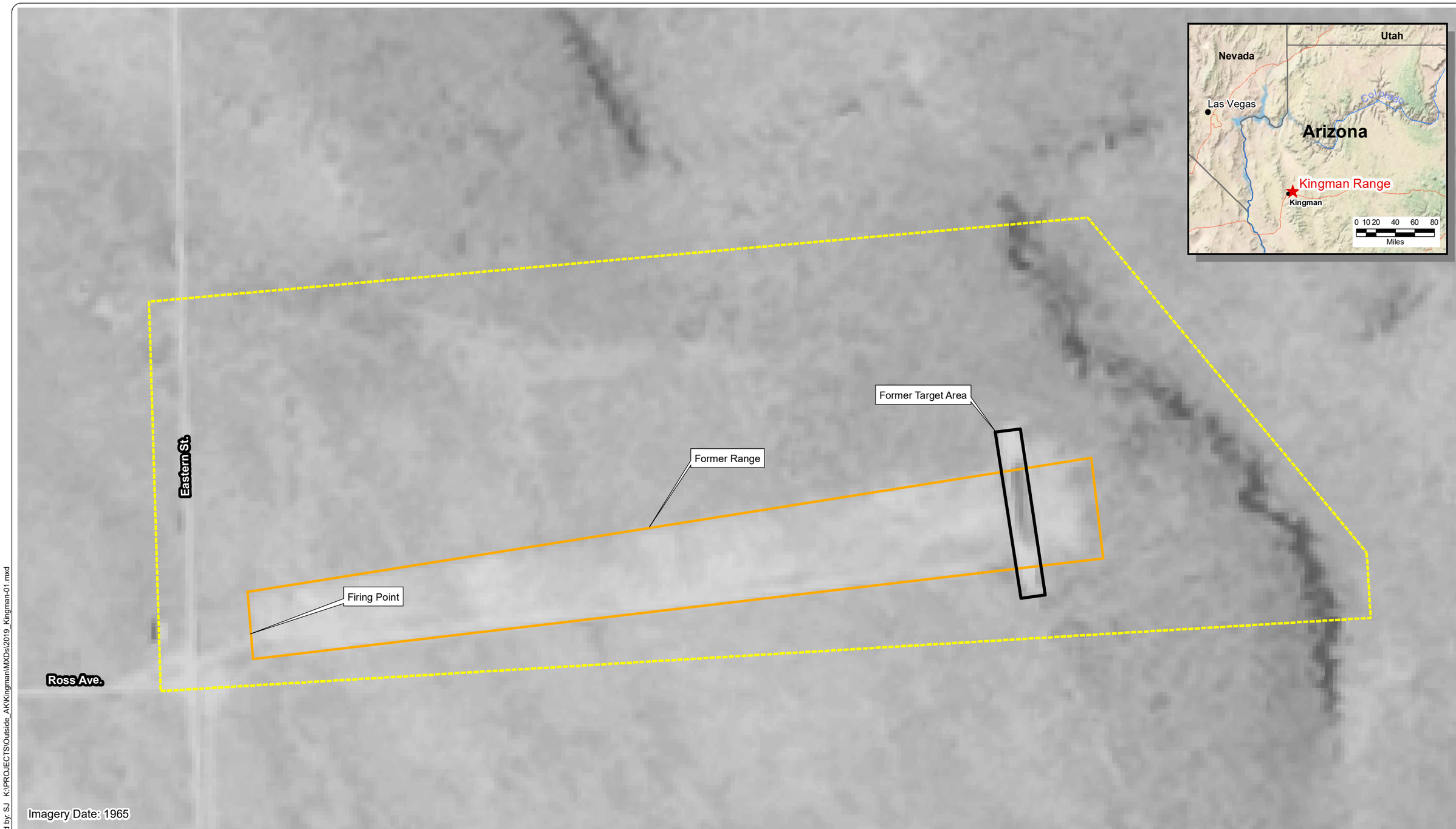

N

0 100 200 300 400
Feet

Legend

- Range Floor
- Target
- Kingman MRS

SITE HISTORICAL MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
2

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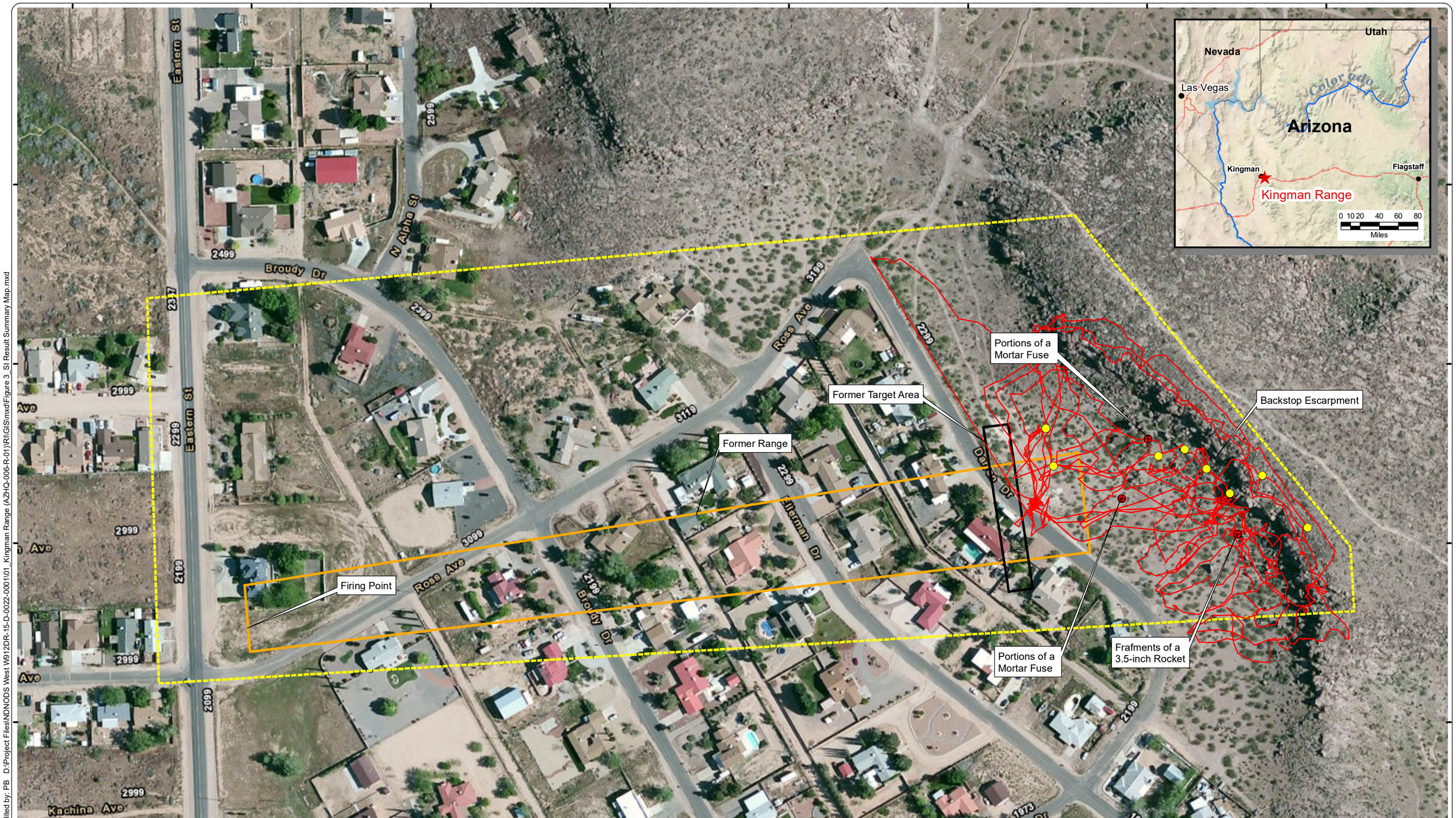

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Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- SI Soil Sample Location
- SI MD and Soil Sample Location
- SI Transects
- Former Range Floor
- Former Target Berm
- Kingman Range MRS (33.43 acres)

SUMMARY OF SITE INSPECTION RESULTS
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
3

Date: 07 Apr 2020 Last Edited by: PB D:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\R\GIS\mxd\Figure 3_SI Result Summary Map.mxd

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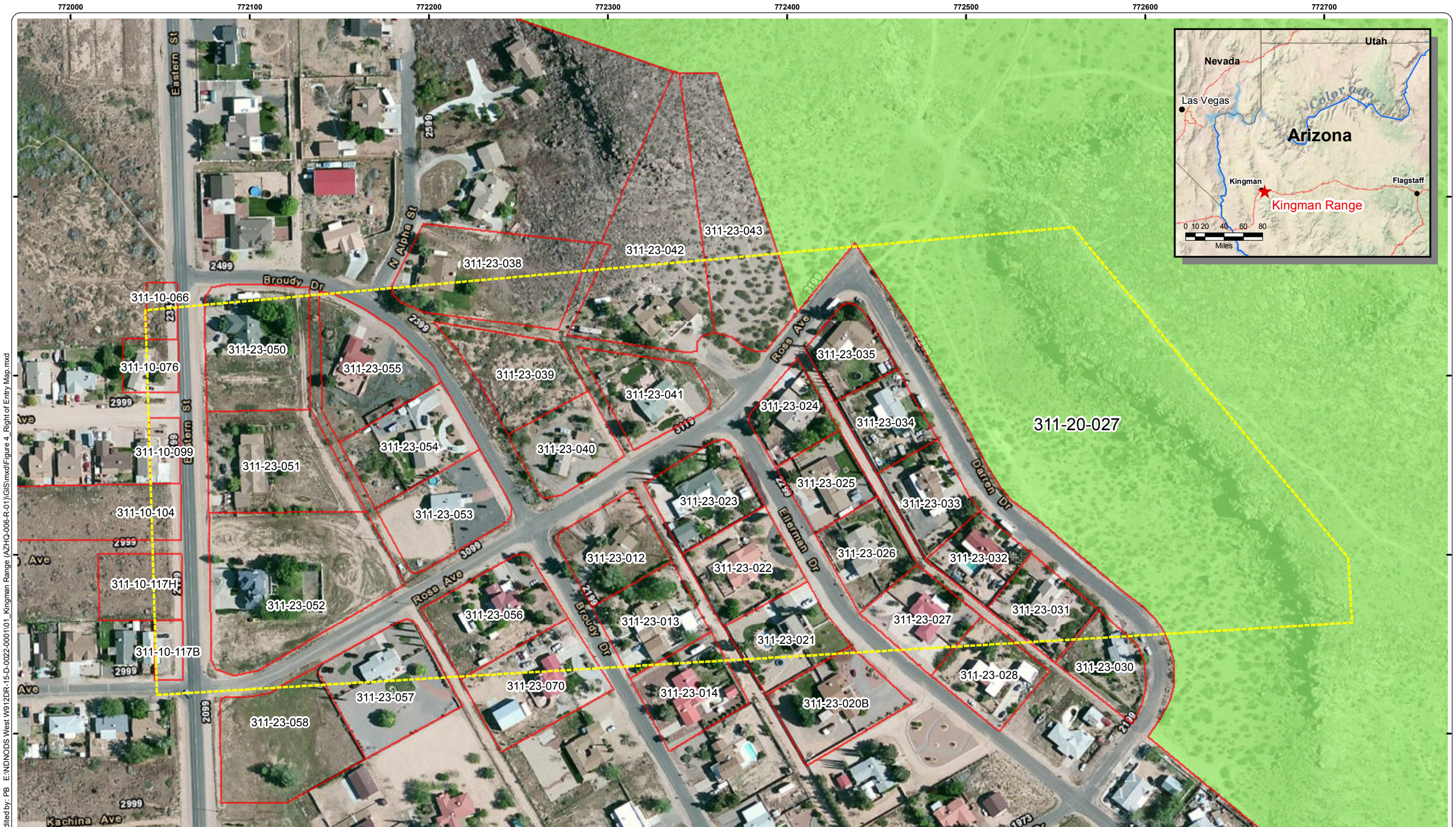

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0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Parcel Boundary with Parcel ID Number
- ROE Obtained
- Kingman MRS

RIGHT OF ENTRY MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
4

Date: 13 Dec 2018 Last Edited by: PB E:\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\Figure 4_Right of Entry Map.mxd

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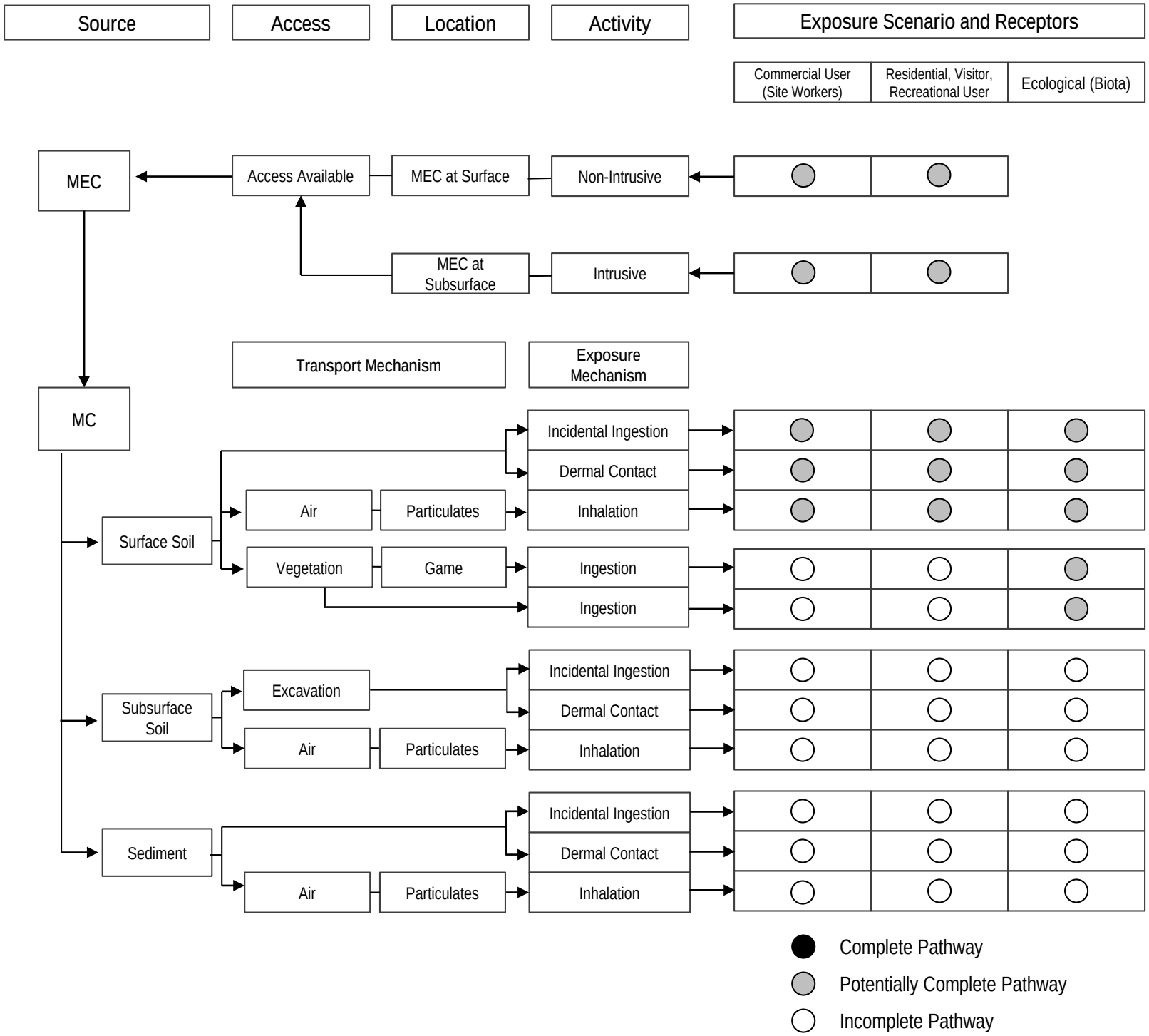

Figure 5 – Initial Conceptual Site Model

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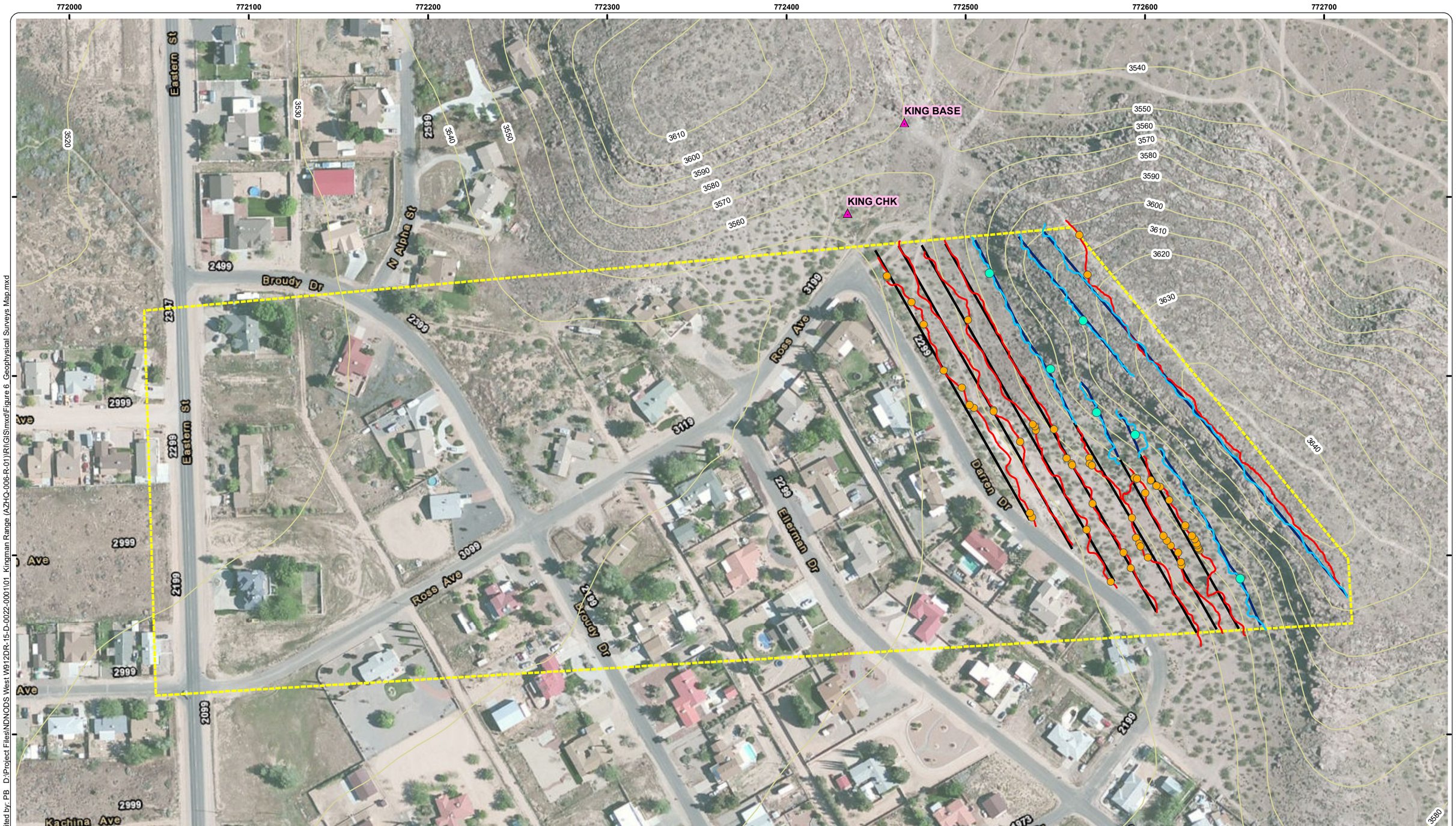

Date: 07 Apr 2020 Last Edited by: PB D:\Project Files\NDNODS West W912DR-15-D-0022-0001\01 Kingman Range (AZHQ-006-R-01)\R\GIS\mxd\Figure 6_Geophysical Surveys Map.mxd

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0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Survey Control Points
- Analog Target Locations
- DGM Target Locations
- Analog Transects Collected
- DGM Transects Collected
- Proposed DGM Transects
- Proposed Analog Transects
- Topographic Contour (10 feet)
- Kingman Range MRS (33.43 acres)

GEOPHYSICAL SURVEY MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
6

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Date: 03 Apr 2020 Last Edited by: PB D:\Project Files\NDNODS West W912DR-15-D-0022-0001\01 Kingman Range (AZHQ-006-R-01)\R\GIS\mxd\Figure 7_Intrusive Investigation Map.mxd

N

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Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Munitions Debris
- Small Arms Debris
- Non-Munitions Related Debris
- Seed
- Grids (50 ft x 50 ft)
- Analog Transects
- DGM Transects
- Former Range Floor
- Former Target Berm
- Parcel Boundaries
- Kingman Range MRS (33.43 acres)

INTRUSIVE INVESTIGATION MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
7

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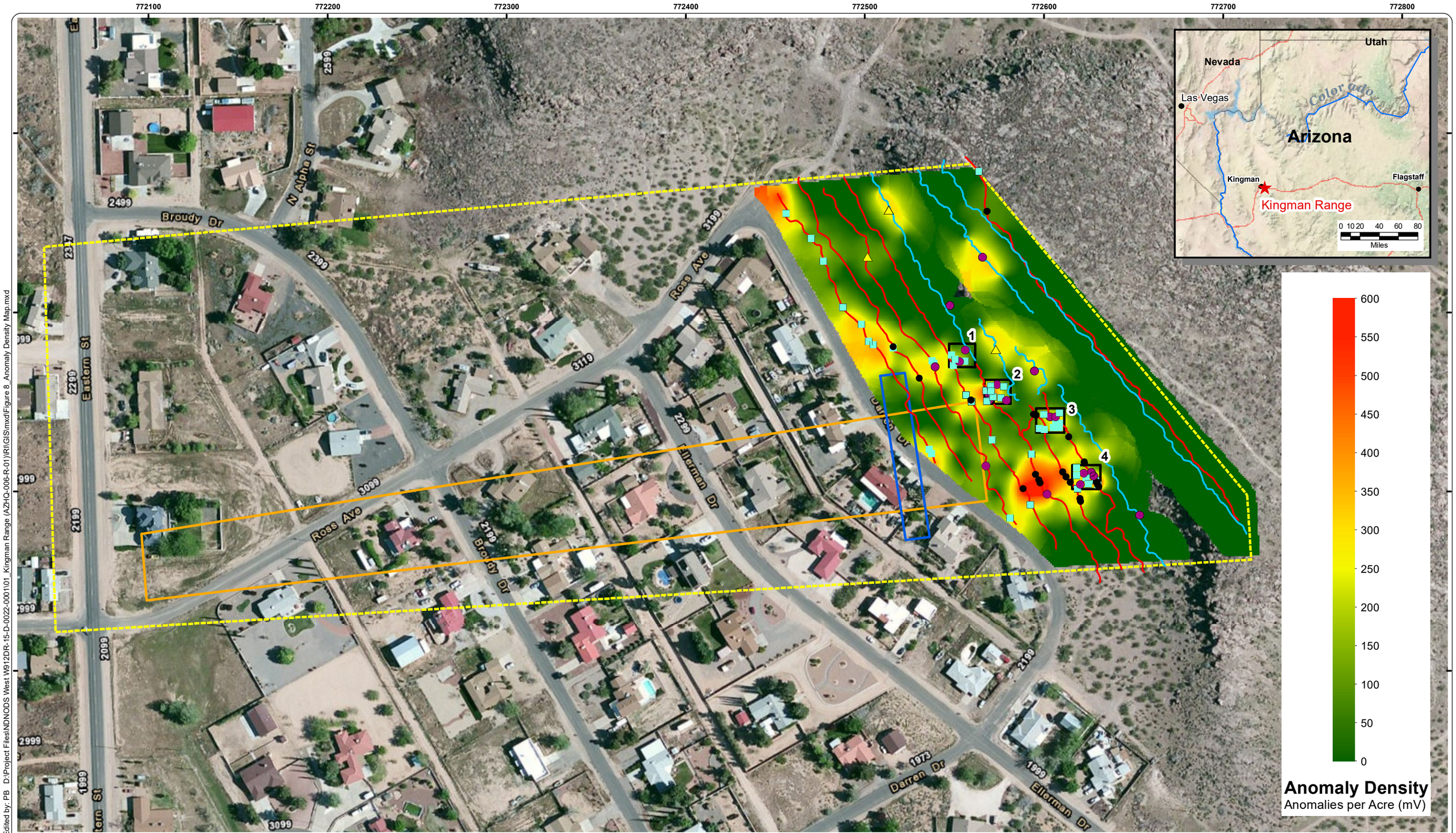

N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Munitions Debris
- Small Arms Debris
- Non-Munitions Related Debris
- Seed
- Analog Transects
- DGM Transects
- Grids (50 ft x 50 ft)
- Former Range Floor
- Former Target Berm
- Kingman Range MRS (33.43 acres)

ANOMALY DENSITY MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
8

Date: 03 Apr 2020 Last Edited by: PB D:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\RI\GIS\mxd\Figure 8_Anomaly Density Map.mxd

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N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- SI Sample Location
- Decision Unit
- Former Target Berm
- Kingman Range MRS (33.43 acres)

MC SAMPLING LOCATION MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
9

Date: 05 Dec 2019 Last Edited by: PB D:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\Figure 9_MC Sampling Location Map.mxd

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N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

Kingman Range MRS (AZHQ-006-R-01)

Kingman Range - Residential Area MRS (AZHQ-006-R-02)

PROPOSED MRS BOUNDARIES
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
10

Date: 02 Jul 2020 Last Edited by: PB F:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\FS\Figure 10_Proposed MRS Boundaries.mxd

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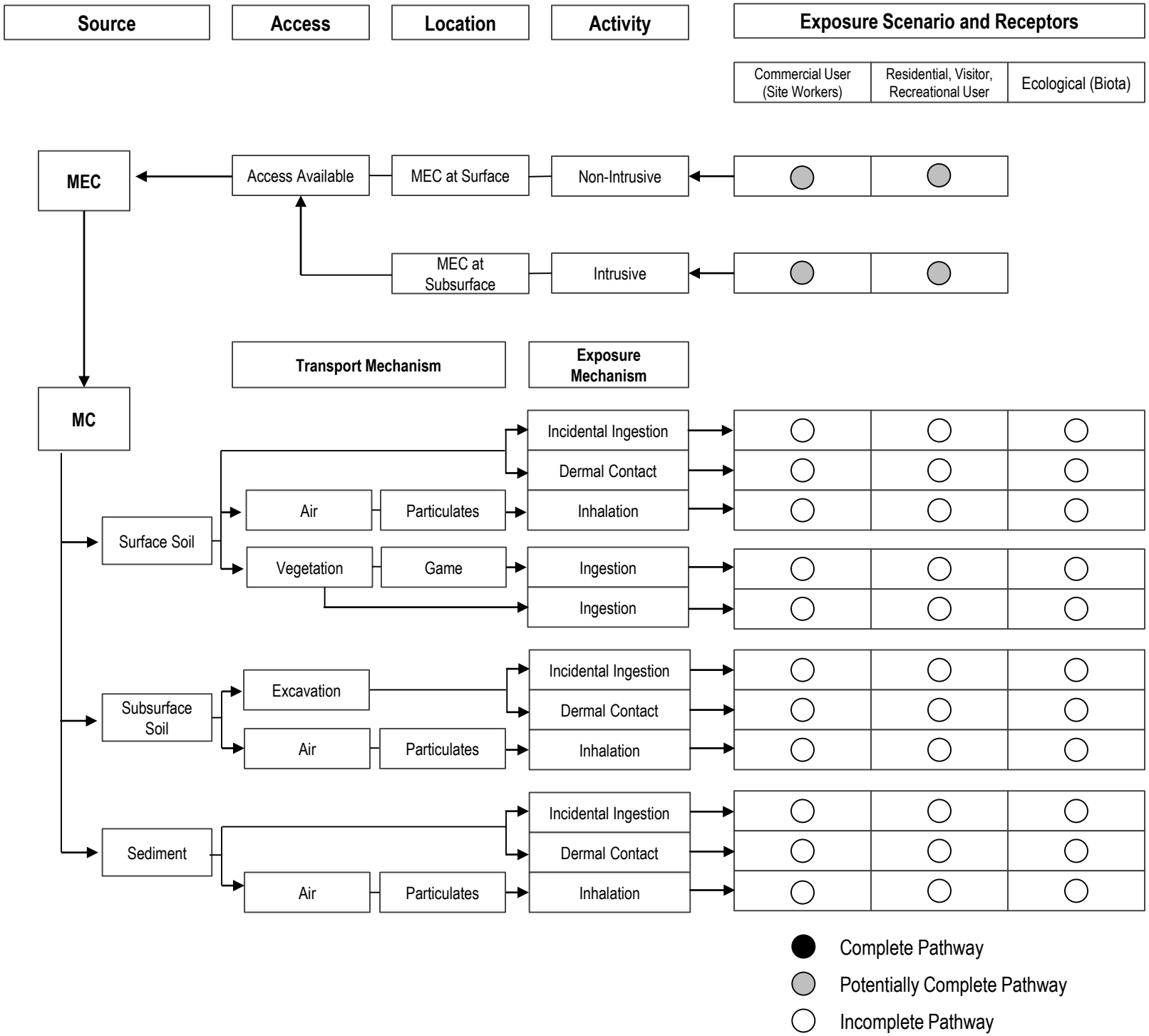

Figure 11 – Post- RI CSM for the Kingman Range MRS

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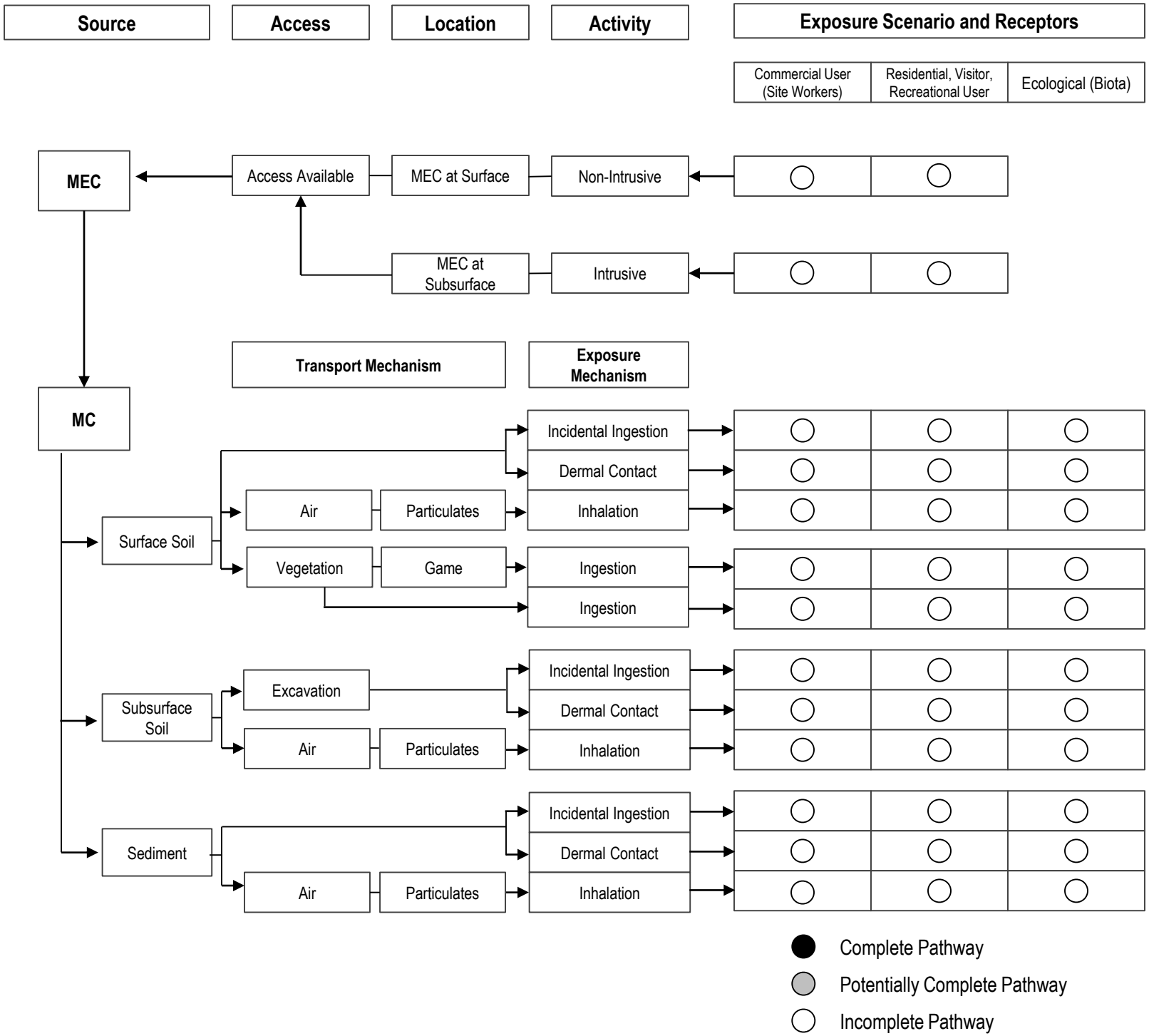

Figure 12 – Post-RI CSM for the Kingman Range – NFA Area MRS

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APPENDIX B

RIGHT OF ENTRY

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DACA09-3-19-3036

DEPARTMENT OF THE ARMY
RIGHT OF ENTRY(RoE)
FOR
Remedial Investigation (RI)
Military Munitions Response Program (MMRP)

Site-AEDB-R #: AZHQ-006-R-01
Project: Kingman Range Area
Property I.D. #: Assessor Parcel Number (APN) 311-20-027

The undersigned, herein called the **"Owner"**, in consideration for the mutual benefits of the work described below, hereby grants the **UNITED STATES OF AMERICA**, hereinafter called the "Government", a RoE upon the following terms and conditions:

1. The Owner hereby grants to the Government an irrevocable and assignable right to enter in, on, over and across the land described below in APN 311-20-027, ***for a period not to exceed twenty-four (24) months***, beginning with the date of the signing of this instrument, and terminating with the earlier of the completion of the inspection or the expiration of the term; for use by the United States, its representatives, agents, and contractors, and assigns, as a work area for MMRP Remedial Investigation; including the right to investigate and collect samples; and perform any other such work which may be necessary and incident to the Government's use for the investigation and response on said lands.

2. The Owner also grants the right to enter and exit over and across any other lands of the Owner as necessary to use the described lands for the purposes listed above.

3. If any action of the Government's employees or agents in the exercise of this RoE result in damage to the real property, the Government will, in its sole discretion, either repair such damage or make an appropriate settlement with the Owner. In no event shall such repair or settlement exceed the fair market value of the fee title to the real property at the time immediately preceding such damage. The Government's liability under this clause is subject to the availability of appropriations for such payment, and nothing contained in this agreement may be considered as implying that Congress will at a later date appropriate funds sufficient to meet deficiencies. The provisions of this clause are without prejudice to any rights the Owner may have to make a claim under applicable laws for any damages other than those provided for herein.

4. We will attempt to telephone you at least ten (10) days prior to commencing any activities at **(818) 986-5253**.

5. The land affected by this right-of-entry is located in Kingman, Mohave County, AZ, and is described as follows: APN 311-20-027, as shown on **EXHIBIT "A"** attached hereto.

Dated this 15 day of March, 20 19.

Owner:

ROGER A. FRANKLIN

THE UNITED STATES OF AMERICA

By:

JOSEPH M. GATTI
Chief, AZ/NV Real Estate Office
Real Estate Contracting Officer

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APPENDIX C

INSTITUTIONAL ANALYSIS REPORT

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FINAL
INSTITUTIONAL ANALYSIS REPORT

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION / FEASIBILITY STUDY

KINGMAN RANGE MRS (AZHQ-006-R-01)
MOHAVE COUNTY, ARIZONA

CONTRACT NO. W912DR-15-D-0022
DELIVERY ORDER 0001`

Prepared For:

U.S. ARMY CORPS OF ENGINEERS,
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January 2021

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ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
ARNG-D	Army National Guard - Directorate
AZARNG	Arizona Army National Guard
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EOD	Explosives and Ordnance Disposal
EP	Engineer Pamphlet
FS	Feasibility Study
IA	institutional analysis
LUC	land use control
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDNODS	Non-Department of Defense Owned, Non-Operational Defense Sites
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance

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1.0 INTRODUCTION

This institutional analysis (IA) report was prepared by Weston Solutions, Inc. in support of the Remedial Investigation (RI) conducted at the Non-Department of Defense (DoD) Owned, Non-Operational Defense Site (NDNODS) Kingman Range (AZHQ-006-R-01) Munitions Response Site (MRS) in Kingman, Mohave County, Arizona. This IA has been prepared in accordance with the *Military Munitions Response Program (MMRP) RI/Feasibility Study (FS) Guidance* (United States [U.S.] Army, 2009); Engineer Pamphlet (EP) 1110-1-24 (U.S. Army Corps of Engineers [USACE], 2000); the U.S. Environmental Protection Agency (USEPA) guidance EPA-540-R-09-001 *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* (USEPA, 2012); and Data Item Description WERS-017.01 *Institutional Analysis and Institutional Control Plan* (USACE, 2010).

As a result of the RI, the Kingman Range MRS was split into two MRSs, the Kingman Range MRS (AZHQ-006-R-01), the 8.14 acre area corresponding with the RI area of investigation, and the Kingman Range – No Further Action Area MRS (AZHQ-006-R-02), which consists of the residential area to the west of the area of investigation. This document presents the institutional analysis for the 8.14-acre Kingman Range MRS only. This document is intended to be an appendix to the RI; please refer to the RI for additional background information.

1.1 STRATEGIES FOR ADDRESSING MUNITIONS AND EXPLOSIVES OF CONCERN

The typical strategies for addressing the presence of munitions and explosives of concern (MEC) on a site are physical removals and land use controls (LUCs). Although physical removals may be conducted to reduce the amount of MEC at a site, current technologies are not always adequate to provide for the detection and removal of all MEC items. Therefore, even in the event that physical removals are performed, LUCs are implemented to manage any potential residual MEC risk remaining at a site. LUCs are also sometimes put into place as a stand-alone response without a physical removal. Landowners provide critical input into the development of a viable LUC program at a site located on their property. If a LUC program is selected for a site on a property not under the control of the DoD, it is the property owner and/or appropriate state and local governments that have the authority to maintain compliance with the provisions of the LUCs and maintain the effectiveness of the LUCs.

LUCs consist of various legal mechanisms, engineering control measures, and educational control measures used to minimize the potential for hazards to human receptors from a property impacted with MEC or other hazards. Instead of direct elimination of MEC, the LUC remedial action relies on behavior modification and access control strategies to reduce or eliminate risk. There are four categories of LUCs, as described in USEPA EPA-540-R-09-001 (USEPA, 2012):

- Proprietary controls are generally created pursuant to state and tribal law to prohibit or restrict activities that may result in unacceptable risk to human health or the environment. These generally consist of easements and covenants.

- Governmental controls impose restrictions on land use or resource use, using the authority of a government entity. Typical examples of governmental controls include zoning, building codes, groundwater use regulations, commercial fishing bans, and sports/recreational fishing limits.
- Enforcement and permit tools with LUC components are legal tools, such as administrative orders, permits, Environmental Covenants, Federal Facility Agreements and Consent Decrees that limit certain site activities or require the performance of specific activities (e.g., to monitor and report on a LUC's effectiveness). They may be issued unilaterally or negotiated.
- Informational devices provide information or notification to local communities that residual or contained contamination remains on site. Typical informational devices include state registries of contaminated sites, notices in deeds, tracking systems, and fish advisories.

To effectively manage long-term residual risk at a MEC site, USACE seeks and encourages meaningful stakeholder involvement. Coordination with landowners and local, county, and state officials and other stakeholders is essential to identifying site-specific objectives for an effective LUC program. This coordination includes conducting an IA. The IA process provides the opportunity to obtain information from and coordinate with landowners and local, county, and state officials and other stakeholders in developing and implementing a site-specific LUC program. The objectives of an IA are to illustrate the opportunities that exist to implement a LUC program at a specific site; identify landowners and government agencies having jurisdiction over the site; and assess the appropriateness, capability and willingness of landowners and government agencies to assert their control over the site.

1.2 PURPOSE

The overall purpose of this IA is to provide information regarding the viability of government agencies or other non-government entities associated with the NDNODS Kingman Range MRS to take part in implementing LUCs for the purpose of minimizing opportunities for exposure to MEC. The IA will aid in the evaluation of LUCs that are a component of alternatives in the feasibility study. More specifically, the objectives of this analysis are to:

- Document which agencies or entities have jurisdiction over any lands at the Kingman Range MRS;
- Assess the authority, capability, and willingness of each agency or entity to assert control that would protect the community from MEC hazards;
- Document the obligations, if any, of each agency or entity to protect the surrounding community from associated risks under the law; and
- Document any existing LUCs currently in place at the Kingman Range MRS for the protection of human health from MEC hazards.

Local, state, and federal agencies and other non-government entities that will be required to support short- and long-term LUCs proposed for the MRS are described and evaluated in this IA.

1.3 HAZARD REVIEW

The Kingman Range MRS is a 8.14-acre site used by the National Guard from 1951 until 1968 for small arms and artillery practice. The MRS has been developed and privately owned since 1968 and is located on privately owned, residentially zoned land that is undeveloped. A Preliminary Assessment recommended further investigation in a Site Inspection (SI). The SI identified confirmed evidence of munitions debris (MD) consisting of mortar fuze fragments and debris from 3.5-inch M29 Practice Rockets. The SI recommended the site be further investigated in a RI. At the time of the RI, The MRS consisted of 33.43 acres. No RI activities were designed to take place within the developed areas of the MRS (25.29 acres) due to hardscaping and soils being previously disturbed. No evidence of military munitions has been reported in the residential area. Prior to the SI field work conducted in December 2011 (WESTON, 2012), Rights of entry were requested for 16 properties; however, only 4 property owners granted access. An inspection was conducted east of Darren Drive near the impact area. Significant development and hardscaping in the residential area was present and the residential parcels were not considered critical. During the RI, prior to field work, interviews were conducted with the Mayor, Deputy Police Chief, and Deputy Fire Chief of Kingman on 31 May 2018. None of those interviewed were aware of any munitions being encountered or explosive ordnance disposal (EOD) responses in the residential portion of the MRS. This resulted in an 8.14-acre area of investigation. As a result of the RI, the MRS was split into two MRSs, but the RI area of investigation corresponded with the current boundaries of the Kingman Range MRS. The results of the RI confirmed the nature (type) of MD at the MRS as follows:

- A total of 14 MD items were recovered as part of the digital geophysical mapping transects investigation:
  - One (1) fragment – M22 smoke grenade (empty);
  - Five (5) fragments – 3.5-inch M29 Practice Rocket – tail fins, tail shroud, nose cone;
  - One (1) fragment – 60-millimeter (mm) mortar – tail boom;
  - Seven (7) fragments – unidentifiable frag and 60-mm mortar fragmentation debris.
- A total of seven (7) MD items were recovered as part of the 100%-coverage analog grid investigation:
  - Seven (7) fragments – unidentifiable frag and 60-mm mortar fragmentation debris.

During the SI field investigation, 11 surface soil samples were collected and analyzed for explosive compounds and select metals. The MC samples collected during the SI were from potential "worst-case" areas associated with small arms impact berms and encountered MD. Explosive compounds were not detected while detected metals were below their respective Arizona screening levels. Four (4) munitions constituent (MC) samples collected during the RI were from the undeveloped portion of the MRS in the location of a former target berm.

The results of the RI fieldwork indicated explosives compounds were not detected above project remediation goals and metals were detected above background. While all metals exceeded ecological screening levels, the decision units, representative of the larger undeveloped portion of the MRS in the location of the former target berm, are not sufficient in size to support an ecology that can submit to ecological review. Because it was determined that MC does not pose a risk to human health or the ecology, no further action was recommended for MC in the RI.

1.4 REGULATORY BACKGROUND

A number of existing statutes, regulations, and guidance documents allow for and/or clarify the implementation of LUCs and the performance of an IA. The regulatory authorities governing the establishment and maintenance of LUCs during munitions response actions include: Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); National Oil and Hazardous Substances Pollution Contingency Plan (NCP); and Defense Environmental Restoration Program (DERP). These statutes, regulations, and resulting guidance documents are discussed below.

CERCLA (commonly known as Superfund) was enacted in 1980 to provide a legal framework to clean up sites contaminated with hazardous substances. CERCLA was enlarged and reauthorized by the Superfund Amendments and Reauthorization Act (SARA) in 1986. The SARA included aspects that directly apply to MEC-contaminated sites. SARA also included Section 211, the DERP statute. This portion of the statute amended Title 10 of the U.S. Code (USC) by adding Chapter 160 to Title 10, Environmental Restoration, thus establishing the DERP. The DERP created the authority of the DoD to undertake certain response actions and established the Defense Environmental Restoration Account. One of the goals of DERP is the correction of environmental damage (such as detection and disposal of munitions and munitions constituents) that creates an imminent and substantial endangerment to public health/welfare or to the environment. The DERP is required to undertake response actions at facilities or sites under the jurisdiction of the DoD and owned by, leased to, or otherwise possessed by the U.S. at the time of the actions leading to contamination. As a matter of DoD policy, munitions responses are conducted in accordance with CERCLA, as amended by the SARA, and the NCP.

The NCP was established by the Clean Water Act of 1972 and has been revised and broadened several times since then. The NCP is codified in 40 Code of Federal Regulations (CFR) Part 300. The purpose of the NCP is to provide the organizational structure and procedures for developing, evaluating, and implementing response actions at a site. The March 1990 revision is the latest version of the NCP. Paragraph 300.120(c) identifies the DoD as the removal response authority with respect to incidents involving DoD military weapons and munitions.

The National Defense Authorization Act for fiscal year 2002 (Public Law 107-107) formally amended the DERP by establishing the MMRP. The MMRP is a program element of the DERP for the remediation of property known or suspected to contain MEC. Under the MMRP, the DoD conducts munitions responses per CERCLA, the NCP, and applicable federal and state laws.

The DoD considers reasonably anticipated future land use in the design and implementation of response actions and provides, to the fullest extent practicable, the opportunity for meaningful involvement of state and local governments and members of the public in the munitions response process.

1.5 INSTITUTION SELECTION

Institutions were selected for this analysis based on an ability to have jurisdiction and authority over the NDNODS Kingman Range MRS, and/or have a specific mission to protect the public from MEC hazards. The institutions selected for the Kingman Range MRS include the Arizona Army National Guard (AZARNG), the Army National Guard – Directorate (ARNG-D), the USACE, and the Arizona Department of Environmental Quality (ADEQ). The majority of the Kingman Range MRS (western portion, about 75%) is developed and consists of a multi-parcel residential community (**Appendix A, Figure 4**).

The eastern portion of the MRS (remaining 25%) is undeveloped vacant land. A portion of this area contains the former target area, and the RI area of investigation, and is zoned for residential land use. The future land use of the MRS is expected to remain the same. Each institution identified is discussed below.

- **Arizona Army National Guard:** AZARNG is headquartered in Phoenix, Arizona. The Department manages a joint federal-state program that keeps readiness trained and equipped military organizations for the Governor in the event of a state emergency and the President in the event of a national emergency. The mission of the AZARNG is to "provide a trained and ready force capable of performing unified land operations and defense support to civil authorities" (AZARNG, 2015). Based on historical records, the AZARNG's official presence at the Kingman Range MRS was between 1951 and 1968.
- **Army National Guard – Directorate:** The ARNG-D is headquartered in Arlington, Virginia, and provides trained units to the states, territories and the District of Columbia and keeps itself equipped to protect life and property. The ARNG-D also provides trained units to the nation equipped and ready to defend the U.S. and its interests all over the globe (National Guard, 2016). The ARNG-D is statutorily responsible for the MRS and centrally managed all work performed during the RI. It is the lead agency and consulted with USACE for investigating, reporting, and decision making regarding the MRS.
- **United States Army Corps of Engineers:** The USACE was established in 1775 under the Continental Congress for military and civil works missions. The USACE is a major Army command that provides engineering, design, and construction management services. The mission of the USACE is to "deliver vital public and military engineering services; partnering in peace and war to strengthen our nation's security, energize the economy and reduce risks from disasters." (USACE, 2020).

- **Arizona Department of Environmental Quality:** The ADEQ is headquartered in Phoenix, Arizona with a field office in Tucson, Arizona. Its mission is to "protect and enhance public health and the environment" (ADEQ, 2016). The ADEQ was created in 1987 under the Environmental Quality Act of 1986 as a cabinet-level environmental agency. Before ADEQ was formed, the state's environmental programs were managed by a number of offices within the Arizona Department of Health Services. The agency has three (3) main goals: support environmentally responsible economic growth, enhance Arizona's unique environment, and accelerate clean-ups.

