



**Final Proposed Plan for  
Military Munitions Response Program  
Known Distance Range  
Munitions Response Site  
Camp Dawson  
Kingwood, West Virginia**



## Army National Guard Announces Proposed Plan

### Introduction

The **Proposed Plan**<sup>1</sup> presents the proposed decision of **No Further Action (NFA)** for the following **Military Munitions Response Program (MMRP)** site at the West Virginia Army National Guard (WVARNG) Camp Dawson, Kingwood, West Virginia (**Figure 1**):

Known Distance (KD) Range **Munitions Response Site (MRS)**, hereafter referred to as “the MRS.”

The Proposed Plan provides the rationale for proposing NFA as the proposed decision at the MRS. The Proposed Plan includes a summary of the assessment and investigation activities conducted at the MRS.

The MMRP was established by the U.S. Congress in 2001 to assess areas that had been used in the past for military training, but were no longer operational ranges. If historical data, such as military records, newspaper records, or even personal recollections, suggested that live-fire training may have occurred in these areas (called MRSs), they are investigated under the MMRP. Investigation results indicate whether or not munitions or munitions chemicals, such as **lead**, are present and could be a potential **risk** to human health or the environment. Areas currently used for active training are excluded from the MMRP.

The document is being issued by the Army National Guard (ARNG), the lead agency for site activities, with support from the WVARNG and the U.S. Army Corps of Engineers (USACE). The document has been prepared in coordination with the West Virginia Department of Environmental Protection (WVDEP), the state regulatory authority for site cleanups. As a result of the assessment and investigation activities conducted at the MRS and as detailed in the following

sections, the ARNG, the WVARNG, and USACE, in consultation with the WVDEP, have concluded no further action is required at the MRS.

The Proposed Plan summarizes information, including sample results and associated regulatory screening

### *MARK YOUR CALENDARS*

#### **PUBLIC COMMENT PERIOD January 25, 2016 – February 24, 2016**

The Army National Guard (ARNG) will accept written comments on the Proposed Plan during the public comment period. Comment letters must be postmarked by February 24, 2016, and should be submitted to:

Amanda Sullivan  
Environmental Compliance Specialist  
Randolph County Armed Forces Reserve Center  
201 Caisson Drive  
Belington, WV 26250

Email: amanda.d.sullivan7.nfg@mail.mil  
Phone: 304-561-6019 (office) 304-951-5087 (cell)

To request an extension, send a written request to:

Mr. Pat Shaw, Army National Guard Directorate, 111 South George Mason Drive, Arlington, Virginia 22204 or patrick.p.shaw2.civ@mail.mil by February 15, 2016.

#### **PUBLIC MEETING**

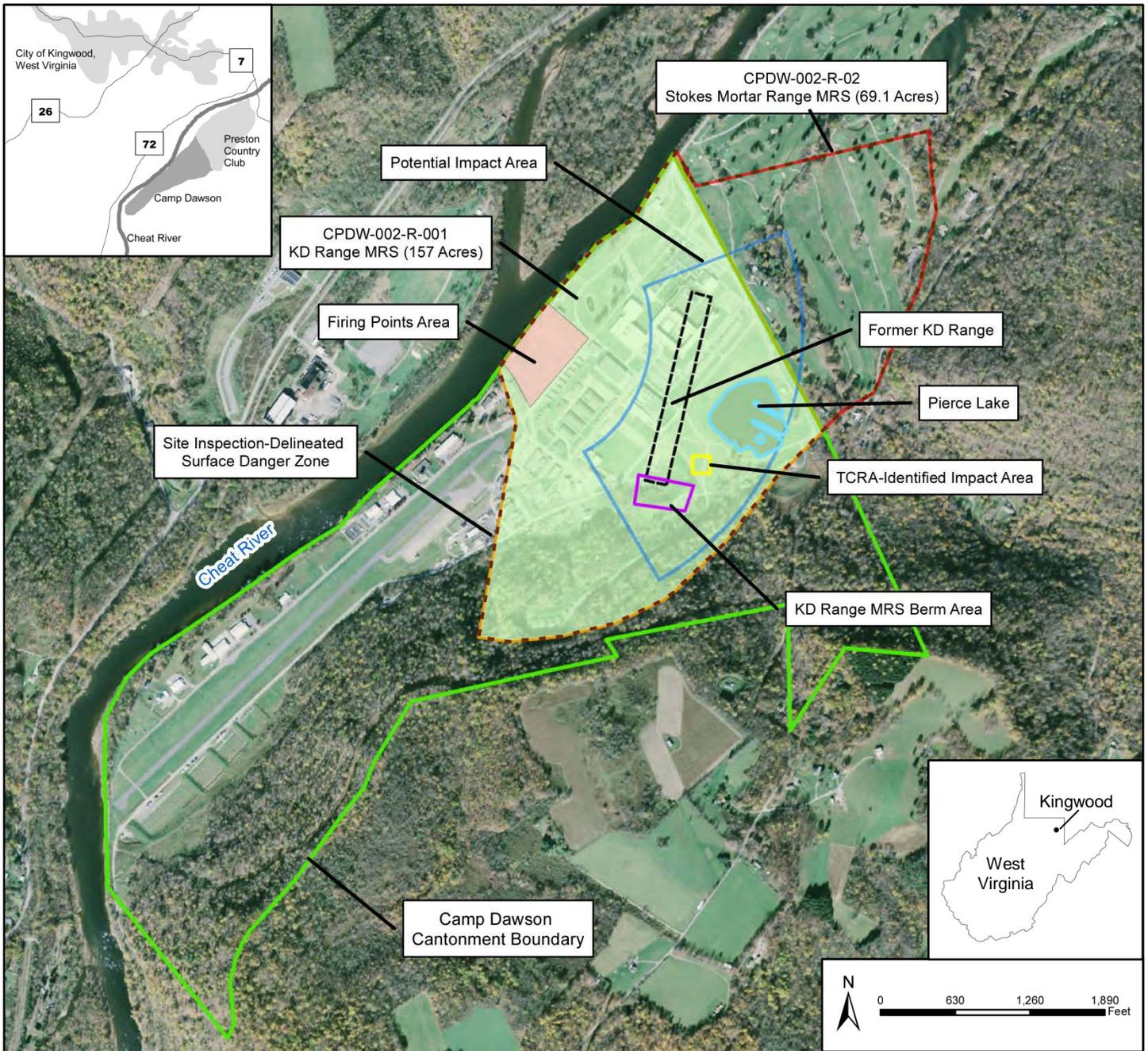
The public is encouraged to contact the ARNG by February 24, 2016, if they have an interest in attending a public meeting where the ARNG will explain the Proposed Plan and the proposed decision for the MRS. The ARNG will issue additional public notices to announce the date, time, and location of any meetings. Additional oral and written comments will also be accepted at the meeting.