1.6 INSTITUTIONAL ANALYSIS METHODOLOGY

As part of the IA, there are five (5) elements that are considered when assessing the ability of a local, county, or state agency, or landowner to assist in the implementation or monitoring of a proposed LUC program. These five (5) elements are:

- Jurisdiction – The jurisdiction is the territorial range of authority and is generally defined by geographic boundaries within the property, city, county, or state. Federal, state, and/or local government agencies may have jurisdiction within the area of a project site. The laws governing the existence of the specific agency will convey this jurisdiction. In some areas, several agencies may be involved, depending on the type of LUC or what specific aspect of a LUC is being contemplated. Private agencies do not usually have any jurisdictional authority.
- Authority – The authority of an institution is considered to be the nature and extent of controls available to the institution and the legal ability to enforce these controls in a given jurisdiction. For instance, a local government would have the authority to restrict activities that occur on private land through zoning or permitting, but has no authority to direct a land-owner to construct a fence and restrict access to a property. Alternatively, a land-owner could construct a fence to restrict access, but would require the authority of local law officials to enforce trespassing regulations. Key questions that must be asked regarding the authority exercised by a government agency are listed below. Private agencies usually do not have any enforcement authority other than those provided by normal trespass laws.
    - What are the limits of the agency's authority?
    - What is the origin of the agency's authority?
    - How much control is exercised by the agency?
    - Does the agency have enforcement authority?
- Mission – The specific mission of the agency is critical to its ability to implement, enforce, or maintain an institutional control program.
- Capability – Even if an agency has the jurisdiction, authority, and mission to be involved in a LUC program, if it does not have the capability, it cannot be an effective partner. In the case of local government agencies, the capabilities may be unique and are often a reflection of the desires of the local community. The capabilities of a government or private agency can be augmented; however, this may require additional funding.

- Desire – The desire of a particular government or private agency to participate in a LUC program is absolutely critical to its success. The effectiveness of LUCs is increased when local officials are convinced that participation in a LUC program is in their best interests. Resources in the form of funding for the agency's implementation costs may overcome the initial hesitancy to become involved.

These five (5) elements are considered for each identified stakeholder for the MRS in **Section 3.0**. A summary of LUC options that are available for the MRS is provided in **Section 2.0**.

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2.0 LAND USE CONTROLS

This section provides a summary of LUC options that are available for the NDNODS Kingman Range MRS. LUCs protect property owners and the public from potential hazards present at the MRS by warning of potential MEC hazards and/or limiting access to, or use of, the MRS. LUCs may include legal mechanisms, engineering controls, and educational controls. However, the effectiveness of LUCs depends on the support, involvement, and willingness of local agencies and landowners to enforce and maintain LUCs.

2.1 LEGAL MECHANISMS

Legal mechanisms limit or control the land use and/or activities that can occur on a property through actions such as deed restrictions, covenants, zoning, permits, and activity requirements/restrictions.

2.1.1 Deed Restriction (Public Benefit Conveyance)

A deed restriction is a type of LUC that may be used to prevent access, provide warnings via signage, or to restrict residential use, thereby preventing houses from being built at a site. Residents are thereby prevented from being exposed to contaminants or conditions deemed to be hazardous under the residential exposure scenario. There are no known deed restrictions on the Kingman Range MRS. The portion of the MRS that is under consideration for LUCs (the 8.14 acre area of investigation) is privately owned. Specific land use activities are not expected to change.

2.1.2 Environmental Covenants

The state of Arizona provides an additional option for LUCs and remedial actions on a property with environmental concerns through environmental covenants [Ariz. Rev. Stat. Ann. §49-152 and §49-158 (Association of State and Territorial Solid Waste Management Officials, 2015)]. An environmental covenant is a voluntary process, but once an environmental covenant is filed, it becomes a legally enforceable document. The environmental covenant would then define roles and responsibilities and financial obligations of the interested parties. An environmental covenant is filed with the property record and is in effect until all signing parties agree to withdraw the covenant.

The environmental covenant requires the governing agency providing regulatory oversight of the covenant to be defined. This agency is responsible for assuring that the LUCs remain protective. For environmental covenants on state-led sites in the State of Arizona, the governing agency would usually be the ADEQ. The environmental covenant is signed by the governing agency and the holders. The holders are the grantee(s) of the covenant and have supervisory responsibilities for enforcement and operational monitoring and maintenance of the long-term monitoring.

Holders are typically the property owner and/or operators, since they have the most interest in the property; however, third parties, and even other government agencies, could be named as holders. Administrative and legal costs would be incurred to prepare documents associated with filing the covenant, including the governing agency administration fees.

An environmental covenant is typically best suited to situations where remediation system operations or environmental media monitoring are required, or for sites requiring LUCs that have multiple parties, none of which have governmental authority. At this time, there are no remediation system operations or environmental media monitoring at the MRS, and it is privately owned by a single party.

2.1.3 Zoning

Zoning consists of land use or activity restrictions within a specified area as established by a governmental entity (usually a local government such as a municipality or county). The zoning requirements can specify the type of land use (i.e., rural, residential, business, etc.) and can provide specific requirements such as building sizes, setbacks, and street and parking provisions. Mohave County has the authority to create and enforce zoning requirements through Section II of Mohave County Ordinance No. 2015-07.

2.1.4 Dig Permit System

A dig permit system may be established similar to that of a building permit. A dig permit system could be set up to document who is completing the work and the size and purpose of the digging activity. The permit may require that workers review and sign off on information provided to them (see Educational Controls) on potential explosive hazards and/or MEC avoidance and encounter protocols.

Implementation of a dig permit system would require establishing an authority to administer and enforce the permits. A dig permit system would also require establishing rules on what types and sizes of digging activities would necessitate obtaining a permit. Costs for the dig permit system would include initial program setup and then annual administration.

No dig permit system is currently established for the MRS. Establishment of such a system would require coordination with the landowner and could affect ground disturbances.

2.1.5 Contractor Control Policies

Contractor control policies are written procedures that dictate how contractors working at a site with LUCs will be trained and monitored. They are generally site-specific and tailored to the potential hazards, as well as the ability of the landowners/governing authorities to perform the monitoring.

At this time, there are no control policies in place to inform contractors working on the MRS of security procedures and protocols.

2.1.6 Construction Support

In the event that intrusive activities are planned, either on-site or on-call construction support may be provided. For sites where, based on a search of available historical records or on-site investigation data, it has been determined that there is a moderate to high probability that MEC is present, on-site construction support by Explosives and Ordnance Disposal (EOD)- or unexploded ordnance (UXO)-qualified personnel is required. These personnel must attempt to identify and remove any explosive hazards in the construction footprint prior to any intrusive construction activities (DoD, 2010). On-call construction support is utilized for sites that have been determined to have a low probability of encountering MEC. On-call construction support does not require EOD- or UXO-qualified personnel to be present during intrusive activities, but rather the construction workers are provided recognition training for military munitions items and are to contact EOD- or UXO-qualified personnel in the event that a suspected MEC item is identified.

On-call construction support has not been utilized to date at the MRS. However, the City of Kingman Explosives Disposal Team (via local law enforcement) provides munitions-related support on an as-needed basis for munitions items encountered at the site during non-construction activities. If an anomaly or potential munitions item is identified by the private landowner or members of the public, local law enforcement is notified and the City of Kingman Explosives Disposal Team is then contacted to determine a response by military EOD. These personnel are EOD- and/or UXO-qualified personnel and perform all activities required to manage and dispose of the item. Munitions-related support is expected to continue using the same process.

2.2 ENGINEERING CONTROLS

Engineering controls are physical structures to warn or prevent access to the site. The most probable structures for the MRS are fencing, signage, and land covers.

2.2.1 Fencing

Fences are used to restrict public access to a site that contains a potential public hazard. Fences are considered in areas where MEC is present and where public access would result in potential exposures. Fences require inspection, maintenance, and repair in order to remain effective.

There is currently no fencing around the Kingman Range MRS for purposes of LUCs. Adding fencing would reduce access to the MRS, however, the area is privately owned and the landowner would need to agree to fencing.

2.2.2 Warning Signs

Warning signs can be used to notify and inform the public of a potential hazard on a site. Such signs should state the nature of the MEC hazard, how to avoid the hazard, and who to contact for additional information. Warning signs may be mounted on existing fencing or posts, or may be used where fencing is not an option.

There are currently no signs located near the Kingman Range MRS warning the public of potential MEC hazards or buried explosives hazards and what to do if an item is encountered. It is recommended that signs be placed on the outer boundaries of the MRS and at access points to the MRS to warn and remind the public of the potential dangers.

2.2.3 Physical Barriers to Access

Physical barriers, such as pavement, engineered covers, or other types of structures, provide a layer of protection to minimize exposure to potential MEC. No physical barriers are present that would minimize exposure to potential MEC at the MRS. The landowner would have to agree to any physical barriers prior to placement.

2.3 EDUCATIONAL CONTROLS

The use of educational programs is an effective means to reduce risk from public exposure to MEC. Education activities can be tailored to meet specific needs on the MRS. Examples of educational programs include public notices, management plans, and formal education sessions. Educating the local community is an important aspect of any institutional control program. Public awareness of the hazards associated with a site will encourage the public to take the necessary precautions to avoid exposure. Educational programs may be audience-specific and can be performed as often as necessary to educate those with the greatest risk for exposure to MEC (e.g., local homeowners, individuals, and users of a public area). Educational efforts can be a stand-alone institutional control, but can also improve the effectiveness of other controls.

2.3.1 Public Notices

The local community can be educated through implementation of a public-notice campaign that may include mailings of informational pamphlets, installation of display cases, public service announcements, or recurrent notices in local newspapers. These educational media can serve to educate the local community and visitors to the area. The following paragraphs provide details concerning various types of public notices that can be used to educate and inform local communities. Maintaining a website or telephone hotline would also be effective in public notification.

2.3.1.1 Management Plans

Management plans are intended to prevent inadvertent exposure of receptors by identifying how residual contamination should be handled. Management plan requirements may be recorded in a deed restriction.

2.3.1.2 Community Awareness Meetings

Community awareness meetings are normally held when significant site remediation documents are released to the public and provide information regarding:

- How this information was evaluated in the RI and FS reports;
- MEC previously recovered at the site;
- Options available to remove MEC (if required) and enhance public safety; and
- Recommendations being made to address a particular site.

2.3.1.3 Letter Notifications, Informational Pamphlets, and Fact Sheets

Letter notifications (U.S. certified mail) are an effective means of informing property owners of the results of the RI and FS investigations and the types of MEC that have been found. Letter notifications can be mailed to each landowner/resident within or adjacent to a MEC site to inform them of the investigation results and the proposed recommendations for the area. Informational pamphlets and fact sheets can be developed and distributed to support safety briefings and/or speaking engagements and can be effective as stand-alone educational materials. Informational pamphlets and fact sheets can warn the public of the hazards of MEC and provide information relating to the former military operations that occurred at a site. Informational pamphlets and fact sheets can be mailed to residents in the vicinity of a MEC site, or they can be distributed from central locations in the City of Kingman, such as libraries, or posted at strategic locations (e.g., U.S. Post Office), or included at parking areas and access points to the MRS. Effective pamphlets or fact sheets contain photographs and/or drawings of typical MEC items that the public might encounter and previously recovered MEC locations on a map, and the expected response/safety guidance. A telephone number for the appropriate local authority should be included in the informational pamphlet or fact sheet. Informational pamphlets could be revised and distributed on a regular basis.

2.3.1.4 Formal Education Sessions

Formal education sessions may include community education classes. The classes can be given to a variety of audiences including public forums, local government, emergency response personnel, property owners, developers and real estate agents, and children at the local schools. The training sessions can be tailored to meet the specific interests/concerns of the audience, and can be an effective method to communicate the nature and extent of the hazards associated with MEC and the precautions to be taken in the event a person comes into contact with MEC.

The training sessions may either be provided live by personnel knowledgeable in the site-specific conditions or through the distribution of MEC safety awareness training pamphlets or videos to local organizations and public libraries. Recurrent educational sessions are more effective at ensuring that the public does not become complacent about the hazards associated with MEC. Formal education sessions that are consistently performed are also successful in educating new homeowners and visitors to the area.

2.3.1.5 Website

A publicly accessible website could be developed and maintained to keep the public informed by providing general project information, activities, and progress updates. This website could include a schedule of activities, including when open houses will be held, notices of upcoming site activities, maps to inform the public of effected areas, copies of news releases, contact information, and a page devoted to MEC safety which includes the DoD 3Rs concept (Recognize, Retreat, Report).

3.0 INSTITUTIONAL SUMMARIES

Each institution selected for analysis in **Section 1.5** and its jurisdiction, authority, mission, and potential role in a LUC program is briefly discussed below. Specific information regarding each institution is provided in **Tables 3-1** through **3-4**.

3.1 ARIZONA ARMY NATIONAL GUARD

The AZARNG has no jurisdiction as the Kingman Range MRS is located on private property. However, under the MMRP process, the Army National Guard would remain the responsible party for the LUCs and cleanup should the RI/FS document a release that requires response actions.

The AZARNG's role in a LUC program would be in agreeing to assist the Army National Guard with annual LUC inspections (if necessary). Basic information for AZARNG is summarized in **Table 3-1**.

3.2 ARMY NATIONAL GUARD DIRECTORATE

The ARNG-D has no jurisdiction as the Kingman Range MRS is located on private property. The ARNG-D's role in a LUC program would be in working with USACE, ADEQ, AZARNG, and the landowner, and funding LUCs on the MRS. Basic information for ARNG-D is summarized in **Table 3-2**.

3.3 UNITED STATES ARMY CORPS OF ENGINEERS

The USACE has no jurisdiction as the Kingman Range MRS is located on private property. The agency does have authority under DERP to implement response actions for releases of hazardous substances from facilities that are or were under the jurisdiction of the U.S. DoD. Basic information for the USACE is summarized in **Table 3-3**.

3.4 ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

The ADEQ does have jurisdiction in the state of Arizona regarding the protection of public health and the environment. The ADEQ is primarily a regulatory agency with a diverse range of environmental regulatory, monitoring and compliance programs. Basic information for the ADEQ is summarized in **Table 3-4**.

Table 3-1
Arizona Army National Guard Institutional Analysis

Origin of Institution	AZARNG was established in 1930. AZARNG (a division of the Arizona Department of Emergency and Military Affairs) manages a joint federal-state program that keeps readiness trained and equipped military organizations for the Governor in the event of a state emergency and the President in the event of a national emergency.
Geographic Jurisdiction	The agency has no geographic jurisdiction over the Kingman Range MRS which is located on privately owned property.
Basis of Authority	**What are the limits of the agency's authority?** Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DoD in accordance with DERP and CERCLA.
	Origin of Authority: The U.S. Army is the origin of authority for the AZARNG; however the Kingman Range MRS is located on privately owned land. Under the MMRP process, the Department of the Army would remain the responsible party for the cleanup should the RI/FS document a release that requires cleanup in the future. DERP [USC. Section 2701 et seq.] Executive Order 12580 / Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DoD, in accordance with DERP and consistent with CERCLA.
	How Much Control is Exercised by the Agency? AZARNG has minimal control relative to implementing, maintaining, monitoring, or enforcing institutional controls on property they do not own.
	Does the agency have enforcement authority? AZARNG does not have enforcement authority related to institutional controls at Kingman Range MRS.
Sunset Provisions	None.
Public Safety Function	AZARNG's mission is to provide ready organizations and individuals to perform state and federal missions, globally and domestically.
Land Use Control Function	The MRS is located on private property zoned for residential use. The potential future land use would be consistent with current use for the MRS.
Financial Capability	The AZARNG is a fiscally responsible agency which receives Federal funding.
Desire to Participate	Yes. The AZARNG has the resolve to assist ARNG with annual LUC inspections, if necessary.
Constraints to Institutional Effectiveness	The MRS is located on privately owned property, and the landowner has the authority to choose to allow ARNG to implement and maintain LUCs.

Table 3-2
Army National Guard - Directorate Institutional Analysis

Origin of Institution	The Army National Guard, in the form of various state militias, dates back to the early 1600s. The National Guard is a unique element of the U.S. military that serves both community and country. The Guard responds to domestic emergencies, overseas combat missions, counterdrug efforts, reconstruction missions and more. (National Guard, 2016).
Geographic Jurisdiction	The agency has no geographic jurisdiction over the Kingman Range MRS which is located on privately owned property.
Basis of Authority	**What are the limits of the agency's authority?** Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DoD in accordance with DERP and CERCLA.
	Origin of authority: The U.S. Army is the origin of authority for the ARNG-D; however the Kingman Range MRS is located on privately owned land. Under the MMRP process, the Department of the Army would remain the responsible party for the cleanup should the RI/FS document a release that requires cleanup in the future. DERP [USC. Section 2701 et seq.] Executive Order 12580 / Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DoD, in accordance with DERP and consistent with CERCLA.
	How much control is exercised by the agency? ARNG-D has minimal control relative to implementing, maintaining, monitoring, or enforcing institutional controls on property they do not own.
	Does the agency have enforcement authority? ARNG-D does not have enforcement authority related to institutional controls at Kingman Range MRS.
Public Safety Function	ARNG-D's mission is to provide trained and equipped soldiers and airmen to protect life and property, and to preserve peace, order and public safety when called upon by the Governor.
Land Use Control Function	The MRS is located on private property zoned for residential use. The potential future land use would be consistent with current use for the MRS.
Financial Capability	The ARNG-D is a fiscally responsible agency which receives Federal funding.
Desire to Participate	Yes. The ARNG-D has the resolve to implement institutional controls as evidenced by this RI/FS and related activities.
Constraints to Institutional Effectiveness	The MRS is located on privately owned property, and the landowner has the authority to choose to allow ARNG to implement and maintain LUCs.

Table 3-3
United States Army Corps of Engineers Institutional Analysis

Origin of Institution	The USACE was established in 1775 under the Continental Congress for military and civil works missions.
Geographic Jurisdiction	The USACE is organized geographically into nine divisions in the U.S. and 45 subordinate districts throughout the U.S., Asia, and Europe. The districts oversee project offices throughout the world. Divisions and districts are defined by watershed boundaries, not by states. However, the USACE has no geographic jurisdiction over the MRS as it is located on privately owned property.
Basis of Authority	**What are the limits of the agency's authority?** Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DoD in accordance with DERP and CERCLA.
	Origin of Authority: DERP [USC. Section 2701 et seq.] Executive Order 12580 / Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the DOD in accordance with DERP and consistent with CERCLA.
	How Much Control is Exercised by the Agency? USACE has minimal control relative to implementing, maintaining, monitoring, or enforcing institutional controls on privately owned property.
	Does the agency have enforcement authority? USACE does not have enforcement authority related to institutional controls at Kingman Range MRS.
Sunset Provisions	None.
Public Safety Function	Not Applicable.
Land Use Controls	The MRS is located on private property zoned for residential use. The potential future land use would be consistent with current use for the MRS.
Financial Capability	The USACE is a fiscally responsible agency which receives Federal funding.
Desire to Participate	USACE have resolve to implement institutional controls as evidenced by this RI/FS and related activities. However, funding and oversite of institutional controls will be completed by ARNG.
Constraints to Institutional Effectiveness	The MRS is located on privately owned property, and the landowner has the authority to choose to allow ARNG to implement and maintain LUCs.

Table 3-4
Arizona Department of Environmental Quality Institutional Analysis

Origin of Institution	Under the Environmental Quality Act of 1986, the Arizona State Legislature created ADEQ in 1987 as the state's cabinet-level environmental agency.
Basis of Authority	**What are the limits of the agency's authority?** The ADEQ has the authority under Arizona law to enforce environmental regulations and is composed of three environmental programs: Air Quality, Water Quality and Waste.
	Origin of authority: Statutory authority for ADEQ comes from Arizona Administrative Code, Title 18. Other applicable rules: Title 49 (Arizona Revised Statutes), Title 45 (Water), Title 44 (Trade and Commerce), Title 41 (rule making process), Title 28 (Transportation) NRS 232.136, 444, 444A, 445A, 445B, 445C, 459, 486A, 519A, 590, and 704
	How much control is exercised by the agency? The ADEQ does have control regarding implementing, maintaining, monitoring, or enforcing institutional controls related to public and environmental health on the Kingman Range MRS.
	Does the agency have enforcement authority? The ADEQ is the regulatory, enforcement and permitting authority for the EPA in the state of Arizona for the Clean Air Act, the Clean Water Act, and Resource Conservation and Recovery Act.
Sunset Provisions	None.
Geographic Jurisdiction	The ADEQ has jurisdiction within the State of Arizona.
Public Safety Function	ADEQ enforces state environmental quality rules and regulations.
Land Use Controls	The MRS is located on private property zoned for residential use. The potential future land use would be consistent with current use for the MRS.
Financial Capability	ADEQ receives its budget through the state legislature from state taxes and some federal funding.
Desire to Participate	ADEQ has resolve to implement institutional controls as evidenced by this RI/FS and related activities. However, funding and oversite of institutional controls will be completed by ARNG.
Constraints to Institutional Effectiveness	The MRS is located on privately owned property, and the landowner has the authority to choose to allow ARNG to implement and maintain LUCs.

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4.0 EVALUATION OF EXISTING AND RECOMMENDATION FOR ADDITIONAL INSTITUTIONAL CONTROLS

The future land use of the MRS is expected to remain the same as current land use. Current land use for the MRS is as privately owned, undeveloped land zoned for residential use. This section provides an evaluation of existing controls and recommendations for additional controls that would apply to current and future MRS land use (see **Section 2.0**) using the institutional information presented in **Section 3.0**.

4.1 EVALUATION OF EXISTING CONTROLS

LUCs already in place or that have been used during the implementation of the RI/FS at the MRS include:

- Educational Controls:
  - Public Notices, and
  - Letter Notifications, Informational Pamphlets, and Fact Sheets.

No engineering controls currently exist at the Kingman Range MRS. There are no measures to notify future trespassers, guests of the private property owner, or contractors/maintenance workers of the private property owner performing intrusive actions of potential explosive hazards and there is a lack of measures to provide information on anomaly avoidance/encounter protocols.

Educational controls such as public notices were distributed during the RI/FS. These notices informed the public of upcoming activities and provided contact information. No public meetings were held during the RI/FS.

The current controls lack measures to notify future contractors/maintenance workers or other users performing intrusive actions of potential explosive hazards and lack measures to provide information on anomaly avoidance/encounter protocols.

4.2 RECOMMENDATIONS FOR ADDITIONAL CONTROLS

Recommended institutional controls to be retained for development of remedial action alternatives are:

- Engineering Controls:
  - Fencing; and,
  - Warning Signs.
- Educational Controls:
  - Public Notices, and
  - Fact Sheets.
- Long-term monitoring.

Fencing would serve as an engineering control that would restrict public access thereby limiting exposure to potential MEC on the MRS. Fencing would be required surrounding the entire 8.14-acre MRS in order to be effective. Fencing would require inspection, maintenance, and repair in order to remain effective.

Warning signs would serve as engineering controls for educating those accessing the MRS property (both with and without landowner permission) of the potential MEC hazards at the Kingman Range MRS. Warning signs would also serve as educational controls for educating the public of the potential MEC hazards at the MRS.

Fact sheets are recommended for distribution at key times during any MRS remediation activities. In addition, fact sheets are recommended for distribution to public officials, emergency management agencies, and the private landowner notifying land users of potential MEC.

The roles, responsibilities, and authorities that each organization would have in implementing, maintaining, monitoring, and enforcing institutional controls are provided in **Table 4-1**. Long-term implementation of institutional controls would be the responsibility of the AZARNG/ARNG-D.

Table 4-1
Roles, Responsibilities and Authorities for Implementation of Institutional Controls

Agency	Role	Responsibility	Authority
AZARNG	Assist ARNG, if necessary, in implementation and annual inspections of LUCs.		
ARNG-D, USACE	Represents federal government in execution, oversight, and procurement of munitions response actions at the Kingman Range MRS.	▪ Initiate memorandum of agreement, if necessary in the future. ▪ Inspect condition of signage. ▪ Report new discoveries of MEC to agency capable of appropriate management. ▪ Disseminate information ▪ Brief landowners on ongoing effectiveness of institutional controls.	▪ Fund MEC response actions. ▪ Perform MEC investigations and munitions response actions.
ADEQ	Represent respective State and Federal government agencies conducting regulatory oversight of munitions response actions at Kingman Range MRS.	▪ Permit, report, variance and application review ▪ Participate in public meetings ▪ Interact with landowner	▪ Concurrence authority on Decision Documents ▪ Enforcement of environmental laws.

5.0 REFERENCES

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APPENDIX D

REMEDIAL INVESTIGATION DAILY REPORTS

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Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Wednesday 10/11/2017 0830 – 1130

WEATHER/TEMPERATURE: Sunny, Lows 55°F / High 83°F

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☐ NONE ☒ surveyor ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Mike Link (WESTON) – Geophysicist – 3 hrs on site, (7 hours travel time to and from Tempe AZ)

Surveyor subcontractor : Shephard – Wesnitzer, Inc. 3 hrs on site

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Mike met the surveyor on site to install 2 control points outside the MRS boundary but with the parcel with the approved right of entry. The two control points were named "KING BASE" and "KING CHK". "KING BASE" is a cotton picker spindle and aluminum tag stamped RLS 27253 in a rock outcrop at the top of the saddle between the two peaks that are the focus of this project. "KING CHK" is a ½" rebar with an aluminum cap stamped RLS 27253 at the bottom of the hill near the edge of the west dirt road and will serve as the secondary control point.

Two hours of observations were obtained between each control point.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

none

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

none

SCHEDULED WORK FOR THE DAY

Installation of 2 control points outside the MRS boundary.

TO DO LIST FOR CLIENT:

No action at this time.

Photo1: Setting up at Kingman Base control point.

Photo 2: Final Kingman Base control point.

Photo 3: Establishing Kingman QC check control point.

Photo 4: Final Kingman QC check point.

PREPARED BY:

Tracy Lestochi

SIGNATURE: Tracy E Lestochi

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Sunday 10/15/2017 0600 – 19:30 Mob Day

WEATHER/TEMPERATURE: Sunny, Lows 55°F / High 83°F

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Tracy Lestochi (WESTON) – Site lead/SSHO – 0 hrs on site, 8 hrs MOB from PA to Kingman AZ
Mike Link (WESTON) – Geophysicist – 0 hrs on site, 6 hrs MOB from Kayenta AZ to Tempe AZ to pick up equipment to Kingman
Scott Kirk (WESTON) – UXO Escort – 0 hrs, 8 hrs MOB from PA to Kingman AZ

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Field team mobilized to Kingman AZ, collected necessary field equipment and supplies.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

DGM data collection and soil sampling.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

none

SCHEDULED WORK FOR THE DAY

Mob to Kingman AZ will all necessary field equipment and supplies.

TO DO LIST FOR CLIENT:

No action at this time.

PREPARED BY:	SIGNATURE:
Tracy Lestochi	Tracy Lestochi

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Monday 10/16/2017 0700 – 1700

WEATHER/TEMPERATURE: Sunny, Lows 40°F / High 85°F

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL:

Tracy Lestochi (WESTON) – Site lead/SSHO – 9.5 hrs
Mike Link (WESTON) – Geophysicist– 9.5 hrs
Scott Kirk (WESTON) – UXO Escort– 9.5 hrs

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Set up base station, installed the IVS and background lane. Ran QC check for EM61and the whites all metal detector.

The location of the incremental background sampling decision unit (DU) was acquired using the Trimble GPS, however the majority fell in an area covered with large boulders. An alternate location up-gradient of the MRS was laid out based on the availability of soil. One incremental sample consisting of 30 increments and 2 replicates were collected for background analysis.

Site visitors: Kim Birdsall onsite 4:20pm – offsite 5:00 pm. Prior to Kim's arrival two people walking by stopped to inquire about activities. They were not hostile, however, one requested a business card and AZ guard contact phone number. We provided Kim Birdsall's contact information.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

DGM data collection and soil sampling.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

Location depicted on map where background sample were to be collected was an area of large boulders. Adjusted the location based on accessible soil up-gradient of the MRS.

Cooler delivery from Test American scheduled to arrive this morning is not going to arrive until tomorrow. Will purchase a temporary cooler to store the collected samples.

SCHEDULED WORK FOR THE DAY

Install IVS and perform QC check. Collect background samples and begin collecting DGM transects.

TO DO LIST FOR CLIENT:

No action at this time.

PHOTOS:

Photo 1 – Location shown on map for back ground sampling.

Photo 2 – Adjacent area sampled for background. Looking south west.

Photo 3 – Typical soil.

Photo 4 – Setting up base station.

Photo 5 – Static IVS QC (static spike).

Photo 6 – Performing QC check on the IVS.

PREPARED BY:

Tracy Lestochi

SIGNATURE: Tracy Lestochi

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Tuesday 10/17/2017 0700 – 1500

WEATHER/TEMPERATURE: Sunny, Lows 55°F / High 88°F

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Tracy Lestochi (WESTON) – Site lead/SSHO – 8 hrs
Mike Link (WESTON) – Geophysicist – 8 hrs
Scott Kirk (WESTON) – UXO Escort – 8 hrs

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Performed DGM collection activities with UXO escort.

No issues with DGM data collection sporadic large vegetation and large boulders were located throughout the MRS. The most eastern transect Transects A_06 on top of the escarpment was very rocky and rugged See photos below. All DGM data collection was completed today.

The location of the surface soil incremental sampling decision units (DU) were acquired using the Trimble GPS. One large pile and 1 small pile of construction debris and non-native soil extended across the two eastern DUs. The extent was larger than anticipated based on aerial photo graphs. With consultation with Kim Birdsall, the boundary of the 2 DUs were adjusted so that DU1 was the native soil and DU2 was the obviously non-native soil. The total acreage of the 2 DUs remained the same, however they were determined based on soil type. The boundary of the non-native soil was GPS-ed using an RTK system. One incremental sample consisting of 30 increments and 2 replicates were collected from DU1 – native soil, one incremental sample consisting of 30 increments was taken from DU2- non-native soil.

Site visitors: Kim Birdsall onsite 7:00 am – offsite 9:45 am.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

DGM data collection and soil sampling.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

A large amount of non-native soil and construction debris located across 2 planned DUs for sampling. Adjusted DUs to sample based on soil type.

SCHEDULED WORK FOR THE DAY

DGM data collection and processing. Incremental surface soil sampling.

TO DO LIST FOR CLIENT:

No action at this time.

PHOTOS:

Photo 1 – Static background test.

Photo 2 – Placing seed for static spike test.

Photo 3 – Post-data collections IVS survey (seeded path).

Photo 4 – QC Seed placement – 4inch bgs.

Photo 5 – Typical DGM data collection along transect, UXO Tech II, RTK GPS navigation and DGM data collection .

Photo 6 – DGM data collection on top of the escarpment.

Photo 7 – DGM data collection along transect A_06, heading east. Rugged and rocky.

Photo 8 – Looking east across the MRS.

Photo 9 – Typical large vegetation found throughout the MRS.

Photo 10 – Typical boulders found across the northern portion of the MRS.

Photo 11 – Construction debris and non-native soil.

Photo 12 – Native soil sampled as DU1.

 Photo 13 – Sampling non-native soil as DU2.	 Photo 14 – Recording the boundary of non-native soil with GPS.
PREPARED BY: Tracy Lestochi	**SIGNATURE:**

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Wednesday 10/18/2017 0800 – 1600

WEATHER/TEMPERATURE: Sunny, Lows 55°F / High 83°F

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Tracy Lestochi (WESTON) – Site lead/SSHO – 8 hrs
Mike Link (WESTON) – Geophysicist – 5 hrs
Scott Kirk (WESTON) – UXO Escort – 8 hrs

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Field team review DGM processed data and break down equipment. Survey the site to clean up any pin flags or survey stakes. Prepare chain of custody, package and ship samples to the lab. Replace equipment and supplies.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

Data processing, sample processing and shipping. Review GPS data to ensure no data gaps. Break down equipment to demob.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

none

SCHEDULED WORK FOR THE DAY

Complete all remaining activities, review data to ensure no data gaps and prepare to demob.

TO DO LIST FOR CLIENT:

No action at this time.

PREPARED BY:	SIGNATURE:
Tracy Lestochi	Tracy E Lestochi

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Sunday, 15 July 2018; 0630 – 1430 hours

WEATHER/TEMPERATURE:

Partly Cloudy; 74º to 95º F; 53% Humidity; 0.01 inches Precipitation; 13 mph (SE) wind speed.

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Anthony Rodriguez (WESTON) – Site Manager/Geoscientist – 6 hours mobilization, 2 hours onsite.
Brian Grassmyer (WESTON) – SUXOS – 8 hours mobilization.
Robert Prosperi (WESTON) – UXOQCS/UXOSO – 8 hours mobilization.
Chuck Aquilina (WESTON) – UXO Technician III – 8 hours mobilization.
Lloyd Jones (WESTON) – UXO Technician II – 8 hours mobilization.
David Arguello (WESTON) – UXO Technician II – 8 hours mobilization.

Mobilization Hours: 48
Total Daily On Site Hours: 2
Total Project On Site Hours: 2
Demobilization Hours: 0

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

All project personnel mobilize to Kingman, AZ via POV, as well as, via air plane and rental vehicles.

1000 to 1200 hours: WESTON personnel (A. Rodriguez) onsite to meet with residents along Ross Avenue/Darren Drive at six (6) properties and handed out 72-hour notifications for voluntary evacuation as part of the Evacuation Plan. Twenty-three DGM targets have an exclusion zone that intersect at least one nearby residential property. Voluntary evacuations requested on Wednesday, 18 July 2018 from 0900 to 1600 hours.

3150 Ross Ave. (Parcel No. 311-23-035): Spoke with the resident and provided 72-hour notification. Additional correspondence needed to ensure all tenants of the property are able to vacate.

2275 Darren Dr. (Parcel No. 311-23-034): Spoke with the resident and provided 72-hour notification. Tenants will be at work during the requested evacuation date and time frame.

2235 Darren Dr. (Parcel No. 311-23-033): Property is vacate and for sale. Spoke with posted real estate agent to notify of planned activities and to provide a contact number should a showing be scheduled on the requested evacuation date.

2195 Darren Dr. (Parcel No. 311-23-032): Spoke with the resident and provided 72-hour notification. Tenants will be at work during the requested evacuation date and time frame.

2145 Darren Dr. (Parcel No. 311-23-031): Resident was not present. 72-hour notification was left in the mailbox since front yard gate was locked. Previous contact made on 15 June 2018 during the one month notification, the resident had no concerns.

2105 Darren Dr. (Parcel No. 311-23-030): Spoke with the resident and provided 72-hour notification. Tenant works from home so they are willing to depart the property either in the AM or PM. Tenant to notify project personnel of intended vacated time frame upon receipt of the 24-hour notification.

1200 to 1400 hours: WESTON personnel (A. Rodriguez) purchase expendable site supplies from local venders.

QUALITY CONTROL:

None.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*
Field activities will begin on Monday, 16 July 2018. Planned activities include site kickoff orientation and safety briefs, reacquisition of DGM targets (58) using RTK GPS, intrusive investigation of DGM and analog targets with data collection, demolition activities (if needed), and MDAS certification and T&D.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*
None.

SCHEDULED WORK FOR THE FOLLOWING DAY (Monday, 16 July 2018)
Field personnel will receive site kickoff orientation and project briefs in accordance with the UFP-QAPP. Delivery of a project storage container and portable toilet are scheduled for delivery. Project personnel will set up the site for field activities, including, set up of the RTK GPS base station and rover, equipment checks, reacquisition and flagging of DGM targets, and intrusive investigations.

TO DO LIST FOR CLIENT:
No action at this time.

PREPARED BY:	
Anthony Rodriguez, P.G.	**SIGNATURE:**

PHOTOS:

Photo 1 – Overview of DGM targets area near the location of the surveyed base station control point.

Photo 2 – Arizona 811 notification utility markings at Ross Ave. and Darren Dr. intersection.

SIGNATURE:

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Monday, 16 July 2018; 0700 – 1600 hours

WEATHER/TEMPERATURE:

Partly Cloudy; 75º to 95º F; 17% Humidity; 0.00 inches Precipitation; 7 mph (SE) wind speed.

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Anthony Rodriguez (WESTON) – Site Manager/Geoscientist – 10 hours.
Brian Grassmyer (WESTON) – SUXOS – 10 hours.
Robert Prosperi (WESTON) – UXOQCS/UXOSO – 10 hours.
Chuck Aquilina (WESTON) – UXO Technician III – 9 hours.
Lloyd Jones (WESTON) – UXO Technician II – 9 hours.
David Arguello (WESTON) – UXO Technician II – 9 hours.

Mobilization Hours: 48
Total Daily Hours: 57
Total Project Hours: 59
Demobilization Hours: 0

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

0700 to 1000 hours: WESTON personnel (A. Rodriguez, B. Grassmyer, R. Prosperi, C. Aquilina, L. Jones, and D. Arguello) meet to attend the project kick-off meeting. Discuss the UFP- QAPP, SSHP/APP, Site History, Project Objectives, Hazard Communication Program, ESP, Quality Control, EPP, Site Security, Evacuation Plan, and Communication Plan. Project personnel sign the SSHP/APP. All Activity Hazard Analysis (AHA) forms were reviewed and signed by personnel.

0750 hours: WESTON personnel (A. Rodriguez) arrive on site to accept delivery of a storage container and portable toilet.

0805 to 0830 hours: Echo Storage Options deliver an 8 ft. wide by 20 ft. long storage container, placed just north of the investigation area outside of the MRS boundary.

0945 to 0950 hours: Kingman Portable toilets deliver one standard portable toilet to the site and placed adjacent to the storage container.

0950 to 1000 hours: Kingman Police Officer (Ms. Ashley Walker, 928-753-2191) arrives onsite due to a resident calling 911 of suspicious activity in the neighborhood. WESTON personnel (A. Rodriguez) discuss field activities with the Police Officer and provide contact information for project team members from the USACE, ARNG, and WESTON PM.

1000 to 1300 hours: UXO Technician personnel onsite and prepare for field activities, including, placing field gear and supplies into storage container, assemblage of White's MXT All Metal Detectors (3), operations check of White's at instrument test strip, operational review of Trimble Geo7x GPS units,

1040 to 1110 hours: WESTON personnel (A. Rodriguez) depart site for hotel to pick up shipment of Trimble R10 RTK GPS system.

1110 to 1410 hours: WESTON personnel (A. Rodriguez and C. Aquilina) set up Trimble RTK GPS system at professionally surveyed and installed control point (KINGBASE). Technical issues preventing base receiver start up were trouble shot with support from instrument provider Western Data Systems. At 1410 hours, system is operational and quality control check performed using stakeout of professionally surveyed and installed control point (KING CHK).

1300 to 1545 hours: UXO Technician personnel conduct analog surveys and intrusive investigation of proposed analog transects (AT-01 through AT-06) investigated as a five (5) feet wide transect using White's MXT All Metal Detectors and Trimble Geo7X GPS units equipped with UXO Respond Fast data collector program. Analog transect summary: AT-01 (2 digs & 1 Blind Seed recovered), AT-02 (1 dig & 1 Blind Seed recovered), AT-03 (1 dig), AT-04 (1 dig), AT-05 (1 dig), AT-06 (0 digs), resulting in approximately 1,300 ft. surveyed (100% completed). The UXO Team documented four (4) locations of MD items. Findings included an expended M22 Rifle Grenade, Smoke; 3.5 inch M29 Practice Rocket, tail fins; 3.5 inch M29 Practice Rocket, fin shroud; and 3.5 inch M29 Practice Rocket, nose cone.

1545 to 1600 hours: UXO Dig team return to the site storage container to sort MD recovered. Trimble RTK GPS system taken down.

Onsite storage container secured. End of daily field activities.

Munitions: Items Recovered Today (Project Totals)
MEC/MPPEH: None
MD: 4 lbs. (4 lbs.)
NMRD: 0 lbs. (0 lbs.)

QUALITY CONTROL:
UXOQCS/UXOSO review UFP-QAPP and brief project personnel. Topic's covered included SSHP/ APP/ AHA's/ ESP/ Definable features of work. UXOQCS/UXOSO held Daily H&S Tailgate Meeting. All field personnel reported fit for daily activities. Observed daily activity operations. All personnel are working in accordance with the UFP-QAPP, wearing proper PPE, and working in a safe manner. Two QC seeds were found during analog surveys and approximately 4 pounds of MD was recovered. Transects AT-01 and AT-02 passed QC. MD recovered was inspected, determined to be MDAS, and stored in the onsite storage container. No discrepancies noted. See daily DQCR.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*
Reacquisition of DGM targets (58) using RTK GPS, intrusive investigation of DGM targets with data collection, demolition activities (if needed), and MDAS certification and T&D.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*
Rental Trimble RTK GPS system start up issues were trouble shot with Western Data System technical support. System was operational upon completion of trouble shooting.

SCHEDULED WORK FOR THE FOLLOWING DAY (Tuesday, 17 July 2018)
Project personnel will set up the site for field activities, including, set up of the RTK GPS base station and rover, equipment checks, reacquisition and flagging of DGM targets, and intrusive investigations of DGM targets with an exclusion zone not intersecting nearby residents.

TO DO LIST FOR CLIENT:
No action at this time.

PREPARED BY:	
Anthony Rodriguez, P.G.	**SIGNATURE:**

PHOTOS:

Photo 1 – Delivery of a storage container by Echo Storage Options.

Photo 2 – Delivery and placement of a portable toilet.

Photo 2 – Set up of Trimble RTK GPS system at control point KINGBASE.

Photo 2 – Summary of MD encountered during analog surveys, including M22 Rifle Grenade Smoke and 3.5 inch M29 Practice Rocket components (nose cone, fin shroud, and fins).

SIGNATURE:

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Tuesday, 17 July 2018; 0700 – 1600 hours

WEATHER/TEMPERATURE:

Partly Cloudy, Isolated Thunderstorms; 77º to 97º F; 64% Humidity; 0.00 inches Precipitation; 4 mph (SE) wind speed.

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Anthony Rodriguez (WESTON) – Site Manager/Geoscientist – 10 hours.
Brian Grassmyer (WESTON) – SUXOS – 10 hours.
Robert Prosperi (WESTON) – UXOQCS/UXOSO – 10 hours.
Chuck Aquilina (WESTON) – UXO Technician III – 9 hours.
Lloyd Jones (WESTON) – UXO Technician II – 9 hours.
David Arguello (WESTON) – UXO Technician II – 9 hours.

Mobilization Hours: 48
Total Daily Hours: 57
Total Project Hours: 116
Demobilization Hours: 0

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

0700 to 0715 hours: WESTON UXOQCS/UXOSO (R. Prosperi) holds Daily Safety Tailgate Meeting with B. Grassmyer, C. Aquilina, L. Jones, D. Arguello, and A. Rodriguez present. Discuss general health and safety, physical/chemical/biological hazards, scheduled daily tasks, and UXO discussion of encountered/expected munitions items onsite.

0715 to 0725 hours: UXO Field crew set up the Trimble RTK GPS Base Station at control point (KINGBASE) and prepare for daily activities including DGM target location reacquisition and intrusive investigation activities. UXO Techs conduct system QC checks of Trimble RTK GPS system using a control point (KING CHK) and White's metal detectors at the IVS strip.

0725 to 0925 hours: UXO Field crew perform DGM target location reacquire activities using the Trimble RTK GPS rover. The UXO Team flags DGM targets whose exclusion zone does not impact nearby residents.

0800 to 0900 hours: WESTON personnel (A. Rodriguez) attempts to meet with residents along Ross Avenue/Darren Drive at six (6) properties and hands out 24-hour notifications for voluntary evacuation as part of the Evacuation Plan. Twenty-three (23) DGM targets have an exclusion zone that intersect at least one nearby residential property. Voluntary evacuations are requested on Wednesday, 18 July 2018 from 0900 to 1600 hours.

3150 Ross Ave. (Parcel No. 311-23-035): Provided 24-hour notification to children of residence. Spoke with family member on the phone. He expressed his appreciation of investigation activities; however, mentioned the hassle of coordination to remove his grandfather from the home for the day.

2275 Darren Dr. (Parcel No. 311-23-034): A 24-hour Notification was left on the front door. Spoke with the grandmother taking the children to daycare. Tenants will be vacate during the requested evacuation date and time frame.

2235 Darren Dr. (Parcel No. 311-23-033): Property is vacate and for sale. A 24-hour Notification was left on the front door.

2195 Darren Dr. (Parcel No. 311-23-032): Spoke with the residents and provided a 24-hour notification. Tenants will be at work during the requested evacuation date and time frame.

2145 Darren Dr. (Parcel No. 311-23-031): Resident was not present. A 24-hour notification was left on the front gate. Previous contact made on 15 June 2018 during the one month notification, the resident had no concerns.

2105 Darren Dr. (Parcel No. 311-23-030): Spoke with the resident and provided a 24-hour notification. Tenant agreed to vacate his home in the AM and requested that WESTON personnel notify him via cell phone when targets affecting his property have been cleared.

0925 to 1530 hours: UXO Dig Team (UXO Tech III, UXO Tech II, and UXO Tech I) with oversite by the SUXOS and UXOQCS/UXOSO begin intrusive activities at DGM target locations reacquired and flagged. Dig data recorded using a Trimble Geo7X equipped

with UXO Fast program. UXO Dig Team completed 35 of 58 targets (60% completed). Findings included MD (60mm mortar tail boom, frag, and M29 tail fin), small arms ammunitions (SAA), and non-munitions related debris (NMRD) (scrap metal, cans, wire, and foil).

1450 to 1525 hours: Field crew activities were placed on hold due to lightening within a 10 mile radius of the site from passing thunderstorms.

1525 to 1600 hours: UXO Dig team return to the site storage container to sort MD recovered. Trimble RTK GPS system taken down. Onsite storage container secured. End of daily field activities.

Munitions: Items Recovered Today (Project Totals)
MEC/MPPEH: None
MD: 3 lbs. (7 lbs.)
NMRD: 4 lbs. (4 lbs.)

QUALITY CONTROL:
UXOQCS/UXOSO held Daily H&S Tailgate Meeting. All field personnel reported fit for daily activities. Observed daily activity operations. All personnel are working in accordance with the UFP-QAPP, wearing proper PPE, and working in a safe manner. UXOQCS conducted QC at 35 DGM target locations following intrusive investigations. No discrepancies noted. See daily DQCR.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*
Reacquisition of DGM targets (23 of 58) using RTK GPS, intrusive investigation of DGM targets with data collection, demolition activities (if needed), MDAS certification and T&D, and demobilization.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*
None.

SCHEDULED WORK FOR THE FOLLOWING DAY (Wednesday, 18 July 2018)
Project personnel will set up the site for field activities, including, set up of the RTK GPS base station and rover, equipment checks, reacquisition and flagging of DGM targets, and intrusive investigations of 23 DGM targets with an exclusion zone intersecting nearby residents. WESTON personnel will ensure that nearby residents have voluntarily vacated their homes prior to intrusive investigations, which will begin at 9am per the Evacuation Plan notifications made to affected residents.

TO DO LIST FOR CLIENT:
No action at this time.

PREPARED BY:	
Anthony Rodriguez, P.G.	**SIGNATURE:**

PHOTOS:

Photo 1 – UXO Crew setup the Trimble RTK GPS system.

Photo 2 – UXO Tech conduct QC check of Trimble RTK GPS system using control point (KING CHK).

Photo 2 – UXO Techs performing DGM target reacquisition activities.

Photo 2 – MD, 60mm Mortar tail boom, encountered at target T-08.

Photo 2 – MD, frag, encountered at target T-15.

Photo 2 – UXO Crew conducting intrusive investigations at DGM targets with UXOQCS/UXOSO oversite.

SIGNATURE:

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Wednesday, 18 July 2018; 0700 – 1500 hours

WEATHER/TEMPERATURE:

Partly Cloudy; 72º to 96º F; 38% Humidity; 0.00 inches Precipitation; 9 mph (SW) wind speed.

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Suzie Kaufman (WESTON) – Project Manager – 2 hours.
Anthony Rodriguez (WESTON) – Site Manager/Geoscientist – 9 hours.
Brian Grassmyer (WESTON) – SUXOS – 9 hours.
Robert Prosperi (WESTON) – UXOQCS/UXOSO – 9 hours.
Chuck Aquilina (WESTON) – UXO Technician III – 8 hours.
Lloyd Jones (WESTON) – UXO Technician II – 8 hours.
David Arguello (WESTON) – UXO Technician II – 8 hours.

Mobilization Hours: 48
Total Daily Hours: 53
Total Project Hours: 169
Demobilization Hours: 0

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

0700 to 0730 hours: WESTON UXOQCS/UXOSO (R. Prosperi) holds Daily Safety Tailgate Meeting with B. Grassmyer, C. Aquilina, L. Jones, D. Arguello, and A. Rodriguez present. Discuss general health and safety, physical/chemical/biological hazards, scheduled daily tasks, exclusion zone set up and road guard locations and duties, and UXO discussion of encountered/expected munitions items onsite.

0730 to 0800 hours: UXO Field crew set up the Trimble RTK GPS Base Station at control point (KINGBASE) and prepare for daily activities including DGM target location reacquisition and intrusive investigation activities. UXO Techs conduct system QC checks of Trimble RTK GPS system using a control point (KING CHK) and White's metal detectors at the IVS strip.

0745 to 0900 hours: WESTON personnel (A. Rodriguez) attempts to meet with residents along Ross Avenue/Darren Drive at six (6) properties to ensure voluntary evacuation as part of the Evacuation Plan. Twenty-three (23) DGM targets have an exclusion zone that intersect at least one nearby residential property. Voluntary evacuations are requested from 0900 to 1600 hours.

3150 Ross Ave. (Parcel No. 311-23-035): Spoke with resident via text message. Occupants to be vacated by 0830 hours.

2275 Darren Dr. (Parcel No. 311-23-034): Spoke with residents. Occupants to vacate by requested 0900 hours.

2235 Darren Dr. (Parcel No. 311-23-033): Property is vacate and for sale.

2195 Darren Dr. (Parcel No. 311-23-032): Spoke with the residents prior to departing for work.

2145 Darren Dr. (Parcel No. 311-23-031): Spoke with resident upon departing her residence.

2105 Darren Dr. (Parcel No. 311-23-030): Spoke with the resident upon departing his property before 0900 hours.

0800 to 0900 hours: UXO Field crew perform DGM target location reacquire activities using the Trimble RTK GPS rover. The UXO Team flags remaining 23 DGM targets whose exclusion zone impact nearby residents on Darren Drive and Ross Ave.

0900 to 1100 hours: WESTON confirm that residents within the exclusion zone have voluntarily vacated their residences prior to intrusive operations. Road Guards set up at two designated locations to notify UXO dig team to stop intrusive operations if non-essential personnel/residents enter the exclusion zone. UXO Dig Team (UXO Tech III, UXO Tech II, and UXO Tech I) with oversite by the UXOQCS/UXOSO begin intrusive activities at DGM target locations reacquired and flagged. Dig data recorded using a Trimble Geo7X equipped with UXO Fast program. UXO Dig Team completed 23 targets (100% completed, 58 of 58 DGM targets). Findings included MD (M29 tail fin, frag), small arms ammunitions (SAA) (projectiles, casings, links), non-munitions related debris (NMRD) (wire, scrap metal, nails), and a QC seed (T-43 location). RI Field activities complete.

1100 to 1300 hours: UXO Dig team return to the site storage container to sort MD recovered. SUXOS and UXOQCS confirm all project

MD as MDAS and prepare for shipping to demilitarization/recycling facility. Trimble RTK GPS system taken down. IVS seeds were removed from the ground. Contents of the onsite storage container are unloaded for demobilization. Rental equipment is packaged up for return shipping. End of onsite RI field activities.

1300 to 1500 hours: Rental equipment and MDAS was dropped off at an authorized FedEx ship center for shipping. MDAS is shipped to demilitarization and recycling subcontractor. Non munitions-related debris (NMRD, i.e., scrap metal) was taken to Bulldog Recycling located at 3880 E. Andy Devine Ave, Kingman, AZ. Field rental truck was returned to Enterprise.

Munitions: Items Recovered Today (Project Totals)
MEC/MPPEH: None
MD: 2 lbs. (9 lbs.)
NMRD: 1 lbs. (5 lbs.)

QUALITY CONTROL:
UXOQCS/UXOSO held Daily H&S Tailgate Meeting. All field personnel reported fit for daily activities. Observed daily activity operations. All personnel are working in accordance with the UFP-QAPP, wearing proper PPE, and working in a safe manner. UXOQCS conducted QC at 23 DGM target locations following intrusive investigations. UXOQCS confirmed that MD was MDAS in preparation of shipping to demilitarization subcontractor. No discrepancies noted. See daily DQCR.

UXO Dig Team recovered QC Seed at Target T-43.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*
Demobilization.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*
None.

SCHEDULED WORK FOR THE FOLLOWING DAY (Thursday, 19 July 2018)
All project personnel will demobilize from Kingman, AZ via personal vehicle, rental vehicles, and airplanes. Onsite storage container and portable toilet to be picked up by the rental providers. WESTON personnel does not need to be onsite during pick up.

TO DO LIST FOR CLIENT:
No action at this time.

PREPARED BY:	
Anthony Rodriguez, P.G.	**SIGNATURE:**

PHOTOS:

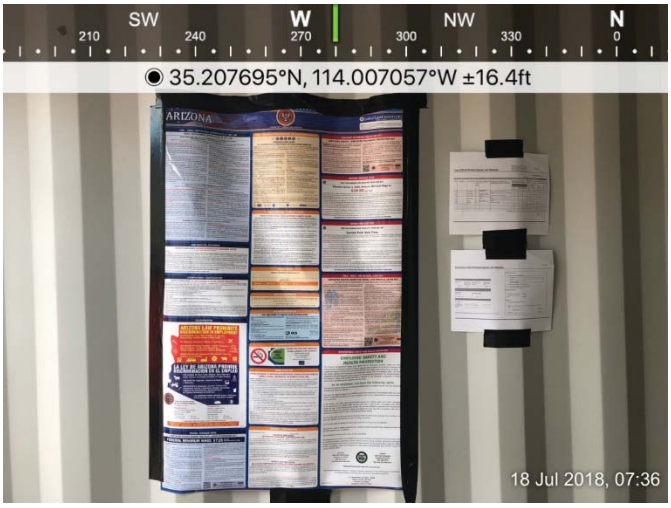


Photo 1 – Project job board and rights to work located inside the storage container.

Photo 2 – UXO Crew conducting intrusive investigations at DGM target with UXOQCS/UXOSO oversite.

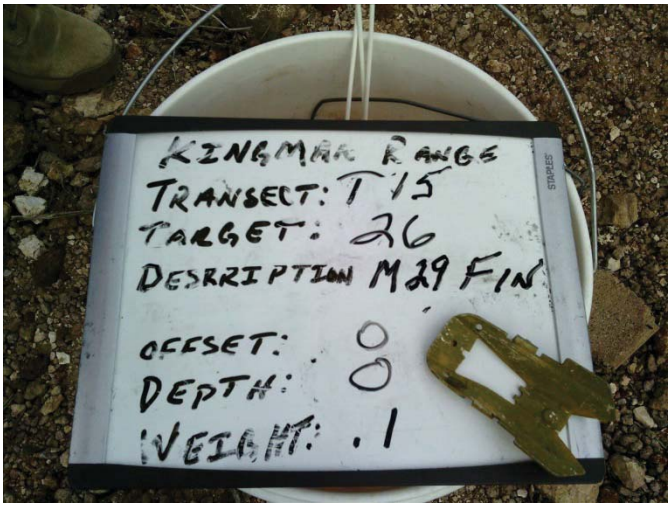


Photo 2 – MD, M29 fin, encountered at target T-26.

Photo 2 – QC Seed encountered at target T-43.

Photo 2 – MD, frag, encountered at target T-39.

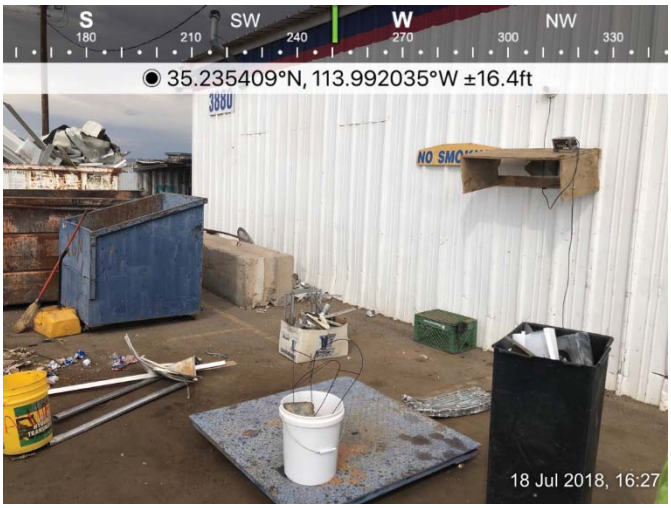


Photo 2 – NMRD dropped off at recycling center in Kingman, AZ.

SIGNATURE:

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001	03886.552.101.2000.41	Thursday, 19 July 2018; 0700 – 1500 hours

WEATHER/TEMPERATURE:

Partly Cloudy; 72º to 96º F; 38% Humidity; 0.00 inches Precipitation; 9 mph (SW) wind speed.

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

Anthony Rodriguez (WESTON) – Site Manager/Geoscientist – 8 hours.
Brian Grassmyer (WESTON) – SUXOS – 8 hours.
Robert Prosperi (WESTON) – UXOQCS/UXOSO – 8 hours.
Chuck Aquilina (WESTON) – UXO Technician III – 8 hours.
Lloyd Jones (WESTON) – UXO Technician II – 8 hours.
David Arguello (WESTON) – UXO Technician II – 8 hours.

Mobilization Hours: 48
Total Daily Hours: 53
Total Project Hours: 169
Demobilization Hours: 48

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Project personnel demobilized from Kingman, AZ.

QUALITY CONTROL:

None.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

None.

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

None.

SCHEDULED WORK FOR THE FOLLOWING DAY (Friday, 20 July 2018)

No additional field work is planned at this time.

TO DO LIST FOR CLIENT:

No action at this time.

PREPARED BY:

Anthony Rodriguez, P.G.

SIGNATURE:

PHOTOS:

Photo 1 – MDAS placed in a tool box for shipment to demilitarization subcontractor.

Photo 2 – Tool box was locked and secured with a ball seal.

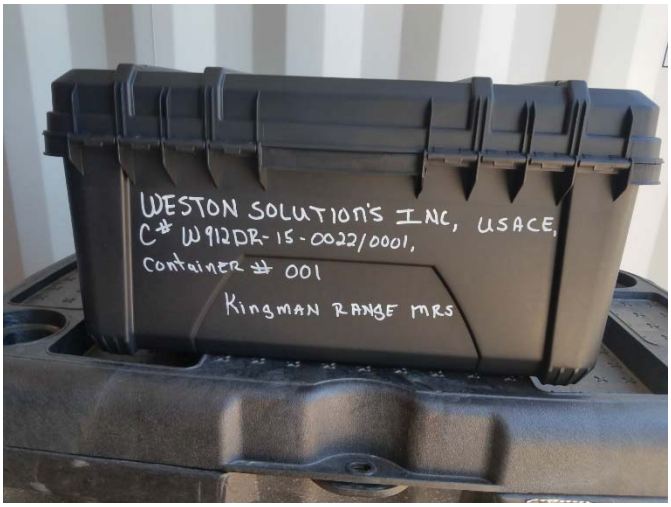


Photo 3 – Shipping container properly tagged with project information. Not shown, 1348-1A and Chain of Custody placed in a plastic see through sleeve on the outside with the airbill.

SIGNATURE:

Daily Summary

MMRP Kingman Range, Mohave County, Arizona

CONTRACT #	WORK ORDER #	DAY/DATE/TIME
W912DR-15-D-0022 Delivery Order: 0001		Tuesday/ 21 May 2019/ 17:30

WEATHER/TEMPERATURE:

L: 44/ H: 72, Sunny with wind gusts to 10 mph

WORK LOCATION: Kingman Range MRS

Subcontractor(s) and/or Teaming Partner(s) On-Site: ☒ NONE ☐ OTHER ☐ OTHER2 ☐ OTHER3

PERSONNEL/HOURS ON SITE:

SUXOS: Ward Stern/ 10 hrs.
UXOQC and Safety: Doug Gates/ 10 hrs.
UXO Tech III: Brian Addison/ 10 hrs.
Project Geo: Mike Link/ 10 hrs.

SUMMARY OF DAILY ACTIVITIES & SITE STATUS:

Team arrived at site location, met with state regulators, and USACE OESS (Daily Sign In Sheet annotated)
First Day Site Orientation/ Site Specific Safety and Plan Briefings conducted by UXO Safety, and SUXOS.
Establish IVS/ ITS, and tested project instrumentation.
Establish 4 (four) 50' X 50' Grids using GPS instrumentation.
UXOQC emplaced required ISO into established grids.
UXO Team (SUXOS and UXO Technician III) use all metals detector and hand shovel to perform intrusive activities, effectively completing required RI activities for these four additional grids.
UXO Team certifies collected MDAS (less than 1 lb.)
Site restoration completed.
Reports filed, and Project Manager notified of site completion.

QUALITY CONTROL:

UXOQCS performed Daily QC functions in accordance with approved project documentation.

ONGOING SITE ACTIVITIES/CONDITIONS: *(comments will remain in this section until no longer valid)*

N/A

PROBLEMS/RESOLUTIONS: *(Including nonconformance details, corrective actions, and other government instructions)*

No nonconformance, corrective action item, or "other government instructions" noted at site.
UXOQCS/UXOSO reported that he had his backpack stolen off of his vehicle while he was engaged in QC/ Safety activities away from his vehicle. The UXOQCS/UXOSO stated the backpack contained the Daily Sign In Sheet, other QC/ Safety documentation, as well as data storage devices containing project information. Local law enforcement authorities notified, and a police report was filed.

SCHEDULED WORK FOR THE FOLLOWING DAY (Friday, 20 July 2018)

Demobilization of team members from site.

TO DO LIST FOR CLIENT:

PREPARED BY:	SIGNATURE:
WR Stern, SUXOS Weston Solutions	WR Stern


KINGMAN RANGE
MR5 - 50' x 50'
GRIDS
GRID 1 of 4
5/21/19


KINGMAN RANGE
MRS - 50' x 50'
GRIDS
GRID 2 of 4
5/21/19


KINGMAN RANGE
MR5 - 50' x
GRIDS
GRID 3 of 4
5/21/19

Daily UXO SUXOS Site Report

WESTON SOLUTIONS

CONTRACT NO. / D.O.: - W912DR-15-D-0022/0001

DATE: 21 May 19

WORK LOCATION: Remedial Investigation , NDNODS Kingman Range, MRS Mohave County, AZ

WORK COMPLETED:

- ☐ Survey Activities.
- ☐ EM and Dig Transect Activities
- ☒ EM and Dig Grid Activities
- ☐ Reacquire/Investigate Anomalies.
- ☐ Grid QC List.
- ☐ Grid QA
- ☐ Munitions Constituents Sampling
- ☐ UXO Technician Escort activities.
- ☐ Magazine secured.
- ☐ Equipment Maintenance.
- ☐ Equipment Issues (List Below)
- ☐
- ☒ Safety briefing given

Comments: 1 day - Complete 4 50'x50' foot grids -

PROBLEMS/RESOLUTIONS: UXO QCS/SO had pickpuck stolen from Work site - Police Report Filed.

DAILY ACTIVITIES: Cleared 4 50'x50' Grids

Total Number/Line miles completed: N/A

Total Number Grids completed MRS: - 4

MD, NMRD, MEC/MPPEH: 7 pieces MD (MDAS)

Team2: —

Team 3: —

UXO items located: NONE

UXO Daily Total:

Remarks: SUXOS _____, UXOSO/QCS _____

Geophysical Teams:

Team 1:

Team 2:

Demo Team:

Sample Team:

PREPARED BY: W. Stern

SIGNATURE: W. Stern

WESTON SOLUTIONS

Grid Sweep Log

Project Name/Location: NDNODS Kingman Range MRS, NDNODS MMRP RI, Mohave County, AZ

Work Order No.: 03886.552.002

Grid No.: 1 Size: 50'x50'

Date Started: 21 May 19

Date Completed: 21 May 19

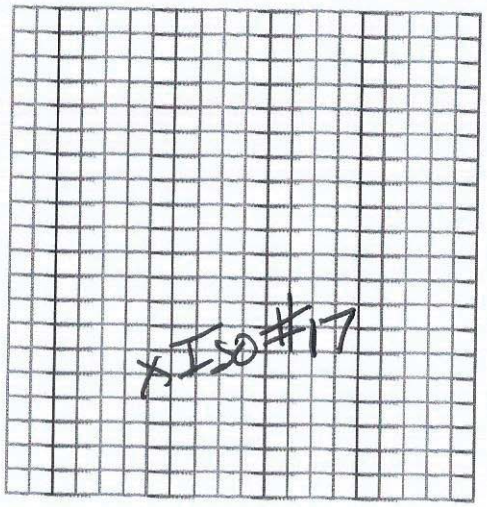
Insert Magnetic North Direction

Team No.: 1

UXO Supervisor:

UXO Supervisor:

Total Anomalies	Total Excavations	Anomalies > .5 ft.	Total UXO	Pounds MEC Scrap	Pounds Non-MEC Scrap
5	5	5	Ø	>1	—



UXO	Nomenclature	Depth
	N/A	

Reference Pt. Each Increment Line Equals____x____ft.

ACTION:	DATE	SIGNATURE
Mag Sweep Complete	21 May	[illegible]
Excavation Complete	21 May	[illegible]
Quality Control Complete	21 May	
Client Quality Assurance Complete		

REMARKS:

WESTON SOLUTIONS

Grid Sweep Log

Project Name/Location: NDNODS Kingman Range MRS, NDNODS MMRP RI, Mohave County, AZ

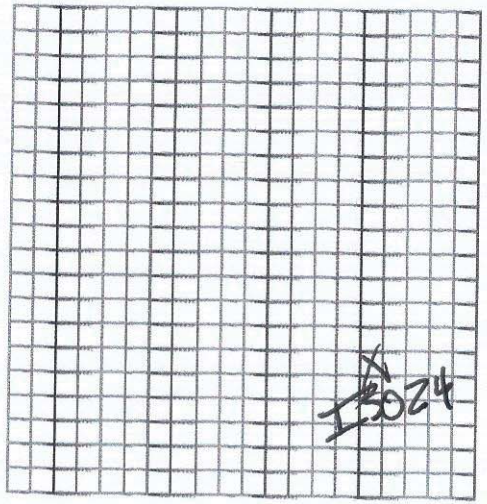
Work Order No.: 03886.552.002

Grid No.: 2 Size: 50'X50'
Date Started: 21 May 19
Date Completed: 21 May 19

Insert Magnetic North Direction

Team No.: 1
UXO Supervisor:
UXO Supervisor:

Total Anomalies	Total Excavations	Anomalies > 1 ft.	Total UXO	Pounds MEC Scrap	Pounds Non-MEC Scrap
9	9	9	Ø	>1	—



UXO	Nomenclature	Depth
	N/A	

Reference Pt. Each Increment Line Equals____x____ft.

ACTION:	DATE	SIGNATURE
Mag Sweep Complete	21 May	[illegible]
Excavation Complete	21 May	[illegible]
Quality Control Complete	21 May	
Client Quality Assurance Complete		

REMARKS:

WESTON SOLUTIONS

Grid Sweep Log

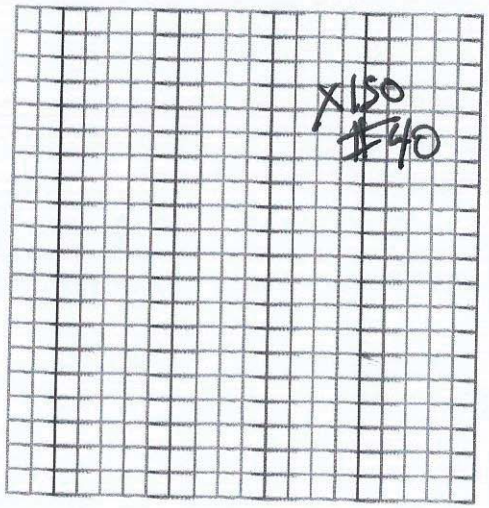
Project Name/Location: NDNODS Kingman Range MRS, NDNODS MMRP RI, Mohave County, AZ

Work Order No.: 03886.552.002

Grid No.: 3 Size: 50'x50'
Date Started: 21 May 19
Date Completed: 21 May 19

Insert Magnetic North Direction

Team No.: 1
UXO Supervisor:
UXO Supervisor:



Reference Pt. Each Increment Line Equals____x____ft.

Total Anomalies	Total Excavations	Anomalies > .5 ft.	Total UXO	Pounds MEC Scrap	Pounds Non-MEC Scrap
6	6	6	Ø	71	—

UXO	Nomenclature	Depth
	N/A	

ACTION:	DATE	SIGNATURE
Mag Sweep Complete	21 May	WRS
Excavation Complete	21 May	WRS
Quality Control Complete	21 May	
Client Quality Assurance Complete		

REMARKS:

WESTON SOLUTIONS

Grid Sweep Log

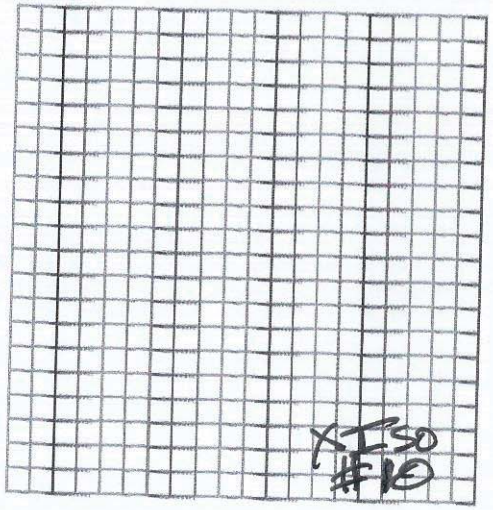
Project Name/Location: NDNODS Kingman Range MRS, NDNODS MMRP RI, Mohave County, AZ

Work Order No.: 03886.552.002

Grid No.: 4 Size: 50' x 50'
Date Started: 21 May 19
Date Completed: 21 May 19

Insert Magnetic North Direction

Team No.: 1
UXO Supervisor:
UXO Supervisor:



Total Anomalies	Total Excavations	Anomalies > 15 ft.	Total UXO	Pounds MEC Scrap	Pounds Non-MEC Scrap
6	6	6	Ø	Ø	Ø

UXO	Nomenclature	Depth
	N/A	

Reference Pt. Each Increment Line Equals____x____ft.

ACTION:	DATE	SIGNATURE
Mag Sweep Complete	21 May	WRS
Excavation Complete	21 May	WRS
Quality Control Complete	21 May	
Client Quality Assurance Complete		

REMARKS:

APPENDIX E

PROFESSIONAL SURVEY REPORT

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Shephard Wesnitzer, Inc.

75 Kallof Place
Sedona, AZ 86336

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Sedona, AZ 86340

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Engineering an environment of excellence.

SURVEY REPORT

Project Control Points
NDNODS Kingman Range MRS
Kingman, AZ
SWI # 17223

Prepared for:

Tracy Lestochi, P.E.
Project Manager
Weston Solutions, Inc.
841 Bishop Street
Suite 2301
Honolulu, HI 96813

Prepared by:

Earl Watts, RLS
Shephard – Wesnitzer, Inc.
75 Kallof Place
Sedona, AZ 86336

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
27253
EARL G.
WATTS
10/12/17
Date Signed
ARIZONA, U.S.A.
Expires 6/30/20

Background:

SWI was retained by Weston Solutions to establish two project control points for the NDNODS Kingman Range Project in Kingman, AZ.

On October 11, 2017, Earl Watts, (survey project manager for SWI) met with Mike Link (Weston Solutions) and agreed on the location of the two monuments.

Procedures:

The two control points were named “KING BASE” and “KING CHK”. “KING BASE” is a cotton picker spindle and aluminum tag stamped RLS 27253 in a rock outcrop at the top of the saddle between the two peaks that are the focus of this project.

“KING CHK” is a ½” rebar with an aluminum cap stamped RLS 27253 at the bottom of the hill near the edge of the west dirt road and will serve as the secondary control point.

Fixed height tripods, a Trimble R7 and a 5700 GPS receiver with Trimble Zephyr Geodetic antennas were set up on each control point.

Two hours of observations were obtained between each control point.

Post processing was performed using Trimble Business Center v4.00 along with NGS Absolute antenna models and NGS ephemeris files.

NGS CORS Stations KGMN (DL9798), KING (AM7015), AZGV (DM7868), AZBH (DL1709) and AZDS (DN8733) were used as the basis of reported positions for this control project.

A least squares adjustment was performed using the above NGS CORS stations as “fixed” positions. KGMN, KING and AZGV were “fixed” for the vertical component.

Base files from the GPS receivers were submitted to the NGS OPUS website and compared to the post processed values as verification.

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75 Kallof Place
Sedona, Arizona 86336
928.282.1061 ph
928.282.2058 fx
info@swiaz.com
www.swiaz.com

Results:

The following results are based on the NGS NAD 83 (2011) published positions of the 5 CORS stations used for post processing.

WGS 1984 (NAD83-NA2011) GEODETIC COORDINATES					
NAME	LATITUDE	LONGITUDE	ELLIP. HGT.	HORIZONTAL ERROR	VERTICAL ERROR
AZBH	N35°06'26.96486"	W114°36'17.90293"	152.433	FIXED	0.022
AZDS	N35°31'59.26612"	W114°21'33.19095"	871.394	FIXED	0.052
AZGV	N35°15'15.73140"	W114°15'15.31191"	868.348	FIXED	FIXED
KGMN	N35°13'51.76807"	W114°00'08.41888"	1016.433	FIXED	FIXED
KING	N35°11'50.48154"	W114°02'29.27572"	1130.212	FIXED	FIXED
KING BASE	N35°12'29.65960"	W114°00'25.14442"	1058.989	0.008	0.007
KING CHK	N35°12'28.05113"	W114°00'26.45584"	1053.713	0.008	0.007

UTM ZONE 12 NORTH GRID COORDINATES				
NAME	NORTHING	EASTING	ELEV.	CODE
AZBH	3890913.357	171397.058	182.68	DL1709
AZDS	3937360.475	195410.024	899.93	DN8733
AZGV	3906108.834	203912.363	897.29	DM7868
KGMN	3902797.791	226761.805	1044.70	DL9798
KING	3899168.188	223085.277	1158.60	AM7015
KING BASE	3900280.020	226262.187	1087.28	SPINDLE IN ROCK
KING CHK	3900231.452	226227.513	1082.01	CPR 1/2" AL CAP LS 27253

UTM ZONE 11 NORTH GRID COORDINATES				
NAME	NORTHING	EASTING	ELEV.	CODE
AZBH	3887588.161	718285.684	182.68	DL1709
AZDS	3935375.777	739429.907	899.93	DN8733
AZGV	3904708.851	749808.249	897.29	DM7868
KGMN	3902784.918	772812.403	1044.70	DL9798
KING	3898940.032	769361.852	1158.60	AM7015
KING BASE	3900241.584	772465.756	1087.28	SPINDLE IN ROCK
KING CHK	3900191.011	772434.078	1082.01	CPR 1/2" AL CAP LS 27253

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Point Locations:

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www.swiaz.com
SEDONA COTTONWOOD FLAGSTAFF PRESCOTT KINGMAN

```
 FILE: 21932840.17o OP1507821936116
 Station: KING BASE

 2005   NOTE:  The IGS precise and IGS rapid orbits were not available
 2005   at processing time.  The IGS ultra-rapid orbit was/will be used to
 2005   process the data.
 2005
                            NGS OPUS SOLUTION REPORT
                            ========================

All computed coordinate accuracies are listed as peak-to-peak values.

      USER: ewatts@swiaz.com                        DATE: October 12, 2017
RINEX FILE: 2193284p.17o                            TIME: 15:30:44 UTC


   EPHEMERIS: igu19703.eph [ultra-rapid]              STOP: 2017/10/11  18:21:00
  NAV FILE: brdc2840.17n                        OBS USED:  5967 /  6502   :  92%
  ANT NAME: TRM41249.00     NONE             # FIXED AMB:    40 /    43   :  93%
ARP HEIGHT: 1.8                             OVERALL RMS: 0.009(m)


 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)             IGS08 (EPOCH:2017.7773)

         X:     -2122935.582(m)   0.006(m)          -2122936.452(m)   0.006(m)
         Y:     -4766627.524(m)   0.009(m)          -4766626.190(m)   0.009(m)
         Z:      3657377.810(m)   0.002(m)           3657377.676(m)   0.002(m)

       LAT:   35 12 29.65946      0.006(m)        35 12 29.67206      0.006(m)
     E LON:  245 59 34.85612      0.006(m)       245 59 34.80324      0.006(m)
     W LON:  114  0 25.14388      0.006(m)       114  0 25.19676      0.006(m)
    EL HGT:         1058.961(m)   0.007(m)              1058.178(m)   0.007(m)
 ORTHO HGT:         1087.252(m)   0.020(m) [NAVD88 (Computed using GEOID12B)]

                        UTM COORDINATES    STATE PLANE COORDINATES
                         UTM (Zone 12)         SPC (0203 AZ W)
Northing (Y) [meters]     3900280.016           466720.240
Easting (X)  [meters]      226262.201           189961.485
Convergence  [degrees]    -1.73475387          -0.14816499
Point Scale                1.00052358           0.99994008
Combined Factor            1.00035730           0.99977390

US NATIONAL GRID DESIGNATOR: 12STE2626200280(NAD 83)


                            BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
DN8733 AZDS DOLAN SPRINGS CORS ARP         N353159.266 W1142133.190   48214.2
```

```
DM7868 AZGV GOLDEN VALLEY CORS ARP         N351515.731 W1141515.311   23087.8
DN6065 AZYC YUCCA CORS ARP                 N345245.385 W1140849.121   38674.7

                 NEAREST NGS PUBLISHED CONTROL POINT
FS0577      Y 124                          N351254.    W1140035.        790.5
```

```
 FILE: 23302841.17o OP1507821952791
 Station: KING CHK

 2005   NOTE:  The IGS precise and IGS rapid orbits were not available
 2005   at processing time.  The IGS ultra-rapid orbit was/will be used to
 2005   process the data.
 2005
                            NGS OPUS SOLUTION REPORT
                            ========================

All computed coordinate accuracies are listed as peak-to-peak values.


      USER: ewatts@swiaz.com                        DATE: October 12, 2017
RINEX FILE: 2330284q.17o                            TIME: 15:32:22 UTC



 EPHEMERIS: igu19703.eph [ultra-rapid]              STOP: 2017/10/11  18:14:00
  NAV FILE: brdc2840.17n                       OBS USED:  4891 /  5359   :  91%
  ANT NAME: TRM41249.00     NONE             # FIXED AMB:    45 /    46   :  98%
ARP HEIGHT: 1.8                              OVERALL RMS: 0.009(m)


 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)             IGS08 (EPOCH:2017.7773)

         X:     -2122975.763(m)   0.012(m)          -2122976.633(m)   0.012(m)
         Y:     -4766636.199(m)   0.007(m)          -4766634.865(m)   0.007(m)
         Z:      3657334.258(m)   0.007(m)           3657334.124(m)   0.007(m)

       LAT:   35 12 28.05095      0.006(m)        35 12 28.06358      0.006(m)
     E LON:  245 59 33.54472      0.009(m)       245 59 33.49183      0.009(m)
     W LON:  114  0 26.45528      0.009(m)       114  0 26.50817      0.009(m)
    EL HGT:         1053.684(m)   0.011(m)              1052.900(m)   0.011(m)
 ORTHO HGT:         1081.976(m)   0.025(m) [NAVD88 (Computed using GEOID12B)]

                        UTM COORDINATES    STATE PLANE COORDINATES
                         UTM (Zone 12)         SPC (0203 AZ W)
Northing (Y) [meters]     3900231.446           466670.758
Easting (X)  [meters]      226227.527           189928.189
Convergence  [degrees]    -1.73494513          -0.14837337
Point Scale                1.00052381           0.99994010
Combined Factor            1.00035836           0.99977475

US NATIONAL GRID DESIGNATOR: 12STE2622700231(NAD 83)


                            BASE STATIONS USED
```

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN8733	AZDS DOLAN SPRINGS CORS ARP	N353159.266	W1142133.190	48229.3
DN6065	AZYC YUCCA CORS ARP	N345245.385	W1140849.121	38616.9
DM7868	AZGV GOLDEN VALLEY CORS ARP	N351515.731	W1141515.311	23066.5

NEAREST NGS PUBLISHED CONTROL POINT

FS0577	Y 124	N351254.	W1140035.	828.4

Project file data		Coordinate System	
Name:	P:\2017\17223\Survey\Trimble-TBC\17223 Kingman Range Control Points.vce	Name:	UTM
Size:	220 KB	Datum:	WGS 1984
Modified:	10/12/2017 9:41:49 AM (UTC:-7)	Zone:	12 North (111W)
Time zone:	US Mountain Standard Time	Geoid:	GEOID12A (Conus)
Reference number:		Vertical datum:	
Description:		Calibrated site:	
Comment 1:			
Comment 2:			
Comment 3:			

Point Comparison Report

Horizontal search:	1.000 m	**Horizontal tolerance:**	0.020 m
Vertical search:	1.000 m	**Vertical tolerance:**	0.050 m
Selected points:	4 / 9	**Point-pairs found:**	2

From Point	To Point	Δ Horizontal	North Azimuth	Δ Northing	Δ Easting	Δ Vertical
KING BASE	KING BASE OPUS	0.014 m	108°43'59"	-0.005 m	0.014 m	-0.028 m
KING CHK	KING CHK OPUS	0.015 m	113°09'04"	-0.006 m	0.014 m	-0.029 m

10/12/2017 10:35:49 AM	P:\2017\17223\Survey\Trimble-TBC\17223 Kingman Range Control Points.vce	Trimble Business Center

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APPENDIX F

INSTRUMENT VERIFICATION STRIP REPORT

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John Jackson
Project Geophysicist
USACE – Sacramento District
1325 J Street
Sacramento, CA 95814-2922

October 17, 2017

Subject: Geophysical Instrument Verification Strip Letter Report
Remedial Investigation of Kingman Range MRS (AZHQ-006-R-01)
Mohave County, Arizona
Contract No. W912DR-15-D-0022

INTRODUCTION

The Geophysical System Verification (GSV) approach is being implemented for the Military Munitions Response Program (MMRP) Remedial Investigation/Feasibility Study (RI/FS) for the Kingman Range MRS (AZHQ-006-R-01), Mohave County, Arizona. The GSV approach includes the installation of an instrument Verification Strip (IVS) and placing blind seed items (BSI) within digital geophysical mapping (DGM) survey areas at an average rate of one BSI per day of data collection. The purpose of this letter report is to document the demonstrated geophysical system performance at the IVS and achieve the following objectives:

- Determine response amplitudes of each particular seed item collected with the EM61-MK2A in wheeled cart configuration;
- Demonstrate equipment functionality and positional accuracy at the IVS pre- and post-survey;
- Allow repeatability of the equipment to be quantified on a daily basis with use of BSIs;
- Determine an adequate target selection threshold for reliable detection of targets of interest; and;
- Verify conformance with specifications in the Final Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP).

The initial IVS data at the Kingman Range MRS was collected on October 16, 2017 using a standard wheel-mounted EM61 metal detector paired with a Trimble RTK GPS system. The IVS is located just north of the MRS on Bureau of Land Management (BLM) land where right of entry has been obtained. The location was cleared with a White's all-metal detector to ensure that no surface or subsurface metal was present. No intrusive removal was performed to clear the IVS location.

INSTRUMENT VERIFICATION STRIP DESCRIPTION

The IVS location was selected on Monday October 16, 2017 by the Site Geophysicist. The location was chosen based on its accessibility, proximity to the MRS, and similarity in terrain and geology to the surrounding production environment. Three Small Industry Standard Objects (ISO) items and one survey nail were placed in the IVS in a line running approximately north-south with nominal 10 foot spacing. Non-metallic pin flags were placed at the start and end of the IVS lane to identify IVS endpoints in the data. Flagging was used to mark the locations of the items. **Appendix A** contains a photo log of the IVS installation.

Table 1 shows the types, depths, orientations, and the coordinates of the ISO items used in the IVS. The area was mapped in real-time with the EM61 prior to emplacing the ISO items to ensure the area was free of metallic anomalies.

Table 1: IVS Seed Descriptions

ID	Northing (m)	Easting (m)	Description	Orientation	Depth (in)
Seed-01	3900210.05	772412.82	Small ISO Item	Horizontal, Across- Track (E-W)	4
Seed-02	3900207.83	772410.78	Small ISO Item	Horizontal, Across-Track (E-W)	6
Seed-03	3900205.53	772408.72	Small ISO Item	Horizontal, Across-Track (E-W)	8
Seed-04	3900203.35	772406.82	Survey Nail	Vertical	Surface

A background noise lane (BNL) was also marked approximately 25 feet east of the IVS location. Both lines were marked with stakes and rope, and the end points were recorded with RTK GPS in WGS 84, UTM Zone 11 North, meters.

GEOPHYSICAL SURVEY EQUIPMENT

EM61-MK2A

The EM61-MK2A device generates an electromagnetic pulse that triggers eddy currents in the subsurface. The eddy current decay produces a secondary magnetic field that is measured by a receiver coil. These secondary magnetic fields are recorded as data and stored in a data logger until it can be downloaded to a personal computer (PC) for processing and interpretation.

The EM61-MK2A is configured in the standard wheeled cart configuration, with the bottom coil 42 centimeters (cm) above the ground surface. The transmitter and receiver coils are coincident in the bottom air-cored coil, and measure 0.5 meters (m) by 1.0 m. The top air-coil receiver coil is

positioned 30cm above the main coil. This survey was performed with the 1.0 m edge perpendicular to the direction of travel. The EM61-MK2A Allegro data logger collects the data at automatic time intervals determined by the user. The data was logged at a rate of 10 Hz and recorded from the standard four time gates (216, 366, 660, and 1266 microseconds) of the lower coil. The top coil was only used to affix the GPS tripod mount for this project.

Global Positioning System Equipment

A Trimble Model R10-GNSS Real-Time Kinematic (RTK) Global Positioning System (GPS) was used to provide positional data during the IVS survey. Positional data and other GPS data were recorded at 1 Hz in the geographic coordinates, which were later converted to the WGS84, UTM Zone 11 N, Meters in the processing phase. The GPS rover antenna was placed on a tripod directly above the center of the coil for accurate location of data. Control Points were established by a Professional Licensed Surveyor from the state of Arizona. Below (**Table 2**) are the control point locations:

Table 2: NHV Control Points

ID	Northing (m)	Easting (m)	Elevation (m)	Description
King Base	3900241.5840	772465.756	1087.28	Control Point
King CHK	3900191.0110	772434.078	1082.01	Control Point

GEOPHYSICAL SURVEY PROCEDURES

DATA ACQUISITION

During the IVS demonstration several tests were conducted to verify that the instruments were operating properly. Data were recorded from the instrument while it was stationary and subjected to cable shake, personnel test, and static tests. The tests were performed at a known location for repeatability from day to day.

EM61-MK2A data were then collected by pulling the cart back and forth across the IVS in a variety of positional offsets to better quantify data quality objectives. Data was collected offset by .5 meters to each side of the IVS to ascertain the horizontal extent of detection.

Cable shake, personnel test, static, IVS, and background tests will be performed at the beginning of each day where geophysical mapping is performed. Static, IVS, and background tests will also be performed at the end of the day, except in circumstances where weather prevents these tests from safely being collected.

DATA PROCESSING

Equipment operators monitored the quality of the data in real-time. Upon completion of the IVS survey, the raw data were downloaded from the Allegro data recorder. The geophysical and

positional data collected over the IVS survey area were processed using the procedures listed below:

- Raw geophysical data were converted to XYZ format using TrackMaker61MK2 (a geophysical data processing/merging program).
- The raw XYZ files were imported into Geosoft Oasis montaj using scripts to import the data, create channels, apply a leveling algorithm such as non-linear and median filters for comparison to remove drift. The median filter was used for the analysis and for target picking. Latency corrections of 0.5 seconds were applied to the datasets.
- The static, static spike, cable vibration, and personnel tests were evaluated for Quality Control (QC) compliance, as noted below. All QC tests passed.
- Geophysical sensor data were evaluated in profile format for spikes, gaps, and sensor failure.
- The data sets were gridded using a grid cell size of 0.0762 meters and a blanking distance of 0.549 meters.
- Both positional and sensor data quality were checked. Data were monitored for gaps or incomplete coverage to locate any possible sensor failure.
- Anomalies were selected from the filtered and gridded Stack (Sum of Channels 1, 2, 3, and 4) data using a peak-picking algorithm in Oasis montaj. Decay analysis may be performed to remove targets that have atypical decays by applying a filter of CH1-CH2, CH2-CH3, and CH3-CH4. Though not performed on the IVS data, the decay analysis will be used to remove terrain induced noise and instrument bounces over the rough and rocky terrain in production data. Signal-to-Noise Ratio (SNR) was calculated by dividing the calculated background noise (7x root mean square [RMS]) by the seed responses. Targets were reviewed and verified by the processing geophysicist and QC geophysicist.
- Data processing steps were tracked to ensure all data were processed in the same manner.

RESULTS

The IVS data are displayed below along with results for a variety of tests as specified in the work plan. The IVS and BNL spatial plot **(Figure 1**) and the IVS profile (**Figure 2**) are shown below.

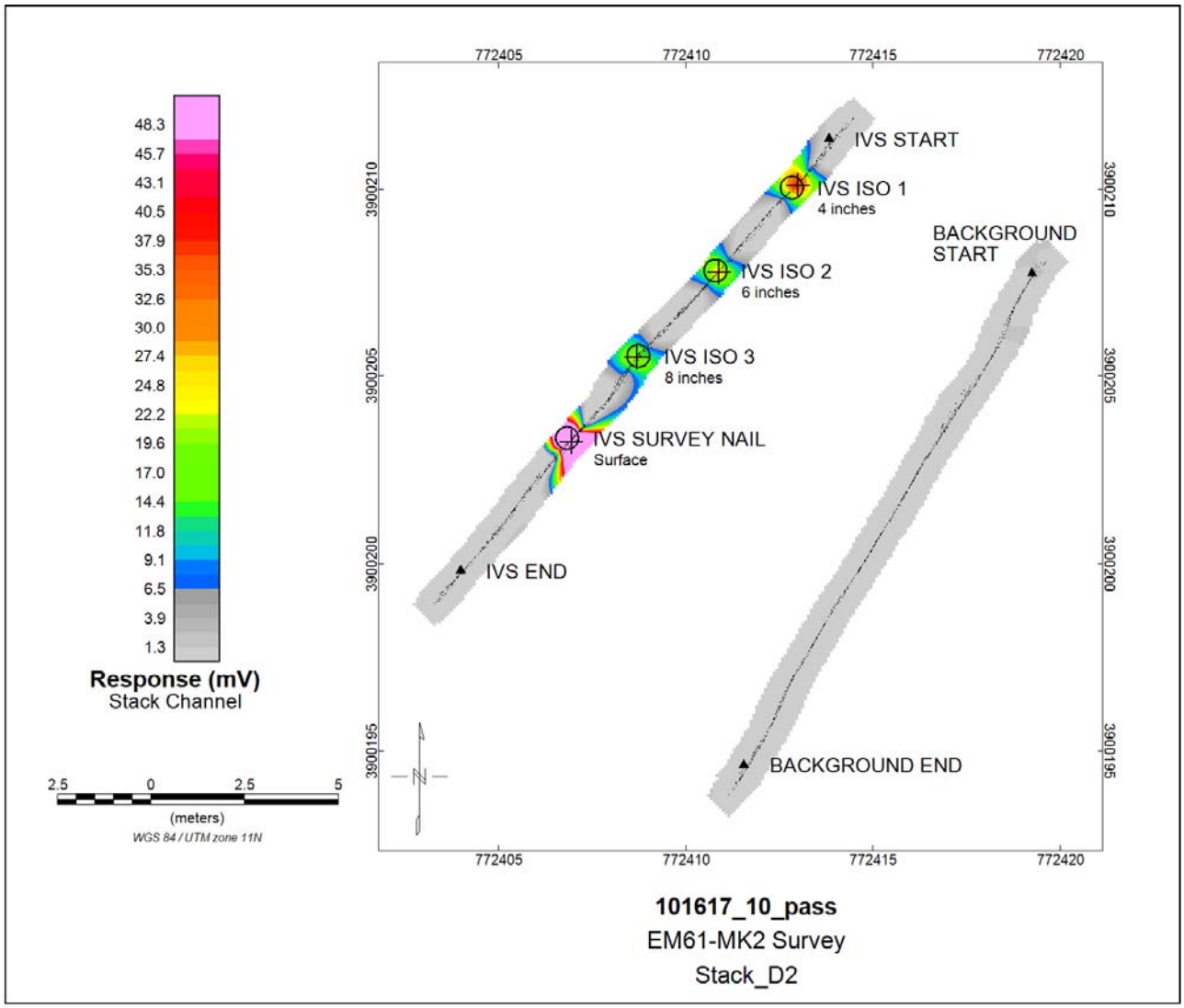


Figure 1 IVS and BNL Spatial Map.

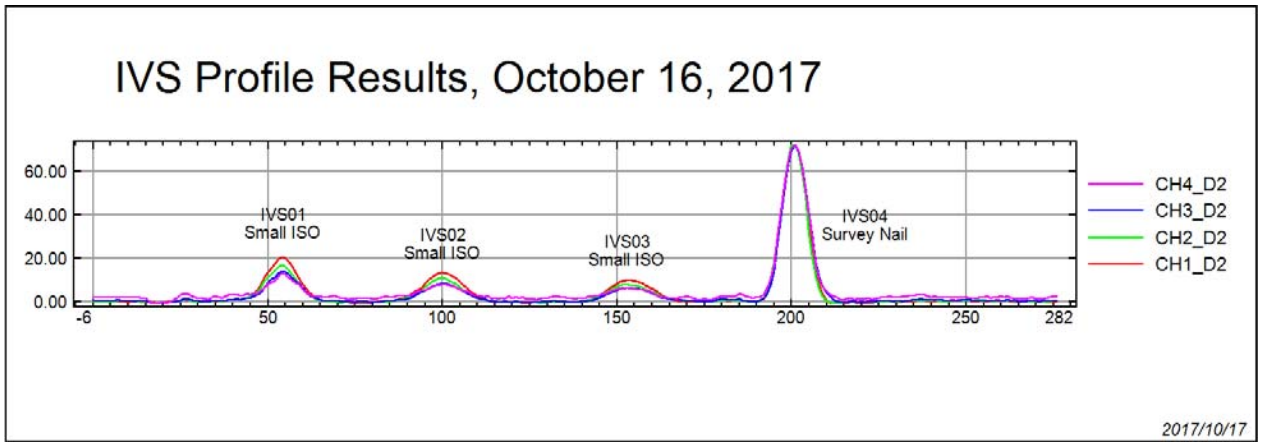


Figure 2 IVS Profile

DYNAMIC PEAK RESPONSE AND LOCATION OFFSETS

Table 3 contains the measured offsets between the peak response and peak instrument response identified in the IVS and the known location of the ISO items and demonstrates the effectiveness of the positioning equipment coupled to the EM61. Data results from the IVS survey lane are displayed in the **Figure 2**. Ongoing QC inspections will be compared to average values from the initial IVS survey.

Table 3 IVS Offset Values Between Measured and Known Locations

ID	Actual Northing	Actual Easting	Mean Measured Northing	Mean Measured Easting	Stack Response (mV)	Offset (m)	Offset Direction
Seed-01	3900210.05	772412.82	3900210.13	772412.97	38.76	0.17	NE
Seed-02	3900207.83	772410.78	3900207.79	772410.86	26.21	0.09	SE
Seed-03	3900205.53	772408.72	3900205.42	772408.65	21.14	0.14	SW
Seed-04	3900203.35	772406.82	3900203.26	772406.91	190.57	0.13	SE

All seed item responses were plotted with the least favorable orientation (LFO) and most favorable orientation (MFO) curves for the medium ISO. The LFO and MFO curves were generated with input points coming from the Naval Research Laboratory (NRL) Report, EM61-MK2 Response of Three Munitions Surrogates. Responses of each seed item fall within the predicted response curves. A most and least favorable orientation response curve is shown in

Figure 3 with responses from all three small ISO seed items. All the polar offset plots are contained in **Appendix B**.