#### **FOR MORE INFORMATION**

The ARNG and USACE make information regarding the KD Range MRS available to the public by maintaining copies of all of the technical documents prepared up to this time at the following locations and days and hours of operation:

Kingwood Public Library 205 West Main Street Kingwood, WV 26537 Phone: 304-329-1499	<u>Days and Hours of Operation</u> Monday: 9 a.m.-8 p.m. Tuesday/Thursday: noon-5 p.m. Wednesday/Friday: 9 a.m.-5 p.m. Saturday: 10 a.m.-2 p.m.
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<sup>1</sup> Terms in bold are included in the Glossary of Terms.



**Figure 1: Camp Dawson and KD Range MRS Location**

criteria, which can be found in greater detail in the **Remedial Investigation (RI)**, **Site Inspection (SI)**, and **Historical Records Review (HRR)**.

The RI, which summarizes SI and HRR findings, is available for review at the Kingwood Public Library at 205 West Main Street, Kingwood, WV 26537. The ARNG, the WVARNG, and WVDEP encourage the public to review these documents to gain an understanding of the MRS and the previous investigations.

**Site History and Background**

Although the Proposed Plan recommends NFA for the MRS, a final determination will not be made until the public comment period ends and all comments are reviewed and addressed. The final determination will be documented in a **Decision Document**. The NFA decision for the MRS may be reviewed and modified in the future if new information becomes available that indicates the presence of contamination or **exposure routes** that may cause an unacceptable risk to human health or the environment. Therefore, the public is encouraged to review and comment on

information presented in the Proposed Plan. For reference, a Glossary of Terms and a list of acronyms and abbreviations used in the document are provided at the end of the Proposed Plan.

### **Camp Dawson History and Background**

Camp Dawson was established on May 7, 1909, when 196.5 acres of land along the Cheat River were authorized for purchase by the West Virginia State Legislature. Camp Dawson was named in honor of William M. O. Dawson, a native of Preston County who served as the governor of West Virginia from 1905 to 1908 (Weaver, 2005). Camp Dawson operated as a seasonal camp, with troop training occurring from its creation in 1909 to the start of World War I. Training was suspended during World War I and was not started again until 1928, when Camp Dawson was reopened as a training ground for the West Virginia State Militia. Units trained regularly at Camp Dawson until the start of World War II (WVARNG, 1913-1950). During World War II, the State of West Virginia leased Camp Dawson to the Army for use as a Prisoner of War Camp under a Federal Mission. In 1944 and 1945, the facility was used as a camp for Italian Prisoners of War (Keefer, 1993). In 1945, the State of West Virginia obtained fee simple ownership of the last parcels that mark the current Camp Dawson boundaries.

In 1985, a major flood occurred in the area. Federal funding was used to repair and rebuild the areas affected. Also at this time, the seasonal camp became a permanent, year-round, training facility. In 1989, the State of West Virginia deeded Camp Dawson to State Armory Board. The State Armory Board operates Camp Dawson in conjunction with Department of Public Safety and Military Affairs.

### **KD Range MRS History and Background**

The MRS consists of approximately 157 acres located in the northeastern portion of the Camp Dawson **Cantonment** and contains the footprint of a former small arms range, including the KD Range MRS Berm Area. The MRS also includes the **firing points** area and the **impact area** for a 3-inch **Stokes mortar** range. The MRS boundary is based on the footprint of the **surface danger zone** of the 3-inch Stokes mortar range that falls within the Camp Dawson Cantonment.

The former small arms range was used for training from 1906 until 1997. Stokes mortar training occurred from approximately 1918 to World War II.

Based on the **dispersal pattern** and the location of munitions identified during the previous MMRP investigations, Stokes mortar firing points are suspected to have been located along the eastern banks of the Cheat River. The exact locations of the firing points are unknown.

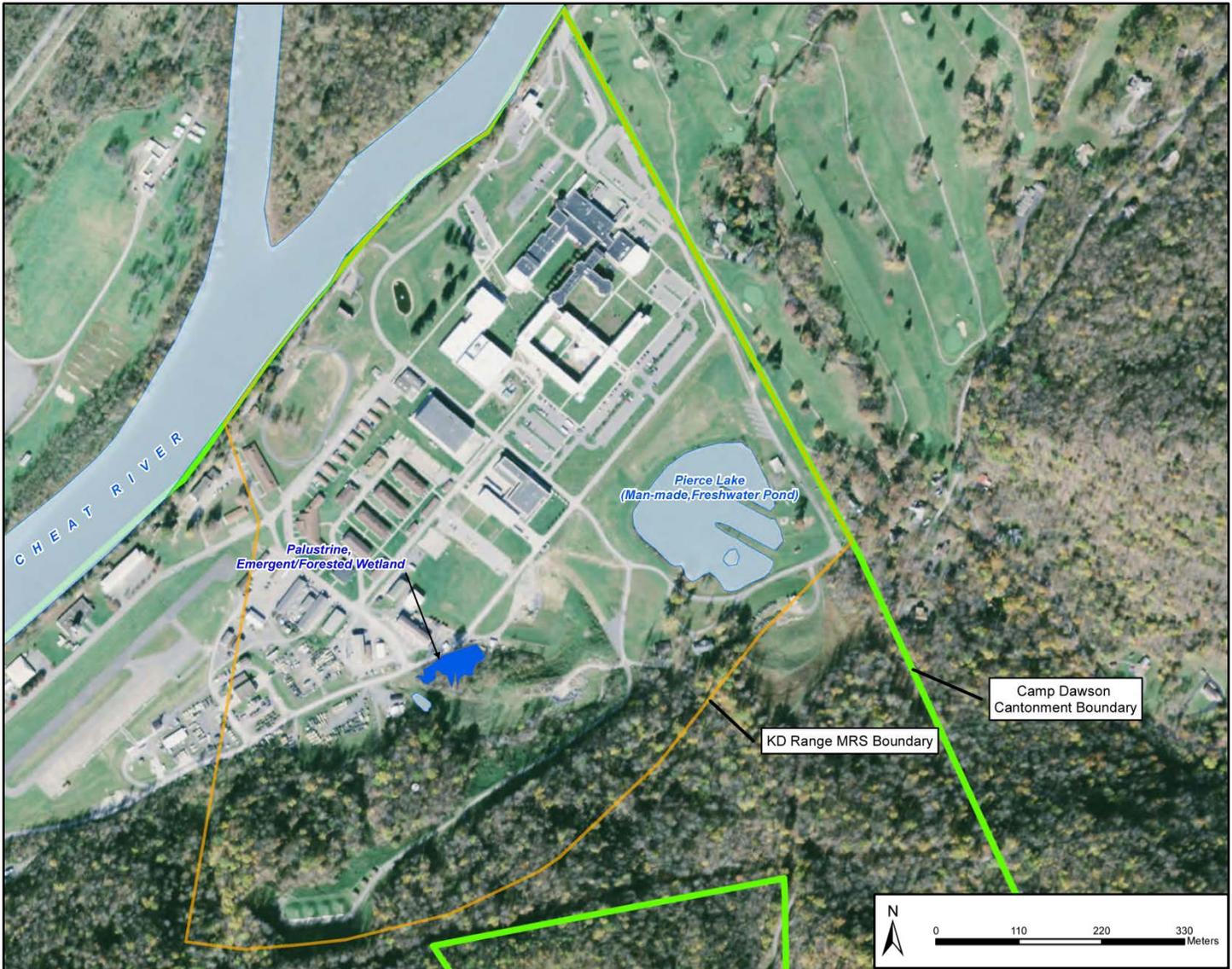
A **Time-Critical Removal Action (TCRA)** was completed and identified an area where a high concentration of **munitions debris (MD)** was removed (AMEC, 2012a). Because no **munitions constituents (MC)** sampling was conducted during the TCRA, this area was investigated for MC as part of RI sampling activities.