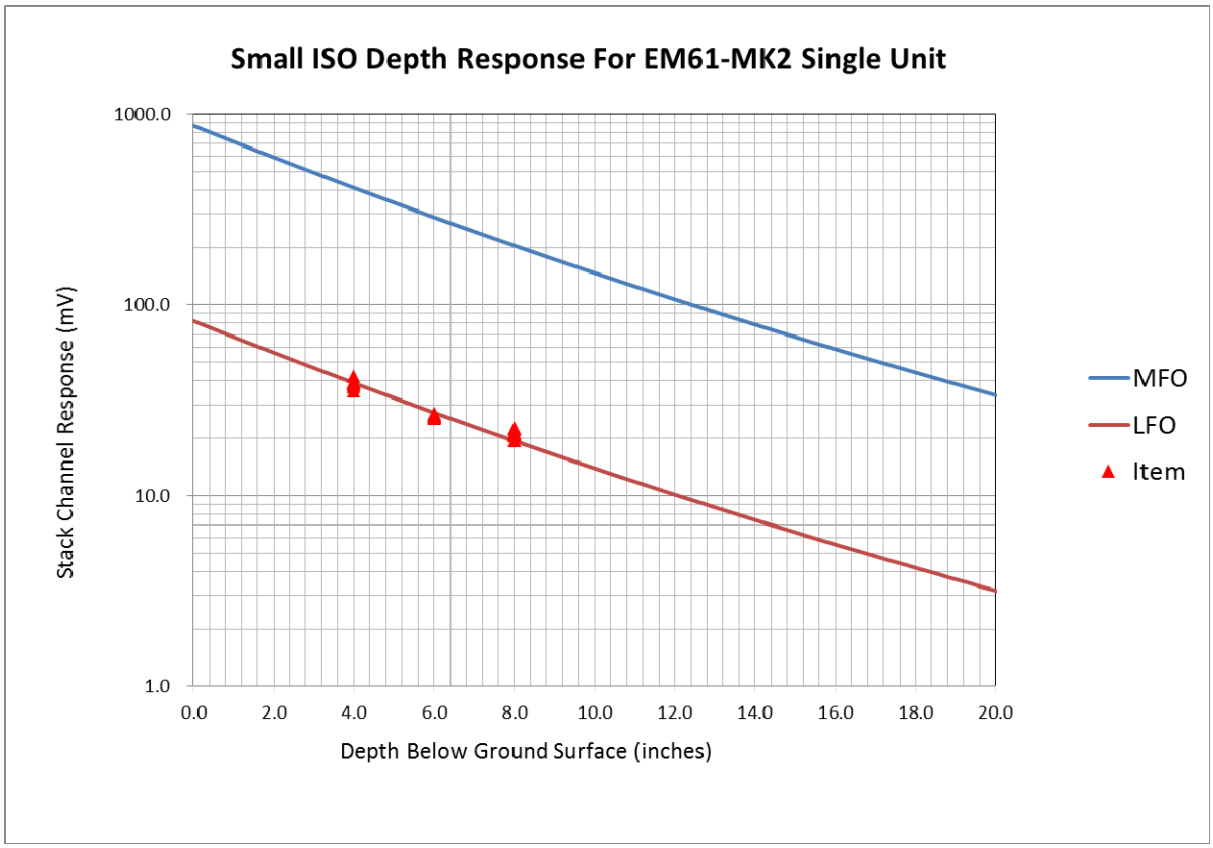


Figure 3 Least Favorable Orientation/Most Favorable Curves for Small ISO.

BACKGROUND NOISE LEVELS

In addition to the seeded portion of each IVS, a background noise lane was surveyed (**Figure 4**). **Table 4** shows the Background Noise Lane statistics for the data. An analysis of the background noise was completed with regard to IVS instrument response to assess the SNR values using various picking channels to determine the most effective response channel (or combination thereof) from which to perform target selection. SNR values were calculated at each seed item location by dividing the calculated background noise (7xRMS) from the average responses of the seeds. Results of the analysis indicate that the stack channel (Sum of channels 1, 2, 3, and 4) offers the best overall SNR within the IVS data and will be used as the primary channel to select targets. Results of the analysis are detailed in **Figure 5**, where each channel for each ISO, the X-axis, is compared to the SNR, the Y-AxisIn each case the SNR for the Sum1234 exceeds the Sum234. The leveled responses for each channel are displayed for comparison purposes.

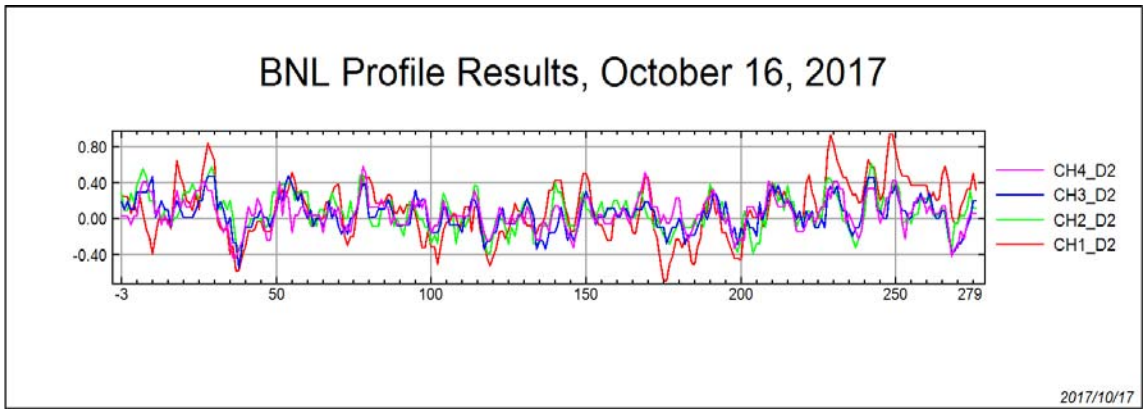


Figure 4 BNL Profile

Table 4 IVS Background Noise Lane Statistics				
Channel Name	**Minimum (mV)**	**Maximum (mV)**	**Mean (mV)**	**Standard Deviation (mV)**
Ch1	-0.85	1.06	0.10	0.31
Ch2	-0.79	0.89	0.06	0.25
Ch3	-0.76	0.72	0.05	0.22
Ch4	-0.81	0.72	0.04	0.22
Sum234	--2.29	2.17	0.16	0.62
Stack (Sum 1,2,3, & 4)	-2.98	3.11	0.26	0.88

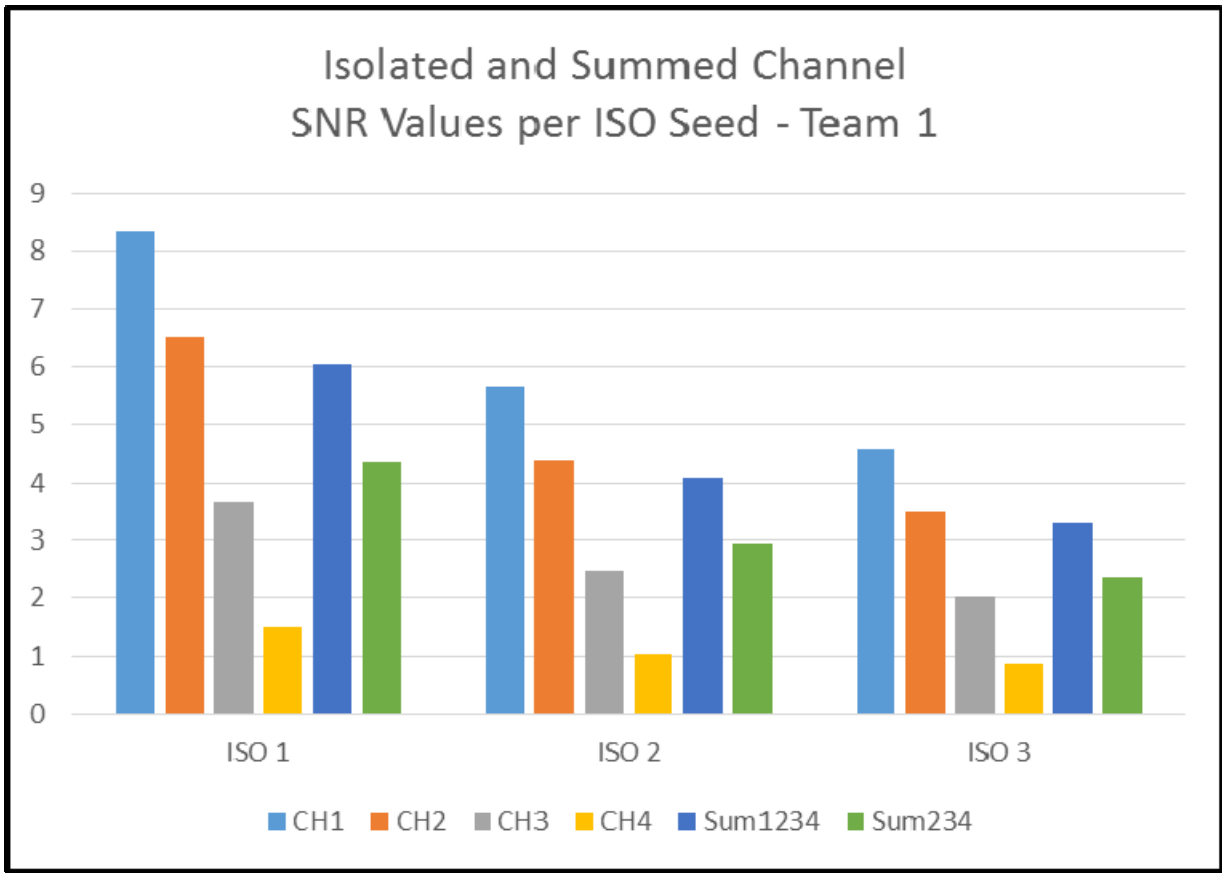


Figure 5 SNR Analysis

QUALITY CONTROL

Quality control for the IVS data was maintained by performing the tests described below and regularly reviewing the tests for compliance during all mapping efforts.

EQUIPMENT WARM-UP

The geophysical equipment was warmed up for over fifteen minutes prior to collecting data, as documented in the team field logbook.

CABLE SHAKE (VIBRATION TEST) AND PERSONNEL TEST

Prior to completing the morning static test the cables and connectors were shaken to verify that there were no loose connections or bad cables. The personnel involved in the data collection stepped towards and away from the instrument coil in order confirm that they do not have any metallic items that will influence the data results. Otherwise no data spikes were observed in the field or when the test results were reviewed during data processing. Data from the cable shake test is displayed in the profile below (**Figure 6**).

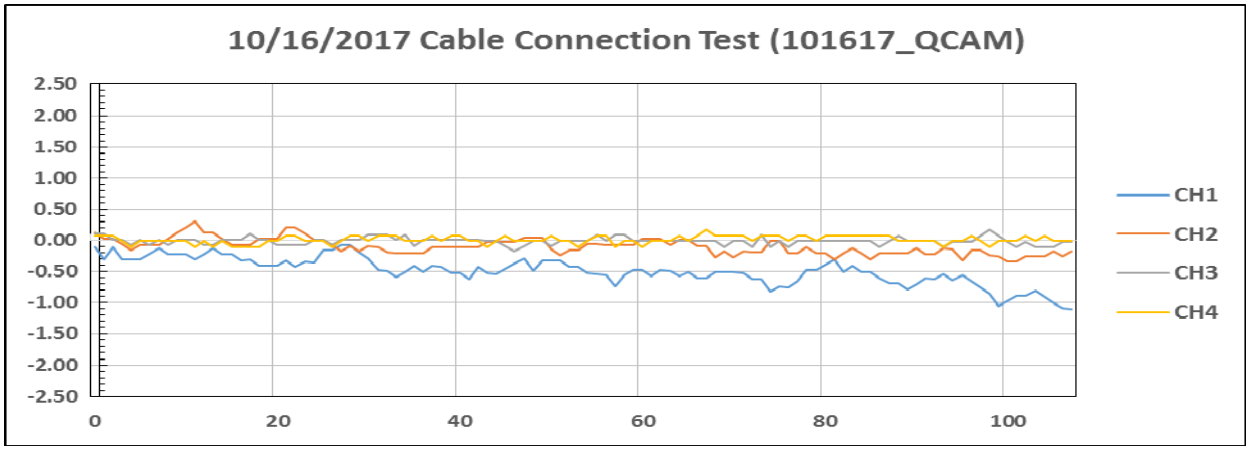


Figure 6 Cable Shake Test

STATIC BACKGROUND TEST

The static background test (**Figure 7**) was performed by collecting data for 3 minutes in an area free of metallic items before and after data collection. The static test indicated the maximum peak to peak deviation specified in the work plan of 2.5 mV was met on all channels. Data from the Static test is displayed in **Table 5** below.

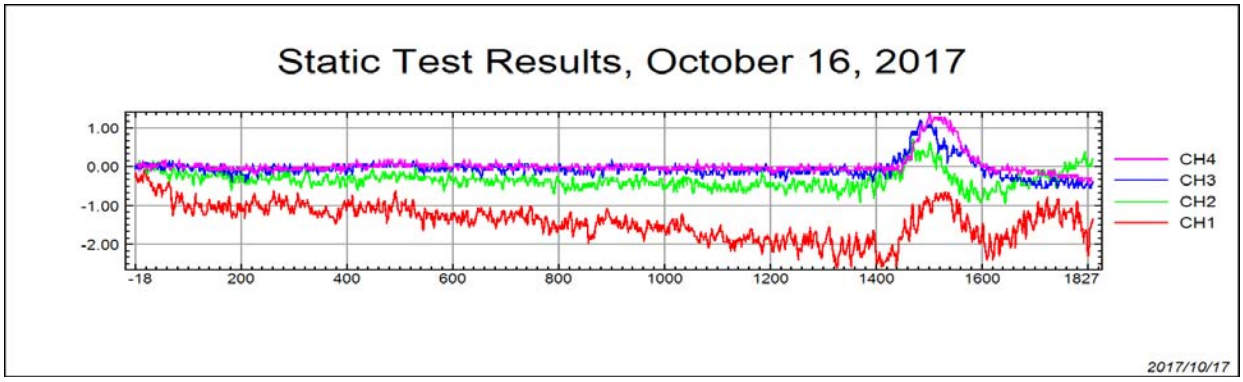


Figure 7 Static Test Results

Table 5 Static Background Test Results				
Channel	**Minimum (mV)**	**Maximum (mV)**	**Mean (mV)**	**SD (mV)**
1	-2.61	-0.07	-1.41	0.45
2	-0.95	0.71	-0.34	0.23
3	-0.56	1.19	-0.05	0.24
4	-0.47	1.38	0.03	0.25

CONCLUSIONS AND RECOMMENDATIONS

Overall, the IVS results demonstrate the capability and effectiveness of the equipment, personnel, and procedures to locate buried simulated MEC items under anticipated conditions at the site to the project depth detection requirements. All of the ISO seed items buried in the IVS were detected and located accurately. WESTON proposes to use sum of channel 1, 2, 3, and 4 (Stack) to identify anomalies. Based on our SNR channel assessment (**Figure 5**) and because random noise tends to cancel we believe this to be the best choice for target selection. The standard deviation (SD) background noise average is 0.88 mV (**Table 4**) as determined by averaging ten Background Noise Lane data sets. A common criterion for establishing a picking threshold based on background noise is 4 to 7 SDs of the background noise (*EM61 101, Nelson and Bell, Spring 2010*). Using 7 SDs, a threshold would be established at 6.16 mV. According to the preliminary conceptual model detailed in the Final UFP-QAPP Kingman Range, munitions debris consisting of potentially small arms projectiles, two mortar fuzes fragments, and pieces from a 3.5-inch rocket were observed during the SI. It is not known from what type of mortar the fuze fragments are from. Due to the low site noise observed in the data and to be conservative, WESTON will base the target picking threshold off the expected response of a 60mm mortar, the smallest mortar, buried at 11 times its diameter for a target threshold of 16.2 mV on the stack channel. Provided in **Figure 8** is a plot of the theoretical response of a 60mm mortar with respect to the target selection threshold. With this threshold, a 60mm mortar can be detected at 66 cm below ground surface in its least favorable orientation, which is 11 times its diameter.

Respectfully Submitted,

Brian Guthrie

Project Geophysicist

Weston Solutions, Inc.

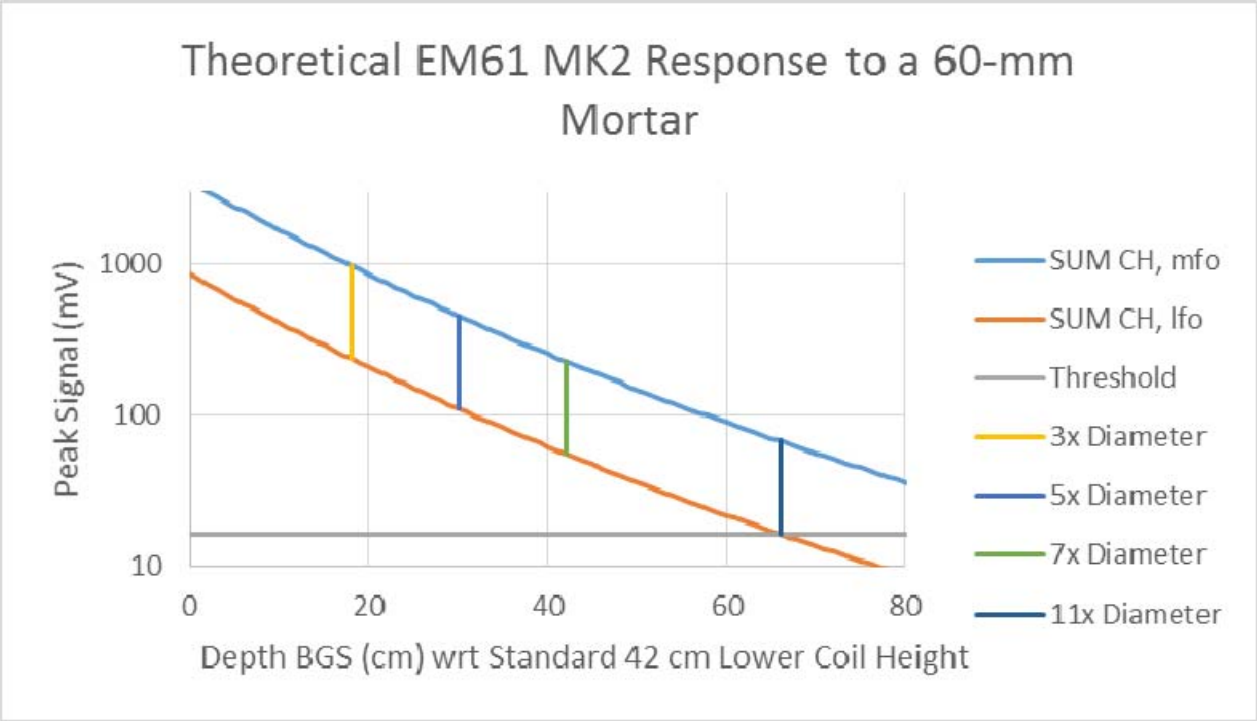


Figure 8. Theoretical response of a 60 mm mortar.

APPENDIX A

PHOTO LOG


SMALL ISO
4"
10/16/17 KINGMAN
RANGE MRS

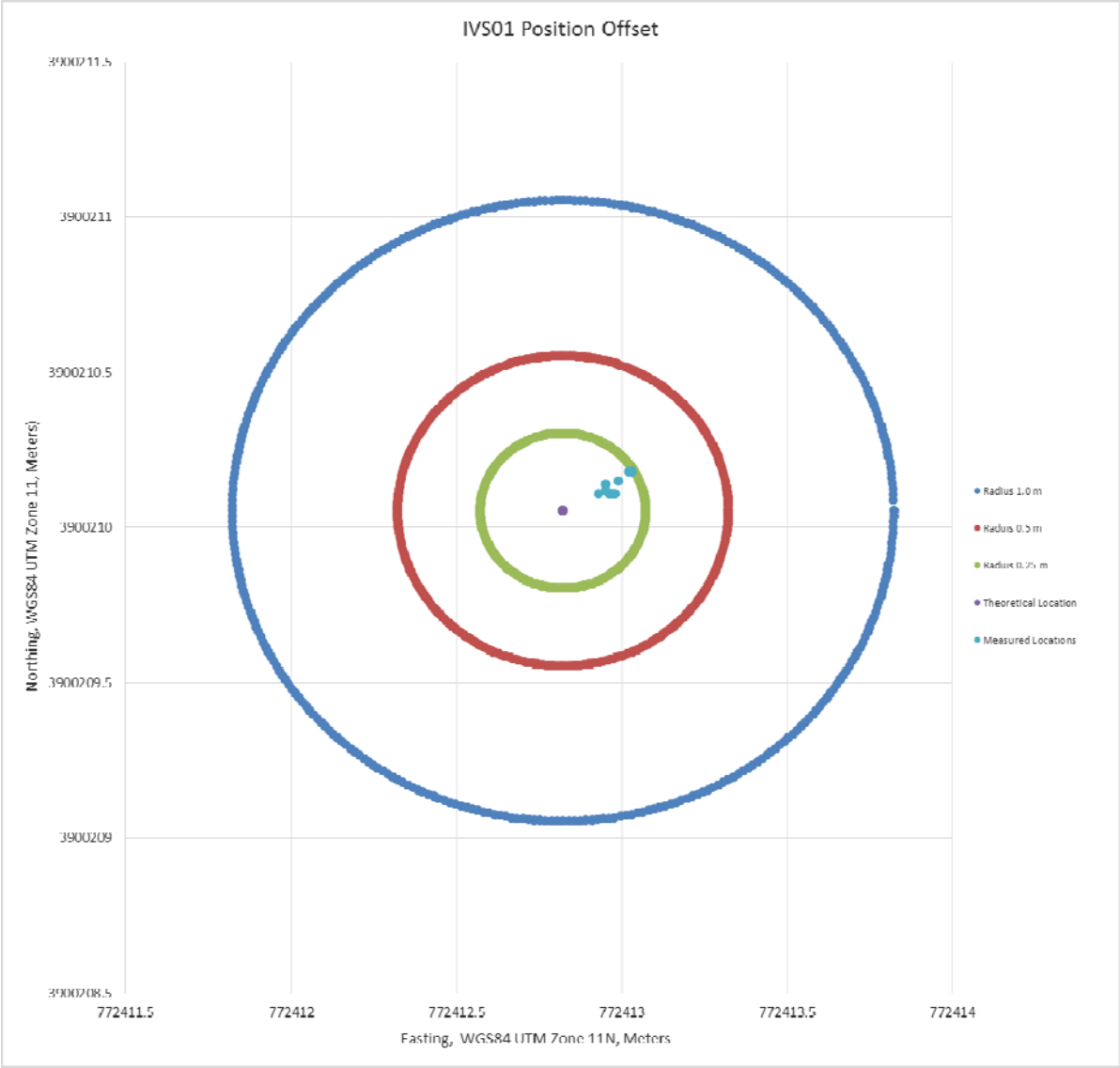

SMALL ISO
6"
10/16/17 KINGMAN
RANGE MRS

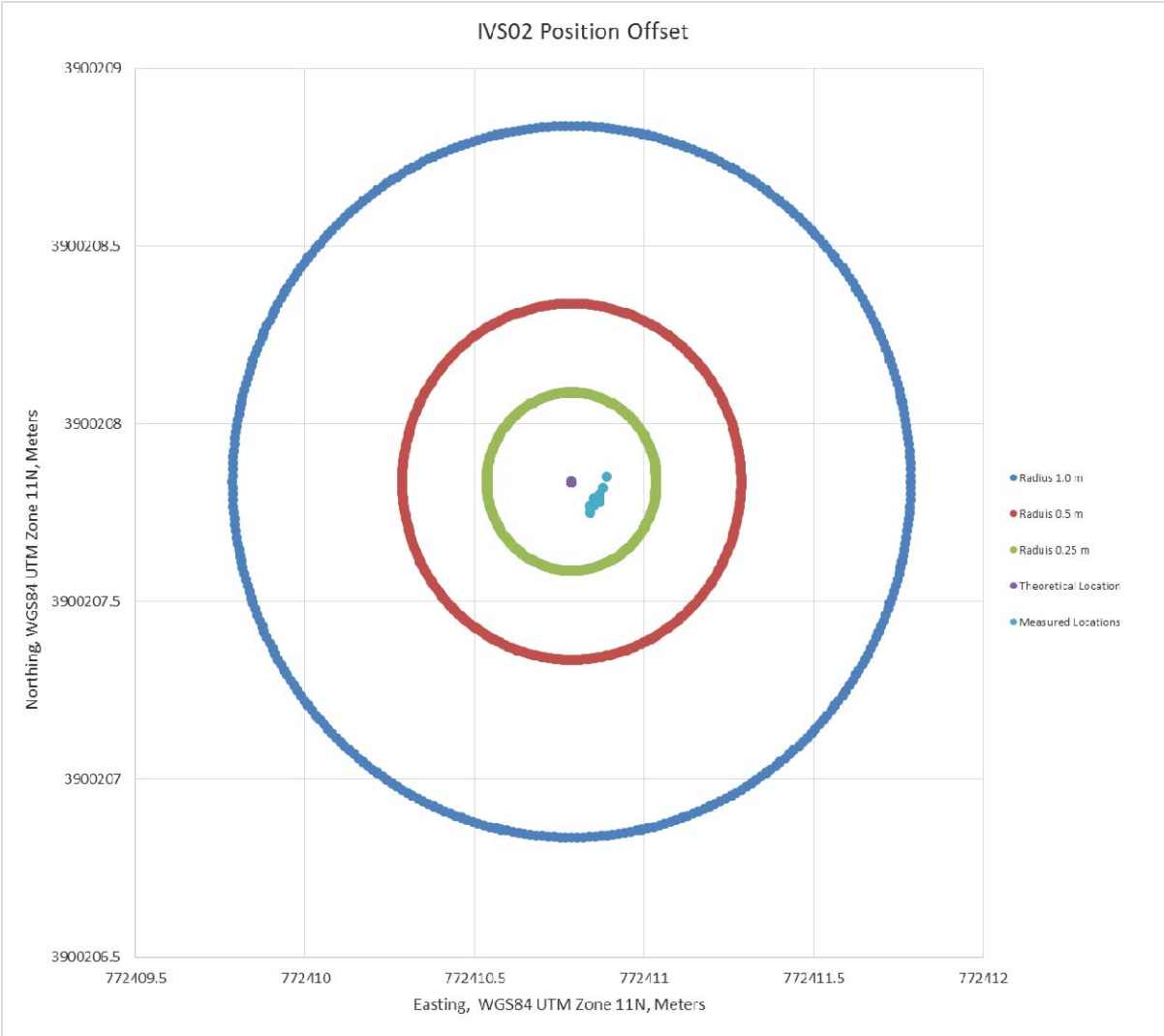

SMALL ISO
8"
10/16/17 KINGMAN
RANGE MRS

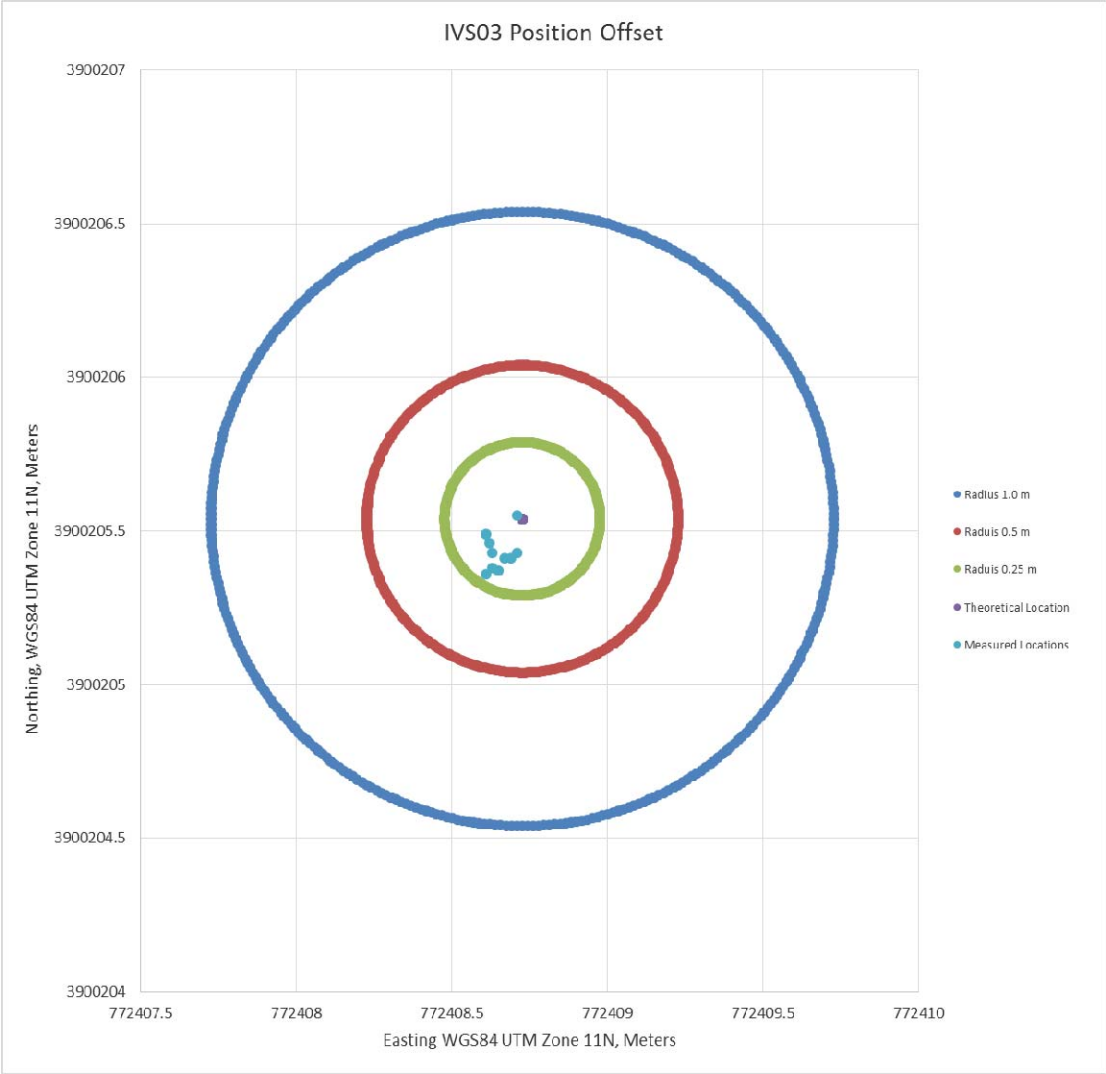

SURVEY NAIL
10/16/17 KINGMAN
RANGE MRS

APPENDIX B

POLAR OFFSET PLOTS


IVS01 Position Offset
3900211.5
3900211
3900210.5
3900210
3900209.5
3900209
3900208.5
Northing, WGS84 UTM Zone 11, Meters)
772411.5
772412
772412.5
772413
772413.5
772414
Easting, WGS84 UTM Zone 11N, Meters
Radius 1.0 m
Radius 0.5 m
Radius 0.25 m
Theoretical Location
Measured Locations


IVS02 Position Offset
3900209
3900208.5
3900208
3900207.5
3900207
3900206.5
Northing, WGS84 UTM Zone 11N, Meters
772409.5
772410
772410.5
772411
772411.5
772412
Easting, WGS84 UTM Zone 11N, Meters
Radius 1.0 m
Radius 0.5 m
Radius 0.25 m
Theoretical Location
Measured Locations


IVS03 Position Offset
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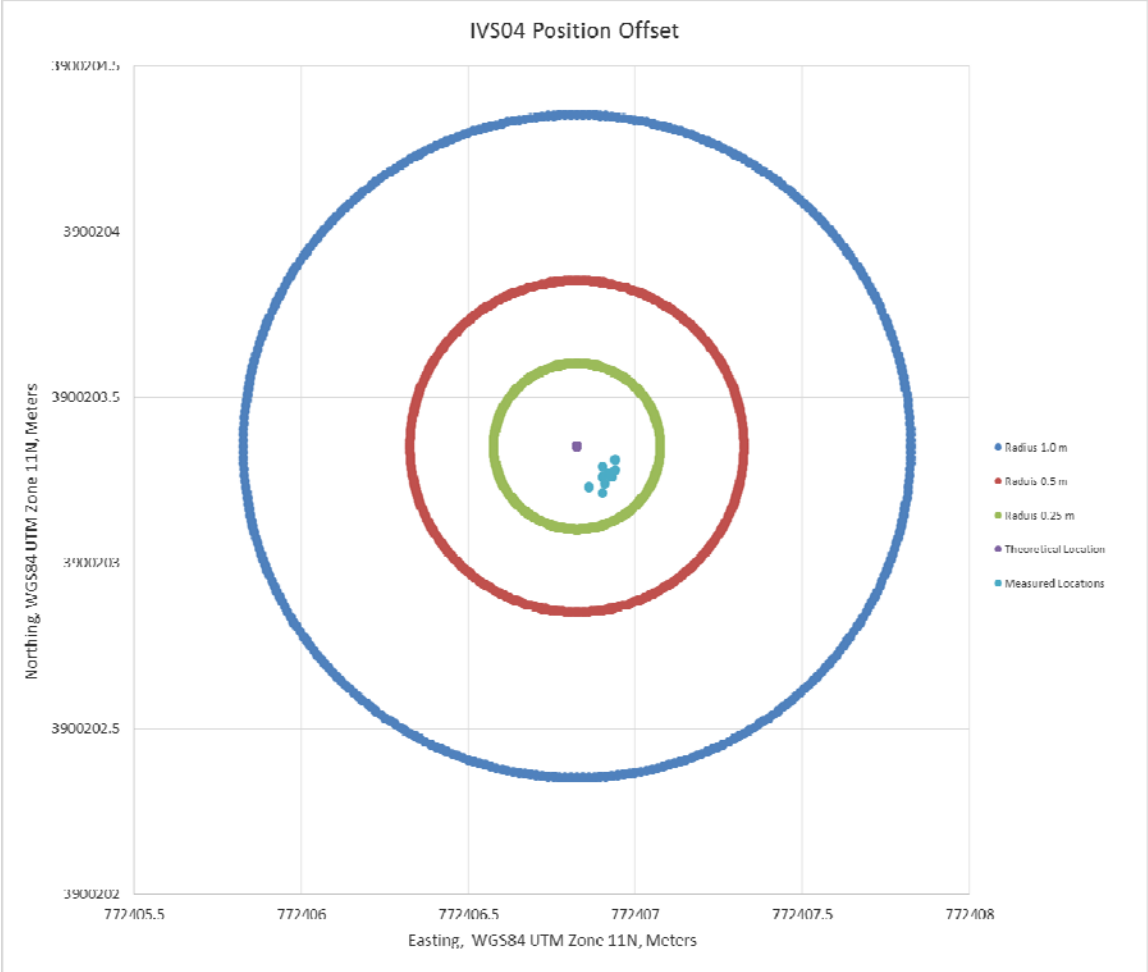
3900206.5
3900206
3900205.5
3900205
3900204.5
3900204
Northing, WGS84 UTM Zone 11N, Meters
772407.5
772408
772408.5
772409
772409.5
772410
Easting WGS84 UTM Zone 11N, Meters
Radius 1.0 m
Raduis 0.5 m
Raduis 0.25 m
Theoretical Location
Measured Locations


IVS04 Position Offset
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3900203.5
3900203
3900202.5
3900202
Northing, WGS84 UTM Zone 11N, Meters
772405.5
772406
772406.5
772407
772407.5
772408
Easting, WGS84 UTM Zone 11N, Meters
Radius 1.0 m
Radius 0.5 m
Radius 0.25 m
Theoretical Location
Measured Locations

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APPENDIX G

DIGITAL GEOPHYSICAL MAPPING DATA

Provided on CD Only

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APPENDIX H

INTRUSIVE INVESTIGATION RESULTS

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APPENDIX H
REMEDIAL INVESTIGATION INTRUSIVE RESULTS

Report Type	Item ID	Project Site Name	Area of Concern Name	Transect/Grid ID	Log Date	Easting (m)	Northing (m)	Item Type	Item Category	Comments	Quantity	Depth (in)	Weight (lbs)	Current Status
Analog	AT-01-201	Kingman	Kingman Range MRS	AT-01	7/16/2018 17:36	772547.52	3900103.81	Grenade, Rifle	Munitions Debris	M22 smoke, empty	1	0.00	1.00	Removed from site
Analog	AT-01-202	Kingman	Kingman Range MRS	AT-01	7/16/2018 18:02	772513.37	3900157.20	Blind QC 1” x 4” pipe	Seed	Blind QC Seed #AT-01	1	0.00	0.50	Removed from site
Analog	AT-02-201	Kingman	Kingman Range MRS	AT-02	7/16/2018 18:03	772573.14	3900079.49	Blind QC 1” x 4” pipe	Seed	Blind QC Seed #AT-02	1	0.00	0.50	Removed from site
Analog	AT-03-201	Kingman	Kingman Range MRS	AT-03	7/16/2018 18:05	772594.65	3900067.25	Projectile	Munitions Debris	M29 tail fin	1	0.00	0.10	Removed from site
Analog	AT-04-201	Kingman	Kingman Range MRS	AT-04	7/16/2018 18:06	772653.31	3899986.84	Projectile	Munitions Debris	M29 tail schroud	1	0.00	0.50	Removed from site
Analog	AT-05-201	Kingman	Kingman Range MRS	AT-05	7/16/2018 18:08	772565.67	3900130.79	Projectile	Munitions Debris	M29 nose cone	1	0.00	1.00	Removed from site
DGM	T04-1-1	Kingman	Kingman Range MRS	T04	7/17/2018 15:16	772549.47	3900070.30	Can	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T04-2-1	Kingman	Kingman Range MRS	T04	7/17/2018 15:16	772556.46	3900053.91	Wire	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T04-3-1	Kingman	Kingman Range MRS	T04	7/17/2018 15:17	772559.23	3900051.08	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T04-4-1	Kingman	Kingman Range MRS	T04	7/17/2018 15:18	772559.61	3900050.26	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T04-5-1	Kingman	Kingman Range MRS	T04	7/18/2018 14:04	772570.95	3900028.71	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T04-6-1	Kingman	Kingman Range MRS	T04	7/18/2018 14:03	772588.29	3900001.51	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T04-7-1	Kingman	Kingman Range MRS	T04	7/18/2018 14:04	772592.38	3899992.69	Wire	Non-Munitions Related Debris		1	2.00	0.10	Removed from site
DGM	T08-8-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:18	772630.70	3900002.67	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T08-9-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:19	772630.24	3900003.54	Foil	Non-Munitions Related Debris		1	3.00	0.10	Removed from site
DGM	T08-10-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:19	772629.94	3900003.95	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T08-11-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:20	772629.35	3900005.35	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T08-12-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:20	772628.95	3900006.34	Metal Scrap	Non-Munitions Related Debris		1	1.00	0.10	Removed from site
DGM	T08-13-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:22	772627.85	3900008.71	Projectile	Munitions Debris	M29 tail fin	1	4.00	0.10	Removed from site
DGM	T08-14-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:23	772626.41	3900010.76	Mortar	Munitions Debris	60mm	1	6.00	0.50	Removed from site
DGM	T08-15-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:24	772622.71	3900015.74	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T08-16-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:24	772622.58	3900016.52	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T08-17-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:25	772613.85	3900030.52	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T08-18-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:25	772608.75	3900038.08	Wire	Non-Munitions Related Debris		1	0.00	0.50	Removed from site
DGM	T08-19-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:26	772606.64	3900038.72	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T08-20-1	Kingman	Kingman Range MRS	T08	7/17/2018 15:27	772603.46	3900041.73	Frag	Munitions Debris		1	0.00	0.10	Removed from site
DGM	T07-21-1	Kingman	Kingman Range MRS	T07	7/17/2018 15:27	772594.35	3900043.12	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T15-22-1	Kingman	Kingman Range MRS	T15	7/17/2018 15:28	772593.08	3900020.72	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T15-23-1	Kingman	Kingman Range MRS	T15	7/18/2018 14:05	772595.25	3900009.61	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T15-24-1	Kingman	Kingman Range MRS	T15	7/18/2018 14:06	772597.12	3900006.46	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T15-25-1	Kingman	Kingman Range MRS	T15	7/18/2018 14:07	772597.83	3900004.88	Other	Small Arms		1	2.00	0.10	Removed from site
DGM	T15-26-1	Kingman	Kingman Range MRS	T15	7/18/2018 14:11	772601.74	3899998.58	Projectile	Munitions Debris	M29 tail fin	1	0.00	0.10	Removed from site
DGM	T07-27-1	Kingman	Kingman Range MRS	T07	7/17/2018 15:29	772620.59	3899994.42	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T07-28-1	Kingman	Kingman Range MRS	T07	7/17/2018 15:30	772620.22	3899995.99	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T07-29-1	Kingman	Kingman Range MRS	T07	7/17/2018 15:31	772618.80	3900001.55	Foil	Non-Munitions Related Debris		1	1.00	0.10	Removed from site
DGM	T07-30-1	Kingman	Kingman Range MRS	T07	7/17/2018 15:31	772614.69	3900005.21	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T07-31-1	Kingman	Kingman Range MRS	T07	7/17/2018 17:50	772612.36	3900008.13	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T07-32-1	Kingman	Kingman Range MRS	T07	7/17/2018 17:50	772610.48	3900010.85	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T07-33-1	Kingman	Kingman Range MRS	T07	7/17/2018 17:51	772600.24	3900034.64	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T07-34-1	Kingman	Kingman Range MRS	T07	7/17/2018 17:51	772595.65	3900042.63	Other	Small Arms		1	2.00	0.10	Removed from site
DGM	T15-35-1	Kingman	Kingman Range MRS	T15	7/17/2018 17:52	772569.21	3900054.17	Frag	Munitions Debris		2	0.00	1.00	Removed from site
DGM	T15-36-1	Kingman	Kingman Range MRS	T15	7/17/2018 17:53	772569.34	3900051.00	Frag	Munitions Debris		1	2.00	0.50	Removed from site
DGM	T15-37-1	Kingman	Kingman Range MRS	T15	7/17/2018 17:53	772570.58	3900050.14	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T03-38-1	Kingman	Kingman Range MRS	T03	7/18/2018 14:12	772581.08	3899985.11	Wire	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T03-39-1	Kingman	Kingman Range MRS	T03	7/18/2018 14:13	772567.59	3900014.24	Frag	Munitions Debris		2	0.00	1.00	Removed from site
DGM	T03-40-1	Kingman	Kingman Range MRS	T03	7/17/2018 18:07	772539.29	3900069.62	Frag	Munitions Debris		1	0.00	0.10	Removed from site
DGM	T03-41-1	Kingman	Kingman Range MRS	T03	7/17/2018 18:08	772538.74	3900071.67	Metal Scrap	Non-Munitions Related Debris		1	4.00	0.10	Removed from site
DGM	T03-42-1	Kingman	Kingman Range MRS	T03	7/17/2018 18:08	772537.66	3900072.89	Can	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T03-43-1	Kingman	Kingman Range MRS	T03	7/18/2018 14:13	772501.54	3900131.19	Blind QC 1” x 4” pipe	Seed	Blind QC Seed #BS01	1	3.00	0.50	Removed from site
DGM	T02-44-1	Kingman	Kingman Range MRS	T02	7/18/2018 14:15	772515.81	3900080.88	Other	Small Arms		1	0.00	0.10	Removed from site
DGM	T02-45-1	Kingman	Kingman Range MRS	T02	7/18/2018 14:15	772515.85	3900080.18	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T02-46-1	Kingman	Kingman Range MRS	T02	7/18/2018 14:16	772530.45	3900063.24	Other	Small Arms		1	1.00	0.10	Removed from site
DGM	T01-47-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:17	772537.16	3900021.06	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.50	Removed from site
DGM	T01-48-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:18	772535.99	3900023.41	Metal Scrap	Non-Munitions Related Debris		1	4.00	0.50	Removed from site
DGM	T01-49-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:18	772504.71	3900082.07	Link	Small Arms		1	0.00	0.10	Removed from site
DGM	T01-50-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:19	772502.17	3900083.79	Nail	Non-Munitions Related Debris		1	0.00	0.10	Removed from site

APPENDIX H
REMEDIAL INVESTIGATION INTRUSIVE RESULTS

Report Type	Item ID	Project Site Name	Area of Concern Name	Transect/Grid ID	Log Date	Easting (m)	Northing (m)	Item Type	Item Category	Comments	Quantity	Depth (in)	Weight (lbs)	Current Status
DGM	T01-51-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:20	772498.03	3900093.41	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T01-52-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:20	772487.80	3900102.92	Metal Scrap	Non-Munitions Related Debris		1	12.00	0.50	Removed from site
DGM	T01-53-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:21	772476.72	3900128.65	Wire	Non-Munitions Related Debris		1	0.00	0.50	Removed from site
DGM	T01-54-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:21	772469.90	3900141.20	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	T01-55-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:22	772456.14	3900155.24	Metal Scrap	Non-Munitions Related Debris		1	1.00	0.10	Removed from site
DGM	T01-56-1	Kingman	Kingman Range MRS	T01	7/18/2018 14:23	772456.18	3900155.81	NA	Duplicate Target	Same as target #55	0	1.00		NA
DGM	TA06-57-1	Kingman	Kingman Range MRS	TA06	7/17/2018 17:55	772563.59	3900178.54	Metal Scrap	Non-Munitions Related Debris		1	0.00	0.10	Removed from site
DGM	TA06-58-1	Kingman	Kingman Range MRS	TA06	7/17/2018 17:55	772568.17	3900156.40	Other	Small Arms		1	0.00	0.10	Removed from site
Analog	G01-01-1	Kingman	Kingman Range MRS	G01	5/21/2019 12:00	772548.62	3900076.19	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G01-02-1	Kingman	Kingman Range MRS	G01	5/21/2019 12:00	772556.08	3900078.89	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G01-03-1	Kingman	Kingman Range MRS	G01	5/21/2019 12:00	772555.76	3900072.70	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G01-04-1	Kingman	Kingman Range MRS	G01	5/21/2019 12:00	772552.74	3900072.54	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G01-05-1	Kingman	Kingman Range MRS	G01	5/21/2019 12:00	772550.36	3900073.65	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-01-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772567.98	3900050.32	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-02-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772571.64	3900052.70	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-03-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772567.67	3900056.35	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-04-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772573.70	3900059.68	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G02-05-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772577.51	3900058.57	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-06-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772575.92	3900052.22	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-07-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772579.10	3900050.79	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G02-08-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772570.21	3900058.89	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G02-09-1	Kingman	Kingman Range MRS	G02	5/21/2019 12:00	772570.37	3900056.03	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G03-01-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772606.40	3900041.75	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G03-02-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772605.29	3900035.87	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G03-03-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772597.35	3900035.08	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G03-04-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772600.05	3900043.02	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G03-05-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772608.47	3900035.55	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G03-06-1	Kingman	Kingman Range MRS	G03	5/21/2019 12:00	772608.62	3900043.97	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G04-01-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772623.55	3900007.45	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G04-02-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772620.37	3900003.96	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G04-03-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772624.98	3900004.28	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G04-04-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772618.31	3900013.33	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site
Analog	G04-05-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772622.28	3900010.15	Frag	Munitions Debris		1	3.00	0.05	Removed from site
Analog	G04-06-1	Kingman	Kingman Range MRS	G04	5/21/2019 12:00	772618.31	3900009.04	Metal Scrap	Non-Munitions Related Debris		1	3.00	0.05	Removed from site

APPENDIX I

MATERIAL DOCUMENTED AS SAFE DOCUMENTATION

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DMI DEMIL METALS, INC.

601 N. Skokie Blvd
Northbrook, IL 60062

Date: *12/20/18*

From: Mike Schaffer
Demil Metals, Inc.
601 N Skokie Blvd. #207
Northbrook, Il. 60062

To: Weston Solutions, Inc.
ATTN: Anthony Rodriguez
841 Bishop St, Suite 2301
Honolulu, Oahu, Hawaii

SUBJECT: Certification of Destruction

Demil Metals, Inc., certifies that the contents of the sealed container received on *07/23/18* from Weston Solutions, Inc; King Range MRS, Kingman, AZ; Contract Number W912DR-15-D-0022, PO# 0097083 project site were demilitarized in accordance with guidelines in DoD 4160.21-lVI-l and have been shredded and are only identifiable by their basic content.

Seal #'s Container 001 Seal # B-433273

Signed:

Name: Michael Schaffer

Point of Contact Information: mike@demilmetals.com 847-929-9650

DEMIL METALS, INC.
P.O. BOX 126
GLENCOE, IL 60022

Tel: 847.266.0117 www.demilmetals.com Fax: 847.266.0119

CHAIN OF CUSTODY

Project: Kingman Range MRS

Site Location: Kingman Range MRS, Kingman, AZ	Date:07/18/18

Description of Material Documented as Safe (MDAS): 3.5 inch M29 Practice Rocket components and 60 mm Mortar Frag, and M22 Rifle Grenade expended - assorted brass, and mix metals.

Obtained from (name, title, address, phone, email): Weston Solutions, Inc., Brain Grassmyer (SUXOS), (757) 650-3607, Kingman Range MRS, Kingman, AZ.

Printed name/ title: Brian Grassmyer (SUXOS)	Signature: Brian R Grassmyer	Date obtained: 07/18/18

Load #/ Bin #: Container 001 (Black Tool Box approx. 10 Gallon) Seal #B-433273 (Locked and Sealed)

The contents of this container will not be co-mingled, sold, traded, or otherwise given to another party until the contents have been processed and are only identifiable by their basic metal content.

Temporary disposition of item(s): Roswell North Range, secure conex pending shipment.

Released by (printed name/ signature): ANTHONY RODRIGUEZ	Released to (printed name/ signature): FEDEX 8120 9818 6702	Date: 1555 7/18/18

Temporary disposition (location):

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:

Temporary disposition (location):

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:

Temporary disposition (location):

Released by (printed name/ signature): Michael Sloan	Released to (printed name/ signature): DEMIL METALS, INC.	Date: 7/23/18

Attach additional pages as necessary.