Portions of the MRS may have been used as **bivouac** areas where troops may have discarded used or unused munitions items (based on personal communications). The exact locations of the potential bivouac areas are unknown. However, they are believed to be within an area that has been developed with buildings, parking areas, and training facilities. The bivouac area scenario would explain the 40-millimeter (mm) **smoke projectiles** recovered during the TCRA and the M-8 practice anti-personnel mines recovered during a **geophysical survey** and **anomaly** assessment.

The geophysical survey and anomaly assessment was conducted in 2009 to determine the potential for encountering **munitions and explosives of concern (MEC)** during the military construction projects planned within the MRS (AMEC, 2010). TCRA activities removed MEC from the areas designated for future construction. A 37mm projectile (not consistent with **Stokes Mortar Range** activities) was also found during the TCRA field activities.

West Virginia infantry regiments that trained at Camp Dawson after World War I had 37mm guns and Stokes mortars in their organization. The U.S. 37mm Infantry Gun M1916 was likely the source for the 37mm projectile and fragments found at the MRS. There are, however, no historical records of the U.S. 37mm Infantry Gun M1916 being fired at Camp Dawson.

The MRS is also adjacent to a former 3.5-inch rocket range. Identifiable fragments and pieces of 3.5-inch *practice* rockets were found at or just below ground surface during field reconnaissance. These items, along with anecdotal information gathered from former Camp Dawson personnel, confirm that this type of munition was fired into a hillside located



**Figure 2: Surface Water in KD Range MRS at Camp Dawson**

within the MRS in the past. There is no documented use of *high explosive* rockets within the former 3.5-inch rocket range.

The majority of the KD Range MRS has been developed with buildings, parking areas, and training facilities, or has been otherwise disturbed since training activities occurred. Both the small arms range firing lines and the majority of the Stokes mortar range impact area are covered by infrastructure.

The MRS Berm Area, located in the southern area of the KD Range MRS, was investigated as part of an **Engineering Evaluation/Cost Analysis (EE/CA)** to initiate an interim action to address elevated lead concentrations detected during the MMRP SI. A **palustrine**, emergent/forested wetland is located

west of the KD Range MRS Berm Area (**Figure 2**). The man-made wetland was unintentionally formed when Range Road was constructed.

Pierce Lake, an 8-acre man-made pond, is located near the northeastern border of the KD Range MRS (AMEC, 2007). The man-made pond was created between 1956 and 1967, after Stokes mortar training had concluded.

Significant excavation and disturbance recently occurred at the suspected Stokes mortar range firing points area as part of Camp Dawson improvement activities.

Previous activities completed at the MRS include:

- Geophysical survey and anomaly assessment – AMEC, 2009

- **Preliminary Assessment (PA)** – ARNG, 2009
- Time-Critical Removal Action – AMEC, 2010
- Historical Records Review – AMEC, 2010
- Site Inspection – AMEC, 2012
- Engineering Evaluation and Cost Analysis – WESTON, 2014
- **Non-Time-Critical Removal Action (NTCRA)** – WESTON, 2014
- Remedial Investigation – WESTON, 2015

The following sections provide a brief description of each of the environmental activities conducted at the MRS.

***Geophysical Survey and Anomaly Assessment – AMEC, 2009***

WVARNG conducted a geophysical survey and anomaly assessment after encountering a **fuzed** 3-inch Stokes mortar during the construction of the Mountaineer Challenge Academy building, which is near the former small arms range within the MRS. A geophysical survey and anomaly assessment were conducted in 2009 to determine the potential for encountering MEC during the military construction projects planned within the MRS.

As reported in the Final Site Inspection Report (AMEC, 2012b), a total of 310 anomalies were identified as potential MEC and were investigated. Nine of the items were classified as MEC, including eight fuzed, 3-inch Stokes mortars and one fuzed, 81mm practice mortar. Ninety-five of the investigated anomalies were classified as MD, including 3.5-inch practice rockets, 3-inch Stokes mortars, grenades, and M-8 practice antipersonnel mines. A total of 185 items were classified as non-munitions debris.

Twenty-one anomalies were not investigated because of their location within roadways or because an anomaly source was not encountered during the investigation. The Geophysical Survey and Anomaly Assessment Letter Report (AMEC, 2010) recommended a MEC removal action and construction support throughout construction activities within the MRS.

***Preliminary Assessment – ARNG, 2009***

A Preliminary Assessment (PA) was conducted by the ARNG Directorate in 2009 to determine whether the Camp Dawson Cantonment, specifically the MRS, was eligible for inclusion in the MMRP. The

PA documented historical range use within the MRS, including a small arms training range and a former Stokes mortar range. The small arms range was active from approximately 1906 through 1997.

Information presented in the PA indicates Stokes mortar training occurred from approximately 1918 to World War II. The PA identified approximately 330 acres (of 430 acres) in the Camp Dawson Cantonment as containing or suspected to contain munitions from previous use of the Stokes mortar range.

Munitions density was identified as low. The 3-inch Stokes mortar was suspected to have been fired from the eastern banks of the Cheat River toward the hillside along the southern boundary of the Camp Dawson Cantonment.

In the PA report (ARNG, 2009), it was concluded that the MRS met the MMRP eligibility requirements. Therefore, the MRS was recommended for further investigation in an SI phase. In addition, a TCRA was recommended for areas of the MRS that were planned for construction.

***Time-Critical Removal Action – AMEC, 2010***

In accordance with the findings of the PA, a TCRA was conducted in June 2010 in the construction area of the KD Range MRS at Camp Dawson. The TCRA was performed to remove MEC from areas designated for future construction to protect human health and the environment from explosive hazards.

In association with the TCRA, an **explosives safety submission** was prepared by USACE because it was determined that a moderate to high probability of encountering MEC would exist during the planned construction activities. The results of the TCRA activities performed at the KD Range MRS are summarized in the Final After Action Report for Camp Dawson (AMEC, 2012a). Approximately 43 acres were investigated as part of the TCRA.

Approximately 3,737 anomalies were detected within the removal action footprint. One item (a 37mm M1A2 **light explosive projectile**) was classified as MEC and blown-in-place, and 287 items were classified as MD. In addition, 2,275 items were classified as non-munitions debris, 76 items were classified as rocks or soil with magnetic properties, and 15 items were **quality control (QC) blind seed items**. Because of their location within roadways or because data showing an item could not be

reproduced during the investigation activities, 1,083 anomaly locations were not investigated.

Upon completion of the TCRA, USACE, in an Ordnance and Explosives Safety Memo, certified clearance of 168 grids of 265 grids. **Institutional controls** were recommended for grids or portions of grids that were not cleared during the TCRA to prevent potential exposure in these grid areas. Controls were implemented in the form of **unexploded ordnance (UXO)** standard operating procedures.

#### **Historical Records Review – AMEC, 2010**

An HRR was conducted in 2010 to identify potential MRSs where training and disposal activities might have occurred at Camp Dawson. Information resources used in the research included the following:

- Archival research performed at the National Archives; the West Virginia State Archives; and other federal, state, and local agencies.
- Historical aerial photographs of Camp Dawson.
- Historical records, including the deed for Camp Dawson.
- Historical articles from local sources, including WVARNG, historical societies, the *Preston County Journal*, and West Virginia University.
- Personnel interviews.

The results from archival research, historical records, and review of aerial photographs confirmed the use of Camp Dawson as a small arms and mortar training range from the early 1900s through 1997. The information obtained during personnel interviews was used to identify potential MRSs at Camp Dawson where training and disposal activities may have occurred. The results of the personnel interviews indicated two MRSs are present at Camp Dawson, the KD Range MRS and the **Non-Department of Defense, Non-Operational Defense Site (NDNODS) Rocket Range MRS**.

The HRR is included in the Site Inspection Work Plan (AMEC, 2011). The NDNODS Rocket Range MRS is not part of the Remedial Investigation/ Feasibility Study Work Plan (WESTON, 2014a). During the SI, the MRS was subdivided into two MRSs, the KD Range MRS and the Stokes Mortar Range MRS. The subdivision into two MRSs was made in the event that the off-post MRS (Stokes Mortar Range MRS) was found to have no MC,

MEC, or MD. In this case, the Stokes Mortar Range MRS could be closed out.

#### **Site Inspection – AMEC, 2012**

The SI field investigation was conducted from July 12, 2011 to July 14, 2011. The primary objective of the SI was to collect the appropriate amount of information to support recommendations of NFA, immediate response, or further characterization concerning the presence of MEC and/or MC at the MRS.

A **digital geophysical mapping** survey was conducted along five **transects** spaced 100 feet apart at the 3-inch Stokes mortar range firing points area. The survey totaled 1.6 miles or 0.77 acre. Ninety-two subsurface anomalies were detected. An **analog visual survey** was conducted over the KD Range MRS Berm Area. This survey was completed over nine transects spaced approximately 60 feet apart, totaling 1,522 linear feet or 0.35 acre.

No intrusive work at anomaly locations was performed during either of the two surveys. No MEC or MD was observed during the surveys.

Thirteen surface and subsurface soil samples were collected at the KD Range MRS Berm Area. Total lead exceeded screening criteria in seven of the samples collected.

In summary, it was recommended in the SI that an RI be conducted for the following reasons:

- The extent of MEC and MD within the MRS was unknown.
- Lead was detected above screening criteria.

#### **Engineering Evaluation/Cost Analysis – WESTON, 2014**

An EE/CA was finalized in June 2014 to evaluate the response alternatives to address lead-contaminated soils at the KD Range MRS Berm Area. A **Streamlined Risk Evaluation (SRE)** was performed for the KD Range MRS Berm Area investigation to determine whether the human health risk was within an acceptable range for unrestricted use. The SRE was evaluated for unrestricted use by **the Integrated Exposure Uptake Biokinetic (IEUBK) model** to predict the **blood lead levels** in young children. The basis for the evaluation is the use of the area by youths attending the Mountaineer Challenge Academy and the likely future use of the MRS for military housing.

The data collection to support the EE/CA and SRE consisted of soil samples analyzed by both **X-ray fluorescence** and an off-site chemical analysis laboratory. The frequency of detection for lead at the KD Range MRS Berm Area was 100%. The maximum detected soil concentration for lead in **validated samples** was 3,768 milligrams per kilogram (mg/kg). The **mean value** for lead was 448 mg/kg, which represented an unacceptable risk for unrestricted use (i.e., residents). The U.S. Environmental Protection Agency (EPA) and WVDEP have established a residential value of 400 mg/kg.

A lead risk-based removal action goal for the KD Range MRS Berm Area soils was developed using the IEUBK model. The results indicated that lead concentrations at the MRS would pose an unacceptable risk to residents, including young children (0 to 84 months). The calculated risk-based removal action goal of 418 mg/kg was developed to be protective for residential land use. Although the risk-based model allows a lead level of 418 mg/kg, the West Virginia Voluntary Remediation and Redevelopment Rule residential remediation standard of 400 mg/kg was selected as the removal action goal

for the KD Range MRS Berm Area because it is considered a chemical-specific **applicable or relevant and appropriate requirement (ARAR)**.

Three remedial alternatives are discussed in the EE/CA: Alternative 1, No Action; Alternative 2, Excavation, Treatment, and Repurpose; and Alternative 3, Excavation and Off-Site Disposal. Alternative 2 was deemed to be the most cost-effective remedial option. Alternative 2 would meet the removal action objectives, would remove the contaminated material from the KD Range MRS Berm Area permanently, and would provide adequate protection to human health and the environment.