DEMIL METALS, INC
P.O. BOX 128
GLENCOE, IL 60022

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

1 2 3	4 5 6	7	23 24	25 26 27 28 29	45 46 47 48 49	50 51 52	53 54 55	56 57 58	59 60 61	62 63	64 65	66 67	68 69	70 71	72 73	74 75 76 77 78 79 80
DOCUMENT	RI FROM	M&S	UNIT	ISS QUANTITY	SER SUPPLEMENTARY ADDRESS	SIG FUND	DISTRIBUTION	PROJECT	PRI	REQD DEL DATE	ADV	RI	O/P COND	MGT		

1. TOTAL PRICE		2. SHIP FROM	3. SHIP TO
UNIT PRICE DOLLARS / CTS	DOLLARS / CTS	Kingman Range MRS Kinhgman, AZ	615 Northwest Ave North Lake, IL 60164
		4. MARK FOR	

5. DOC DATE	6. NMFC	7. FRT RATE	8. TYPE CARGO	9. PS
07/18/2018				

10. QTY. REC'D	11. UP	12. UNIT WEIGHT	13. UNIT CUBE	14. UFC	15. SL
		estimated 7 lbs			

16. FREIGHT CLASSIFICATION NOMENCLATURE
Munitions Debris /Mixed Metals /Steel/Brass

17. ITEM NOMENCLATURE
Munitions Debris

18. TY CONT	19. NO CONT	20. TOTAL WEIGHT	21. TOTAL CUBE

22. RECEIVED BY — 23. DATE RECEIVED 7/23/18

DEMI METALS INC
P.O. BOX 126
GLENCOE, IL 60022

PREVIOUS EDITION MAY BE USED

24. DOCUMENT NUMBER & SUFFIX (30-44)

Weston Solutions
1435 Garrison Street, Suite 100
Lakewood, CO 80215

Contract # W912DR-15-D-0022 / 0001

Signature of receiving agent: _____

25. NATIONAL STOCK NO. & ADD (8-22)

Munitions Debris (Material Documented as Safe)

Estimated weight: 7 lbs Actual weight: 7 lbs

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

King Range MRS
Kingman, AZ
CONTRACT NO. / D.O. NO.: W912DR-15-D-0022 / 0001
Weston Solutions, Inc./ Container #001 Seal # B-433273

27. ADDITIONAL DATA

This certifies and verifies that the material listed has been 100% inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related materials

Brian Grassmyer, Senior UXO Supervisor
Cell: 757-650-3607 Brian R Grassmyer

Robert Prosperi, UXO Quality Control Specialist
Cell: 828-450-3179

Adobe Designer 7.0

DMI DEMIL METALS, INC.

601 N. Skokie Blvd
Northbrook, IL 60062

Date: *07/31/19*

From: Mike Schaffer
Demil Metals, Inc.
601 N Skokie Blvd. #207
Northbrook, Il. 60062

To: Weston Solutions, Inc.
ATTN: Anthony Rodriguez
841 Bishop St, Suite 2301
Honolulu, Oahu, Hawaii

SUBJECT: Certification of Destruction

Demil Metals, Inc., certifies that the contents of the sealed container received on *07/01/19* from Weston Solutions, Inc; NDNODS Kingman Range MRS, Mohave Co, AZ; Contract Number W912DR-15-D-0022, PO# 0097083 project site were demilitarized in accordance with guidelines in DoD 4160.21-lVI-l and have been shredded and are only identifiable by their basic content.

Seal #'s Container 001 Seal # 1528345

Signed:

Name: Michael Schaffer

Point of Contact Information: mike@demilmetals.com 847-929-9650

DEMIL METALS, INC
P.O. BOX 128
GLENCOE, IL 60022

CHAIN OF CUSTODY

Project: **MMRP Kingman Range, Mohave County, Arizona.** CONTRACT # W912DR-15-D-0022 Delivery Order: 0001

Site Location: Kingman Range MRS	Date: 21 May 2019

Description of Item(s): Materials Documented as Safe (mixed metals).

Obtained from (name, title, address, phone, email): recovered at NDNODS Kingman Range, MRS Mohave Co. AZ

Printed name/ title:	Signature:	Date obtained:
WR Stern SUXOS Weston Solutions		21 May 2019

Load #/ Bin #: Shipped Fed Ex to Demil Metals

The contents of this container will not be co-mingled, sold, traded, or otherwise given to another party until the contents have been processed and are only identifiable by their basic metal content.

Temporary disposition of item(s): smelting

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:
Demil Metals, Mike Schaffer	Mike Schaffer DEMIL METALS, INC P.O. BOX 126 GLENCOE, IL 60022	7/1/19

Temporary disposition (location):

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:

Temporary disposition (location):

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:

Temporary disposition (location):

Released by (printed name/ signature):	Released to (printed name/ signature):	Date:

Attach additional pages as necessary.

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

DOC IDENT	RI FROM	M&S	UNIT	ISS	QUANTITY	SUPPLEMENTARY ADDRESS	SIG	FUND	DISTRIBUTION	PROJECT	PRI	REQD	DEL DATE	ADV	RI	O/P	COND	MGT	UNIT PRICE	DOLLARS	CTS

1. TOTAL PRICE

2. SHIP FROM: NDNODS Kingman Range MRS Mohave Co AZ

3. SHIP TO: Block 27 see additional data

4. MARK FOR

5. DOC DATE: 20171109

6. NMFC

7. FRT RATE

8. TYPE CARGO: Container (Box)

9. PS

10. QTY. REC'D: N/A

11. UP

12. UNIT WEIGHT

13. UNIT CUBE

14. UFC

15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE: Munitions Documented As Safe (MDAS) - Mixed Metal

18. TY CONT

19. NO CONT

20. TOTAL WEIGHT

21. TOTAL CUBE

22. RECEIVED BY: DEMIL METALS, INC P.O. BOX 126 GLENCOE, IL 60022

23. DATE RECEIVED: 7/01/19

PREVIOUS EDITION MAY BE USED

24. DOCUMENT NUMBER & SUFFIX (30-44)

Mixed Metal- Material Documented as Safe (MDAS)
Contract #: W912DR-15-D-0022/001
Container# 001 Seal#s 1528345 Weight 3LBS

25. NATIONAL STOCK NO. & ADD (8-22)

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

Certified by: WR Stern
SUXOS
Weston Solutions
Suite, 101, 960 W. Elliot Rd
Tempe, AZ 85284
Signature

Verified by: Doug Gates
UXOQCS/UXOSO
Weston Solutions
Suite 101, 960 W. Elliot Rd
Tempe, AZ 85284
Signature

27. ADDITIONAL DATA

"Material has been 100% inspected and 100% re-inspected and is determined to be free of an explosive hazard."
Block 3 Ship to : Demil Metals, Inc.
ATTN: Mike Schaffer
601 N. Skokie Blvd # 302
Northbrook, IL. 60062
P: 847-266-0117

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APPENDIX J

FINAL ANALYTICAL LABORATORY DATA QS/QC SUMMARY REPORT

Analytical Data & Validation Data on CD Only

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FINAL
ANALYTICAL LABORATORY DATA
QA/QC SUMMARY REPORT

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION / FEASIBILITY STUDY

KINGMAN RANGE MRS (AZHQ-006-R-01)
MOHAVE COUNTY, ARIZONA

CONTRACT NO. W912DR-15-D-0022
DELIVERY ORDER 0001`

Prepared For:

U.S. ARMY CORPS OF ENGINEERS,
SACRAMENTO DISTRICT
1325 J Street
Sacramento, CA 95814

ARMY NATIONAL GUARD DIRECTORATE
111 South George Mason Drive
Arlington, VA 22204

ARIZONA ARMY NATIONAL GUARD
5636 East McDowell Road, Building M5330
Phoenix, AZ 85008

Prepared By:
WESTON SOLUTIONS, INC.
1435 Garrison Street, Suite 100
Lakewood, CO 80215

January 2021

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TABLE OF CONTENTS

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1.0 INTRODUCTION

This Quality Assurance/Quality Control (QA/QC) Report for Sample Delivery Group (SDG) 280-102553-1 summarizes the evaluation of laboratory data collected to support the remedial investigation and feasibility study at Kingman Range MRS located in Mohave County, Arizona. These data have been reviewed and validated to evaluate compliance with QA/QC criteria based on data quality objectives (DQOs) specified in the *Kingman Range MRS Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (WESTON, 2017).

This appendix to the *Kingman Range MRS Remedial Investigation/Feasibility Study Report* includes a QA/QC Summary Report for each SDG; a sample summary, including all samples collected and submitted to the laboratory for the associated site; and the analytical laboratory reports for each SDG (provided in electronic format).

Acceptance criteria for this project are specified in the *Kingman Range MRS UFP-QAPP*; the accepted analytical methods; and the analytical laboratory standard operating procedures (SOPs). Non-conformances of data are identified, discussed, and qualified in this report. Any potential bias resulting from the data quality issue identified by a qualifier is discussed in this report. When possible, direction of potential bias is assigned.

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2.0 DATA REVIEW, VERIFICATION, VALIDATION, AND QUALIFICATION

Data review, verification, and validation were performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved with the project. The data review, verification, and validation procedures described in Worksheets #34 through #37 of the *Kingman Range MRS UFP-QAPP* were followed.

The following information was reviewed as part of the data validation:

- Sample handling and chain of custody (CoC);
- Sample preservation and holding time compliance;
- Field QC samples (including field duplicates);
- Laboratory reporting limits, including the detection limit (DL) and limit of quantitation (LOQ);
- Method blank (MB) sample recovery;
- Laboratory control sample (LCS) and LCS duplicate (LCSD) recoveries;
- Surrogate spike recoveries;
- Matrix spike (MS) and MS duplicate (MSD) recoveries;
- Serial dilution differences;
- Initial and continuing calibration summary information;
- Precision, including relative percent difference values for duplicate analyses;
- Case narrative review, laboratory flagging review, and other analytical method-specific criteria; and
- Completeness.

Analytical DQOs were considered met when the quality of the sample data met the precision, accuracy, representativeness, completeness, comparability, and sensitivity requirements specified in the *Kingman Range MRS UFP-QAPP* (WESTON, 2017).

Qualifiers applied to the analytical data set, as appropriate, included the following:

- R – The data are rejected because of deficiencies in meeting QC criteria and may not be used for decision making.
- U – The constituent was analyzed for, but not detected.
- UJ – The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.

- J – The analyte was positively identified, and the quantitation is an estimated because of discrepancies in meeting certain analyte-specific QC criteria; or the analyte was positively identified, but the associated concentration is estimated greater than or equal to the DL and below the LOQ.
- B – The analyte was detected in the sample at a concentration less than or equal to five times the amount found in the method blank (ten times for common laboratory contaminants).

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers listed in order of the most severe through the least severe are R, B, J, UJ, and U.

3.0 DATA QUALITY SUMMARY

Seven soil samples were collected for this SDG. Test America Laboratories of Arvada, Colorado performed chemical analyses for explosives and trace metals on four and seven samples respectively. The analyses for all parameters were performed in accordance with the *Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories* (DoD, 2017). Samples were prepared and analyzed in accordance with analytical methods specified in *Test Methods for Evaluating Solid Waste SW-846* (United States Environmental Protection Agency [USEPA], 2007); and laboratory SOPs.

A review and assessment of the analytical results and associated QC samples found the overall quality of the project data to be acceptable. Results of this evaluation are provided in the following sections.

3.1 SAMPLE HANDLING AND CHAIN-OF-CUSTODY AND PRESERVATION

The COC forms and laboratory case narratives were reviewed to assess sample handling procedures that may affect the integrity of the samples and quality of the resulting data. Copies of COCs and cooler receipt forms were included in the data deliverables from the laboratories.

Samples were packed with ice and shipped to the Test America laboratory in Arvada, Colorado via FedEx. The COC forms, cooler receipt documentation, and laboratory case narratives were reviewed to determine if any sample handling procedures might affect the integrity of the samples and the quality of the resulting data. These included handling issues such as temperature blank and ambient cooler temperatures, holding times, and container integrity. All project UFP-QAPP requirements were met. All samples were properly preserved for the analytical procedures utilized for this project.

3.2 HOLDING TIME COMPLIANCE

All samples were extracted and/or analyzed within the recommended hold time.

3.3 LABORATORY REPORTING LIMITS

Laboratory-specific DLs and LOQs were evaluated against the project action limits, cleanup levels, and/or screening criteria to determine whether the sensitivity of the data is sufficient for its intended use. Project-required DLs and LOQs are included in Worksheet #15 of the *Kingman Range MRS UFP-QAPP*.

Unless dilution was required during analysis due to high concentrations of method-specific analytes, the laboratory DLs and LOQs achieved by the laboratory met the project objectives.

3.4 METHOD BLANK SAMPLE RECOVERY

Method blank samples are prepared and analyzed concurrently with each batch of 20 or fewer samples for each analytical procedure performed for this project. These samples are prepared in the laboratory in conjunction with field samples to monitor for potential introduction of contamination during the laboratory analytical procedure.

For this project, method blank samples were analyzed at the required frequency. None of the analytes were detected in the method blanks.

3.5 LABORATORY CONTROL SAMPLE/LABORATORY CONTROL SAMPLE DUPLICATE ANALYSIS

The LCS samples (and LCSD samples, if required) are prepared and analyzed concurrently with each batch of 20 or fewer samples. The primary purpose of the LCS is to demonstrate that the laboratory can perform the overall analytical approach in a matrix free of interferences (e.g., in reagent water, clean sand, or another suitable reference matrix).

All analyte recoveries from the LCS/LCSD met the recovery criteria specified in *Kingman Range MRS UFP-QAPP* and DoD QSM 5.1, except as noted in Section 4.0.

3.6 MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERIES

The MS/MSD samples are prepared (if applicable) and analyzed concurrently with a batch of 20 or fewer samples for each analytical procedure performed for this project. Analyte recoveries from the field sample matrices may be used to assess the presence and effect of physical and chemical interferences associated with the sample matrices.

All MS/MSD recoveries met the recovery criteria specified in *Kingman Range MRS UFP-QAPP* and DoD QSM 5.1, except as noted in Section 4.0.

3.7 SERIAL DILUTION

Serial dilution test is performed on a sample if MS or MSD analysis fails to determine whether or not significant physical or chemical interferences exist due to sample matrix.

All serial dilution percent differences met QC criteria specified in *Kingman Range MRS UFP-QAPP* and DoD QSM 5.1, except as noted in Section 4.0.

3.8 SURROGATE SPIKE RECOVERIES

Surrogates are specified for organic chromatographic analytical procedures. Surrogates are compounds chemically similar to those tested and are specified for methods employed for this project. Surrogate recoveries are used to evaluate accuracy, method performance, and extraction efficiency.

Surrogate recoveries met the criteria specified in *Kingman Range MRS UFP-QAPP* and DoD QSM 5.1, except as noted in Section 4.0.

3.9 INITIAL AND CONTINUING CALIBRATION SUMMARY INFORMATION

Initial calibration verification (ICV) and continuing calibration verification check (CCV/CCC) standards are analyzed to monitor instrument performance prior to, during, and/or at the conclusion of sample analysis sequences. Frequency and acceptable ranges for each analysis performed for this project are outlined in *Kingman Range MRS UFP-QAPP*, DoD QSM 5.1, the analytical methods, or the laboratory SOPs.

All ICV and CCV/CCC recoveries met control criteria specified, except as noted in Section 4.0.

3.10 PRECISION

Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms. Precision data are used to evaluate consistency and reproducibility of field sampling and/or analytical procedures. Precision was evaluated by comparing the following:

- The LCS and LCSD (if prepared and analyzed) to determine the precision of the laboratory procedures and verify matrix interference.
- The MS and MSD samples to determine the effect of the sample matrix on the precision of the results generated using the selected analytical method.
- Primary and field duplicate sample results.

Field duplicates are generally collected at a frequency of 10 percent (one per 10 or fewer primary samples, per analyte, per matrix). Evaluation of field duplicate results is performed by calculation of the relative percent difference (RPD) between the parent sample and its field duplicate for every analyte of interest and matrix. In general, acceptance criteria are RPD less than 50% for soils and 30% for waters.

Precision measurements met the criteria specified in *Kingman Range MRS UFP-QAPP* and DoD QSM 5.1, except as noted in Section 4.0

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4.0 ANALYTICAL METHODS

The following sections describe the results of the review and assessment of data for each analytical method. Measurement performance criteria for each analytical method are included in Worksheet #12 of the *Kingman Range MRS UFP-QAPP*. Quality control exceedances identified during the review may require results to be qualified. Qualified results are considered estimated and, whenever possible, potential direction of bias is indicated.

In general, site characterization samples were collected for analysis by methods SW8321B and SW6020A. A summary of analytical and validation results is provided in Table 1.

4.1 NITROAROMATIC AND NITRAMINE COMPOUNDS (EXPLOSIVES) – EPA SW-846 METHOD 8321B

For SDG **280-102553-1**:

The MS/MSD was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Sample	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Flag
KR-DU01-101717	Tetryl	128 (36-120)	130 (36-120)	1 (≤20)	NA

No data were qualified since there were no associated sample results in this SDG. Relative percent differences were within QC limits.

LCS and LCSSRM were analyzed as required by the method. Percent recoveries were within QC limits with the following exceptions:

Compound	%R		%R Limits
	LCS	LCSSRM	
Tetryl	122	28	36-120

Since there were no associated sample results in this SDG, all of the non-detect results for Tetryl in this SDG were qualified UJ.

Samples KR-DU01-101717, KR-DU01R1, and KR-DU01R2-101717 are field triplicates and all %RPDs were below the less than 50% criteria for soils.

No other data qualification was required for explosives analyses for this project.

4.2 METALS – EPA SW-846 METHOD 6020A

For SDG **280-102553-1**:

One sample (KR-DU01-101717) had to be re-prepared and re-analyzed by the lab due to the original result for Lead being significantly different from multiple replicates, indicating a suspect extreme outlier. Re-analyzed value confirmed the original to be an outlier, therefore, the original value was excluded from the dataset.

Sample	Lead Result, mg/kg	Notes
KR-DU01-101717 original	1,400	Analyzed 11/03/2017
KR-DU01R1-101717	42	Field replicate
KR-DU01R2-101717	85	Field replicate
KR-DU01-101717 MS	123	Matrix spike, includes 9.93 mg/kg spike
KR-DU01-101717 MSD	69	Matrix spike duplicate, includes 9.52 mg/kg spike
KR-DU01-101717 re-analyzed	58	Re-analyzed 11/10/2017

MS and MSD sample analysis was performed on an associated project sample. For KR-DU01-101717 MS/MSD, no data were qualified for Lead and Zinc percent recoveries outside the QC limits since the parent sample results were greater than 4X the spike concentration. Data for Copper was qualified as estimated (J) in one sample due to %R outside QC limit low in MS/MSD and post digestion spiked sample.

Sample	Analyte	Flag	Reason
KR-DU01-101717	Copper	J (all detects)	MS/MSD (%R)

LCS sample met percent recovery criteria.

For samples diluted 20 fold or above, no qualifications were made due to failed surrogate recoveries.

Serial dilution analysis was performed on an associated project sample. Serial dilution percent difference (%D) was not within the acceptance criteria for Copper, Lead, and Zinc. No data were qualified for Lead and Zinc %D since the associated MS/MSD %Rs were acceptable. Data for Copper was qualified as estimated (J) in one sample due to %D outside the acceptance criteria in the serial dilution.

Sample	Analyte	Flag	Reason
KR-DU01-101717	Copper	J (all detects)	Serial dilution (%D)

Samples KR-DU01-101717, KR-DU01R1-101717, KR-DU01R2-101717 and samples KR-DUBG-101617, KR-DUBGR1-101617, and KR-DUBGR2-101617 were identified as field triplicates. All of the %RSD were within QC limits.

No other data qualification was required for metals analyses for this project.

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5.0 COMPLETENESS

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. Completeness should not be determined only on the basis of laboratory data qualifiers.

Completeness is calculated and reported for each method, matrix, and analyte combination using the formula below:

$$\% \, Completeness = 100 \, x \, (\frac{V}{n})$$

Where: V = number of measurements judged valid

n = total number of measurements

The goal for completeness is 95% for aqueous samples and 90% for soil samples. All completeness goals were met for the project.

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6.0 OVERALL DATA ASSESSMENT

In general, the overall quality of the project data was acceptable. No data were rejected. All data are considered acceptable for use, with the limitations discussed within this QA/QC report and the ADEC Laboratory Data Review Checklists regarding the qualifiers applied to the results.

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7.0 REFERENCES

Department of Defense (DoD), 2017. *Quality Systems Manual (QSM) for Environmental Laboratories.* January.

United States Environmental Protection Agency (EPA), 2007. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. EPA Publication *SW-846* (3rd edition through Final Update IV). February.

Weston Solutions, Inc. (WESTON), 2017. Final Uniform Federal Policy-Quality Assurance Project Plan. Kingman Range MRS, Mohave County, Arizona. August.

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APPENDIX K

MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL

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Table A

MRS Background Information

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

Munitions Response Site Name: KINGMAN RANGE MRS (AZHQ-006-R-01)

Component: NON-DOD OWNED, NON-OPERATIONAL DEFENSE SITES, WESTERN REGION

Installation/Property Name: NDNODS KINGMAN RANGE MRS

Location (City, County, State): KINGMAN, MOHAVE COUNTY, ARIZONA

Site Name/Project Name (Project No.): NDNODS, KINGMAN RANGE MRS

Date Information Entered/Updated: 8/7/2020 11:00:00 AM

Point of Contact (Name/Phone): JOHN HAINES, (703) 607-7986

Project Phase (check only one):

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

Media Evaluated (check all that apply):

o Groundwater	o Sediment (human receptor)
n Surface soil	o Surface Water (ecological receptor)
o Sediment (ecological receptor)	o Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The NDNODS Kingman Range MRS (8.14 acres) was used by the Arizona Army National Guard (AZARNG) from 1951 until 1968. Training included small arms (.22 caliber, .30 caliber, and .45 caliber) and submachine gun practice. Historical training activities included live firing (west-to-east) into targets at the western-facing slope of a natural bedrock escarpment. A Site Inspection (SI) was conducted in 2011. Evidence of military activities identified included small arms projectiles and MD from two mortar fuzes and a 3.5-inch rocket. No evidence of MEC was identified. Based on the results of the SI, further investigation of MEC was recommended. RI field activities were conducted from 2017-2019. No MEC was identified. Small arms (projectiles and casings) and MD consisting of an expended M22 Rifle Grenade (Smoke), 3.5-inch M29 Practice Rocket components (nose cone, fin shroud, and tail fins), 60 mm mortar tail boom, and fragmentation debris were identified. Surface soil sampling using ISM was conducted from the accessible portions of the former target berm and were compared to background concentrations. No potential MC sources were identified. It was recommended in the RI that the original 33.43-acre Kingman Range MRS be divided into two MRSs: the Kingman Range MRS (8.14 acres, discussed in this MRSPP) and the Kingman Range – No Further Action (NFA) Area MRS (25.29 acres) (Sections 1.3, 4.1, 5.1, 5.2, and 7.5, RI/FS Report, Weston, 2020).

References used in this report:
Weston Solutions, Inc., 2020. Remedial Investigation / Feasibility Study Report, Military Munitions Response Program, Remedial Investigation / Feasibility Study, Kingman Range MRS (AZHQ-006-R-01), Mojave County, Arizona.

USACE, 2014. Handbook on Delineation and Munitions Response Site Prioritization Protocol Implementation. 29 March.

Description of Pathways for Human and Ecological Receptors:

Although MEC was not observed at the Kingman Range MRS during the SI or RI field activities, MD from HE items was recovered during the RI. Therefore, the MEC pathway is considered to be potentially complete. Analytical results of MC in surface soil from the former target berm indicated no potential MC source; therefore, no complete human or ecological receptor pathways are present (Section 4.1, RI/FS Report, Weston, 2020).

Description of Receptors (Human and Ecological):

Potential human receptors to MEC include residents, commercial users (site workers), site visitors, trespassers, and recreational users (Section 2.4.1, RI/FS Report, Weston, 2020).

N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

Kingman Range MRS (AZHQ-006-R-01)

Kingman Range - Residential Area MRS (AZHQ-006-R-02)

MRS MAP - NDNODS KINGMAN RANGE - RESIDENTIAL AREA MRS AZHQ-006-R-02

Figure **1**

Army National Guard
Kingman, Mohave County, Arizona

Date: 02 Jul 2020 Last Edited by: PB F:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\FS\Figure 10_Proposed MRS Boundaries.mxd

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Table 1

EHE Module: Munitions Type Data Element Table

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

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

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

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

The Kingman Range MRS was used by the Arizona Army National Guard from 1951 until 1968. Training included small arms (.22 caliber, .30 caliber, and .45 caliber) and submachine gun practice. MD evidence from 60 mm mortar (indeterminate type), 3.5-inch M29 practice rockets (potential source of high explosive [HE]), and M22 (Smoke) Rifle Grenades (potential source of Pyrotechnic) was also observed during the RI. The presence of MD from potential HE and Pyrotechnic munitions indicates that it is possible that MEC may be present at the MRS (Section 4.1, RI/FS Report, Weston, 2020).

Table 2

EHE Module: Source of Hazard Data Element Table

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

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

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

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

The Kingman Range MRS was used by the AZARNG from 1951 until 1968. Training included small arms ammunition firing. Based on recovered MD items during the SI and RI, practice rockets, small mortars, flares, and rifle grenadres have been fired there (Section 4.1, RI/FS Report, Weston, 2020).

Table 3

EHE Module: Location of Munitions Data Element Table

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

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

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

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

During the SI, the MD consisted of two mortar fuzes fragments and pieces of from a 3.5-inch rocket identified on the ground surface near the target area. During the RI, the MD encountered consisted of components from the M29 3.5-inch practice rocket (i.e., nose cone, tail fins, and tail shroud), M22 rifle grenade (smoke), 60-mm mortar tail boom, and fragmentation debris. All items encountered during the RI were found within the upper 6 inches and in the vicinity of the target area (Section 4.1, RI/FS Report, Weston, 2020).

Table 4

EHE Module: Ease of Access Data Element Table

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

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

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

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

The MRS is privately owned, undeveloped vacant land without any barriers preventing access (Section 2.1.2.8, RI/FS Report, Weston, 2020).

Table 5

EHE Module: Status of Property Data Element Table

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

Classification	Description	Score
Non-DoD control	u The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies.	*5*
Scheduled for transfer from DoD control	u The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	u The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	*5*

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

The MRS is non-DoD controlled. The MRS is privately owned, undeveloped vacant land (Section 2.2.1, RI/FS Report, Weston, 2020).

Table 6

EHE Module: Population Density Data Element Table

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

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

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

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

Census data for 2010 indicates that approximately 806 persons per square mile inhabit Kingman, AZ (Section 2.1.2.8, RI/FS Report, Weston, 2020).

Table 7

EHE Module: Population Near Hazard Data Element Table

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

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

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

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

There are multiple inhabitable structures within 2 miles of the site. The MRS is located within the city limits of Kingman, AZ within a populated residential and mixed land use area (Section 1.3.1, RI/FS Report, Weston, 2020).

Table 8

EHE Module: Types of Activities/Structures Data Element Table

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

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

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

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

The MRS is located within the city limits of Kingman, AZ and includes residential and mixed land uses (Section 1.3.1, RI/FS Report, Weston, 2020).

Table 9

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

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

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

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

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

There are no federal or state threatened or endangered species known to exist in the MRS. After review of the AZSHPO database, it was concluded that no areas of cultural or archaeological significance are located within the MRS (Sections 2.1.2 and 2.1.3, RI/FS Report, Weston, 2020).

Table 10
Determining the EHE Module Rating

DIRECTIONS:

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

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

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	25	35
Source of Hazard	Table 2	10	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	10	25
Ease of Access	Table 4	10	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	5	15
Population Near Hazard	Table 7	5	
Types of Activities/ Structures	Table 8	5	
Ecological and /or Cultural Resources	Table 9	0	
EHE MODULE TOTAL			*75*

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

Table 11

CHE Module: CWM Configuration Data Element Table

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

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

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

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

There is no known historical or physical evidence from previous investigations, clearance efforts, or the RI to indicate that CWM may be present at the MRS (Section 7.4, RI/FS Report, Weston 2020).

Tables 12-19 are intentionally omitted according to MRSPP Guidance (USACE Handbook on Delineation and MRS Prioritization Protocol Implementation, March 2014).

Table 20

Determining the CHE Module Rating

DIRECTIONS:

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

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

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

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

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

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

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 21 Comments: Groundwater samples were not collected during the RI at the MRS. The groundwater pathway is considered to be incomplete. Depth to groundwater at the MRS is greater than 150 ft bgs. Annual precipitation averages of 10.4 inches. Actual groundwater recharge is minimal due to low precipitation amounts and high evapotranspiration rates in the desert climate (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 22 Comments: Surface water samples were not collected during the RI at the MRS. The surface groundwater pathway is incomplete because there are no sources of surface water other than precipitation (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 23 Comments: Sediment samples were not collected during the RI at the MRS. The sediment pathway is incomplete because there are no sources of sediment associated with surface water (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 24 Comments: Surface water samples were not collected during the RI at the MRS. The surface groundwater pathway is incomplete because there are no sources of surface water other than precipitation (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 25 Comments: Sediment samples were not collected during the RI at the MRS. The sediment pathway is incomplete because there are no sources of sediment associated with surface water (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios
Lead	85	400	mg/Kg	0.21
Copper	18	3100	mg/Kg	0.0058
Antimony	0.96	31	mg/Kg	0.031
Nitroglycerine	0.034	1000	mg/Kg	3.4E-05
2,4-Dinitrotoluene	0.022	120	mg/Kg	0.00018

CHF Scale	CHF Value	Sum The Ratios	0.25
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

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

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 26 Comments: As part of the RI, four ISM surface soil samples were collected from the accessible portion of the former target berm (representing the “worst-case” scenario) and analyzed for explosive compounds and select metals. Two explosive compounds were detected at estimated concentrations near their respective laboratory detection levels. Concentrations of three detected metals exceeded their respective calculated 95% UCL background concentrations. The migratory pathway for surface soil is considered to be potential because explosives and metals above background were detected but were below comparison values; no geological structures or physical controls are present. The RI investigation area is undeveloped, though access to the MRS is unrestricted, so there is potential for receptors to have access to the surface soil (Sections 1.3, 2.2.1, and 6.1, RI/FS Report, Weston, 2020).

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

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

Note: Dissolved, rather than total, metals analyses are used when both are available.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28

Determining the HHE Module Rating

DIRECTIONS:

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

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

DIRECTIONS (cont.):

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

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

HHE MODULE RATING	***E***

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

Table 29
MRS Priority

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

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

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

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Table A

MRS Background Information

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

Munitions Response Site Name: KINGMAN RANGE - NFA AREA MRS (AZHQ-006-R-02)

Component: NON-DOD OWNED, NON-OPERATIONAL DEFENSE SITES, WESTERN REGION

Installation/Property Name: NDNODS KINGMAN RANGE MRS

Location (City, County, State): KINGMAN, MOHAVE COUNTY, ARIZONA

Site Name/Project Name (Project No.): NDNODS, KINGMAN RANGE MRS

Date Information Entered/Updated: 8/7/2020 11:10:00 AM

Point of Contact (Name/Phone): JOHN HAINES, (703) 607-7986

Project Phase (check only one):

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

Media Evaluated (check all that apply):

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

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The NDNODS Kingman Range - No Further Action (NFA) Area MRS (25.29 acres) was used by the Arizona Army National Guard (AZARNG) from 1951 until 1968. Training included small arms (.22 caliber, .30 caliber, and .45 caliber) and submachine gun practice. Private residential development of this MRS began sometime after 1968 and continued through the early 1980s. Since that time, the Kingman Range NFA Area MRS has consisted of private residential properties. A Site Inspection (SI) was conducted in 2011. No evidence of MEC or MD was identified within the NFA Area MRS. An RI was conducted from 2017 to 2019. No MEC or MD was identified within the NFA Area MRS. It was recommended in the RI that the original 33.43-acre Kingman Range MRS be divided into two MRSs: the Kingman Range – NFA Area MRS (25.29 acres, discussed in this MRSPP) and the Kingman Range MRS (8.14 acres). Based on no evidence of military munitions present in the Kingman Range - NFA Area MRS, the alternative MRS Rating "No Longer Required" has been selected. All necessary DoD response actions have been completed (Sections 1.3, 4.1, 5.1, 5.2, and 7.5, RI/FS Report, Weston, 2020).

References used in this report:
Weston Solutions, Inc., 2020. Remedial Investigation / Feasibility Study Report, Military Munitions Response Program, Remedial Investigation / Feasibility Study, Kingman Range MRS (AZHQ-006-R-01), Mojave County, Arizona.

USACE, 2014. Handbook on Delineation and Munitions Response Site Prioritization Protocol Implementation. 29 March.

Description of Pathways for Human and Ecological Receptors:

No MEC or MD has been observed during the SI or RI at the Kingman Range - NFA Area MRS. Therefore, MC sampling has not occurred at the MRS because no MC sources are present. The MEC and MC pathways are incomplete at the NFA Area MRS (Section 4.1, RI/FS Report, Weston, 2020).

Description of Receptors (Human and Ecological):

Potential human receptors to MEC include residents, commercial users (site workers), site visitors, trespassers, and recreational users (Section 2.4.1, RI/FS Report, Weston, 2020).

N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

Kingman Range MRS (AZHQ-006-R-01)

Kingman Range - Residential Area MRS (AZHQ-006-R-02)

MRS MAP - NDNODS KINGMAN RANGE - RESIDENTIAL AREA MRS AZHQ-006-R-02

Figure **1**

Army National Guard
Kingman, Mohave County, Arizona

Date: 02 Jul 2020 Last Edited by: PB F:\Project Files\NDNODS West W912DR-15-D-0022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\FS\Figure 10_Proposed MRS Boundaries.mxd

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Table 1

EHE Module: Munitions Type Data Element Table

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

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

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

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

At the conclusion of the Remedial Investigation, it was confirmed that there is no evidence of military munitions present in the Kingman Range – NFA Area MRS (Section 7.1, RI/FS Report, Weston, 2020).

Tables 2-9 are intentionally omitted according to Army Guidance (USACE Handbook on Delineation and MRS Prioritization Protocol Implementation, March 2014).

Table 10

Determining the EHE Module Rating

DIRECTIONS:

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

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

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

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

Table 11

CHE Module: CWM Configuration Data Element Table

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

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

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

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

There is no known historical or physical evidence from previous investigations, clearance efforts, or the RI to indicate that CWM may be present at the MRS (Section 7.4, RI/FS Report, Weston 2020).

Tables 12-19 are intentionally omitted according to MRSPP Guidance (USACE Handbook on Delineation and MRS Prioritization Protocol Implementation, March 2014).

Table 20
Determining the CHE Module Rating

DIRECTIONS:

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

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

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

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

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

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

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 21 Comments: Groundwater samples were not collected during the RI at the MRS. The groundwater pathway is considered to be incomplete. Depth to groundwater at the MRS is greater than 150 ft bgs. Annual precipitation averages of 10.4 inches. Actual groundwater recharge is minimal due to low precipitation amounts and high evapotranspiration rates in the desert climate (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Note: Use dissolved, rather than total, metals analyses when both are available.

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

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

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

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 22 Comments: Surface water samples were not collected during the RI at the MRS. The surface groundwater pathway is incomplete because there are no sources of surface water other than precipitation (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 23 Comments: Sediment samples were not collected during the RI at the MRS. The sediment pathway is incomplete because there are no sources of sediment associated with surface water (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 24 Comments: Surface water samples were not collected during the RI at the MRS. The surface groundwater pathway is incomplete because there are no sources of surface water other than precipitation (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 25 Comments: Sediment samples were not collected during the RI at the MRS. The sediment pathway is incomplete because there are no sources of sediment associated with surface water (Section 2.1.2, RI/FS Report, Weston, 2020).

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

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

Contaminant	Maximum Concentration	Comparison Value	Unit	Ratios

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

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

Migratory Pathway Factor

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

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

Receptor Factor

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

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

Table 26 Comments: Soil samples were not collected during prior investigations within the developed, residential portion of the MRS. The soil pathway is incomplete because there are no sources of MC in these areas (Section 6.1, RI/FS Report, Weston, 2020).

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

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

Note: Dissolved, rather than total, metals analyses are used when both are available.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio

Table 28

Determining the HHE Module Rating

DIRECTIONS:

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

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

DIRECTIONS (cont.):

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

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

HHE MODULE RATING	***No Longer Required***

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

Table 29
MRS Priority

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

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

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

APPENDIX L

FEASIBILITY STUDY

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FINAL
FEASIBILITY STUDY

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION / FEASIBILITY STUDY

KINGMAN RANGE MRS (AZHQ-006-R-01)
MOHAVE COUNTY, ARIZONA

CONTRACT NO. W912DR-15-D-0022
DELIVERY ORDER 0001`

Prepared For:

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January 2021

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LIST OF ATTACHMENTS

LIST OF ACRONYMS

ºF	degrees Fahrenheit
%	percent
ADEQ	Arizona Department of Environmental Quality
AGC	advanced geophysical classification
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard
ARNG G9	Army National Guard G9
AZARNG	Arizona Army National Guard
bgs	below ground surface
BIP	blow-in-place
BUD	Berkeley UXO Discriminator
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDC	contained detonation chamber
CFR	Code of Federal Regulations
cm	centimeter
CSM	conceptual site model
DGM	digital geophysical mapping
DGPS	differential global positioning system
DMM	discarded military munitions
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc.
EMI	electromagnetic induction
EMM	earth moving machinery
EP	Engineering Pamphlet
FDEMI	frequency domain electromagnetic induction
ft.	foot/feet
FS	Feasibility Study
GPS	global positioning system
GRA	general response action
HAZWOPER	Hazardous Waste Operations and Emergency Response
in.	inch/inches
IR	infrared
LTM	long-term management
LUC	land use control
LUCIP	Land Use Control Implementation Plan

LIST OF ACRONYMS (CONT.)

MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MSD	minimum separation distance
MRS	Munitions Response Site
NA	not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDNODS	Non-Department of Defense, Non-Operational Defense Sites
NFA	no further action
NMRD	non-munitions related debris
O&M	operation and maintenance
PP	Proposed Plan
PPE	personal protective equipment
RAO	remedial action objective
RI	Remedial Investigation
ROD	Record of Decision
RTS	robotic total station
SI	Site Inspection
SUXOS	Site Unexploded Ordnance Supervisor
TBC	to-be-considered
TDEMI	time-domain electromagnetic induction
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
WESTON	Weston Solutions, Inc.

1.0 INTRODUCTION

This report summarizes the work performed and results of the Feasibility Study (FS) conducted at the Non-Department of Defense (DoD), Non-Operational Defense Site (NDNODS) Kingman Range (AZHQ-006-R-01) Munitions Response Site (MRS), in Kingman, Mohave County, Arizona. The FS was completed by Weston Solutions, Inc. (WESTON®) in accordance with the United States (U.S.) Environmental Protection Agency (USEPA) October 1988 document *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (USEPA, 1988); the U.S. Army Military Munitions Response Program (MMRP) document, *Final Munitions Response Remedial Investigation/Feasibility Study Guidance* (U.S. Army, 2009); and U.S. Army Corps of Engineers (USACE) *Engineering Pamphlet (EP) – 1110-1-18 Ordnance and Explosives Response* (USACE, 2000).

This FS was conducted in support of the MMRP at the request of the USACE. This task was issued as Delivery Order 0001 under the USACE Multiple Award Environmental Services Contract W912DR-15-D-0022 (USACE, 2016), and was performed in accordance with the 4 January 2016 Performance Work Statement.

The U.S. Congress established the MMRP to address former defense sites where munitions and explosives of concern (MEC) in the form of unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) may be present as a result of past training activities. NDNODS, defined as those defense sites that were exclusively used by the Army National Guard (ARNG) and were never owned, leased, or otherwise possessed or used by the U.S. Army or other DoD component, are a subcategory of MMRP. An MRS co-used by other DoD components or which fulfills other eligibility criteria may also be addressed under the ARNG G9 (ARNG G9) MRS Remedial Investigation (RI)/FS phase.

1.1 PURPOSE

The purpose of this FS is to determine the best approach to mitigate the potential human health hazards from potential MEC that remain at the Kingman Range MRS. Information was collected during the Site Inspection (SI) and RI relating to the nature and extent as well as the fate and transport of MEC. This information is used in the FS to identify and screen remedial technologies and process options, develop and screen alternatives, and perform a detailed comparative evaluation of those alternatives. MC was investigated during the SI and RI. The RI recommended no further action (NFA) with regard to MC. Therefore, no remedial alternatives for MC were developed for analysis in this FS.

The FS was developed with regard to specific criteria set forth by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The NCP was established by the Clean Water Act of 1972 and has been revised and broadened several times since then. The NCP is codified in 40 Code of Federal Regulations (CFR) Part 300. The purpose of the NCP is to provide the organizational structure and procedures for developing, evaluating, and implementing response actions at a site. The March 1990 revision is the latest version of the

NCP. Paragraph 300.120(c) identifies the DoD as the removal response authority with respect to incidents involving DoD military weapons and munitions. The remedial alternatives proposed in this FS are protective of human health, the environment, and meet the requirements of all stakeholders.

The FS is the mechanism for the development, screening, and detailed evaluation of alternative remedial actions if such are determined to be required. In addition, a Proposed Plan (PP) describing the recommendations of the RI and FS will be completed for stakeholder and public review. A Record of Decision (ROD) will be prepared following approval of the PP to identify the remedial alternative chosen from the FS.

1.2 REPORT FORMAT

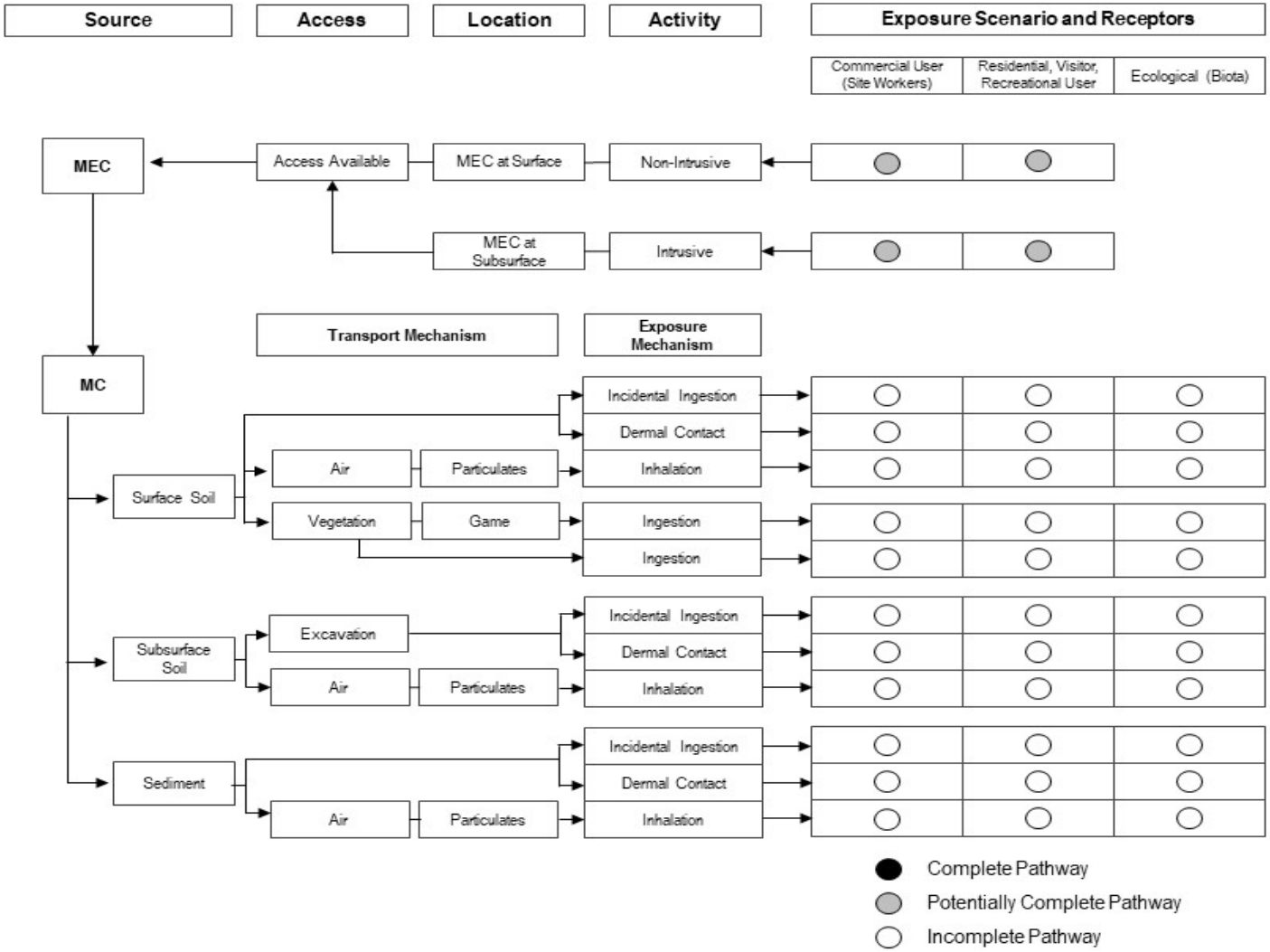
The FS report format is as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Installation Description;
- Section 3.0 – Previous Investigations;
- Section 4.0 – Applicable or Relevant and Appropriate Requirements (ARARs);
- Section 5.0 – Identification and Screening of Technologies;
- Section 6.0 – Development and Screening of Alternatives;
- Section 7.0 – Detailed Analysis of Alternatives; and
- Section 8.0 – References.

2.0 INSTALLATION DESCRIPTION

See **Section 1.3.1** and **Section 2.1** in the Kingman Range MRS RI Report for the installation description. **Figure 2-1** presents the conceptual site model (CSM) exposure pathways for MEC and MC at the Kingman Range MRS. Exposure pathways for MEC are considered potentially complete at the surface and subsurface. Exposure pathways for MC are considered incomplete for all receptors.

Figure 2-1
Kingman Range MRS CSM for MEC and MC



3.0 PREVIOUS INVESTIGATIONS

The following documents detail the investigations completed to date at the Kingman Range MRS as part of the CERCLA and MMRP process:

- EA Engineering, Science, and Technology, Inc. (EA), 2008. *Final State/Territory Inventory Report, National Guard Bureau, Non-Department Of Defense Owned Non-Operational Defense Sites Inventory, Arizona*. November.
- WESTON, 2011. *Final Historical Records Review / Site Inspection Work Plan for Arizona, Army National Guard Munitions Response Sites, Site Inspection Phase*. November.
- WESTON, 2012. *Final Site Inspection Report for Arizona, Army National Guard Munitions Response Sites, Site Inspection Phase*. October.
- WESTON, 2017. *Final Uniform Federal Policy for Quality Assurance Project Plan. Military Munitions Response Program, Non-DOD Non-Operation Defense Sites/Western Region, Remedial Investigation/Feasibility Study. Kingman Range MRS (AZHQ-006-R-01), Mohave County, Arizona*. August.
- WESTON, 2020. *Stakeholder Draft Remedial Investigation Report, Military Munitions Response Program, Remedial Investigation/Feasibility Study, Kingman Range MRS (AZHQ-006-R-01), Mohave County, Arizona.* May.

See **Section 1.3.2** of the Kingman Range MRS RI Report for a discussion of site history and previous investigations (Preliminary Assessment, Historical Records Review, and SI). For a detailed discussion of the design and results of the RI, see **Section 3.0** and **Section 7.0** of the Kingman Range MRS RI Report.

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4.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Remedial Alternatives offered in this FS will be consistent with the guidance provided in CERCLA (42 U.S. Code [USC] 9601-9675) and the NCP (40 CFR 300). CERCLA and the NCP require compliance with ARARs of promulgated laws.

Applicable Requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable (40 CFR 300.5).

Relevant and Appropriate Requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, addresses problems or situations sufficiently similar to those encountered at the CERCLA site such that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate (40 CFR 300.5).

Remedial Alternatives may incorporate environmental policies or proposals that are not applicable (NA) or relevant and appropriate, but do address site-specific concerns. Such to-be-considered (TBC) standards may be used in determining the cleanup levels necessary for protection of human health and the environment. TBCs are non-promulgated advisories or guidance issued by Federal or State government that are not legally binding and do not have the status of potential ARARs (USEPA, 1988). TBCs may be used where ARARs do not exist or apply, such as for certain chemicals, circumstances, federal advisories, or guidance documents, which help determine what is protective for a site.

According to the USEPA, ARARs fall into three (3) categories: chemical-specific, action-specific, and location-specific:

- Chemical-specific ARARs are typically health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment (USEPA, 1988).
- Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to specific hazardous wastes (USEPA, 1988).
- Location-specific ARARs are restrictions on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations (USEPA, 1988).

TBC requirements are used when there are no ARARs, or when ARARs alone may not adequately protect human health and the environment. TBC requirements are meant to complement the use of ARARs, not to compete with or replace them. The ARARs are summarized in **Table 4-1.**

On 4 June 2020, per request, the Arizona Department of Environmental Quality (ADEQ) provided a list of potential ARARs. After analyzing the list, it has been determined that the potential ARARs do not apply to this Kingman Range MRS, because, as the MRS has been recommended for NFA for MC, there will be no generators or transporters of hazardous waste, no owners or operators of hazardous waste facilities, and no soil remediation required at the MRS.

Table 4-1
Identification of ARARs

Regulatory Authority	Characteristic Location	Requirement	Status	Applicability/Relevance
Location-Specific ARARs				
Federal	U.S.	Migratory Bird Treaty Act – 16 USC 703	ARAR	Protects almost all species of native birds in the U.S. from unregulated taking.
Federal	U.S.	Endangered Species Act – Prohibited Acts – 16 USC1538(a)(1)(B) and (1) (2) (B)	ARAR	There is potential for endangered/threatened species to be present on the MRS; however, it is unlikely (Section 2.1.3.1 of the RI Report). The following endangered/threatened species may be present: Hualapai Mexican vole (endangered), Mojave desert tortoise (threatened), Northern Mexican Gartersnake (threatened), Relict leopard frog (candidate), Bonytail chub (endangered), Humpback chub (endangered), Razorback sucker (endangered), Roundtail chub (proposed threatened), Virgin River chub (endangered), Woundfin (endangered), and Virgin spinedace (conservation agreement), California Condor (endangered), California Least Tern (endangered), Mexican spotted owl (threatened), Southwestern willow flycatcher (endangered), Yellow-billed cuckoo (threatened), and Yuma clapper rail (endangered), Arizona cliffrose (endangered), Fickeisen plains cactus (endangered), Gierisch mallow (endangered), Holmgren (Paradox) milk vetch (endangered), Jones cycladenia (threatened), and Siler pincushion cactus (threatened). (U.S. Fish and Wildlife Service, 2016).
Federal	U.S.	The Bald and Golden Eagle Protection Act	ARAR	Although the presence of protected species has not been documented at the MRS, the bald eagle may be present.
Federal	U.S.	National Historic Preservation Act (16 USC. 470) of 1966, as amended	ARAR	Requires protection of historical and cultural resources to the maximum extent practicable.
Federal	U.S.	Archaeological Resources Protection Act of 1979 (16 USC 470aa-470mm, Public Law 96-95 and amendments)	ARAR	Regulates preservation of cultural resources.
Federal	U.S.	Hazardous Waste Operations and Emergency Response (HAZWOPER) – 29 CFR 1910.120	ARAR	Site conditions at the MRS are not known or believed to be hazardous; however, at a minimum, personnel on-site will be 40-hour HAZWOPER trained. Training is designed for persons engaged in hazardous substance removal or other associated activities.
Federal	U.S.	Resource Conservation and Recovery Act 40 CFR Part 264 Subpart X	ARAR	Relevant parts relate to the management of MEC that is recovered, including characterization as hazardous waste and requirements for treatment, storage, and transportation. Establishes actions required for the disposal of waste explosives by open burning or open detonation. May be applicable if storage and transportation of recovered military munitions is performed during remedial actions. May also be applicable if disposal of explosives is performed during remedial actions.
Federal	U.S.	Management of Military Munitions - 40 CFR 266, Subpart M	ARAR	Describes when military munitions are exempt from being managed as solid or hazardous waste.
TBC Criteria				
Federal	DoD Facilities	DoD Ammunition and Explosive Sites Standards - 6055.09-M, February 2008, Reissued August 2010, Chapter 12	TBC	Provides guidance for assessment, remedial planning, and remedial processes in support of reuse/redevelopment of sites contaminated with ammunition, explosives, or chemical agents.

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5.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Alternatives for remediation are developed by assembling combinations of technologies, with respect to the media to which they would be applied, into alternatives that appropriately address contamination (in this case potential MEC) on a site wide basis. This process consists of six (6) general steps, which are listed below and described in the referenced sections (USEPA, 1988).

- Develop remedial action objectives (RAOs) – Section 5.1
- Develop general response actions (GRAs) – Section 5.2
- Identify volumes or areas of media to which GRAs might be applied – Section 5.3
- Identify and screen potential technologies within relevant GRA categories – Section 5.3
- Evaluate and select representative process options for each technology– Section 5.4
- Assemble selected technologies into alternatives – Section 6.0

5.1 REMEDIAL ACTION OBJECTIVES

The first step in the development and screening of alternatives process is to define the RAOs. The remedial actions selected by this FS will be designed to achieve the RAOs. The RAO for the Kingman Range MRS is to:

- Prevent direct contact with surface and subsurface MEC to 18-inches (in.) below ground surface (bgs) by current and future receptors, including recreational users (trespassers), site visitors, construction workers, and the private landowner.

A depth of 18-in. bgs is included in the RAO as all munitions-related material recovered during the RI was found between zero (0) –in. and six (6)-in. bgs. This depth allows for a 12-in. buffer below the lowest identified munitions debris (MD) items. This depth also takes into consideration the detection capabilities of the digital geophysical mapping (DGM) and analog geophysical detection equipment which is generally capable of detection to 24-in. bgs. While it is possible that additional items could be found below 18-in. bgs, it is considered unlikely. For any alternatives that include MEC removal, all anomalies will be resolved to the depth of detection.

5.2 GENERAL RESPONSE ACTIONS AND SCREENING OF TECHNOLOGIES

In general, MEC investigations are limited to topography with slopes of less than 30 degrees. Conducting routine MEC work in areas where the slope is greater than 30 degrees presents significant safety concerns. Major concerns include the inability to use MEC detection technologies (analog and DGM) effectively, the inability to perform intentional detonations due to the condition (ability to move an item) and location (mitigation procedure implementability) of MEC, and slips, trips and fall incidents.

GRAs are selected to satisfy the RAOs for each medium of concern and relate to basic methods of protection such as land use controls (LUCs), treatment, removal, or containment. GRAs may be combined to form alternatives such as LUCs and removal.

Location-specific and action-specific ARARs have the potential to place restrictive parameters on the design, construction, operation, monitoring, and maintenance of the GRAs. MEC is potentially present on the ground surface and in the subsurface at the MRS. The following GRAs will be considered at the Kingman Range MRS:

- **No Action** – No action means that no remedial action will be undertaken at the MRS and is evaluated to satisfy the NCP requirement of 40 CFR 300.430(e)(6), which requires consideration of this alternative as a baseline for comparison against other remedial response actions.
- **LUCs** – LUCs may include legal mechanisms, engineering controls, educational controls, and long-term management (LTM).
- **MEC Removal** – MEC can be detected and removed from the ground surface and/or below the ground surface. Alternatives for MEC removal will include technologies for MEC detection, positioning systems for the detection technologies, MEC removal, and MEC disposal. No method of MEC detection and removal has proven 100 percent (%) effective; therefore, notifications of the possible presence of MEC must be made to property owners.

A list of potentially applicable MEC technologies and technology process options, corresponding to the GRAs, were examined and retained for further screening if they were technically implementable at the MRS. The three (3) general screening categories that are used to ensure that the GRAs meet the minimum standards of the criteria within each category in the FS process are effectiveness, implementability, and cost (USEPA, 1989). The screening categories are described below:

- **Short- and long-term effectiveness and reductions achieved in toxicity, mobility, or volume** – The "short-term" is considered to be the remedial construction and implementation period while "long-term" begins once the remedial action is complete and RAOs have been met.
- **Implementability, including technical and administrative feasibility** – Technical feasibility includes the ability to construct, reliably operate, and meet regulations, as well as the ability to meet the operations and maintenance, replacement, and monitoring requirements after completion of the remedial action. Administrative feasibility includes the ability to obtain approvals from other agencies; the availability of treatment, storage, and disposal services; and the availability of equipment and technical expertise.
- **Grossly disproportionate cost** – The cost evaluation is to eliminate from further consideration those alternatives whose costs are grossly excessive for the effectiveness they provide.

5.3 EVALUATION AND SCREENING OF TECHNOLOGIES

5.3.1 Evaluation and Screening of Land Use Controls Technologies

Risks related to potential explosives hazards may be managed through LUCs. LUCs protect property owners and the public from potential hazards present at the MRS by warning of potential MEC hazards and/or limiting access to, or use of, the MRS. LUCs may include legal mechanisms, engineering controls, and/or educational controls. Existing and potential LUCs were evaluated as part of the Institutional Analysis Report (**Appendix C** of the RI Report; WESTON, 2020). Examples of LUCs evaluated for the MRS include the following:

- Legal Controls,
  - Deed Restrictions,
  - Environmental Covenants,
  - Zoning,
  - Dig Permit System,
  - Contractor Control Policies, and
  - Construction Support.
- Engineering Controls:
  - Fencing,
  - Warning Signs, and
  - Physical Barriers to Access.
- Educational Controls:
  - Public Notices,
  - Management Plans,
  - Community Awareness Meetings,
  - Letter Notifications, Informational Pamphlets, and Fact Sheets,
  - Formal Educational Sessions, and
  - Website.

No engineering controls currently exist at the Kingman Range MRS. However, public notices were issued during the RI phase. These notices informed the public of upcoming activities and provided contact information. There are no measures to notify future trespassers, guests of the private property owner, or contractors/maintenance workers of the private property owner performing intrusive actions of potential explosive hazards, and there is a lack of measures to provide information on anomaly avoidance/encounter protocols.

5.3.1.1 Retained Land Use Controls

The effectiveness of LUCs depends on the support, involvement, and willingness of local agencies and landowners to enforce and maintain LUCs.

LUCs retained for the development of remedial action alternatives include:

- Engineering Controls:
  - Fencing; and
  - Warning Signs.
- Educational Controls:
  - Public Notice,; and
  - Fact Sheets.

Fencing would serve as an engineering control that would restrict public access thereby limiting exposure to potential MEC on the MRS. Fencing would be required to surround the entire 8.14-acre MRS in order to be effective. Fencing would require inspection, maintenance, and repair in order to remain effective.

Warning signs would serve as engineering controls for educating those accessing the MRS property (both with and without landowner permission) of the potential MEC hazards at the Kingman Range MRS. Warning signs would also serve as educational controls for educating the public of the potential MEC hazards at the MRS.

Fact sheets are recommended for distribution at key times during any MRS remediation activities. In addition, fact sheets are recommended for distribution to public officials, emergency management agencies, and the private landowner notifying land users of potential MEC.

The roles, responsibilities, and authorities that each organization would have in implementing, maintaining, monitoring, and enforcing institutional controls are provided in the Institutional Analysis Report (**Appendix C** of the RI Report; WESTON, 2020). Long-term implementation of institutional controls would be the responsibility of the Arizona Army National Guard (AZARNG)/ARNG G9.

5.3.1.2 Activities Affecting Land Use Controls

Construction Support. If LUCs are established for the MRS, UXO construction support would occur. UXO construction support would be used to ensure the safety of workers or the public in the event that MEC items were discovered at the MRS. For the Kingman Range MRS, construction support would include UXO Technicians providing escort to the workers installing warning signs and fencing at the MRS. The UXO Technicians would clear the ground before any holes are dug to ensure no munitions are present.

CERCLA Five-Year Reviews. If the potential for MEC remains, CERCLA requires the review of remedial actions no less than every five (5) years to assure that human health and the environment are being protected. For LUC alternatives, Five-Year Reviews would be required, including inspections, to assess conditions of LUCs, erosion, and potential migration of MEC

from the subsurface due to frost heave or by surface water overland during precipitation events to areas that have not been cleared.

Recurring reviews for MEC removal actions determine whether a remedial action continues to minimize explosives safety hazards and continues to be protective of human health, safety, and the environment, and provide an opportunity to assess the applicability of new technologies for addressing previous technical impracticability determinations. Recurring reviews will be completed by ARNG G9 and will include the following general steps:

- Prepare Recurring Review Plan;
- Establish project delivery team and begin community involvement activities;
- Review existing documentation;
- Identify/review new information and current site conditions;
- Prepare preliminary Site Analysis and Work Plan;
- Conduct site visit; and
- Prepare Recurring Review Report.

5.3.2 Evaluation and Screening of Munitions and Explosives of Concern Technologies

MEC investigation/mitigation technologies consisting of detection, removal, and disposal were evaluated and screened. A description of the types of technologies used in each step is presented in the following subsections. Specific technologies are described and screened in **Tables 5-1** through **5-5**.

5.3.2.1 Munitions and Explosives of Concern Anomaly Detection

Detection methods for subsurface anomalies and potential MEC are selected based on the potential munitions properties such as the depth and size of the suspected items, physical characteristics of the MRS (i.e., soil type, topography, vegetation, and local geology), and previous experience. Technologies used at the MRS during the RI consisted of both DGM and analog geophysical sensors followed by physical excavation and investigation of identified anomalies. These same technologies are also applicable as a component of a remedial action alternative at the MRS. Positioning technologies include various equipment and instruments that establish geo-referenced locations for detected subsurface anomalies that can be later investigated. Anomaly detection technologies and positioning technologies are described and screened in **Tables 5-1** and **5-2**.

5.3.2.2 Munitions and Explosives of Concern Anomaly Investigation

When subsurface anomalies are detected, investigation operations proceed based on the nature and extent of the explosive hazards. Identification of MEC during anomaly investigation may require excavation for removal and disposal. This aspect of technology evaluation is critical because excavation is considered the primary method for investigation of anomalies in the

subsurface. The actual nature of buried anomalies cannot be determined without them being uncovered, unless advanced geophysical classification (AGC) methods are used. Non-essential personnel evacuations are necessary within a predetermined minimum separation distance (MSD) when anomaly investigations are being completed. The MSD is based on the munition with the greatest fragmentation distance that may be present within the MRS. All non-essential personnel and the general public must be evacuated from and maintain their distance beyond the MSD during any on-going intrusive operations.

Excavation of anomalies takes place with either hand tools or mechanical equipment, depending on the suspected depth of the object. In the case of the RI, hand tools were used. However, hand tools and/or mechanical equipment may be used for overburden removal to access the target of interest. Once an item has been exposed, it is then inspected, identified, collected (if possible), and transported to a designated area for cataloging and disposal. If it is determined during the inspection that the item is MEC and the risk of moving the item from the field is unacceptable, then it may be necessary to blow-in-place (BIP). For intentional detonations, all personnel must observe the applicable MSD. The MSD may also be reduced if engineering controls such as sand bagging are applied. Removal technologies for anomalies are described and screened in **Table 5-3**.

5.3.2.3 Munitions and Explosives of Concern Disposal Methods

Disposal of recovered MEC can take one (1) of two (2) different forms: remote, on-site demolition and disposal; or in-place demolition and disposal. The decision regarding which of these techniques to use is based on the risk involved in employing the disposal option, as determined by the specific area's characteristics and the nature of the items recovered. If a MEC item is determined to be acceptable to move, the item can be moved to a remote part of the MRS where demolition and disposal can safely take place. For movable items, a countercharge can be used to destroy the item. Engineering controls, such as sandbag mitigation, are often used to reduce fragmentation distances when an item is destroyed in this manner.

Alternatively, MEC may be BIP. This method is typically employed when the risk of moving the item is unacceptable. When a BIP is required, procedures similar to those described above are used to detonate the MEC. Engineering controls are again used to minimize the fragmentation. Disposal technologies are described and screened in **Table 5-4**.

All disposal technologies generate a waste stream, which must be addressed when determining which technologies are most viable. The final waste streams generated by MEC disposal technologies include material documented as safe (MDAS). No additional treatment is necessary before recycling MDAS. Treatment technologies for the waste streams generated by disposal are described and screened in **Table 5-5**.

Table 5-1
MEC Detection Technologies

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
Visual Searching	**Medium-High:** Effective for surface removals in open areas with little ground cover. Appropriate for subsurface removals when pits or excavations are opened to observe.	**Medium- High:** Easily implemented by trained UXO Technicians.	**Low:** Lower than other methods that require detection instrumentation and associated equipment.	NA	Typically supported with analog or digital geophysical detection equipment to aid visual observation.	**Medium - High:** Items on or protruding from the soil surface can be identified.
Flux-Gate Magnetometers: Fluxgate magnetometers measure the vertical component of the geomagnetic field along the axis of the sensor and not the total intensity of the geomagnetic field.	**Medium:** Flux-gate magnetometers have been used as the primary detector in traditional mag and flag and mag and dig operations. There is a high industry familiarization. Detects ferrous objects only.	**High:** Light and compact. Can be used in any traversable terrain. Transportation and logistics requirements are equal to or less than other systems. Widely available from a variety of sources. Minimal to no impacts to cultural or natural resources.	**Low:** A number of flux-gate magnetometers have a low cost for purchase and operation compared to other detection systems. Lower than other methods on most terrains.	Schonstedt GA-52Cx Schonstedt GA-72Cd Foerster FEREX 4.032 Foerster FEREX 4.032 DLG Schonstedt 62-CX Ebinger MAGNEX 120 LW Vallon EL130D1 or 1303D Chicago Steel Tape (Magna-Trak 102)	Analog output not usually co-registered with navigational data – NA if screening excavated material.	**Medium:** This technology has been proven effective, but was not employed during the RI. Effectiveness limited if munitions with low ferrous content are present. Iron-bearing rocks and soils limit effectiveness.
Frequency Domain Electromagnetic Induction (FDEMI) Detectors: These systems are man portable and can detect all-metals. They operate in either time or frequency domain.	**Medium-High:** FDEMI metal detectors are the primary detection system in use when targets can potentially be either ferrous or non-ferrous metal. Discrimination capabilities make them particularly effective in ferrous rich soils. Systems are commonplace throughout the industry.	**High:** Light and compact. Can be used in any traversable terrain. Transportation and logistics requirements are equal to or less than other systems. Widely available from a variety of sources. Minimal to no impacts to cultural or natural resources. Classification possibilities exist among some multi-channel systems.	**Low:** Multiple electromagnetic induction (EMI) all-metals detectors have a low cost for purchase and operation compared to other detection systems, with the exception of the Geophex GEM3, which is average. Lower than other methods on most terrain.	Whites All-Metals Detector Minelabs Explorer II Fisher 1266X Foerster Minex Garrett Geophex GEM3	Analog output not usually co-registered with navigational data – NA if screening excavated material. Digital output should be co-registered with positional data	**High:** This technology has been proven effective during the RI. However, handheld EMI detectors have limited detection depth.
Optically Pumped Magnetometers: This technology is based on the theory of optical pumping and operates at the atomic level as opposed to the nuclear level (as in proton precession magnetometers).	**High:** This is the industry standard technology to detect MEC using magnetic data analysis. There is a high industry familiarization. Detects ferrous objects only. These systems can be used effectively for DGM.	**Medium - High:** Equipment is digital, ruggedized, and weather resistant. Common systems weigh more than most flux-gate systems and are affected by heading error. Can be used in most traversable terrain. Widely available from a variety of sources. Processing and interpretation requires trained specialists. Anomaly classification possibilities are limited to positional accuracy, magnetic susceptibility/ magnetic moment estimates, and depth estimates. Detection capabilities are negatively influenced by iron-bearing soils. Minor impacts to cultural or natural resources based on clearing areas for high quality data collection.	**Medium – High:** Has high purchase cost compared to other technologies. More dependent on terrain than flux-gate magnetometers. Lower costs can be realized when using arrays of multiple detector sensors.	Geometrics G-858 Geometrics G-822 GEM Systems GSMP-40 Scientrex Smart Mag	Digital signal should be co-registered with navigational data for best results.	**Low:** The technology is not effective at the Kingman Range MRS due to iron-bearing rocks and soils at the MRS.

Table 5-1
MEC Detection Technologies
(Continued)

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
Time-Domain Electromagnetic Induction (TDEMI) Metal Detectors: TDEMI is a technology used to induce a pulsed magnetic field beneath the Earth's surface with a transmitter coil, which in turn causes a secondary magnetic field to emanate from nearby objects that have conductive properties. This technology is the industry standard for detecting all-metals.	**High:** TDEMI technology is the industry standard for MEC detection using electromagnetic data analysis. There is a high industry familiarization. Detects both ferrous and non-ferrous metallic objects. Discrimination capabilities make them particularly effective in ferrous rich soils. Can be limited by terrain.	**High:** Sensors are typically larger than digital magnetometers. Can be used in most traversable terrain, common and widely available. Systems in many configurations; from single coil, multi-coil arrays, and three (3)-dimensional transmitter and receiver arrays. The arrays can be deployed using litter, wheeled cart, and towed sled. Processing and interpretation are relatively straightforward. Anomaly classification possibilities exist for multi-channel systems. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**Medium:** Has high purchase cost compared to other technologies. Costs per acre are low for multi-coil arrays and increase if terrain dictates a single coil configuration.	Geonics EM61-MK1 Geonics EM61-MK2 Geonics EM61 MK2A Geonics EM61-MK2 HP Geonics EM61-HH Geonics EM63 Zonge Nanotem G-tek TM5-EMU Vallon VMH3 Schiebel AN PSS-12	The EM61 is the industry standard for MMRP DGM surveys. Digital signal should be co-registered with navigational data for best results. Detection depths are highly dependent on coil size (number of turns and wire resistance are important) and transmitter power.	**High:** This technology has been proven effective at the Kingman Range MRS; however, there are limitations in difficult and/or steep terrain (> 30 degree slope).
Advanced EMI Sensors (AGC): Emerging advanced sensors have the ability to precisely capture measurements from enough locations to sample all principal axis responses of an anomaly/item of interest. This provides the necessary information for analysis and classification of hazardous and nonhazardous items.	**High:** Some may be used in production mode to detect subsurface metallic objects, and all can collect static measurements over a target location to record entire EMI response pattern. Greatest ability of all sensors for the classification of anomalies as either a target of interest or a non-target of interest. Detects both ferrous and non-ferrous metallic objects.	**Low to Medium:** MetalMapper™, TEMTADS, and ALLTEM require the use of a vehicle to tow the sensors to the location of an anomaly. Other sensors are man portable. One (1)-meter-wide coil (or greater) limits accessibility in forested or steeply sloped areas; however, man portable systems have the same accessibility as production-level EMI sensors.	**Medium:** Use of the advanced systems often represents additional surveying and processing costs, which may be largely offset by the decrease in the intrusive investigation costs.	ALLTEM- Berkeley UXO Discriminator (BUD) Handheld BUD Geometrics MetalMapper™ Geometrics MetalMapper 2x2 Geonics EM63 TEMTADS TEMTADS MP 2x2 Cart Man-Portable Vector	Sensors have greater industry availability and are becoming a more accepted technology for MEC detection and classification. Requires advanced training for operation, data processing, and analysis. Currently only the MetalMapper™, Metal Mapper 2x2, TEMTADS, and TEMTADS 2x2 are commercially available. All other systems are in development and testing.	**Medium:** This technology has been demonstrated and validated by the DoD's Environmental Security Technology Certification Program. The technology would be generally difficult to implement in the steep areas of the MRS with > 30 degree slope.
Airborne Multi- or Hyper- Spectral Imagery: This airborne method uses unique spectral signatures produced by an item to determine the item composition and size. Multispectral techniques can be used because they provide more information than images from common broadband cameras.	**Low:** Detects both metallic and non-metallic objects. Only detects largest MEC or DMM. Requires line of sight. Low industry familiarization. Effectiveness increases when used for wide area assessment in conjunction with other airborne technologies.	**Low:** Requires aircraft and an experienced pilot. Substantial data processing and management requirements. Available from few sources. Minimal to no impacts to cultural or natural resources.	**High:** Aircraft and maintenance costs must be included. Processing costs are higher than other methods. Costs can be low-medium per acres when surveying large areas (>500 acres).	There are few multi/hyper spectral imagery providers.	Few have applied these technologies to detect MEC.	**Low:** Difficult to implement, high cost, only available from a few sources.
Airborne Laser and Infrared (IR) Sensors: IR and laser technologies can be used to identify objects by measuring their thermal energy signatures. MEC or DMM on or near the soil surface may possess different heat capacities or heat transfer properties than the surrounding soil, and this temperature difference theoretically can be detected and used to identify MEC.	**Low:** Detects both metallic and non-metallic objects. Low industry familiarization. Effectiveness increases when used for wide area assessment in conjunction with other airborne technologies.	**Low:** Requires aircraft and an experienced pilot. Poor implementability when vegetation obscures ground features and it cannot image the ground surface. Not used to locate individual targets of interest. Substantial data processing and management requirements. Available from few sources. Minimal to no impacts to cultural or natural resources.	**High:** Aircraft and maintenance costs must be included. Processing costs are higher than other methods. Costs can be low-medium per acres when surveying large areas (>500 acres).	There are few Airborne Laser and IR providers that have experience with MEC.	Few have applied these technologies to detect MEC.	**Low:** Difficult to implement, high cost, only available from a few sources.

Table 5-2
MEC Positioning Technologies

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
Differential Global Positioning System (DGPS): GPS is a worldwide positioning and navigation system that uses a constellation of 29 satellites orbiting the Earth. GPS uses these satellites as reference points to calculate positions on the Earth's surface. Advanced forms of GPS, like DGPS, can provide locations to centimeter (cm) accuracy.	**Medium**: Very effective in open areas for both digital mapping and reacquiring anomalies. Very accurate when differentially corrected. Not effective in wooded areas or around large buildings. Commonly achieves accuracy to a few cm, but degrades when minimum satellites are available.	**High**: Easy to operate and set up. Available from a number of vendors. Better systems are typically ruggedized and very durable. Minor or no impacts to cultural or natural resources.	**Medium**: Requires rover and base station units. Survey control points required for high accuracy results.	Leica GPS 1200 Trimble Model 5800 Thales Ashtech Series 6500	Recommended in open areas.	**Medium-High:** This technology is effective at the Kingman Range MRS based upon experience using the equipment during the RI.
Robotic Total Station (RTS): RTS is a laser based survey station that derives its position from survey methodology and includes a servo operated mechanism that tracks a prism mounted on the geophysical sensor.	**Medium - High**: Effective in open areas for both digital mapping and reacquiring anomalies. Effective around buildings and sparse trees. Is being used in heavily wooded areas with moderate success. Commonly achieves accuracy to a few cm.	**Medium:** Relatively easy to operate with trained personnel. Requires existing control. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**Low:** Operates as a standalone unit. Typically requires survey control points but can be used in a relative coordinate system.	Leica RTS 1100 Trimble Model 5600	Recommended in open areas and in moderately wooded areas. Typically used with TDEMI metal detectors (like Geonics EM61- MK2) and digital magnetometers (like Geometrics G-858).	**Medium – High:** This technology can be used for data positioning for digital detector systems in open to moderately wooded areas.
Fiducial Method: The fiducial method consists of digitally marking a data string with an indicator of a known position. Typically, markers are placed on the ground at known positions (e.g., 25-feet [ft.]).	**Medium - High**: Medium to high effectiveness when performed by experienced personnel. Low effectiveness when used by inexperienced personnel. Commonly achieved accuracy is 15- cm to 30-cm. The fiducial method can be used to establish physical reference points in combination with use of the Odometer Method.	**Medium**: Application requires a constant pace and detailed field notes. Can be used anywhere, with varying degrees of complexity in the operational setup. Minor impacts to cultural or natural resources.	**Low - Medium**: Minimal direct costs associated with this method; however, poor results may negatively impact costs associated with target resolution. Fiducial method requires more "back-end" data processing than some other methods.	NA	Requires very capable operators. Useful method if digital positioning systems are unavailable. Primarily considered as a method to be used in combination with the Odometer Method to provide fixed reference points.	**High:** This technology can be used in combination with the Odometer Method to delineate areas for excavation.
Odometer Method: This method utilizes an odometer, which physically measures the distance traveled. Tape measures can also be substituted for vertical distance measurements in excavations.	**Medium**: Medium to high effectiveness when performed by experienced personnel. Low effectiveness when used by inexperienced personnel. Commonly achieved accuracy is 15-cm to 30-cm in line and 20-cm to 80-cm on laterals.	**Low**: Setup and operation affected by terrain/environment. Requires detailed field notes and setup times can be lengthy. Can be used anywhere, with varying degrees of complexity in the operational setup. Minor or no impacts to cultural or natural resources.	**Low**: Minimal direct costs associated with this method; however, poor results may negatively impact costs associated with target resolution.	NA	Requires very capable operators. Useful method if digital positioning systems are unavailable.	**High:** Terrain will not significantly affect use.

Table 5-3
MEC Removal Technologies

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
Hand Excavation: Technique includes digging individual anomalies using commonly available hand tools.	**Medium - High**: This is the industry standard for MEC removal. It can be very thorough and provides an excellent means of data collection.	**Low - Medium**: Hand excavation can be accomplished in almost any terrain and climate. Limited to a practical depth of 2-ft. bgs or less and by the number of people available. Minimal to no impacts to cultural or natural resources.	**Medium**: It is the standard by which all others are measured.	Probe, trowel, shovel, pick axe.	Locally available and easily replaced tools.	**High:** This technology can be used for removal, but limited from a practical standpoint to 2-ft. bgs or less in depth. This technology was used during intrusive investigation of anomalies during the RI.
Mechanical Excavation of Individual Anomalies: This method uses commonly available mechanical excavating equipment to excavate items to within 12-in. with the remaining soil removal supported by hand excavations.	**Medium - High**: Used in conjunction with hand excavation when soil is too hard causing time delay during hand excavation. Method works well for the excavation of deep single anomalies or test pits to remove overburden.	**Low - High**: Equipment can be rented, is easy to operate, and allows excavation to within 12-in. of anomalies in hard soil. Access to site may be limited in certain areas by terrain (trees, boulders/rocks). Mechanical excavation is not appropriate for items located on or near the surface when hand excavation can be employed. Moderate impacts to cultural and natural resources.	**Low**: In hard soil, this method has a lower cost than that of having the single anomalies hand excavated.	Tracked mini-excavator, excavator, or wheeled backhoe. Multiple manufacturers.	Easy to rent and operate.	**High:** For deep subsurface anomalies not easily accessible by hand excavation. **Low:** For surface anomalies or shallow subsurface anomalies easily accessible by hand excavation.
Mass Excavation and Sifting: This method uses robotics earth moving machinery (EMM) to allow site workers to remain at a safe distance from excavation activities. Once soil has been excavated and transported to the processing area, it is then processed through a series of screening devices and conveyors to segregate MEC from soil.	**High:** Process works very well in heavily contaminated areas. Can separate several different sizes of material, allowing for large quantities of soil to be returned with minimal screening for MEC.	**Low:** Robotic EMM is not widely available. Equipment is harder to maintain and would require trained robotics EMM operators. Not feasible for large explosively-configured munitions. Not feasible for heavily wooded areas with numerous ecosystems that must be protected. Major impacts to cultural and natural resources because roadways, stockpiles, and material laydown areas would need to be established for both earth moving and sifting equipment.	**High:** Robotics EMM equipment is expensive to rent and insure and has the added expense of high maintenance costs. Robotics EMM would also require trained equipment operators.	**Earth Moving Equipment:** There is limited availability of trained operators in the country and providers for robotic EMM equipment, including excavators, off-road dump trucks, and front-end loaders. **Sifting Equipment:** Trommel, shaker, rotary screen from varying manufacturers.	Can be rented from specialty providers; however, the availability is limited. Significant maintenance costs.	**Low:** The availability of equipment and operators is limited and the high cost is prohibitive, but this technology provides a means of MEC removal below 2-ft. bgs.
Magnetically Assisted Removal: Magnets are used to separate conductive material from soils.	**Low:** Primarily used in conjunction with mass excavation and sifting operations. Can help remove metal from separated soils, but does not work well enough to eliminate the need to inspect the smaller size soil spoils. Magnetic systems are also potentially useful to help with surface removal of MD and surface debris.	**High:** Magnetic rollers are easily obtained from the sifting equipment distributors and are designed to work with their equipment. Major impacts to cultural and natural resources because roadways, stockpiles and material laydown areas would need to be established for both earthmoving and sifting equipment which support magnetic operations.	**Low:** This method adds very little cost to the already expensive sifting operation.	Magnetic rollers or magnetic pick-ups are available from many manufacturers of the sifting equipment noted above.	Installed by sifting equipment owner.	**Low:** Primarily used in conjunction with mass excavation and sifting operations, but the low effectiveness of the technology makes it less desirable for use at the MRS.

Table 5-4
MEC Disposal Technologies

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
BIP: BIP is the destruction of MEC for which the risk of movement beyond the immediate vicinity of discovery is not considered acceptable. Normally, this is accomplished by placing an explosive charge alongside the item.	**High:** Each MEC item is individually destroyed with subsequent results individually verified using quality assurance/quality control. BIP yields unconfined releases of MC and MD, which can be restricted using engineering controls.	**Medium:** Field-proven techniques, transportable tools, and equipment; suited to most environments. Human exposure can limit viability of this option. Engineering controls can further improve implementation by limiting damages to natural and cultural resources and nearby structures.	**Medium:** Manpower intensive. Costs increase in areas of higher population densities or structures that may be damaged. Limited accessibility to construct engineering controls increases costs.	Electric or non-electric firing system.	Potential waste streams must be addressed in BIP operations planning.	**High:** Not implemented during the RI, but found effective on other sites.
Consolidated Shots: Consolidated detonations are the collection, configuration, and subsequent destruction by explosive detonation of MEC for which the risk of movement has been determined to be acceptable within a current working MRS.	**Medium - High:** Limited in use to MEC deemed acceptable to move. Detonation yields unconfined releases of MC and MD, which can be restricted using engineering controls.	**Medium – High:** Generally employs the same techniques, tools, and equipment as BIP procedures at a designated location or disposal area.	**Medium:** Manpower intensive, may require materials handling equipment for large-scale operations.	Electric or non-electric firing system.	Potential waste streams must be addressed.	**High:** Preferred over BIP because hazards are more easily controlled.
Contained Detonation Chambers (CDCs) – Stationary: CDCs involve destruction of certain types of munitions in a chamber, vessel, or facility designed and constructed specifically for the purpose of containing blast and fragments. CDCs can only be employed for munitions for which the risk of movement has been determined acceptable.	**Low – Medium:** CDCs successfully contain hazardous components. Current literature reviewed shows containment up to 40 pounds (assume net explosive weight). Commonly used for fuzes and smaller explosive components. Limited in use to munitions that are "acceptable to move." CDCs yield confined releases of MC and MD.	**Low:** Stationary facilities typically must meet regulatory and construction standards for permanent/semi-permanent waste disposal facilities. Such facilities are not commonly used in support of munitions responses. Produce additional hazardous waste streams. Major impacts to cultural and natural resources because roadways and staging areas would need to be established for equipment.	**High:** Siting and construction required. Low feed rates equal more hours on-site. Significant requirements for maintenance of system.	Typically designed on case-by case basis.	System cleaning and maintenance usually requires personal protective equipment (PPE) and worker training. Probable permitting issues with employment of technology. Not necessary at the MRS, common engineering controls are sufficient.	**Low:** Stationary CDCs are not available.
CDCs – Mobile: Same as above.	**Low – Medium:** CDCs successfully contain hazardous components. Commonly used for fuzes and smaller explosive components. May not be used for larger munitions items. Limited in use to MEC "acceptable to move." CDCs yield confined releases of MC and MDAS.	**Low:** Designed to be deployed at the project site. Greatly reduced footprint compared to stationary facilities. Requires substantial additional handling and transport of MEC. Requires items to be safe to move. Flashing furnaces have low feed rates because of safety concerns. Produces additional hazardous waste streams. Major logistical concerns if roadways and staging areas need to be established for equipment.	**Medium – High:** Possible construction required (e.g., berms and pads). Low feed rates equal more hours on site. Significant requirements for maintenance of system.	Donovan Blast Chamber, Kobe Blast Chamber.	System cleaning and maintenance usually requires PPE and worker training. Probable permitting issues with employment of technology. Not necessary at MRS, common engineering controls are sufficient.	**Low:** Mobile CDCs are not available.

Table 5-5
Waste Stream Treatment Technologies

Technology	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at Kingman Range MRS
Chemical Decontamination: Uses chemical processes to eliminate all explosives residues from MEC.	**Low – Medium:** Great variety in chemicals required to decontaminate various MEC fillers (e.g., propellants, pyrotechnics, explosives). Difficult to test for effectiveness. May generate additional waste streams (some hazardous).	**Low:** Requires containment of multiple hazardous materials. May require emissions controls. Worker training and PPE typically required. No mobile systems deployable to MRS exist.	**High:** Specialized manpower, containment requirements, additional waste stream processing.	Supercritical water oxidation. Photocatalysis. Molten salt oxidation.	National Defense Center for Energy and Environment is working on a mobile system, but it treats only scrap metal, not MEC or DMM.	**Low:** No facilities of this type are available or preferred for the munitions types at Kingman Range MRS.
Shredders and Crushers: These technologies use large machines to deform metal components. This results in unusable remnants and overall reduced volume of scrap.	**Low:** Shredders are mainly used to render MDAS as unrecognizable from the shape of military munitions. Residue typically still requires additional treatment to achieve higher decontamination levels.	**Low - Medium:** Typically stationary facilities. Service life and very high maintenance are expected.	**Medium - High:** Specialized equipment and operators; high maintenance; additional waste stream processing.	Shred Tech ST-100H Roll-Off (vehicle mounted).	Disposition of resultant waste streams must be addressed.	**Low:** This process is used for the certified destruction of MDAS.
Thermal Treatment: Decontamination is achieved by exposing debris to high temperatures (between 600 degrees Fahrenheit [˚F] and 1,400 ˚F) for specified periods of time.	**High:** Furnaces are designed to contain hazardous components. Methods are proven means of attaining high degrees (5X) of decontamination. Commonly used to destroy and decontaminate fuzes and smaller explosive components.	**Low:** Typically stationary facilities. Service life and maintenance are issues. Requires additional handling of MEC. Flashing furnaces have low feed rates because of safety concerns. Produces additional hazardous waste streams.	**High:** Possible construction required. Low feed rates equal more hours on-site. Maintenance of system.	Rotary kiln incinerator. Explosive waste incinerator. Transportable flashing furnace.	System cleaning and maintenance usually requires PPE and worker training. May require permit to deploy technology.	**Low:** No facilities of this type are available. Technology would not be applicable to munitions types at the Kingman Range MRS.
Recycling: Required for MDAS and non-munitions related debris (NMRD) items.	**High:** Very effective for MDAS and NMRD.	**High:** Easily implemented if there is a local metal recycler.	**Low – Medium:** Scrap metal may be accepted without cost. Transportation costs will need to be included.	NA	MDAS must be transported and smelted and a certificate of destruction for the completion of the chain of custody of MDAS is required.	**High:** Technology was used for disposal of NMRD items and MDAS during the RI.

5.4 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

A summary of the technologies retained for RAO development is presented in **Table 5-6**. The general remedial action of MEC removal has been broken down into two (2) remedial alternatives for evaluation:

- Removal of MEC to 18-in bgs - Removal of detectable MEC at the MRS. This includes surface removal (removal of MEC detected on the ground surface and breaching the ground surface). Depth of detection varies based on the depth, orientation, composition, mass and diameter of MEC, and the detection technology.
- Removal of MEC to bedrock – Removal of all MEC at the MRS via excavation to bedrock and sifting of all soils.

All MEC removal alternatives will include a combination of disposal methods, recycling, and LUCs.

The approximate area to which the GRAs may be applied is identified based on exposure routes, the nature and extent of MEC, RAOs, and ARARs.

The extent of the potential MEC hazard at the MRS has been summarized in the RI Report and is shown in **Appendix A, Figure 7** of the RI Report (WESTON, 2020). All munitions-related material recovered during the RI and SI has been found between zero (0)-in. and six (6)-in. bgs.

The eastern portion of the MRS contains a natural bedrock escarpment with steep terrain (greater than 30 degrees) that is not accessible to vehicle or foot traffic. This inaccessible area makes up approximately 20% of the MRS. This area is not accessible for investigation, but remains inside the MRS boundary.

As a result of the RI, the MRS was split into two (2) MRSs. The 25.29-acre Kingman Range – NFA Area MRS (AZHQ-006-R-02) was recommended for NFA for MEC and MC and is not included in this FS. The 8.14-acre Kingman Range MRS (AZHQ-006-R-01), which corresponds with the RI area of investigation is recommended for further action based on the discovery of MD items during the RI. The anticipated future land use for the MRS is the same as current land use (privately owned land), although the parcel is zoned residential and may be developed in the future.

Table 5-6
Retained MEC Technologies for the Kingman Range MRS

MEC Detection		MEC Removal	MEC Disposal	
Geophysical Sensors	**Positioning**		**Disposal**	**Waste Stream Treatment**
1. Digital EMI sensors deployed in a multi-sensor array and/or in a wheeled cart or litter configuration. Instruments deemed viable are: ▪ Geonics EM61-MK2A ▪ MetalMapper ▪ MetalMapper 2x2 ▪ TEMTADS 2x2 2. Analog (mag and dig or excavated soil screening), including all-metals (EMI) detectors. I Instruments deemed viable are: ▪ Whites XLT ▪ Minelab Explorer II ▪ Vallon VMC1 ▪ Vallon VMH3	1. RTK GPS with fiducial and odometer/ tape measurements in specific areas.	1. Hand excavation of anomalies <2–ft. deep. 2. Mass excavation and sifting of soils.	1. A combination of the following methods, based on MEC evaluation in the field by qualified UXO Technicians: ▪ BIP ▪ Consolidation	1. MDAS and NMRD recovered from MEC removal and disposal will be sent to a certified recycler and MDAS will be smelted.

6.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Remedial alternatives are developed in this section by assembling the selected remedial technologies from **Section 5.0**. Remedial alternatives must meet the RAO in order to ensure that the selected remedy is protective of human health and the environment and complies with applicable regulations. This section provides a description of each remedial alternative and of how each remedial alternative meets the RAO for the Kingman Range MRS.

The following alternatives have been assembled: 1) a no action alternative; 2) alternatives that include LUCs, (engineering controls, educational controls, and LTM), and 3) MEC removal. Based on these requirements and the technology screening in **Section 5.0**, the following alternatives have been assembled:

- Alternative 1 – No Action;
- Alternative 2 – LUCs;
- Alternative 3 – LUCs, and surface and subsurface (18 in. bgs) removal of MEC using DGM/AGC; and
- Alternative 4 – Complete surface and subsurface removal of MEC using excavation and sifting, and analog clearance of the rock escarpment.

These remedial alternatives are described in the following subsections. CERCLA and the NCP [CERCLA 121(c) and NCP 300.430(f)(4)(ii)] require Five-Year Reviews where unlimited land use is not achieved (USEPA, 2001), which would apply to Alternatives 1, 2, and 3. Recurring reviews determine whether a remedial action continues to minimize the hazard and continues to be protective of human health and the environment, and provide an opportunity to assess the applicability of new technology for addressing previous impracticability determinations.

6.1 ALTERNATIVE 1 – NO ACTION

The no action alternative is carried through the analysis to provide a baseline for comparison to the other alternatives. This alternative does not provide mitigation of hazards, contaminant reduction, monitoring, or LUCs, and is the least preferred GRA category. This alternative does not meet the RAO but is required by the NCP. Site access is assumed to be unrestricted and there are no limitations on current or future site use or activities.

6.2 ALTERNATIVE 2 – LAND USE CONTROLS

Alternative 2 includes LUCs for the Kingman Range MRS. Alternative 2 is protective of human health and the environment and meets the RAOs and NCP requirements. The remaining potential MEC hazards at the Kingman Range MRS would be mitigated by LUCs to prevent receptors from coming into contact with MEC. However, this alternative offers no physical reduction of MEC potentially present at the MRS.

The Alternative 2 LUCs would consist of various engineering and educational controls including:

- Engineering Controls:
  - Fencing; and
  - Warning Signs – Six (6) signs will be located at corners of the MRS and potential access points.
- Educational Controls:
  - Public Notices; and
  - Fact Sheets.
- LTM.

The fact sheet and public notices would be distributed once, by the contractor. The fact sheet would be prepared for the property owner and for distribution to public officials and emergency management agencies. A public notice would be prepared for local distribution (e.g., newspaper article). A management plan would be drafted to identify how potential MEC present at the MRS should be handled. Four (4) types of management plans may be required: a LUC Implementation Plan (LUCIP), LUC monitoring and maintenance plan, LTM program plan; and Environmental Hazard Management Plan (used to mitigate potential hazards remaining after treatment).

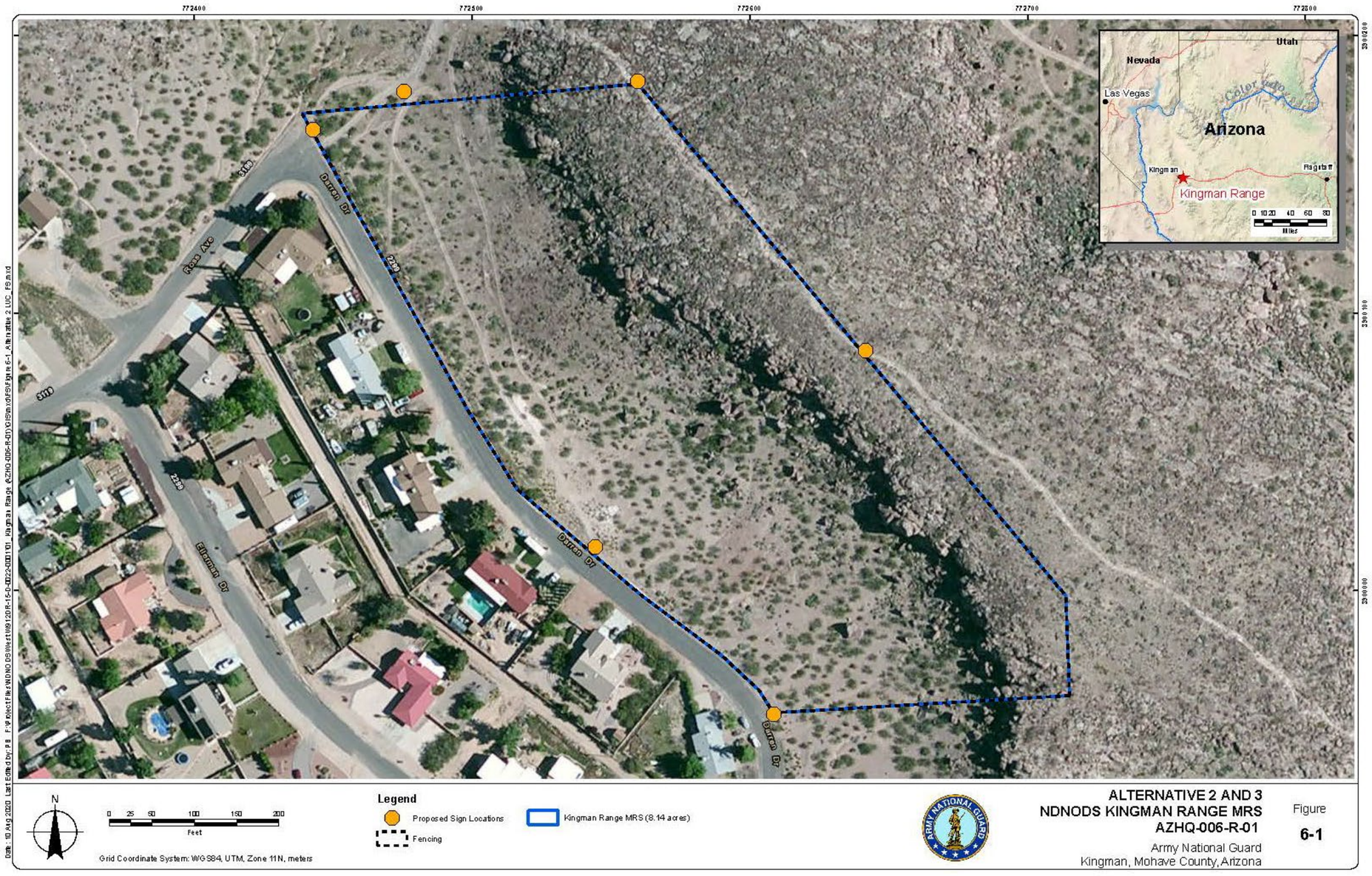
Yearly inspections and replacement of signs every five (5) years, are included as part of LTM and would substantiate LUC restrictions. Annual inspections, sign replacement, and Five-Year Reviews would be conducted by a contractor, using five (5)-year contracts for a total of six (6) contracts over 30 years. A Five-Year Review is required for this remedy, as it results in hazards remaining at the MRS above levels that allow for unrestricted use (USEPA, 2001). **Figure 6-1** presents the LUCs associated with Alternative 2.

6.3 ALTERNATIVE 3 – LUCS, AND SURFACE AND SUBSURFACE (18-INCHES BELOW GROUND SURFACE) REMOVAL OF MEC USING DGM/AGC

Alternative 3 includes LUCs, as described in Alternative 2, as well as MEC detection, removal, and disposal technologies to eliminate the potential explosive hazard at Kingman Range MRS down to 18-inches bgs (**Figure 6-1**). The 8.14-acre Kingman Range MRS would be included in the removal action, with the exception of the escarpment (approximately 1.75 acres or 20% of the MRS). All anomalies would be resolved to detection depth.