The lead-contaminated, hazardous soil would be treated (on-site) so that it would no longer be a **Resource Conservation and Recovery Act (RCRA) characteristic waste**, and the soil would be repurposed at Camp Dawson in an existing range.

The proposed excavation area, determined in the EE/CA, totaled 11,250 square feet (ft<sup>2</sup>) (approximately 0.25 acre). As a result of the EE/CA, an NTCRA was proposed to remediate the lead-contaminated soil within the KD Range MRS Berm Area.



**Figure 3: December 9, 2014 – Excavation of the target berm and stockpiling of lead-contaminated soils for treatment begins at the KD Range MRS Berm Area for the NTCRA.**

## **Non-Time-Critical Removal Action – WESTON, 2014**

The NTCRA was completed in December 2014 to address lead-contaminated soils at the KD Range MRS Berm Area (**Figure 3**). Soils containing lead concentrations greater than 400 mg/kg were excavated and treated with ECOBOND®. ECOBOND® technology **chemically stabilizes** heavy metal contamination (i.e., lead) in the soil to reduce the mobility (**leachability**) of the lead, but does not reduce the **total lead** concentration.

Following ECOBOND® lead stabilization treatment, the field team collected soil samples from each of the soil treatment staging piles. The soil samples were used to verify the success of the lead stabilization, as demonstrated by lead concentrations of the **toxicity characteristic leaching procedure (TCLP)** extract below 5.0 milligrams per liter (mg/L). Two samples were collected from ECOBOND® treated soils to confirm TCLP results of less than 5.0 mg/L lead to allow soil reuse at the Airfield Range.

The laboratory results confirmed treatment results of less than 5.0 mg/L lead. Confirmed treated soils were directly transported to the active Airfield Range at Camp Dawson, which is approximately 0.75 mile to the southwest of the KD Range MRS Berm Area.

Post-excavation **confirmation sampling** of the KD Range MRS Berm Area was based on the collection of soil samples from an area of approximately 900 ft<sup>2</sup> at the bottom of the excavated area. Sidewall post-excavation confirmatory samples were collected every 30 linear feet in accordance to the WVDEP guidance (WVDEP, 2006) and the Final NTCRA Work Plan (WESTON, 2014b).

Upon completion of the target berm lead-contaminated soil removal, the remaining portion of the target berm was excavated to current grade level. The final post-excavation survey showed the pre-existing elevation in front of and behind the target berm to be 1,260 feet. The final grade met the final elevation of 1,260 feet. Because the remaining portion of the target berm was excavated to surrounding grade, post-excavation confirmation samples collected from the target berm were not incorporated into the risk assessments conducted for the MRS RI.

Upon completion of the impact berm lead-contaminated soil removal, the impact berm was graded so that there was a uniform continuous slope and ponding of water would not occur. No import fill

was required. The post-excavation laboratory confirmation samples were collected at the surface with a few in the top 6 inches of existing grade. Post-excavation confirmation samples collected from the impact berm were incorporated into the risk assessments conducted for the MRS RI.

Discussion of the NTCRA activities and results are detailed in a separate NTCRA After Action Report (WESTON, 2015). The results of the NTCRA were considered in the risk assessments and the revised conceptual site model for the KD Range MRS RI.

## **Remedial Investigation – WESTON, 2015**

The goal of the RI was to determine whether further response action is warranted. The RI determined the nature and extent of MEC and MC to evaluate the associated hazards and potential risks posed to human health and the environment.

### **MEC Investigation and Results**

**Magnetometers** and digital geophysical mapping were used to locate potential MEC and MD within the 8.39 acres of the 44.2 acres of the KD Range MRS that remain undeveloped. UXO technicians investigated all anomalies.

No MEC was recovered during the RI. A total of 185 anomalies were detected and investigated. Of the 185 anomalies investigated, 10 were identified as MD. The remaining 175 anomalies investigated were identified as cultural debris (i.e., construction debris, sheet metal, steel tanks, rebar, concrete reinforced with rebar, chain-link fence, and metal pipe). Approximately 211 pounds of cultural debris and 31 pounds of MD were recovered within the survey area.

### **MC Investigation and Results**

Three areas were identified for MC characterization:

- TCRA-identified impact area – To determine if MC is present because MC characterization was not completed during the removal of MD in 2010.
- Firing points area – To determine if MC is present in soil as a result of direct release and deposition during firing of weapons.
- Wetland west of the KD Range MRS Berm Area – To determine if an MC release is present in surface water and/or sediment as a result of surface water runoff and erosion transporting MC outside the lead-contaminated boundary of the KD Range MRS Berm Area.

MC sampling activities were planned to be conducted at the MRS in areas where high densities of MEC or significant MD were observed during the RI. In addition, the identification of a single MEC item observed to be damaged or leaking would also warrant MC sampling activities. High densities of MEC or significant MD were not identified at the MRS during the RI. Additional MC characterization areas were not identified as a result of the RI. Soil and surface water/sediment sampling was conducted during the KD Range MRS RI field activities. MC sampling activities were conducted on October 22, 2014, and October 23, 2014.

**Soil Sampling Results** – Soil samples were collected at the firing points area to determine whether an MC release was present in soil as a result of weapons firing. One incremental soil sample was collected at the TCRA-identified impact area where a high density of MD was removed because no MC characterization was conducted during the TCRA. Incremental soil samples were collected at 0 to 6 inches below ground surface. Fifty incremental soil samples were collected from within each 0.5-acre **decision unit**. The following metals were detected: **cadmium, copper, lead, manganese, nickel, and zinc**. Cadmium, copper, and nickel were detected at concentrations below both the project human health and ecological screening levels. Lead, manganese, and zinc were detected above project ecological screening levels, but below background concentrations and project human health screening levels.

**Surface Water/Sediment Results** – Surface water/sediment sampling was conducted to evaluate MC (lead only) at the wetland west of the KD Range MRS Berm Area to determine whether lead has migrated beyond the berm area by runoff/erosion.

Surface water samples were analyzed for total lead, **dissolved lead, pH, and total hardness**. Lead was not detected in any of the four filtered surface water samples (dissolved lead). Of the four surface water samples collected, three samples had total lead (unfiltered) concentrations less than the project screening level of 50 micrograms per liter ( $\mu\text{g/L}$ ), and one sample exceeded the human health screening level for total lead ( $73.7 \mu\text{g/L}$ ). The four total lead (unfiltered) surface water samples collected were observed to have high amounts of suspended sediment. Because only small pockets of surface water were present when sampling was conducted, sediment was suspended in the surface water sample.