Prior to undertaking the remedial action, a geophysical pilot study would compare the effectiveness of various geophysical clearance methods at the site. This pilot study would be implemented to determine if any potential limitations for detecting and/or classifying subsurface MEC exist at the Kingman Range MRS.

Figure 6-1
Alternative 2 – LUCs and Alternative 3 - LUCs and Surface and Subsurface Removal of MEC Using DGM/AGC



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A full coverage surface clearance would be conducted to remove surficial metal objects. The surface clearance operation would be performed by one (1) UXO Team. This team would consist of one (1) UXO Technician III, one (1) UXO Technician II, and one (1) UXO Technician I. Two (2) UXO Technicians would operate handheld EMI all metals detectors such as the White's MXT or equivalent to aid in locating surface metal, requiring removal and disposal, while the third would operate the personal digital assistant, recording identified item characteristics. A Site UXO Supervisor (SUXOS) would provide overall management of the UXO Team and a UXO Quality Control Specialist (UXOQCS)/UXO Safety Officer (UXOSO) would provide quality and safety oversight.

UXO Team members would traverse the remedial action areas adjacent to each other while sweeping with the handheld detectors and visually inspecting the ground surface. It is estimated that the surface clearance would be conducted over five (5) work days equating to slightly less than two (2) acres per day (three [3] person team with two [2] Technicians sweeping and one [1] Technician recording data). Locations of munitions related items would be recorded using GPS.

Qualified UXO Technicians would inspect each item and classify it as a potential explosive hazard requiring further treatment or MDAS. MD would be segregated from NMRD and stored in locked containers for transfer to a recycling facility for smelting. Recovered MEC would either be BIP or consolidated for detonation and then disposal.

A full coverage DGM survey would be performed across approximately 8.14 acres (excluding the approximately 1.75-acre escarpment) following the surface clearance. The DGM survey would be performed by one (1) team consisting of a Site Geophysicist and UXO Technician II providing anomaly avoidance and escort. The geophysicist would use a three (3) sensor EM61-MK2A towed array and a single EM61-MK2A sensor to collect the digital geophysical data. On average, the towed array would be used to collect data at a rate of two (2) acres per day. The DGM survey would take five (5) days to complete.

Digital geophysical data would be sent to the data processing geophysicist stationed at a home office location. The digital data would be processed and analyzed to identify anomaly locations. The further action area encompasses 8.14 acres, but approximately 1.75 acres are not accessible. Therefore, the geophysical investigation would cover approximately 6.39 acres. Based on analysis of the RI results, it is estimated that there are approximately 170 anomalies per acre at the Kingman Range MRS. Using the statistical data and multiplying the area (in acres) of the accessible area of the MRS by the estimated target density results in an estimated 1,087 targets requiring intrusive investigation.

The UXOQCS/UXOSO would implement a site-wide seeding program to confirm equipment functionality and operator capability for each phase of the geophysical investigation.

Cued interrogation surveys, using an advanced Metal Mapper 2x2 sensor, would be performed at each anomaly location to collect the data necessary to make AGC decisions. The AGC process uses advanced EMI sensors and data analysis software to allow geophysical analysts to estimate parameters such as depth, size, density, wall thickness, and shape of buried metallic items.

Decisions can be made as to whether buried metallic items are potentially MEC or nonhazardous scrap. It is estimated that 150 cued surveys would be conducted per day using an advanced EMI sensor for a total of eight (8) work days. The cued survey data would be transferred to the processing geophysicist for analysis. Anomaly locations identified as potential MEC or locations that could not be analyzed would be selected for reacquisition and excavation. The AGC process is assumed to reduce the overall list of anomalies requiring excavation by 75% for a total of 272 anomalies. In addition, the AGC process requires an additional 200 verification and 200 validation digs. Each of the estimated 474 anomalies would be reacquired via GPS by the site geophysicist and UXO Technician II, at rate of approximately 200 anomalies per day for three (3) days.

The location of each anomaly would be flagged and labeled with a unique ID so it is identifiable. When the anomaly location is identified, intrusive investigations would be performed by a UXO Team comprised of one (1) UXO Technician III, two (2) UXO Technician II, and three (3) UXO Technician I. A SUXOS would provide management of the UXO Team and a dual-hatted UXOQCS/UXOSO would provide quality and safety oversight. The UXO Team would investigate anomalies at a rate of 100 anomalies per day for a total of five (5) work days. MEC, MD and NMRD would be handled in a similar manner to the procedures outlined in the surface clearance discussion.

The following general tasks would be included as part of Alternative 3:

- Pilot Study;
- Mobilization;
- Survey/positioning/target area staking;
- Target area seeding (surface seeding for surface sweep);
- Analog MEC detection (surface sweep);
- Grid staking;
- Grid seeding (blind seeding for DGM survey);
- DGM Survey MEC detection (100% coverage grid survey);
- DGM data processing;
- Cued AGC survey;
- Anomaly reacquisition;
- MEC Removal;
- MEC disposal;
- MD and NMRD waste stream treatment; and
- Demobilization.

6.4 ALTERNATIVE 4 – COMPLETE SURFACE AND SUBSURFACE REMOVAL OF MEC USING EXCAVATION AND SIFTING, AND ANALOG CLEARANCE OF THE ROCK ESCARPMENT

Alternative 4 (**Figure 6-2**) includes excavation and sifting of soil throughout the approximately 6.39 accessible acres of the Kingman Range MRS. The approximately 1.75 inaccessible acres of the rock escarpment would be cleared using analog geophysical methods.

The excavation and sifting operation involves heavy machinery excavating soil at the MRS down to bedrock and transporting it to a nearby temporary screen plant for sifting. It is estimated that the site will need to be excavated to an average of three (3) ft. bgs in order to reach bedrock. Therefore, approximately 31,000 cubic yards of soil would be excavated and sifted at the MRS. The excavation and sifting operation can process approximately 500 cubic yards per 10-hour work day. The total time required to complete the excavation and sifting operation would be approximately 62 days. Following completion of the excavation and sifting operation, backfilling of natural soils and site restoration would occur over the course of 20 days.

In addition to excavation and sifting of the accessible portion of the MRS, the approximately 1.75-acre inaccessible portion of the MRS would be cleared using analog geophysical methods. A UXO Team comprised of one (1) UXO Technician III, one (1) UXO Technician II, and one (1) UXO Technician I would require approximately three (3) days to clear the rock escarpment. A SUXOS would provide management of the UXO Team and a dual-hatted UXOQCS/UXOSO would provide quality and safety oversight. Any MEC encountered during field operations would have to be BIP.

The following general tasks would be included as part of Alternative 4:

- Mobilization;
- Survey/positioning/target area staking;
- Analog MEC detection (surface sweep);
- Excavation and Sifting;
- Site Restoration;
- MEC disposal;
- MD and NMRD waste stream treatment; and
- Demobilization.

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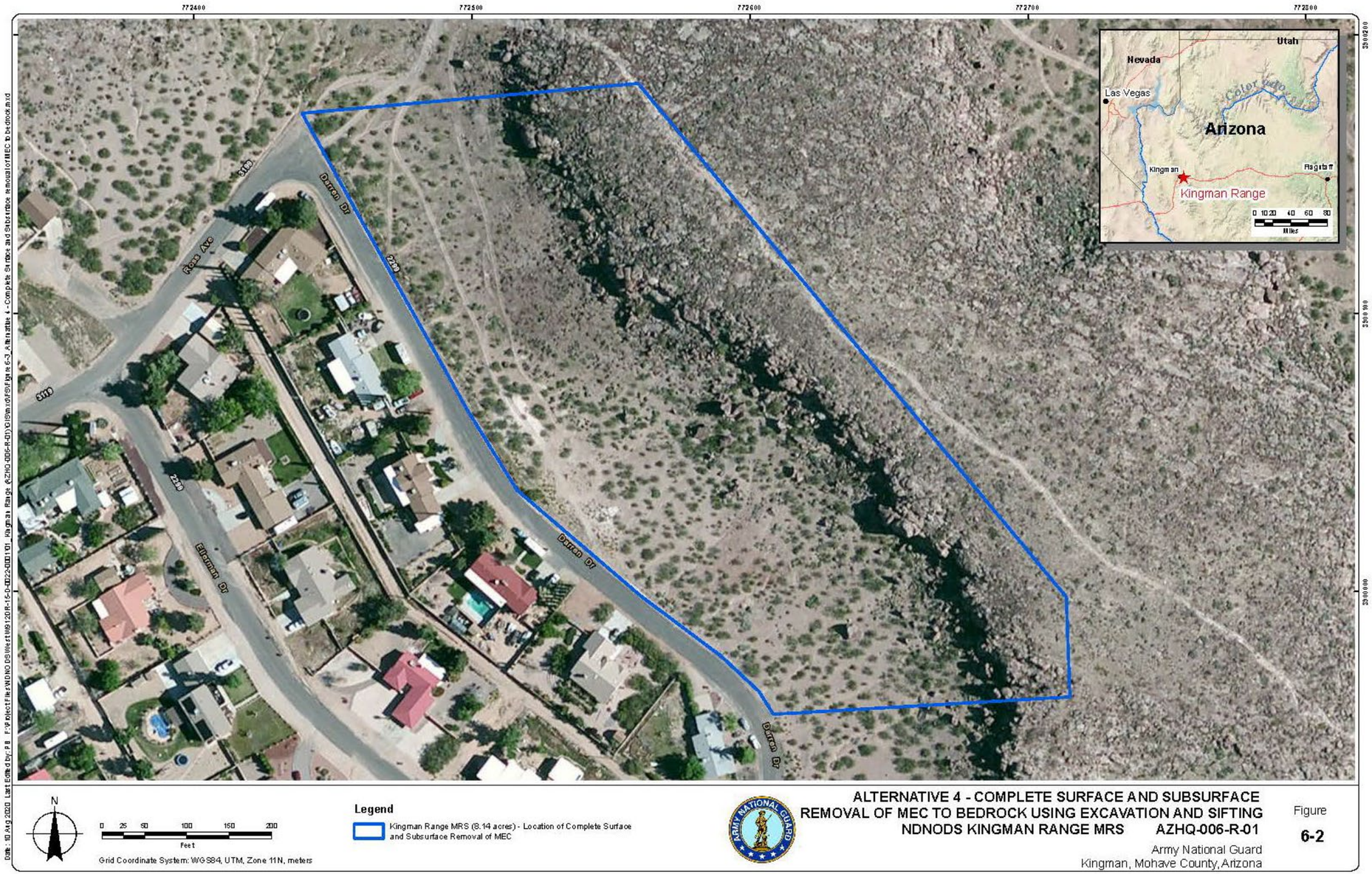
Figure 6-2
Alternative 4 – Complete Surface and Subsurface Removal of MEC Using Excavation and Sifting



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7.0 DETAILED ANALYSIS OF ALTERNATIVES

The detailed analysis of remedial alternatives consists of the analysis and presentation of the relevant information needed to allow decision makers to select a site remedy, not the decision making process itself. **Section 7.1** describes the criteria by which individual alternatives are analyzed according to the NCP. The individual analysis is provided in **Section 7.2**. The results of the individual analyses are then comparatively evaluated in **Section 7.3** to aid in identifying and assessing relative strengths and weaknesses between the remedial alternatives. This approach to analyzing alternatives is designed to provide decision makers with sufficient information to adequately compare the alternatives, select an appropriate remedy for the site, and demonstrate compliance with the NCP and the CERCLA process.

7.1 DETAILED ANALYSIS CRITERIA

The alternatives are evaluated per the criteria in NCP §300.430(e)(9). The USEPA guidance for conducting RIs and FSs was used in this evaluation (USEPA, 1988). They are arranged into three (3) categories: threshold criteria, balancing criteria, and modifying criteria, and are described in the following subsections.

7.1.1 Threshold Criteria

Assessments against the following two (2) criteria relate directly to statutory findings that must ultimately be made in the ROD; therefore, these are categorized as "threshold" criteria because an alternative may not be implemented without compliance. These two (2) criteria are listed below and described in the following subsections:

- Overall protectiveness of human health and the environment; and
- Compliance with ARARs.

7.1.1.1 Overall Protectiveness of Human Health and the Environment

This criterion assesses whether the alternatives can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the MRS by eliminating, reducing, or controlling exposure. Overall protection of human health and the environment draws on the attainment of RAOs and assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

7.1.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses whether the alternatives attain Federal or state ARARs or provides grounds for invoking a waiver. Potential site-specific ARARs are presented in **Section 4.0**. Final ARARs and compliance determinations will be made in consultation with Stakeholders (USACE, ARNG G9, AZARNG, ADEQ, and the private landowner) in the ROD.

7.1.2 Balancing Criteria

The following five (5) "balancing criteria" are grouped together because they represent the primary criteria upon which the individual and comparative analyses are based. The balancing criteria are listed below and described in the following subsections:

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

7.1.2.1 Long-Term Effectiveness and Permanence

The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met. The assessment includes the magnitude of residual risk from untreated waste or treatment residuals and the adequacy and reliability of controls used to manage untreated wastes or treatment residuals.

For MRSs with potential explosives hazards, the ability to maintain protection of human health and the environment over time will typically fall into categories associated with LUCs. The evaluation of long-term effectiveness and permanence of LUCs will take into account the administrative feasibility of maintaining the LUCs and the potential risk/hazard should they fail, as well as mechanisms like the CERCLA Five-Year Review process to evaluate on a periodic basis the long-term effectiveness and permanence, as well as protectiveness, of the alternative.

7.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion assesses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the MRS. Factors that will be considered, as appropriate, include the following:

- Treatment or recycling processes the alternatives employ and the materials they will treat;
- Amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;
- Degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;
- Degree to which the treatment is irreversible;
- Type and quantity of residuals that will remain following treatment; and
- Degree to which treatment reduces the inherent hazards posed by the principal threats at the MRS.

7.1.2.3 Short-Term Effectiveness

This criterion assesses the short-term impacts of alternatives considering the following:

- Short-term risks that might be posed to the community during implementation of an alternative;
- Potential impacts on workers during remedial action and the effectiveness and reliability of mitigation measures during implementation;
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and
- Time until remedial protection is achieved.

7.1.2.4 Implementability

This criterion assesses the ease or difficulty of implementing the alternatives by considering the following types of factors as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

7.1.2.5 Cost

The NCP requires the assessment of the following cost categories:

- Capital costs, including both direct and indirect costs;
- Annual operation and maintenance (O&M) costs; and
- Net present value of capital and O&M costs.

Both capital and O&M costs will be considered, where appropriate. The evaluation will include those O&M costs that will be incurred for as long as necessary, even after the initial remedial action is complete. In addition, potential future remedial action costs will be considered during alternatives evaluation to the extent that can be defined.

Present value analyses will be used during alternatives evaluation to assess expenditures that occur over different time periods. By discounting all costs to a common base year, the costs for different technologies/alternatives can be compared based on a single figure for each alternative. Included in each cost calculation is an estimate as to the amount of time that will be necessary to complete the proposed alternative.

Present value cost is the total cost of an alternative over time in terms of today's dollar value. Costs have been rounded to the nearest thousand dollars and estimates are expected to be accurate within a range of +50% to -30%. **Attachment A** presents the basis of the cost estimates. The costs developed for each alternative are based on vendor quotes, literature values, professional experience, and engineering judgment. The level of detail utilized in these elements is considered appropriate for choosing between alternatives, but the estimates are not intended for use in detailed budget planning.

Final costs will depend on actual labor and material costs, actual MRS conditions, market conditions, final project scope, final project schedule, productivity, and other variable factors. As a result, the final costs will vary from the estimates presented in this FS; however, these factors should not affect the relative cost differences between the alternatives.

7.1.3 Modifying Criteria

The final two (2) criteria, the "modifying factors," will be evaluated following receipt of comments on the FS and the PP. These criteria are listed below and described in the following subsections:

- Regulatory acceptance; and
- Community acceptance.

7.1.3.1 Regulatory Acceptance

This assessment reflects the state's (or support agency's) apparent preferences among or concerns about alternatives.

7.1.3.2 Community Acceptance

This assessment reflects the community's apparent preferences among or concerns about alternatives. Prior to remedy selection, the community is provided with an opportunity to review the FS and subsequent PP during the public comment period. The public is also given the opportunity to express concerns and comments during a community meeting, which is usually held during the public comment period.

7.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

The individual analysis of each of the four (4) alternatives based on the criteria described above is provided in this section.

7.2.1 Alternative 1 – No Action Alternative

7.2.1.1 Overall Protectiveness of Human Health and the Environment

The no action alternative would not decrease the potential risks to human health or the environment and does not meet the RAO for the MRS. This alternative would leave potential MEC on the MRS and offer no controls to prevent exposure to MEC hazards. There would be no impacts to the environment under Alternative 1.

7.2.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

The identified ARARs and TBCs (**Table 4-1**) would only apply to alternatives that include remediation. Because there are no actions under this alternative, Alternative 1 would not meet this criterion.

7.2.1.3 Long-Term Effectiveness and Permanence

This alternative would not provide long-term effectiveness or permanence with regards to MEC removal. The RAO would not be met as potential explosive hazards would still be present on the MRS and nothing would be done to prevent direct contact with current and future receptors (recreational users [trespassers], site visitors, construction workers, and the private landowner), and controls would not be implemented to maintain protection of human health or the environment.

7.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative would not reduce the source of risk, which is potential surface and subsurface MEC. Therefore, there would be no reduction of the number and density of MEC, and as a result Alternative 1 would not meet this criterion.

7.2.1.5 Short-Term Effectiveness

The short-term effectiveness of this alternative is considered to be high because no remedy would be implemented under the no action alternative. No site work would be conducted that would pose a hazard to human health or the environment, including workers and the community, during the construction and implementation of the remedy.

7.2.1.6 Implementability

No activities are proposed; therefore, the alternative would be technically and administratively implementable.

7.2.1.7 Cost

There are no costs associated with Alternative 1.

7.2.1.8 Regulatory Acceptance

This subsection is reserved for the inclusion of regulatory comments. Comments or approval will be incorporated into the final document (**Attachment B**).

7.2.1.9 Community Acceptance

Solicitation of community involvement in the decision making of a final remedy is sought through the PP.

7.2.2 Alternative 2 – Land Use Controls

7.2.2.1 Overall Protectiveness of Human Health and the Environment

This alternative is protective of human health through fencing and signage, limiting access to and identifying the potential MEC hazard area, in addition to educational controls to raise public awareness resulting in increased protection for human health. Through the LUCIP and LTM, land use would be monitored and restricted, protecting human health and the environment. Together, these technologies would be sufficient to meet the RAO for the MRS, with the exception of potential future residents if the private landowner developed the land for residential use in the future. There would be no impacts to the environment under Alternative 2.

7.2.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

The identified ARARs and TBC Criteria (**Table 4-1**) would only apply to alternatives that include remediation. Because ARARs do not apply to Alternative 2, they were not considered.

7.2.2.3 Long-Term Effectiveness and Permanence

The RAO would be met in this alternative as site receptors would be informed of and protected from direct contact with surface and subsurface MEC, with the exception of potential future residents if the private landowner developed its land for residential use in the future, as Alternative 2 would not clean up the MRS to residential standards. LUCs administered under Alternative 2 would meet long-term effectiveness but would be contingent on the cooperation and active participation of the existing powers and authorities of government agencies. The remedial design would specify steps and controls to be put in place that would ensure that the LUCs, including fencing and signs, are maintained. Construction support would be provided as needed, and CERCLA Five-Year Reviews would be conducted to assess the MRS condition and the degree of protectiveness to human health and the environment.

7.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

No treatment would be provided; therefore, there would be no reduction of the number and density of MEC potentially present at the Kingman Range MRS. Therefore, this alternative would not meet this criterion.

7.2.2.5 Short-Term Effectiveness

Land disturbance associated with installation of fencing and warning signs would be minimal and short-term (a couple of weeks). There may be a slight increase in risk to contractor personnel during physical installation, depending on where fencing and signs are posted. Otherwise, there would be no additional risk to contractors because there are no other construction or operation activities associated with Alternative 2. In addition, there are no short-term risks to the community or workers associated with the development of educational materials. Therefore, this alternative would meet this criterion.

7.2.2.6 Implementability

Some of the components recommended in Alternative 2 are already in place and can be easily augmented. Design and implementation of administrative LUCs and maintaining a public information program would require coordination between the USACE, ARNG G9, AZARNG, and ADEQ. However, there may be some administrative implementability concerns because the property is not under the control of the DoD. Signs and educational materials will be made readily available. Additionally, annual site inspections would be conducted as part of the LTM during which the condition of the fencing and signage would be assessed. These tasks are realistically achievable. Therefore, LUCs would be technically and administratively feasible, thereby meeting this criterion.

7.2.2.7 Cost

The estimated cost for this alternative includes the capital cost associated with installing fencing and signage, the implementation of LUCs, and site closure. Periodic costs include those costs associated with annual site inspections and Five-Year Reviews required for CERCLA sites for years 5, 10, 15, 20, 25, and 30. A summary of costs is shown in **Table 7-1**. A detailed breakdown of costs is included in **Attachment A**.

Table 7-1
Alternative 2 Cost Summary

Cost Type	Total Cost
Capital Cost	$365,000
Annual O&M Cost	$284,000
Periodic Cost	$115,000
Total Present Value Cost	**$764,000**

7.2.2.8 Regulatory Acceptance

This subsection is reserved for the inclusion of regulatory comments. Comments or approval will be incorporated into the final document (**Attachment B**).

7.2.2.9 Community Acceptance

Solicitation of community involvement in the decision making of a final remedy is sought through the PP.

7.2.3 Alternative 3 – LUCs, and Surface and Subsurface (18-in. bgs) Removal of MEC using DGM/AGC

7.2.3.1 Overall Protectiveness of Human Health and the Environment

This alternative would protect human health and the environment by removing potential MEC hazards in the surface and subsurface across the accessible areas of the Kingman Range MRS, approximately 6.39 acres, and would meet the RAO for the MRS with the implementation of LUCs as described in Alternative 2. Alternative 3 would cause some disturbance to the environment with the removal of anomalies; however, disturbance would be minimal.

7.2.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 3 would comply with the ARARs in **Table 4-1.**

7.2.3.3 Long-Term Effectiveness and Permanence

Alternative 3 would be effective over the long term because potential MEC would be removed from the surface and the subsurface (to 18-in. bgs) across all of the accessible areas of the MRS. However, the inaccessible areas associated with the rock escarpment would not be cleared. LUCs would be required as described in Alternative 2. Together, the removal in accessible areas of the MRS and implementation of LUCs would meet the RAO of preventing direct contact with potential MEC for all current and future receptors.

7.2.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 3 would reduce the toxicity, mobility and volume of potential MEC across the all accessible areas of the MRS by removing the potential MEC hazards from the surface and subsurface (to 18-in. bgs). However, a low potential for MEC below 18-in. bgs and in the inaccessible areas of the MRS would remain.

7.2.3.5 Short-Term Effectiveness

There would be an increase in risk to workers while the removal action is conducted (estimated at two [2] months). The increased risk to the community during the removal action would be mitigated, where possible, by the use of engineering controls and/or evacuations to maintain MSDs. The risk to workers and to the community associated with MEC that need to be BIP would be greater than the risk associated with consolidation because it is more difficult to control the area around an item. Items that are acceptable to move can be disposed of in a more controlled environment. The risk to the community during the disposal could be mitigated by the use of engineering controls and/or evacuations to maintain MSDs.

7.2.3.6 Implementability

Surface and subsurface removals were implemented effectively during the RI. Specific activities, including noxious weed mitigation, awareness training, and mitigation activities would be required to protect natural resources and are easily implementable. Clearance activities with magnetometers would not be conducted on the escarpment. Regarding MEC disposal, BIP is more difficult to implement than consolidation because it is more difficult to control the area around an item. It may also be more difficult to transport engineering controls to the MEC items for BIP demolition than to a consolidation area that may be more accessible.

For MEC removal, detonation, and recycling, multiple UXO dig teams would need to be mobilized to conduct DGM and analog investigations. Dig teams would intrusively investigate metallic anomalies within the remedial area to ensure that 100% of potential MEC are investigated and rendered safe through detonation. Donor explosives, if needed, would need to be brought on-site by a vendor. After inspection and verification that the items were properly detonated and can be considered MDAS, the metallic remains would be placed in drums and shipped off-site for demilitarization.

However, it is unclear whether or not nearby residences would be amenable to evacuating their houses during surface and subsurface clearance work. For Alterative 3, evacuation would be required for the surface and subsurface clearance in the area near the houses. Therefore, Alternative 3 would be technically feasible, but may not be administratively feasible if land owners are unwilling to evacuate.

7.2.3.7 Cost

The estimated cost for this alternative includes capital costs associated with the removal, detonation, and recycling of potential MEC which includes engineering controls and health and safety documents, reviews, and plans to implement work. Additionally, costs include site closure efforts (After Action Report and Removal Action Report). A summary of costs is shown in **Table 7-2**. A detailed breakdown of costs is included in **Attachment A**.

Table 7-2
Alternative 3 Cost Summary

Cost Type	Total Cost
Capital Costs	$1,268,000
Annual O&M Costs	$284,000
Periodic Costs	$115,000
Total Present Value Cost	**$1,667,00**

7.2.3.8 Regulatory Acceptance

This subsection is reserved for the inclusion of regulatory comments. Comments or approval will be incorporated into the final document (**Attachment B**).

7.2.3.9 Community Acceptance

Solicitation of community involvement in the decision making of a final remedy is sought through the PP.

7.2.4 Alternative 4 – Complete Surface and Subsurface Removal of MEC using Excavation and Sifting, and Analog Clearance of the Rock Escarpment

7.2.4.1 Overall Protectiveness of Human Health and the Environment

This alternative would protect human health and the environment by removing potential MEC hazards in the surface and subsurface across the entire Kingman Range MRS down to bedrock, and clearing the rock escarpment with analog geophysical methods. These actions would meet the RAO for the MRS. Alternative 4 would disturb the environment by removing and sifting through soil over 6.39 acres.

7.2.4.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternative 4 would comply with the ARARs in **Table 4-1.**

7.2.4.3 Long-Term Effectiveness and Permanence

Alternative 4 would be effective over the long term because potential MEC would be removed from the surface and the subsurface (to bedrock) across all of the MRS. LUCs would not be required. Together, the removal in accessible areas of the MRS down to bedrock, and analog clearance of the rock escarpment would meet the RAO of preventing direct contact with potential MEC for all current and future receptors.

7.2.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 4 would reduce the toxicity, mobility and volume of potential MEC across the all of the MRS by removing the potential MEC hazards from the surface and subsurface (to bedrock), and using analog methods to clear the rock escarpment.

7.2.4.5 Short-Term Effectiveness

There would be an increase in risk to workers while the removal action is conducted (estimated at three [3] months). The increased risk to the community during the removal action would be mitigated, where possible, by the use of engineering controls and/or evacuations to maintain MSDs. The risk to workers and to the community associated with MEC that need to be BIP would be greater than the risk associated with consolidation because it is more difficult to control the area around an item. Items that are acceptable to move can be disposed of in a more controlled environment. The risk to the community during the disposal could be mitigated by the use of engineering controls and/or evacuations to maintain MSDs.

7.2.4.6 Implementability

Surface and subsurface removals were implemented effectively during the RI. Specific activities, including noxious weed mitigation, awareness training, and mitigation activities would be required to protect natural resources and are easily implementable. Clearance activities with magnetometers would be conducted on the escarpment. Heavy equipment is necessary for an excavation and sifting operation, and locating a nearby site for sifting may be difficult, as the neighborhood is largely developed outside of the MRS. Regarding MEC disposal, BIP is more difficult to implement than consolidation because it is more difficult to control the area around an item. It may also be more difficult to transport engineering controls to the MEC items for BIP demolition than to a consolidation area that may be more accessible.

For MEC removal, detonation, and recycling, donor explosives, if needed, would need to be brought on-site by a vendor. After inspection and verification that the items were properly detonated and can be considered MDAS, the metallic remains would be placed in drums and shipped off-site for demilitarization.

However, it is unclear whether or not nearby residences would be amenable to evacuating their houses during excavation and sifting activities. For Alterative 4, evacuation would be required for most or all of the excavation activities near the houses. Therefore, Alternative 4 may be technically feasible, if difficult, but may not be administratively feasible if land owners are unwilling to evacuate.

7.2.4.7 Cost

The estimated cost for this alternative includes capital costs associated with the excavation, sifting, removal, detonation, and recycling of potential MEC which includes plans to implement work. Additionally, costs include site closure efforts (After Action Report and Removal Action Report). A summary of costs is shown in **Table 7-3**. A detailed breakdown of costs is included in **Attachment A**.

Table 7-3
Alternative 4 Cost Summary

Cost Type	Total Cost
Capital Costs	$5,612,000
Annual O&M Costs	$0
Periodic Costs	$0
Total Present Value Cost	**$5,612,000**

7.2.4.8 Regulatory Acceptance

This subsection is reserved for the inclusion of regulatory comments. Comments or approval will be incorporated into the final document (**Attachment B**).

7.2.4.9 Community Acceptance

Solicitation of community involvement in the decision making of a final remedy is sought through the PP.

7.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

The results of the alternatives analysis are compared to identify the key tradeoffs among them, and identify their strengths and weaknesses relative to one another. The alternatives are evaluated against each of the nine (9) criteria and the alternatives are then compared to one another to identify their relative performance against the nine (9) criteria. This approach to analyzing alternatives is designed:

- To provide decision makers with sufficient information to adequately compare the alternatives;
- To select an appropriate remedy for the MRS; and
- To demonstrate satisfaction of the CERCLA remedy selection requirements.

The comparative analysis of the alternatives is provided in **Table 7-4**. A rating of favorable, moderately favorable, or unfavorable is applied to each of the nine (9) categories.

This FS presents four (4) possible remedial alternatives to address the potential MEC at the Kingman Range MRS. Each alternative has been evaluated for effectiveness, implementability, and cost relative to current comparable technologies. A detailed evaluation of each alternative was then performed per NCP §300.430(e)(9) and CERCLA criteria. The final step is for stakeholders and decision makers to review the comparative analysis and select the most appropriate remedial alternative. The preferred remedy will be documented in the PP and the public will have the opportunity to review and comment on the proposed remedy. The selected remedy will be documented in the ROD.

Table 7-4
Comparative Analysis of Alternatives

Detailed Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	No Action Alternative	**LUCs**	**Surface And Subsurface (18-In. bgs) Removal Using DGM/AGC and LUCs**	**Complete Surface And Subsurface Removal Down to Bedrock Using Excavation and Sifting, and Analog Clearance of the Rock Escarpment.**
Description	Per the NCP, the no action alternative is included for baseline comparison	Protecting receptors by educating receptors about MEC through educational controls and separating them from MEC with engineering controls	Protecting receptors by removing potential MEC at the surface and subsurface and through the use of educational controls and engineering controls.	Protecting receptors by removing potential MEC at the surface and subsurface down to bedrock and clearing the rock escarpment.
Overall Protectiveness of Human Health	○	◉	◉	●
Overall Protectiveness of the Environment	●	●	◉	○
Compliance with ARARs	○	●	●	●
Long-Term Effectiveness and Permanence	○	◉	◉	●
Reduction of Toxicity, Mobility, or Volume through Treatment	○	○	◉	●
Short-Term Effectiveness	●	◉	○	○
Implementability	●	◉	◉	◉
Cost (Total Present Value)	● ($0)	◉ ($764,000)	○ ($1,677,000)	○ ($5,612,000)

● Favorable (Yes for threshold criteria) ◉ Moderately Favorable ○ Not Favorable (No for threshold criteria)

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8.0 REFERENCES

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ATTACHMENT A

COST ESTIMATE

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Kingman Range MRS — Cost Breakout

Site: Kingman Range MRS
Location: Mohave County, AZ
Phase: Feasibility Study (-30% to +50%)
Base Year: 2021
Date: January 2021

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Remedial Design	**Cost**	**Cost**	**Cost**	**Cost**
Management Plan	-	$ 79,837	$ 79,837	$ 79,837
Community Relations Plan	-	$ 18,211	$ 18,211	$ 18,211
Project Management Plan	-	$ 9,485	$ 9,485	$ 9,485
Quality Assurance Surveillance Plan	-	$ 2,176	$ 2,176	$ 2,176
TPP Meetings (2)	-	$ 19,856	$ 19,856	$ 19,856
Property Management Report	-	$ 12,470	$ 12,470	$ 12,470
Land Use Controls Implementation Plan	-	$ 20,197	$ 20,197	-
Geophysical Pilot Study		$ -	$ 107,654	-
Removal Action	**Cost**	**Cost**	**Cost**	**Cost**
LUC Implementation (Educational Controls - Notification, Fact Sheet, etc.)	$ -	$ 12,709	$ 12,709	$ -
LUC Implementation (Engineering Controls -Warning Signs [6])	$ -	$ 22,412	$ 22,412	$ -
LUC Implementation (Engineering Controls - Fencing)	$ -	$ 83,944	$ 83,944	$ -
NOFA ESS	$ -	$ 12,608	$ -	$ -
ESS	$ -	$ -	$ 12,608	$ 12,608
Mobilization	$ -	$ -	$ 43,930	$ 7,838
Grid Survey	$ -	$ -	$ 18,672	$ -
MRS Survey	$ -	$ -	$ -	$ 3,624
Surface MEC Removal	$ -	$ -	$ 36,419	$ 36,419
Excavation and Sifting				$ 2,785,463
Analog Removal at Escarpment				$ 38,618
DGM	$ -	$ -	$ 52,072	$ -
AGC	$ -	$ -	$ 63,362	$ -
Reacquisition	$ -	$ -	$ 18,500	$ -
Subsurface MEC Removal	$ -	$ -	$ 53,185	$ -
Site Restoration				$ 919,884
MDAS Removal	$ -	$ -	$ 2,152	$ 2,152
Demob	$ -	$ -	$ 43,726	$ 7,838
Site Management	$ -	$ -	$ 59,862	$ 11,690
After Action Report	$ -	$ -	$ 71,760	$ 71,760
Removal Action Report	$ -	$ -	$ 60,870	$ 60,870
Subtotal	**$ -**	**$ 293,905**	**$ 926,069**	**$ 4,100,799**
Contingency - 15%	$ -	$ 44,086	$ 138,910	$ 615,120
Subtotal	**$ -**	**$ 337,991**	**$ 1,064,979**	**$ 4,715,918**
Permitting - 1%	$ -	$ -	$ 10,650	$ 47,159
Project Management - 8%	$ -	$ 27,039	$ 85,198	$ 377,273
Construction Management - 10%	$ -	$ -	$ 106,498	$ 471,592
REMEDIAL DESIGN AND REMOVAL ACTION TOTAL	**$ -**	**$ 365,030**	**$ 1,267,325**	**$ 5,611,943**
Long Term Management	**Cost**	**Cost**	**Cost**	**Cost**
LUC Maintenance (Annual Inspection and Report for 30 years)	$ -	$ 284,260	$ 284,260	$ -
Five-Year Review Report and Signs Every 5 Years (for 30 years)	$ -	$ 114,560	$ 114,560	$ -
LONG TERM MANAGEMENT TOTAL	$ -	$ 398,820	$ 398,820	$ -
TOTAL	**$0**	**$764,000**	**$1,667,000**	**$5,612,000**

Alternative 1 - No Action Alternative — Cost Estimate Summary

Site: Kingman Range MRS
Location: Mohave County, AZ

Description: The No Action Alternative implements no treatment, engineering controls, or institutional controls. It serves as a basis for comparison for all other alternatives. There are no capital costs, annual O&M costs, or period costs for this alternative.

Phase: Feasibility Study (-30% to +50%)
Base Year: 2021
Date: January 2021

	Quantity	Unit	Unit Cost	Cost	Notes
Capital Costs					
Remedial Design				$ -	
Removal Action				$ -	
Sub-Total				$ -	
Contingency	15%			$ -	
Sub-Total				$ -	
Permitting	2%			$ -	
Project Management	5%			$ -	
Construction Management	6%			$ -	
TOTAL CAPITAL COSTS				**$ -**	
Annual O&M Costs					
Institutional Controls				$ -	
TOTAL ANNUAL O&M COSTS				**$ -**	
Periodic Costs					
Five-Year Reviews				$ -	
TOTAL PERIODIC COSTS				**$ -**	

Present Value Analysis

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (0.75%)	Present Value	Notes
Capital Cost	0	$ -	$ -	1.000	$ -	
Annual O&M Cost	1-30	$ -	$ -	0.645	$ -	
Period Cost	5	$ -	$ -	0.935	$ -	
Period Cost	10	$ -	$ -	0.868	$ -	
Period Cost	15	$ -	$ -	0.806	$ -	
Period Cost	20	$ -	$ -	0.748	$ -	
Period Cost	25	$ -	$ -	0.694	$ -	
Period Cost	30	$ -	$ -	0.645	$ -	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$0.00**	

Notes: Discount Factor of .75% (EPA 540-R-00-002 OSWER 9355.0-75 A Guide to Developing and Documenting Cost Estimates During FS and OMB Circular No. A-94 revised November 2015)

Alternative 2 - LUCs — Cost Estimate Summary

Site: Kingman Range MRS
Location: Mohave County, AZ
Phase: Feasibility Study (-30% to +50%)
Base Year: 2021
Date: January 2021

Description: Alternative 2 involves NFA, and Institutional Controls including Land Use Controls (LUCs), Management Plans and Long-Term Management (LTM). Period costs include 5 year review reports assumed to continue for 30 years.

	Quantity	Unit	Unit Cost	Cost	Notes
Capital Costs					
Remedial Design					
Management Plan	1	LS	$ 79,837	$ 79,837	
Community Relations Plan	1	LS	$ 18,211	$ 18,211	
Project Management Plan	1	LS	$ 9,485	$ 9,485	
Quality Assurance Surveillance Plan	1	LS	$ 2,176	$ 2,176	
TPP Meetings (2)	1	LS	$ 19,856	$ 19,856	
Property Management Report	1	LS	$ 12,470	$ 12,470	
Land Use Controls Implementation Plan	1	LS	$ 20,197	$ 20,197	
Removal Action					
LUC Implementation (Educational Controls - Notification, Fact Sheet)	1	LS	$ 12,709	$ 12,709	
LUC Implementation (Engineering Controls - Warning Signs [6])	1	LS	$ 22,412	$ 22,412	
LUC Implementation (Engineering Controls - Fencing)	1	LS	$ 83,944	$ 83,944	
NOFA ESS	1	LS	$ 12,608	$ 12,608	
Sub-Total				$ 293,905	
Contingency	15%			$ 44,086	
Sub-Total				$ 337,991	
Project Management	8%			$ 27,039	
TOTAL CAPITAL COSTS				**$ 365,030**	
Annual O&M Costs					
Annual Inspections and Warning Sign Replacement (Replace All Signs Every 5 Years) for 30 Years Using 5 Year Contracts	1	LS	$ 14,701	$ 14,701	
TOTAL ANNUAL O&M COSTS				**$ 14,701**	
Periodic Costs					
Five-Year Review Reports for 30 Years Using 5-Year Contracts	1	EA	$ 24,396	$ 24,396	
TOTAL PERIODIC COSTS				**$ 24,396**	

Present Value Analysis

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (0.75%)	Present Value	Notes
Capital Cost	0	$ 365,030	$ 365,030	1.000	$ 365,030	
Annual O&M Cost	1-30	$ 441,037.80	$ 14,701	0.645	$ 284,260	
Period Cost	5	$ 24,396	$ 24,396	0.935	$ 22,814	
Period Cost	10	$ 26,935	$ 24,396	0.868	$ 21,177	
Period Cost	15	$ 29,738	$ 24,396	0.806	$ 19,658	
Period Cost	20	$ 32,833	$ 24,396	0.748	$ 18,248	
Period Cost	25	$ 36,251	$ 24,396	0.694	$ 16,939	
Period Cost	30	$ 40,024	$ 24,396	0.645	$ 15,724	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$ 763,850**	

Notes: Discount Factor of .75% (EPA 540-R-00-002 OSWER 9355.0-75 A Guide to Developing and Documenting Cost Estimates During FS and OMB Circular No. A-94 revised November 2015)

Alternative 3-LUCs, Surface & Subsurface MEC Removal to 18-In. Cost Estimate Summary

Site: Kingman Range MRS
Location: Mohave County, AZ

Description: Alternative 3 includes LUCs, a geophysical equipment pilot study, and surface and subsurface removal of MEC to 18-inches below ground surface, detonation, and recycling of potential MEC to eliminate the explosive hazard over the accessible portion of the MRS.

Phase: Feasibility Study (-30% to +50%)
Base Year: 2021
Date: January 2021

	Quantity	Unit	Unit Cost	Cost	Notes
Capital Costs					
Remedial Design					
Management Plan	1	LS	$ 79,837	$ 79,837	
Community Relations Plan and ROE	1	LS	$ 18,211	$ 18,211	
Project Management Plan	1	LS	$ 9,485	$ 9,485	
Quality Assurance Surveillance Plan	1	LS	$ 2,176	$ 2,176	
TPP Meetings	1	LS	$ 19,856	$ 19,856	
Property Management Report	1	LS	$ 12,470	$ 12,470	
Land Use Controls Implementation P	1	LS	$ 20,197	$ 20,197	
Geophysical Pilot Study	1	LS	$ 107,654	$ 107,654	
Removal Action					
LUC Implementation (Educational Controls - Notification, Fact Sheet)	1	LS	$ 12,709	$ 12,709	
LUC Implementation (Engineering Controls - Warning Signs [6])	1	LS	$ 22,412	$ 22,412	
LUC Implementation (Engineering Controls - Fencing)	1	LS	$ 83,944	$ 83,944	
Mobilization	1	LS	$ 43,930	$ 43,930	
Grid Survey	1	LS	$ 18,672	$ 18,672	
Surface MEC Removal	1	LS	$ 36,419	$ 36,419	
DGM	1	LS	$ 52,072	$ 52,072	
AGC	1	LS	$ 63,362	$ 63,362	
Reacquisition	1	LS	$ 18,500	$ 18,500	
Subsurface MEC Removal	1	LS	$ 53,185	$ 53,185	
MDAS Removal	1	LS	$ 2,152	$ 2,152	
Demob	1	LS	$ 43,726	$ 43,726	
Site Management	1	LS	$ 59,862	$ 59,862	
ESS	1	LS	$ 12,608	$ 12,608	
After Action Report	1	LS	$ 71,760	$ 71,760	
Removal Action Report	1	LS	$ 60,870	$ 60,870	
Sub-Total				$ 926,069	
Contingency	15%			$ 138,910	
Sub-Total				$ 1,064,979	
Permitting	1%			$ 10,650	
Project Management	8%			$ 85,198	
Construction Management	10%			$ 106,498	
TOTAL CAPITAL COSTS				**$ 1,267,325**	
Annual O&M Costs					
Sign Replacement (Replace All Signs Every 5 Years) for 30 Years	1	LS	$ 14,701	$ 14,701	
TOTAL ANNUAL O&M COSTS				**$ 14,701**	
Periodic Costs					
Five-Year Review Reports for 30 Years Using 5-Year Contracts	1	EA	$ 24,396	$ 24,396	
TOTAL PERIODIC COSTS				**$ 24,396**	

Present Value Analysis

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (0.75%)	Present Value	Notes
Capital Cost	0	$ 1,267,325	$ 1,267,325	1.000	$ 1,267,325	
Annual O&M Cost	1-30	$ 441,038	$ 14,701	0.645	$ 284,260	
Period Cost	5	$ 24,396	$ 24,396	0.935	$ 22,814	
Period Cost	10	$ 24,396	$ 24,396	0.868	$ 21,177	
Period Cost	15	$ 24,396	$ 24,396	0.806	$ 19,658	
Period Cost	20	$ 24,396	$ 24,396	0.748	$ 18,248	
Period Cost	25	$ 24,396	$ 24,396	0.694	$ 16,939	
Period Cost	30	$ 24,396	$ 24,396	0.645	$ 15,724	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$ 1,666,145**	

Notes: Discount Factor of .75% (EPA 540-R-00-002 OSWER 9355.0-75 A Guide to Developing and Documenting Cost Estimates During FS and OMB Circular No. A-94 revised November 2015)

Alternative 4-Removal of MEC using Excavation and Sifting and Analog Cost Estimate Summary

Site: Kingman Range MRS
Location: Mohave County, AZ

Phase: Feasibility Study (-30% to +50%)
Base Year: 2021
Date: January 2021

Description: Alternative 4 includes complete surface and subsurface removal of MEC using excavation and sifting, clearance of the rock escarpment using analog geophysical methods, detonation, and recycling of potential MEC to eliminate the explosive hazard over the accessible portion of the MRS. Alternative 4 would be undertaken with the goal of reaching UU/UE.

	Quantity	Unit	Unit Cost	Cost	Notes
Capital Costs					
Remedial Design					
Management Plan	1	LS	$ 79,837	$ 79,837	
Community Relations Plan and ROE	1	LS	$ 18,211	$ 18,211	
Project Management Plan	1	LS	$ 9,485	$ 9,485	
Quality Assurance Surveillance Plan	1	LS	$ 2,176	$ 2,176	
TPP Meetings	1	LS	$ 19,856	$ 19,856	
Property Management Report	1	LS	$ 12,470	$ 12,470	
Removal Action					
Mobilization	1	LS	$ 7,838	$ 7,838	
MRS Survey and Staking	1	LS	$ 3,624	$ 3,624	
Surface MEC Removal	1	LS	$ 36,419	$ 36,419	
Excavation and Sifting	1	LS	$ 2,785,463	$ 2,785,463	
Analog Removal	1	LS	$ 38,618	$ 38,618	
Site Restoration	1	LS	$ 919,884	$ 919,884	
MDAS Removal	1	LS	$ 2,152	$ 2,152	
Demob	1	LS	$ 7,838	$ 7,838	
Site Management	1	LS	$ 11,690	$ 11,690	
ESS	1	LS	$ 12,608	$ 12,608	
After Action Report	1	LS	$ 71,760	$ 71,760	
Removal Action Report	1	LS	$ 60,870	$ 60,870	
Sub-Total				$ 4,100,799	
Contingency	15%			$ 615,120	
Sub-Total				$ 4,715,918	
Permitting	1%			$ 47,159	
Project Management	8%			$ 377,273	
Construction Management	10%			$ 471,592	
TOTAL CAPITAL COSTS				**$ 5,611,943**	
Annual O&M Costs					
Annual Inspection					
TOTAL ANNUAL O&M COSTS				**$ -**	
Periodic Costs					
Five-Year Review Report					
TOTAL PERIODIC COSTS				**$ -**	

Present Value Analysis

Cost Type	Year	Total Cost	Total Cost Per Year	Discount Factor (0.75%)	Present Value	Notes
Capital Cost	0	$ 5,611,943	$ 5,611,943	1.000	$ 5,611,943	
Annual O&M Cost	1-30	$ -	$ -	0.645	$ -	
Period Cost	5	$ -	$ -	0.935	$ -	
Period Cost	10	$ -	$ -	0.868	$ -	
Period Cost	15	$ -	$ -	0.806	$ -	
Period Cost	20	$ -	$ -	0.748	$ -	
Period Cost	25	$ -	$ -	0.694	$ -	
Period Cost	30	$ -	$ -	0.645	$ -	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$ 5,611,943**	

Notes: Discount Factor of .75% (EPA 540-R-00-002 OSWER 9355.0-75 A Guide to Developing and Documenting Cost Estimates During FS and OMB Circular No. A-94 revised November 2015)

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APPENDIX M

PUBLIC OUTREACH DOCUMENTS

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PUBLIC NOTICE & MEETING AGENDA

The Arizona Department of Environmental Quality (ADEQ) is holding a virtual public meeting for residents within the Army National Guard Kingman Range Munitions Response Site (MRS) boundary. The Army National Guard is utilizing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), known also as Superfund program, to identify and resolve the threat of munitions and explosives of concern (MEC) and associated munitions constituents (MC) at the site.

Virtual Public Meeting:
Army National Guard Kingman Range MRS
Date: Tuesday, January 5, 2021
Time: 6:00 p.m. – 8:00 p.m.

How to Attend:
Online: https://global.gotomeeting.com/join/138952829
Phone (audio only): 408-650-3123 | **Access Code**: 138-952-829

AGENDA

1. Introductions
    - Arizona Department of Environmental Quality (ADEQ)
    - Arizona Army National Guard (AZARNG)
    - US Army Corp of Engineers (ACE)
2. ADEQ presentation on Kingman Range MRS
    - Site Location and History
    - Current Site Activities
3. Community Questionnaire
4. Discussion and Questions

For more information: contact Natalie Romanoff, romanoff.natalie@azdeq.gov; 602-771-0956, or 800-234-5677, ext. 6027710956.

ADEQ will take reasonable measures to provide access to department services to individuals with limited ability to speak, write or understand English and/or to those with disabilities. Requests for language interpretation, ASL interpretation, CART captioning services or disability accommodations must be made at least 48 hours in advance by contacting Ian Bingham, Title VI Nondiscrimination Coordinator at 602-771-4322 or bingham.iam@azdeq.gov. Teleprinter services are available by calling 7-1-1 at least 48 hours in advance to make necessary arrangements.