Sediment samples were analyzed for lead, **acid volatile sulfide**, and **simultaneously extracted metals** (lead only). Of the 10 sediment samples collected, lead was detected at concentrations greater than the ecological soil screening levels (Eco-SSLs) of 11 and 35.8 mg/kg and background concentration at 8 sample locations. The 10 sediment samples yielded results below the human health screening level of 400 mg/kg.

The following is a summary of the results of the MC sampling investigation conducted at the wetland:

- Ten sediment samples were collected across a relatively small designated wetland (0.61 acre).
- None of the sediment samples had detected lead concentrations above the human health screening level.
- Eight of the sediment samples exceeded the Eco-SSLs and background levels.
- Four surface water samples were collected in each possible location where standing water was present immediately following 10 consecutive days of rain.
- Lead was not detected in any of the four filtered surface water samples (dissolved lead).
- One of the unfiltered surface water samples exceeded the human health screening level. However, all four unfiltered surface water samples were observed to have high amounts of suspended sediment because only small pockets of surface water were present when sampling was conducted.
- Surface water runoff does not appear to flow out of the wetland.
- The potential lead source area from the KD Range MRS Berm Area was removed as part of an NTCRA.
- WVDEP concurs with the final RI report.

### **Scope and Role of the Action**

The Proposed Plan addresses only the KD Range MRS at Camp Dawson, WV. The proposed decision of NFA for the MRS is intended to be the final action. The proposed decision does not affect any other areas at Camp Dawson. NFA is appropriate at the MRS because of the following RI findings:

- A total of 8.39 acres were investigated at the KD Range MRS during the RI. This acreage is less than the proposed coverage because of data gaps in the investigation areas resulting from inaccessible areas. The actual coverage satisfies the data quality objectives.

- No MEC was identified in the MRS during the SI and RI field activities. Although MEC and MD were encountered in subsurface soil during the previous removal actions, the results of the SI and RI geophysical and intrusive investigations indicated that the former Stokes mortar range impact area fell within the boundaries of these removal actions, thus removing the potential to encounter MEC in the MRS. An explosive safety hazard is not anticipated to exist. Incomplete pathways were identified for surface and subsurface soils for all **receptors** having access to the MRS.
- The NTCRA was completed in December 2014 to address lead-contaminated soils at the KD Range MRS Berm Area. The remedial action performed at the target berms has successfully removed the lead exposure hazard caused by the historical range activities. The removal of the source area allows for a No Further Action recommendation.
- MC (lead) was identified in the MRS during the RI field activities. However, as determined in the MRS, the pathways are incomplete for surface and subsurface soils for all receptors having access to the MRS. Therefore, no unacceptable risks are present as a result of exposure to residential chemical concentrations or naturally occurring background levels at the MRS.

The nature and extent of MEC and MC at the MRS have been adequately characterized to support the human health and ecological risk assessments performed during the MRS RI. Camp Dawson has existing installation-wide institutional controls consisting of UXO standard operating procedures, and it is recommended that they remain in place.

Therefore, it is the ARNG and WVDEP judgment that NFA is appropriate at the MRS to protect human health, welfare, and the environment.

### Summary of Site Risks

During the RI, no MEC was found and explosives were not detected in soil. In addition, all metals were either below background or below their respective residential soils regional screening level when set at a **hazard quotient** of 1.0. One lead surface water sample (73.7 µg/L) exceeded its human health screening level of 50 µg/L. However, because of the likelihood of sediment entrainment in the sample as a result of the small amount of surface water at the MRS and the limited **dermal contact** people would

be expected to have with the surface water, risk from lead in surface water is expected to be negligible.

Although the **screening level ecological risk assessment (SLERA)** indicated a potential for ecological risk to receptors, the SLERA used conservative screening-level assumptions. These assumptions included 100% site use, 100% **bioavailability**, 100% of the diet consisting of the most contaminated dietary items, and no effect toxicity data to evaluate risk to populations of **upper trophic level** organisms. The receptors used to evaluate potential risk from the MRS have foraging areas typically larger than 1 acre. Therefore, exposure to chemicals at the MRS would not occur during 100% of foraging, resulting in a significant decrease in potential risk to wildlife. The potential for adverse impacts from soil contaminants on upper trophic level receptors is considered to be low, given the small size of the investigative areas of the MRS; the past disturbance of the areas, which limits the quality of the habitat; and the routine grounds maintenance that occurs in these areas of the MRS. In addition, no federal or state listed species are known to inhabit the MRS.

The **Munitions Response Site Prioritization Protocol (MRSPP)** requires the Army to keep a database of all munitions response sites, ranking the risks posed by their known and suspected hazards. MRSPP score sheets assign relative priorities to munitions response sites.

The MRSPP score sheets for the MRS were updated during the RI. As directed by the March 2014 MRSPP implementation guidance (USACE, 2014), the MRS received an overall MRS Priority of “No Known or Suspected Hazards.”

The proposed decision of NFA will be sufficient to protect public health, welfare, and the environment.

### Proposed Decision

The ARNG proposed NFA decision is the appropriate decision for the MRS because the RI determined an absence of MEC at the site. In addition, soil, surface water, and sediment sampling showed lead concentrations at the MRS are equal to or below background lead concentrations and do not appear to pose unacceptable risks to humans and animals. Therefore, no **Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)** action is necessary to ensure protection of human health and the environment. The

ARNG expects the NFA proposed decision will satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs; and (3) be cost-effective. The other requirements, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable and (5) satisfy the preference for treatment as a principal element, do not apply to an NFA decision.

### Regulatory Participation

WVDEP actively participated with the ARNG to evaluate the MRS both during the RI and subsequent NFA determination. WVDEP reviewed and approved the Quality Assurance Project Plan/Work Plan, and the report associated with the RI at the MRS. In cooperation with the ARNG, WVDEP is in mutual agreement with NFA as the proposed decision for the MRS.

### Acronyms and Abbreviations

µg/L	micrograms per liter
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
Eco-SSL	ecological soil screening level
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ft <sup>2</sup>	square feet
HRR	Historical Records Review
IEUBK	Integrated Exposure Uptake Biokinetic
KD	Known Distance
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MMRP	Military Munitions Response Program
MRS	Munitions Response Site

### Community Participation

Public input is important to the decision-making process. The ARNG and WVDEP have made available information regarding the investigation and evaluation of the MRS to the public through public notices and technical reports at the local public library during the public comment periods. The ARNG and WVDEP encourage the public to learn about the MRS and the assessment and investigations that have been conducted.