ADEQ tomará las medidas razonables para proveer acceso a los servicios del departamento a personas con capacidad limitada para hablar, escribir o entender inglés y / o para personas con discapacidades. Las solicitudes de servicios de interpretación de idiomas, interpretación ASL, subtitulados de CART, o adaptaciones por discapacidad deben realizarse con al menos 48 horas de anticipación contactando a Ian Bingham, Coordinador de Anti-Discriminación del Título VI al

602-771-4322 o bingham.ian@azdeq.gov. Los servicios de teleimpresores están disponibles llamando al 7-1-1 con al menos 48 horas de anticipación para hacer los arreglos necesarios.

ADEQ Arizona Department of Environmental Quality MEETING MINUTES

Subject: Summary of the January 5th, 2021 Non-Department of Defense Owned, Non-Operational 4 Defense Sites (NDNODS) Kingman Range Munitions Response Site (MRS) Virtual Public Meeting.

Meeting Participants:
Natalie Romanoff, ADEQ, Project Manager
Karin Harker, ADEQ, Federal Projects Unit Manager
Mary McGillicudy-ADEQ Community Involvement Coordinator
Dan Haines, UXO Pro, ADEQ Consultant
Steve Willis, UXO Pro, ADEQ Consultant
John Haines- Army National Guard
Jim Lukasko- U.S. Army Corps of Engineers (USACE)
Tim Trego- Weston Project Manager, Army Contractor
Lara Lugo (Kapelanczyk)- Weston, Army Contractor
Jerry Carpineta, Resident of NDNOD Kingman MRS housing area

Summary:

Arizona Department of Environmental Quality (ADEQ) hosted a Virtual Public Meeting to present the findings of the munitions response Remedial Investigation (RI), discuss the current status of the project, and solicit questions and comments from affected residents.

The meeting was scheduled for 6pm to 8pm Mountain Standard Time and was held via GoToMeeting. The meeting started at 6:07pm after waiting for more attendees to join and confirming connections.

Ms. Natalie Romanoff of ADEQ began the meeting by introducing herself as ADEQ's Project Manager and indicated the Army National Guard Bureau (NGB) is the lead agency performing the work with the U.S. Army Corps of Engineers (USACE). Ms. Romanoff noted the meeting was being recorded and Meeting Minutes would be provided for the Administrative Record. She asked participants to turn off their cameras, mute their audio connections, and please hold questions until the end of the presentation. The ADEQ presentation is attached to these meeting minutes for reference.

Ms. Romanoff introduced members of the project team, including ADEQ Federal Projects Unit and its contractor UXO Pro, NGB personnel, USACE personnel, and the USACE's contractor Weston Solutions. Members of the public can contact ADEQ through the agency's My Community webpage.

Ms. Romanoff provided a brief history of the site from 1951 to the present, followed by a review of site maps and investigation results. The site was used for military weapons training in the 1950s, and remnants of that training may remain. The USACE is investigating the site following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The RI field work focused on the area in front of the escarpment that acted as a natural backstop behind the munitions firing line target area. During the investigation, most of the metallic items found were Non-Munitions Related Debris, such as nuts and bolts, nails, and other cultural debris. Some Munitions Debris was found, but no

Unexploded Ordnance was found.

The focus of the Public Meeting is on the residential area of the MRS, with the primary purpose being residential outreach through this meeting and a questionnaire that was recently distributed by the USACE.

Ms. Romanoff requested input from area residents, such as descriptions of any munitions related findings. She reviewed the results of the questionnaires that were mailed to the members of the residential community.

Ms. Romanoff provided the potential remedies that are being evaluated. The remedies are No Further Action (NFA) or additional investigation. The NGB prefers NFA. ADEQ is evaluating the alternatives. If additional investigations are conducted, the public will be notified. In accordance with the CERCLA process, the public will also be given the opportunity to review and comment on the future Proposed Plan.

Mr. John Haines (NGB) asked Ms. Romanoff to present a map showing the properties associated with those questionnaires that were returned to USACE. Mr. Haines then asked the participating member of the public, Mr. Gerald Carpineta, if he had any questions. Mr. Carpineta did not have any questions.

Mr. Haines thanked ADEQ and Mr. Carpineta for hosting and attending the meeting, respectively. Mr. Haines asked Mr. Carpineta if he had ideas for how to proceed in the residential area. Mr. Carpineta did not respond.

Mr. Daniel Haines (UXO Pro) asked for the number of questionnaires returned and the number distributed. Mr. Haines (NGB) responded that eleven questionnaires have been returned out of 46 that were mailed for 41 total properties.

Mr. Haines (UXO Pro) thanked the ADEQ for hosting and the NGB and USACE participating.

The meeting was paused at 6:25pm. The meeting resumed at 7pm and ended at 7:10pm due to lack of additional public participation.

Corrections:

At the request of the Arizona Army National Guard (AZARNG), the slides were modified from the original presentation. AZARNG requested the correction of slide number five titled, *Kingman Range MRS - Site History*, and to document for the record a misstatement made during the presentation regarding the property ownership. The Department of Defense never owned the Kingman Range property, but leased it from a private owner.

AZARNG requested that ADEQ mention for the administrative record that unexploded ordinances (UXO), discarded military munitions (DMM), and munitions constituents (MC) were not discovered during the investigation. ADEQ only mentioned the lack of evidence of UXO and MC during the presentation.

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Welcome to the Kingman Range Munitions Response Site Public Meeting

We will start at 6:00 p.m.

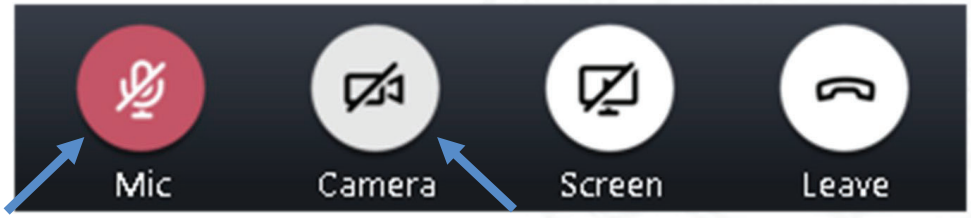
To hear the meeting on your phone:

Call: **(408) 650-3123** | Code: **132-952-829**

ADEQ
Arizona Department of Environmental Quality

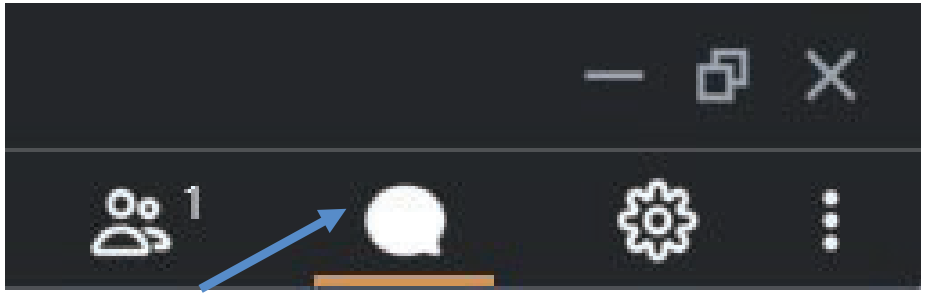
For a great virtual meeting:

- Turn off camera, mute microphone during presentation.



- If using your phone for audio, please mute your computer speakers for the entire meeting.

- Hold questions until end of presentation:
  - Unmute to ask verbally
  - Write question in chat box



AGENDA – Kingman Range MRS Public Meeting

- Introductions
  - Arizona Department of Environmental Quality (ADEQ)
  - Arizona Army National Guard (AZARNG)
  - National Guard Bureau (NGB)
  - US Army Corps of Engineers (ACE)
- ADEQ presentation on Kingman Range MRS
  - Site Location and History
  - Current Site Activities
- Community Questionnaire
- Discussion and Questions

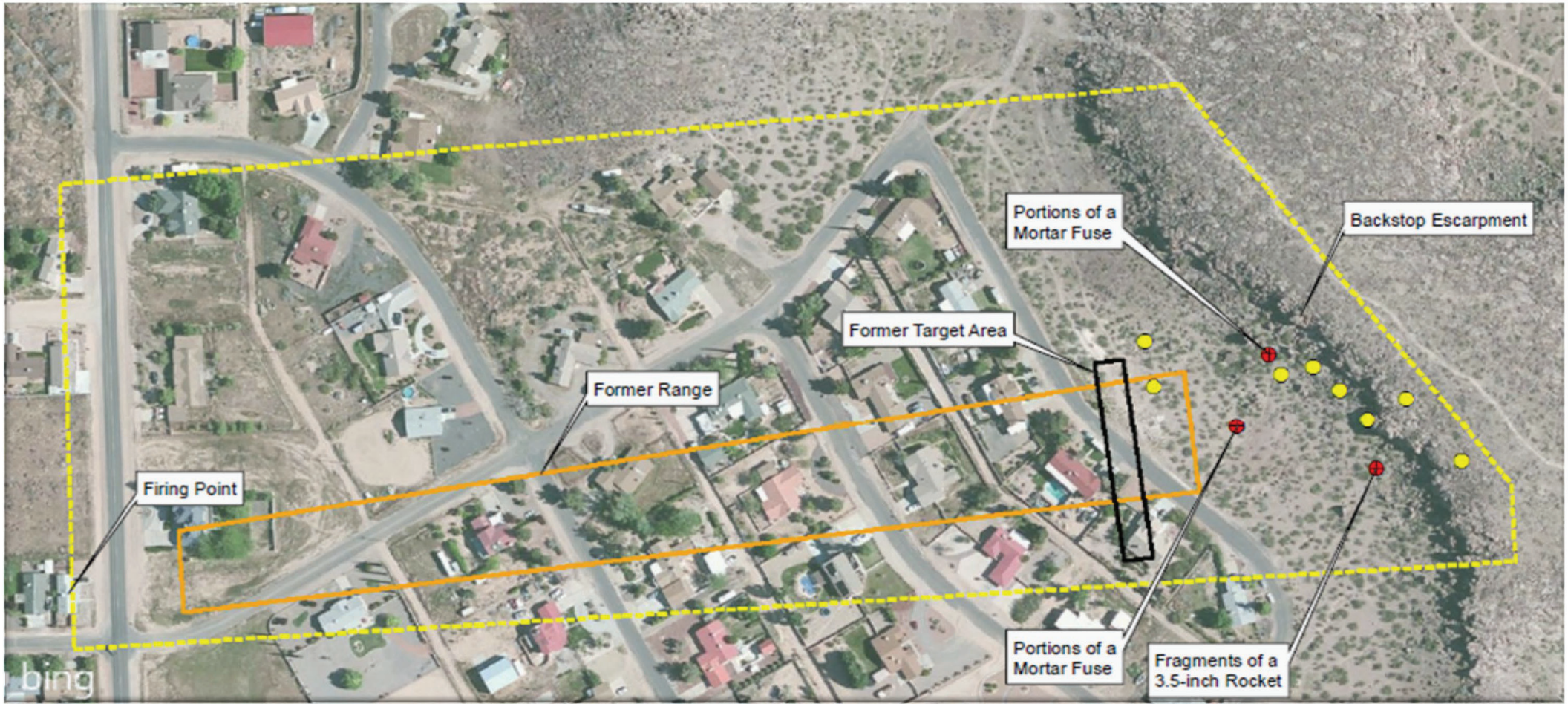
Kingman MRS Location

Kingman Range MRS - Site History

- **1951:** AZARNG acquired a lease from a private owner to conduct weapons training
- **1968:** Range is no longer operational
- **2008**: Site is identified as a Non-Department of Defense, Non-Operational Defense Site (NDNODS) and MRS.
- **2011- 2012**: The National Guard and Army Corps of Engineers completed a Site Inspection
- **2017**: Remedial Investigation began
- **2020**: ADEQ and ARNG working to finalize the RI/FS

(http://azdeq.gov/node/7495)

Kingman MRS Boundary



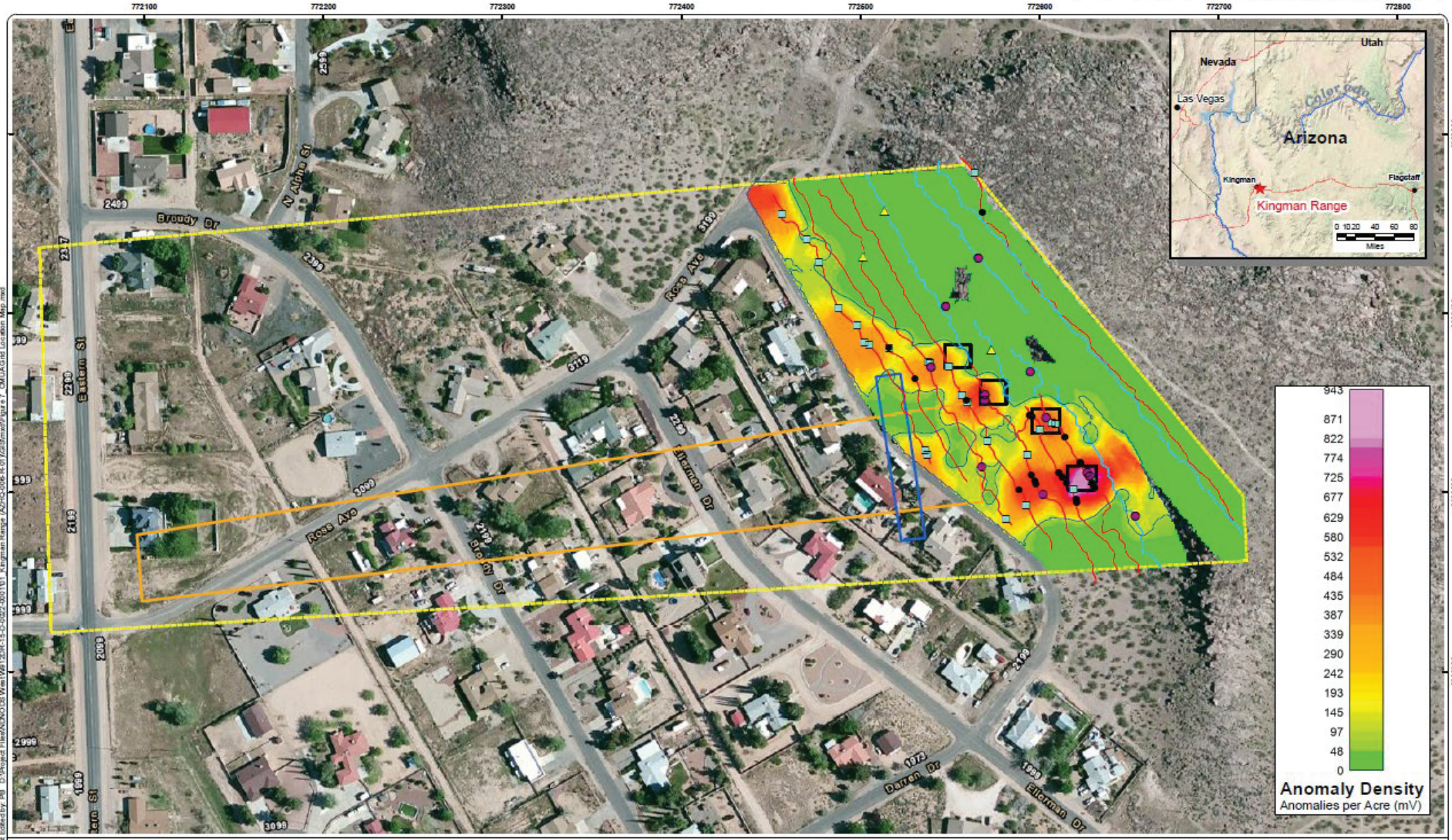
Legend

- SI MD Sample Location
- SI Sample Location
- Former Range Floor
- Former Target Berm
- Kingman Range MRS (33.43 acres)

Current Site Activity

- Remedial Investigation / Feasibility Study (RI/FS)
  - Determine the site's risk to human health and the environment
  - Evaluate and Propose cleanup options
  - Obtain agreement on the proposed remedy among all agencies

Remedial Investigation Area



N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

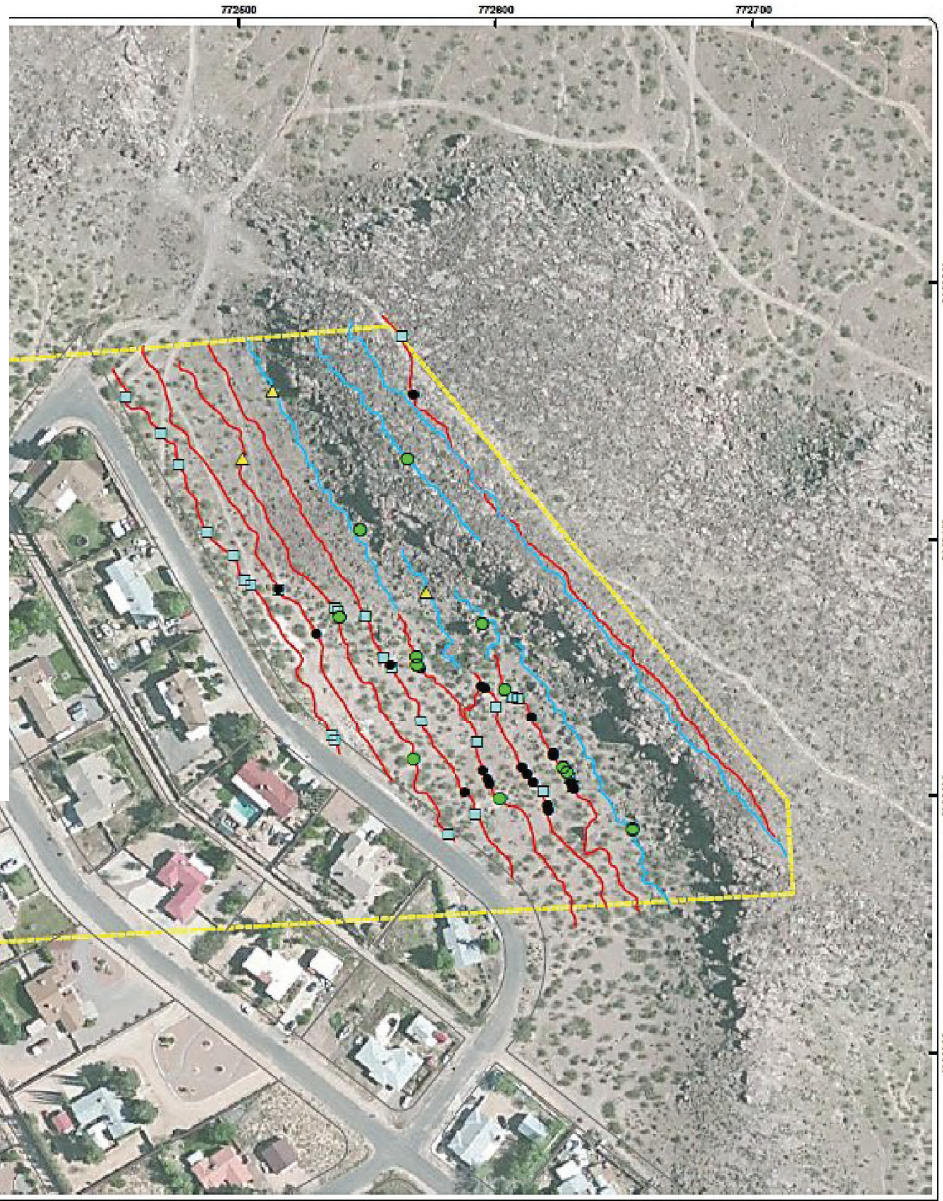
- Munitions Debris
- Small Arms
- Non-Munitions Related Debris
- Seed
- 112 Anomalies/acre Density Contour
- Analog Transects Collected
- DGM Transects Collected
- Proposed Grids (50 ft x 50 ft)
- Former Range Floor
- Former Target Berm
- Kingman Range MRS (33.43 acres)

CMUA GRID LOCATION MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
7

Discoveries along Transects



N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Munitions Debris
- Small Arms
- Non-Munitions Related Debris
- Seed
- Analog Transects Collected
- DGM Transects Collected
- Parcel Boundaries
- Kingman Range MRS (33.43 acres)

INTRUSIVE INVESTIGATION MAP
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
8

Community Questionnaire

Kingman Range MRS
Questionnaire

Questionnaire:

Name: _____

Address: _____

Phone/Email: _____

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

☐ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

☐ Yes ☐ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

_____

_____

_____

_____

_____

3a. Have you heard of anyone in your community finding a munition related object?

☐ Yes ☐ No

3b. If yes, please describe below.

_____

_____

_____

_____

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

- Please return by: **1/15/2021**
  - US Mail (addressed stamped envelope provided)
  - Email:

donna.s.wu.mil@mail.mil

john.b.haines.ctr@mail.mil

Importance of the Questionnaire

- Questionnaire responses will help ADEQ decide residential area's next step:
  1. No Further Action (NFA), or
  2. Require additional investigation

Discussion and Questions

Site Information

- Site documents:
  - http://azdeq.gov/node/7496
  - **Mohave County Library**

    3269 N Burbank Street

    Kingman, AZ 86409

    928-692-2665

Contact Information

ADEQ

- Natalie Romanoff
  - Project Manager
- romanoff.natalie@azdeq.gov
- Phone: 602-771-0956

Army National Guard

- John Haines
  - NDNODS Remediation Project Manager
- john.b.haines.ctr@mail.mil

Kingman Range MRS
Questionnaire

10 December 2020

«Owner_Name»
«Mailing_Street_Address»
«City», «State» «Zip_Code»

Owner of Parcel #: «County_Parcel_Number»

Dear «Owner_Name»:

The United States Army National Guard, in coordination with the United States Army Corps of Engineers – Sacramento District is conducting a Remedial Investigation at the Kingman Range Munitions Response Site (MRS) (AZHQ-006-R-01) located in Kingman, Arizona. The MRS may overlap with your property or your property may be adjacent to the MRS (**Figure 1**). In order to complete our investigation, the Arizona Department of Environmental Quality requests that you please fill out the attached questionnaire.

Purpose: The purpose of this questionnaire is to collect information concerning the presence of items on your property that may be related to past military munitions use. Owners of neighboring parcels have also been contacted and have been requested to provide the same information. If physical evidence of past military munitions use has been found, the United States Army National Guard may be required to conduct further investigations to determine if more of these items are present and remove them.

History: The Kingman Range MRS was used by the Arizona Army National Guard (AZARNG) from 1951 to 1968. AZARNG fired from along Eastern Street eastward toward a natural bedrock escarpment backstop located ~1,500 feet away (**Figure 1**). In 2001, the Army began investigating former military training sites, such as the Kingman Range MRS, as part of the Military Munitions Response Program in order to remove potential hazards remaining from the training.

A Site Inspection was conducted in 2011 to determine the presence or absence of military munitions at the Kingman Range MRS. During the Site Inspection, no live munitions were encountered; however, small arms ammunition projectiles, a rifle clip, two mortar fuze fragments and debris from a 3.5-inch rocket were identified. Owners of property within and near the MRS were contacted prior to the Site Inspection; however, most owners did not respond or denied entry onto their property during the investigation.

The Site Inspection was followed by a Remedial Investigation to determine the nature and extent of military munitions at the MRS. The Remedial Investigation field work was conducted between 2017 and 2019. No live munitions were encountered; however, munitions debris consisting of 3.5-inch M29 Practice Rocket debris (i.e., tail fins, tail shroud, and nose cone), unidentifiable fragmentation debris, a spent M22 Rifle Grenade Smoke, and debris from a 60mm mortar were identified.

No work was conducted in the residential area during the SI or RI because there were no known reports of munitions or munitions debris found there and it was assumed the construction development activities would have already identified any items. As we conclude the Remedial Investigation, the Arizona Department of Environmental Quality is requesting a solicitation for any additional information to determine if there is any known history of munitions use on the nearby residential properties.

The Arizona Department of Environmental Quality requests that each parcel owner complete the attached questionnaire and return it in the provided self-addressed stamped envelope or attach it to an email addressed to Lieutenant Colonel (LTC) Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines at john.b.haines.ctr@mail.mil by **15 January 2021.**

The Arizona Department of Environmental Quality will be hosting a virtual public meeting for all property owners on **05 January 2021** at 6:00 PM with Army National Guard participation. Property owners and residents will have the opportunity to ask additional questions about the project and the questionnaire.

Meeting access information/link: https://global.gotomeeting.com/join/138952829

Please join the meeting from your computer, tablet or smartphone. You can also dial in using your phone: United States: +1 (408) 650-3123, Access Code: 138-952-829

For additional information about the Army National Guard Kingman Range MRS, including points of contact, you may visit the Arizona Department of Environmental Quality project webpage at https://azdeq.gov/node/7490.

Munitions or munitions debris should never be touched, moved or disturbed. Residents can help protect themselves, their families and their neighbors from the potential explosive hazards present by learning and following the 3R's of Safety: Recognize, Retreat, and Report. Please see the attached Kingman Range 3R's Safety Guide for any suspect objects on or near your property in the future.

LTC Donna Wu
Cleanup Branch Chief (ARNG-IED-S)
111 South George Mason Drive
Arlington, VA 22204-1373
(703) 607-2177
donna.s.wu.mil@mail.mil

Questionnaire:

Name: _____

Address:_____

Phone/Email:_____

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☐ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☐ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

_____

_____

_____

_____

_____

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☐ No

3b. If yes, please describe below.

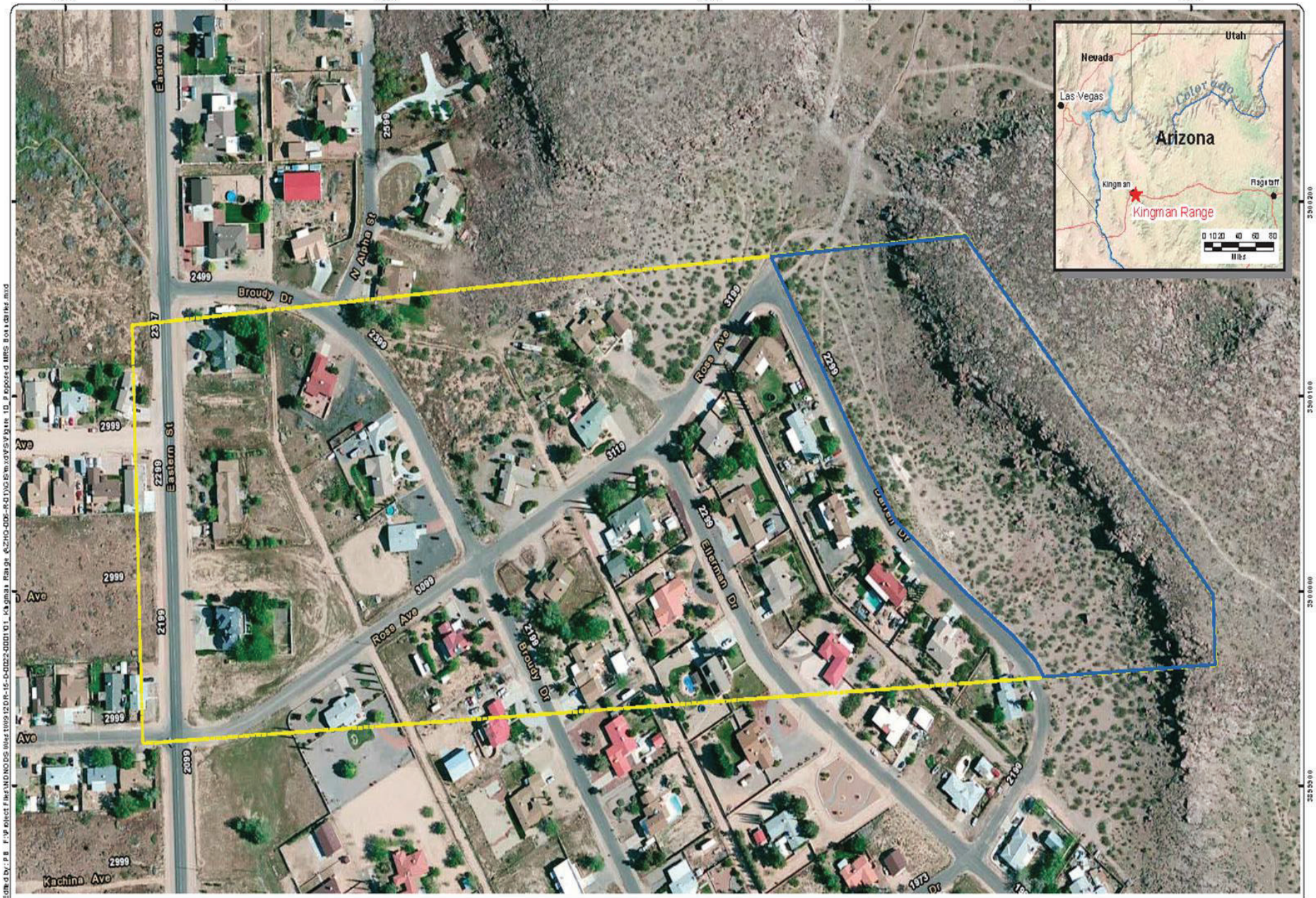
_____

_____

_____

_____

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.



N

0 50 100 200 300 400
Feet

Grid Coordinate System: WGS84, UTM, Zone 11N, meters

Legend

- Kingman Range MRS (AZHQ-006-R-01)
- Kingman Range - NFA Area MRS (AZHQ-006-R-02)

PROPOSED MRS BOUNDARIES
NDNODS KINGMAN RANGE MRS
AZHQ-006-R-01

Army National Guard
Kingman, Mohave County, Arizona

Figure
1

Date: 02/11/2020 Last Edited by: PB F:\Project Files\NDNODS West\09120R-15-D\022-0001\01_Kingman Range (AZHQ-006-R-01)\GIS\mxd\Figure 1D_Proposed MRS Boundaries.mxd

Background

The former Kingman Range Munitions Response Site (MRS) is located in Kingman, Mohave County, Arizona. The 33-acre range was used for training by the Arizona National Guard from 1951 to 1968. Munitions used at the MRS include 3.5-inch M29 practice rockets and 60-millimeter mortars. The former site is now on private lands.

Field work at the Kingman Range MRS was conducted during a Site Inspection in 2011 to determine presence or absence of military munitions. During the Site Inspection, no live munitions were encountered; however, small arms ammunition projectiles, a rifle clip, two mortar fuze fragments and debris from a 3.5-inch rocket were identified. Field work was then conducted in 2017-2019 as part of a Remedial Investigation to determine nature and extent of military munitions. No live munitions were encountered; however, munitions debris consisting of 3.5-inch M29 Practice Rocket debris (i.e., tail fins, tail shroud, and nose cone), unidentifiable fragmentation debris, a spent M22 Rifle Grenade Smoke, and debris from a 60mm mortar were identified.

Weathering may make munitions, which may be on the surface, buried, or whole or in parts, difficult to recognize. As such, area residents should not touch, move or disturb anything encountered that may be a munition or part of one.

All munitions should be considered dangerous, regardless of how long they have been in the environment. Munitions should never be touched, moved or disturbed. Residents can help protect themselves, their families and their neighbors from the potential explosive hazards present by learning and following the 3R's of Safety.

Kingman Range Information

Kingman Range

3Rs Safety Guide

Emergency Contact
Call 911

Contact LTC Donna Wu at:
(703) 607-2177
donna.s.wu.mil@mail.mil
for additional information.

Learn and follow the 3Rs of explosives safety

Recognize
Retreat
Report

Visit the US Army's Explosive Safety Education website:
https://www.denix.osd.mil/uxosafety

Follow the 3Rs

Recognize

Recognize when you may have encountered a munition.

Recognizing when you may have encountered a munition is the most important step in reducing the risk of injury or death. Munitions may be encountered on land or in the water. They may be easy or hard to identify.

To avoid the risk of injury or death:

- Never move, touch or disturb a munition or a suspect munition
- Be aware that munitions do not become safer with age, in fact they may become more dangerous
- Don't be tempted to take or keep a munition as a souvenir

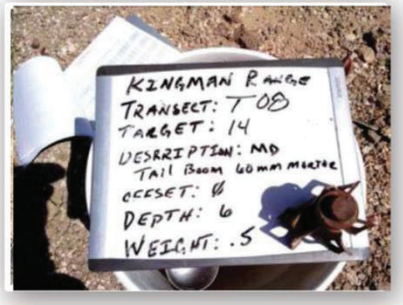
Munitions come in many sized, shapes and colors. Some may look like bullets or bombs while others may look like pipes, small cans or even a car muffler. Whether whole or in parts, new or old, shiny or rusty, munitions can still explode. The easiest way to avoid injury or death is to stay out of areas marked with warning signs.

Retreat

Do not touch, move or disturb it, but carefully leave the area.

Avoid death or injury by recognizing that you may have encountered a munition and promptly retreating from the area.

If you encounter what you believe is a munition, do not touch, move or disturb it. Instead, immediately and carefully leave the area by retracing your steps-going out the way you entered. Once safely away from the munition, mark the path (e.g., with a piece of clothing) so response personnel can find the munition.



Report

Immediately notify the police, if on land, or the U.S. Coast Guard, if on navigable waters.

Protect yourself, your family, your friends and your community by immediately reporting munitions or suspected munitions to the police.

Help us by providing as much information as possible about what you saw and where you saw it. This will help the police and military or civilian explosive ordnance disposal personnel find, evaluate and address the situation.

If you believe you may have encountered a munition, call **911** and report:

- The general area you encountered it
- Its general description. Remember, do not touch, move or disturb it.
- When possible, provide:
  - Its estimated size
  - Its shape
  - Any visible markings, including color

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: _____

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

_____

_____

_____

_____

_____

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

_____

_____

_____

_____

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☐ Yes ☒ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

_____

_____

_____

_____

_____

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

_____

_____

_____

_____

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☑ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☑ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☑ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

☐ Yes ☒ No

2a. Have you found any metal objects or munitions like objects on your property?

☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

☐ Yes ☒ No

2a. Have you found any metal objects or munitions like objects on your property?

☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☒ Yes ☐ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

ONE (1) SPENT 50 CALIBER BULLET, A FEW INCHES BELOW SURFACE.

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

Extensive digging water lines drip lines Many Trees and Building Foundation Just hard dirt.

3a. Have you heard of anyone in your community finding a munition related object?

☐ Yes ☒ No

Thanks for checking

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

over

according to neighbors this ground has been scrapped at least once when prepared for building the house & Back yard when preparing yards to plant -
The only metal found was old nails from when house was built & then when Barn (Garage) was Built -
To this date we have found nothing in front or back yards -
Ground was scrapped in preparing to build house as well as Garage (Barn) & nothing was found
Hope this will help close this issue. I wouldn't have thought the work had been done years ago

[redacted]

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☐ Yes ☒ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

Kingman Range MRS
Questionnaire

Questionnaire:

Name: [redacted]

Address: [redacted]

Phone/Email: [redacted]

1. Have you dug on your land or property (for example, planted trees, installed a fence, etc.)?

   ☒ Yes ☐ No

2a. Have you found any metal objects or munitions like objects on your property?

   ☒ Yes ☐ No

2b. If Yes, describe what you found and if it was in the ground or on the surface:

Found 3 bullet casings in our grass. The grass we planted. Middle of back yard.

3a. Have you heard of anyone in your community finding a munition related object?

   ☐ Yes ☒ No

3b. If yes, please describe below.

/

Please fill out the survey and return it in the self-addressed stamped envelope or respond by email to Lieutenant Colonel Donna Wu at donna.s.wu.mil@mail.mil and cc John Haines john.b.haines.ctr@mail.mil by 15 January 2021.

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ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

VIA EMAIL
FPU 21-166

January 20, 2021

Mr. James Lukasko
Project Manager
US Army Corps of Engineers
Sacramento District CESPK-PM-H
1325 J Street
Sacramento, CA 95814

Re: ADEQ approval for *Stakeholder Draft Remedial Investigation / Feasibility Study Report, Kingman Range MRS (AZHQ-006-R-01), Mohave County, Arizona,* prepared by Weston Solutions

Dear Mr. Lukasko:

The Arizona Department of Environmental Quality's (ADEQ) Federal Projects Unit (FPU) has reviewed all unresolved comments for the revised Stakeholder Draft RI/FS Report for the NDNODS Kingman Range MRS, Mohave, AZ, dated September 2020, and consider all outstanding comments resolved. Please submit the Final Draft with all changes incorporated. ADEQ also requests the public outreach and results, including the meeting minutes and presentation, are included in the Final Draft for review/concurrence and the administrative record.

Based on results of the recent public outreach questionnaires and the virtual public meeting held on January 5, 2021, no munitions or munitions debris were reported by homeowners, with the exception of one .50 caliber bullet. The finding of the .50 caliber bullet is consistent with the conceptual site model and the known historical use of the MRS as a small arms training range, and the location and quantity reported are not considered a significant hazard to receptors in the residential area. The additional information from the public outreach provides the necessary confidence to support the recommendation for "No Further Action" for the residential portion of the NDNODS Kingman MRS.

ADEQ believes the public outreach efforts and results were a necessary line of evidence to update and confirm the conceptual site model in the residential area. The outreach afforded the current residents the opportunity to provide valuable and applicable information to ADEQ before making important decisions about risk and future work at the site.

Should you have any questions or consider a clarification meeting necessary regarding this correspondence, please do not hesitate to contact me by phone at (602) 771-0956 or e-mail at romanoff.natalie@azdeq.gov.

Sincerely,

Natalie Romanoff
Project Manager, FPU
Waste Programs Division, ADEQ

ec: Kim Birdsall, AZDEMA
John Haines, ARNG
Tim Trego, Weston Solutions, Inc.
Karin Harker, ADEQ FPU Manager
Steve Willis, UXO Pro, Inc.
Dan Haines, UXO Pro, Inc.

cc: ADEQ Project File and Reading File

APPENDIX N

STAKEHOLDER COMMENTS

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Comments for the

Stakeholder Draft Remedial Investigation/Feasibility Study (RI/FS) Report
MMRP Munitions Response Services
Army National Guard Bureau
Kingman Range MRS (AZHQ-006-R-01), Arizona
Contract No.: W912DR-15-D-0022
Delivery Order No. 0001

September 2020

Comment Number	Commenter	Page(s)	Section	Line(s)	Comment	Response Code	Response	Commenter	Backcheck Comment	Backcheck Response
TECHNICAL COMMENTS										
1	N. Romanoff	PDF 30/ Doc. 2-10	2.4.1	5	Please provide information, in this section and in the institutional analysis, on any previously documented outreach in the developed residential parcels (Kingman Range NFA Area MRS) recognizing residents have not reported or encountered any evidence of munitions use, debris or fragmentation, EOD responses, etc. Additionally, as this outreach occurred in 2010, ADEQ proposes a new solicitation, via door-to-door, mail, and/or public meeting, to confirm previous responses, owners, and assumptions. This information should be presented in the RI Report along with a summary and timeline of the previous efforts, e.g., fire house, police, nearest EOD shop, and points of contact. ADEQ believes this information, along with the logical conclusion that development and hardscaping would have exposed or revealed any evidence of MEC, is necessary to present and document in the RI Report. As discussed during the TPP#4 meeting, ADEQ would be open to a joint review of any new information or in developing data quality objectives (DQOs) based on the number of responses.	Concur	During TPP #1 and TPP #2 meetings the areas to be investigated were clearly discussed. There were no comments in either meeting minutes where ADEQ disagreed with the approach. Additionally, ADEQ concurred with the Work Plan that outlines the approach. The Work Plan contains DQOs that stipulate 'if then' statements and that the residential area would be NFA. Sampling was discussed at length in TPP #1 and there was no mention of sampling required in the residential area because the SI stated NFA for MC. Respectfully, we disagree with the need for sampling in the residential area and the additional extensive community outreach request. However, in an effort to remain cooperative with ADEQ, the Army Project Delivery Team (PDT) will entertain some type of survey of the residents located in the MRS. But, we need to know the following: 1. What will be in the questionnaire? 2. How many residents should be surveyed? 3. What is a reasonable number of returned surveys? 4. Of the returned surveys, what would satisfy ADEQ that the risk of MEC/MC is negligible to the point that there would be no need for further action? Additionally, information has been added to Section 2.4.1 (page 2-10, lines 6-13) and the IA report (page 1-3, lines 12-20), as requested.	N. Romanoff	ADEQ appreciates the Army's cooperation and agreement to send a questionnaire to current residents located in the MRS. ADEQ believes providing the current residents an opportunity to response will offer input and fulfill concurrence for No Further Action in the developed residential parcels, if there are no responses or the responses are in the negative for munition debris. ADEQ's recommendations: A. Each current resident located in the MRS boundary should be surveyed and given an opportunity to respond. B. The questionnaire should be simple Yes/No questions, 1. Did you dig on your land or property? Yes or No (for example, planted trees, installed a fence, etc.) 2. Have you found any metal objects or munitions like objects? Yes or No If Yes, describe what you found and if it was in the ground or on the surface: 3. Have you heard of anyone in your community finding a munition related object? Yes or No C. Offer an electronic submittal option for the questionnaire via applications such as survey monkey or type form. D. The letter to the residents should include general site background information and a site boundary map. E. Schedule a virtual outreach meeting, preferably after 6 pm or on a weekend, 2-3 weeks after the mail-out date. This meeting will offer another opportunity for feedback and answer questions. This virtual outreach should be documented in the initial survey letter to the residents. Based on these outreach attempts and dependent on the feedback received, ADEQ finds this to be a reasonable outreach effort.	A. Concur - The attached questionnaire will be sent to the owner of record for 41 residential parcels. The residential parcels are the same as those whose owners were contacted during the SI. It should be noted that ownership of 12 of the residential parcels (or 29%) has changed and the new owners may not be aware that their property is located within a MRS. B. Concur - A copy of the questionnaire is attached for your review and concurrence. The questionnaire includes the questions provided in ADEQ's backcheck comments. C. Non-Concur - ARNG will provide a self-addressed stamped envelope and an email address for parcel owners to provide responses to the questionnaire; however, to ensure documentation of the responses and to reduce potential errors, ARNG will not utilize an online survey tool or provide a point of contact's telephone number. If ADEQ would like to include a phone number for responses, ARNG will include that number on the questionnaire. Parcel owners will be given 2 weeks from delivery to respond to the questionnaire.. D. Concur - A brief history and a site boundary map will be included as part of the questionnaire. Please see the attached questionnaire for your review and concurrence. E. Non-Concur - ADEQ concurred with the RI Work Plan which did not include or propose surveying of the residential parcel owners. Therefore, ARNG has not planned or budgeted for conducting a public meeting other than in the Proposed Plan phase of the CERCLA process. ARNG will participate in a public meeting if it is planned and conducted by ADEQ.. ARNG proposes NFA for those parcels whose owners do not respond to the questionnaire and for those owners that respond that military munitions have not been identified on their parcel. If a parcel owner confirms that military munitions have been found on their property, it will be documented in the RI and further investigation of that parcel will be proposed within the decision document.
2	N. Romanoff	PDF 62/ Doc. 6-6	Table 6-3	2	Matrix 1: Aerial photographs indicate the current residential parcels are within the historical range footprint. Neither physical investigations or transects were executed in the residential parcel area during the SI or RI phases. Therefore, ADEQ believes the justification of no evidence of munitions use resulting in an Unlikely determination requires additional supporting documentation in the report, for instance direct outreach with landowners and emergency service agencies. Previous communications and outreach should be documented and summarized in the report. ADEQ proposes renewing outreach efforts to ensure accuracy and solicit new information, preferably with written responses, regarding any knowledge of previous discoveries or responses of munitions debris or UXO. The results of this solicitation for information should be documented in the RI Report. If a majority of residents participate and all respond in the negative to the presence of evidence of munitions on their parcels, then ADEQ believes this would adequately support NFA and an "Unlikely" and "Acceptable" risk determination for MEC in the residential parcels to the West (Kingman NFA MRS). If the residents' participation is low, then the project team will evaluate the location and acreages of responses and decide as to the adequacy of coverage. If new evidence of munitions debris or UXO is reported, then the project team will evaluate and decide if the new information warrants a change to the risk determination or boundary for the Kingman NFA Area MRS in the RI/FS Report.	Concur	See response to comment #1. No changes have been made to Section 6.2.	N. Romanoff	Comment Unresolved	See response to Comment #1.
3	N. Romanoff	PDF 63/ Doc. 6-7	Table 6-4	8	Evidence of high explosive munitions use was confirmed, therefore ADEQ disagrees with the selection of "modest injuries". A detonation of a high explosive 60mm mortar or 3.5 inch rocket would cause death. ADEQ believes that "Seldom" for likelihood of encounter and "Catastrophic" for severity of injuries are appropriate and would result in a "B" for Matrix 2.	Concur	Table 6-4 has been revised from C to B for the Kingman Range MRS (page 6-7)			
4	N. Romanoff	PDF 65/ Doc. 6-9	Table 6-5	2	With the selections of *"B"* and *"1"* from Matrix 2 and 3, the Matrix 4 determination should be a *"B1" "unacceptable"* determination.	Concur	Table 6-5 has been revised to from C1 to B1 for the Kingman Range MRS (page 6-8).			
5	N. Romanoff	PDF 291/ Doc. 5-1	Appendix L, 5.1	24	ADEQ accepts 18 inches for the RAO depth, but expects the subsurface clearance to resolve all anomalies to depth of detection. Please define and clarify this in the RAO and FS where applicable.	Concur	The text has been revised in Section 5.1 (page 5-1, lines 24-25) and Section 6.3 (page 6-2, line 31).			

6	N. Romanoff	PDF 294/ Doc. 5-4	Appendix L, 5.3.1.2	26	Please confirm the applicability of construction support for these MRS and revise accordingly.	Concur	Section 5.3.1.2 has been revised to indicate that construction support will occur during the implementation of LUCs (page 5-4, lines 26-31).			
7	N. Romanoff	PDF 310/ Doc. 6-6	Appendix L, 6.3	5-18	*"The AGC process is assumed to reduce the overall list of anomalies requiring excavation by 75% for a total of 272 anomalies. In addition, the AGC process requires an additional 25 anomalies to be excavated to confirm classification results and an additional 10% for blind seeds. Each of the estimated 324 anomalies would be reacquired via GPS by the site geophysicist and UXO Technician II, at rate of approximately 200 anomalies per day for two (2) days."* The current Advanced Geophysical Classification (AGC) guidance, AGC-QAPP Template and MR QAPP RI/FS Module 1, recommend a minimum requirement of 200 verification and 200 validation digs. Please revise the text and costing accordingly. If there is justification for deviating from the guidance, then ADEQ advises this discussion occur during the remedy TPP process and QAPP development, should AGC be proposed and/or selected.	Concur	The text has been revised to indicate that a minimum of 200 verification and 200 validation digs will be conducted (page 6-6, lines 7-10). No changes have been made to the cost.			
8	N. Romanoff	PDF 327/ Doc. 7-13	Appendix L, Table 7-4	N/A	Overall Protectiveness of Human Health and the Environment for Alternative 4, which includes excavation and sifting to bedrock, may be most favorable for removing all explosive hazards, but it may not be the most favorable in regard to protecting flora and fauna. Please consider breaking this criterion into two rows: 1) Overall Protectiveness of Human Health 2) Overall Protectiveness of the Environment	Concur	A new line has been added to Table 7-4 (page 7-13). Additionally, text has been added to this section for Alternatives 1,3, and 4 (Section 7.2.1.1, page 7-5; Section 7.2.3.1, page 7-8; and Section 7.2.4.1, page 7-10) to discuss in more detail the overall protectiveness of the environment. All references to UU/UE have also been removed from the document as discussed in recent meetings.			
EDITORIAL COMMENTS										

COMMENTS PROVIDED BY

Initials	Name	Department/Organizatio	Email Address	Phone
NR	Natalie Romanoff	AZDEQ	romanoff.natalie@azdeq.gov	(602) 771-0956

ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

Douglas A. Ducey
Governor

Misael Cabrera
Director

VIA EMAIL
FPU 21-175

January 29, 2021

Mr. James Lukasko
Project Manager
US Army Corps of Engineers
Sacramento District CESPK-PM-H
1325 J Street
Sacramento, CA 95814

Re: ADEQ approval for *FINAL Remedial Investigation / Feasibility Study Report, Kingman Range MRS (AZHQ-006-R-01), Mohave County, Arizona,* prepared by Weston Solutions

Dear Mr. Lukasko:

The Arizona Department of Environmental Quality's (ADEQ) Federal Projects Unit (FPU) has reviewed the above referenced document and finds the document acceptable. Please proceed to submit the Final Document. ADEQ recommends modifying the RTC forms to ensure readability of all comments before submission to the administrative record.

Should you have any questions regarding this correspondence, please do not hesitate to contact me by phone at (602) 771-0956 or e-mail at romanoff.natalie@azdeq.gov.

Sincerely,

Natalie Romanoff
Project Manager, FPU
Waste Programs Division, ADEQ

ec: Kim Birdsall, AZDEMA
John Haines, ARNG
Tim Trego, Weston Solutions, Inc.
Karin Harker, ADEQ FPU Manager
Steve Willis, UXO Pro, Inc.

Dan Haines, UXO Pro, Inc.

cc: ADEQ Project File and Reading File