The dates for the public comment period and the location of the RI report at the local public library are provided on Page 1 of the Proposed Plan. Nearby residents and other interested parties are encouraged to use the comment period for questions and concerns about the proposed decision for the MRS. ARNG will summarize and respond to public comments in a responsiveness summary, which will become part of the Decision Document.

MRSP	Munitions Response Site Prioritization Protocol
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDNODS	Non-Department of Defense, Non-Operational Defense Site
NFA	No Further Action
NPL	National Priorities List
NTCRA	Non-Time-Critical Removal Action
PA	Preliminary Assessment
QC	quality control
RI	Remedial Investigation
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SLERA	screening level ecological risk assessment
SRE	streamlined risk evaluation
TCLP	toxicity characteristic leaching procedure
TCRA	Time-Critical Removal Action
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers

## Glossary of Terms

Specialized terms used in the Proposed Plan are defined below.

**Acid volatile sulfide:** See simultaneously extracted metals.

**Analog visual survey:** The process of using a metal detector to identify locations of munitions and explosives of concern and munitions debris in the ground. The munitions item is either fully exposed or partially exposed in which a UXO technician removes leaves and litter down to the ground surface to investigate anomaly detected.

**Anomaly:** An irregularity. During geophysical investigations, an anomaly is recognized as a metallic object (or cluster of objects) detected with specialized equipment at or below ground surface.

**Anomaly source:** The cause (source) for an irregularity (anomaly).

**Applicable or Relevant and Appropriate Requirements (ARARs):** 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, or that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

**Bioavailability:** The proportion of total metals that are available for incorporation into animal and plant life of the site area.

**Bivouac:** A temporary encampment.

**Blind seed item:** A quality control technique to test equipment being used in a study or investigation. The technique involves placing objects that are similar to the items being searched for within the study area. The items are placed with the knowledge of the equipment operator who will conduct the search.

**Blood lead level:** The concentration of lead in a human's blood. Preventing one from exposure to lead is important to lifelong good health. Even low levels of lead in blood have been shown to affect IQ, ability

to pay attention, and academic achievement. The effects of lead exposure cannot be corrected.

**Cadmium:** Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements, such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). All soils and rocks, including coal and mineral fertilizers, contain some cadmium. Most cadmium used in the United States is extracted during the production of other metals like zinc, lead, and copper. Cadmium does not corrode easily and has many uses, including batteries, pigments, metal coatings, and plastics. Cadmium is a component of explosives.

**Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA):** A Federal law, commonly known as Superfund, which was enacted in 1980 and amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA) and in 2002 by the Brownfields Amendments.

The CERCLA Cleanup Program focuses on human health and environmental concerns related to human health. The Cleanup Program is primarily carried out by EPA, working with the states, on sites designated for cleanup on the National Priorities List (NPL). The Cleanup Program emphasizes final solutions such as treatment and contamination removal.

**Cantonment:** A permanent military garrison or camp.

**Characteristic waste:** A substance that has not been specifically listed as a hazardous waste may still be considered a hazardous waste if it exhibits one of the four following characteristics: (1) can create fires under certain conditions (ignitability); (2) capable of corroding metal containers (corrosivity); (3) can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water (reactivity); and (4) can cause harm or death when breathed in, eaten, or touched (toxicity).

**Chemically stabilize:** The use of compounds (chemicals) to secure (stabilize) a contaminant so that it could not move about in its location (environment).

**Confirmation sample/sampling:** Specimens of soil collected at a site after a remedial action and

analyzed to verify that the cleanup action is successful and predetermined cleanup goals are met for the site.

**Copper:** Copper is a chemical element. It is metal that can be stretched into wire and has very high thermal (heat) and electrical conductivity. Pure copper is soft and malleable; a freshly exposed surface has a reddish-orange color. It is used as a conductor of heat and electricity, a building material, and a constituent of various metal compounds. Copper is a component of explosives.

**Decision Document:** A public document that describes the decision made for a site under the CERCLA Cleanup Program and provides a record of the reasons behind the decision made. The Decision Document is developed based on information generated during the RI and other information.

**Decision unit:** The smallest volume (or other media) for which a decision will be made based upon incremental sampling methodology sampling.

**Dermal contact:** Touch with skin.

**Digital geophysical mapping:** Digital geophysical mapping is the method of acquiring and plotting data regarding the nature and properties of matter and energy of the earth from an area using computers and processing the data to allow for the selection of anomalies for further investigation.

**Dispersal pattern:** A configuration or arrangement of munitions and munitions debris resulting from firings from a specific location (i.e., firing point) into a target area.

**Dissolved lead:** In laboratory analysis of concentration levels of lead in water, the term dissolved lead refers to filtered samples of water leaving only dissolved phases of lead in the water. (See: total lead.)

**Engineering Evaluation/Cost Analysis (EE/CA):** An EE/CA is prepared for all NTCRAs as required by the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**. The goals of the EE/CA are to identify the extent of a hazard, identify the objectives of the removal action, and analyze the various alternatives that may be used to satisfy these objectives for cost, effectiveness, and implementability.

**Explosives safety submission:** An assessment of the explosive hazards likely to be encountered during the implementation of the selected cleanup action. It

includes information from previous studies, historical records, and the work plan for the explosive hazards. This document specifies distances required to conduct work in a safe manner around explosives.

**Exposure route:** How a contaminant enters the body (e.g., ingestion, dermal contact).

**Firing point:** A position, such as a firing line, from which a weapon is discharged (fired).

**Fuze:** In military munitions, a fuze is the part of the device that initiates the function of an explosive device (e.g., bombs and grenades). The term fuze is used to indicate a sophisticated ignition device incorporating mechanical and/or electric components.

**Geophysical survey:** Techniques used to characterize (depict) the subsurface without having to dig up large areas.

**Hazard quotient:** The ratio of the potential exposure to the substance and the level at which no adverse effects are expected. If the hazard quotient is calculated to be equal to or less than 1, then no adverse health effects are expected as a result of exposure. If the hazard quotient is greater than 1, then adverse health effects are possible. The hazard quotient cannot be translated to a probability that adverse health effects will occur, and it is unlikely to be proportional to risk. It is important to note that a hazard quotient exceeding 1 does not necessarily mean that adverse effects will occur.

**High explosive:** Materials that detonate by a very rapid rate of decomposition (disintegration) (the front of the chemical reaction moves faster through the material than the speed of sound) are known as “high explosives.” They produce fragments that move out from the detonation at a very fast rate.

**Historical Records Review (HRR):** Collection, analysis, and documentation of historical information pertaining to property potentially impacted by munitions-related activities.

**Impact area:** The identified zone within a range intended to compute or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapon systems.

**Institutional controls:** Non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy. Institutional controls play an important role

in site remedies because they reduce exposure to contamination by limiting land or resource use and guide human behavior at a site. For instance, zoning restrictions prevent site land uses, like residential uses, that are not consistent with the level of cleanup.

***Integrated Exposure Uptake Biokinetic (IEUBK)***

***model:*** Combined with the Technical Review Workgroup for Lead, IEUBK is an EPA workgroup. Its goal is to support and promote consistent application of the best science in the field of lead risk assessment as contaminated sites nationwide. This goal encompasses work to further develop and continue to refine risk assessment for lead, to promote the best use of available scientific data for site assessments, and to serve as an advisor to EPA on lead risk assessment concerns.

***Leachability:*** The ability of water (rainwater) to remove and dissolve substances, such as contaminants, from soil and wash away.

***Lead:*** One of the elements, a heavy, pliable, inelastic metal, having a bright, bluish color, but easily tarnished. It is used for tubes, sheets, and bullets. It is easily fusible and forms alloys with other metals, and is an ingredient of solder and type metal.

***Light explosive projectile:*** A bullet, bomb, shell, or grenade that is propelled by force and contains a low explosive filler, such as black powder, and fragments (explodes into pieces) before striking its target.

***Magnetometer:*** A magnetometer is an instrument that can detect metal objects buried underground.

***Manganese:*** Manganese is a chemical element. It is often found in combination with iron and in many minerals. Manganese is a metal with important industrial metal alloy uses, particularly in stainless steels. Manganese is used in munitions as an explosives component.

***Mean value:*** An average calculated by dividing the sum of a list or group of numbers by the total number in the list or group.

***Military Munitions Response Program (MMRP):*** A program under the Defense Environmental Restoration Program that addresses training ranges that are no longer used, but are suspected or known to contain munitions or contamination from munitions.

***Munitions constituents (MC):*** Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and

emission, degradation, or breakdown elements of such ordnance or munitions.

***Munitions debris (MD):*** Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

***Munitions and explosives of concern (MEC):*** A specific category of military munitions that may pose unique explosive safety risks and may be present in high enough concentrations to pose an explosive hazard.

***Munitions Response Site (MRS):*** A site that was formerly used as a military training range or for munitions disposal, but is no longer in use. An MRS may contain munitions and/or munitions contamination.

***Munitions Response Site Prioritization Protocol (MRSP):*** A system used by the Army to assign relative priorities to MRSs for munitions responses. The priority ranking is based on risks caused by known and suspected hazards at the sites.

***National Oil and Hazardous Substances Pollution Contingency Plan (NCP):*** The National Oil and Hazardous Substances Pollution Contingency Plan, more commonly called the National Contingency Plan or NCP, is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of the United States' efforts to develop a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

The first NCP was developed and published in 1968 in response to a massive oil spill, but it has been broadened substantially over the years to keep pace with the enactment of legislation, most notably the Superfund legislation of 1980.

***Nickel:*** A chemical element that is a silvery-white lustrous metal with a slight golden tinge. Pure nickel shows a significant chemical activity that can be observed when nickel is powdered to maximize the exposed surface area on which reactions can occur. Nickel is used in many specific and recognizable industrial and consumer products, including stainless steel, iron-alloy magnets, coinage, rechargeable batteries, electric guitar strings, microphone capsules, and special alloys. It is also used for plating and as a green tint in glass. Nickel is preeminently an alloy metal, and its chief use is in the nickel steels and nickel cast irons, of which there are many varieties. It

is also widely used in many other alloys, such as nickel brasses and bronzes, and alloys with copper, chromium, aluminum, lead, cobalt, silver, and gold.

**No Further Action (NFA):** A determination that either no contaminants are present at the site, or that any contaminants present at the site or that have migrated from the site have been remediated in accordance with applicable remediation statutes, rules, and guidance such that no further action is necessary.

**Non-Department of Defense, Non-Operational Site (NDNODS):** NDNODS is the Department of Defense program that has identified historical outdoor ranges and training sites where military munitions were used. These sites are investigated and evaluated for cleanup, if necessary.

**Non-Time-Critical Removal Action (NTCRA):** NTCRAs are actions initiated in response to a release or threat of a release that poses a risk to human health, welfare, or the environment. Initiation of removal cleanup actions may be delayed for 6 months or more.

**Palustrine:** Relating to a system of inland, nontidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water, but grows above the surface). Palustrine wetlands range from permanently saturated or flooded land (as in marshes, swamps, and lake shores) to land that is wet only seasonally.

**pH:** In chemistry, pH is a measure of the concentration of hydrogen ions in solution and is used to determine the acidity (pH less than 7) or alkalinity (pH greater than 7) of a solution.

**Preliminary Assessment (PA):** An assessment of information about a site and its surrounding area. A preliminary assessment is designed to determine whether a site poses little or no threat to human health and the environment or, if it does pose a threat, whether the threat requires further investigation.

**Proposed Plan:** A public document that summarizes the preferred remedial action for a site and presents the rationale for the preference. The purpose of the Proposed Plan is to provide the public with a reasonable opportunity to comment on the preferred remedial action, as well as any alternative plans under consideration, and to participate in the selection of the remedial action at a site.

**Quality control (QC):** A process for maintaining proper standards.

**Receptor:** Receptors include both humans and biota (plants or animals) that may come into contact with a hazardous substance, including munitions and munitions constituents, either directly (e.g., picking up an item) or indirectly (e.g., through ingestion).

**Resource Conservation and Recovery Act (RCRA):** RCRA was enacted in 1976 and is the principal federal law in the United States governing the disposal of solid waste and hazardous waste, including the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes.

**Remedial Investigation (RI):** A process used to gather and analyze environmental information to determine the nature and extent of contamination at a site and to provide information for identifying and evaluating options for remedial action.

**Risk:** A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

**Screening level ecological risk assessment (SLERA):** SLERAs are conservative assessments (evaluations) in that they provide a high level of confidence in determining a low probability of adverse risk, and they incorporate uncertainty in a precautionary manner. SLERAs are neither designed nor intended to provide definitive estimates of actual risk or generate cleanup goals and, in general, are not based upon site-specific assumptions. Rather, the purpose of SLERAs is to assess the need and, if required, the level of effort necessary to conduct a detailed or “baseline” ecological risk assessment for a particular site or facility. Therefore, refinement of contaminants of concern occurs in the baseline risk assessment rather than in the SLERA.

**Simultaneously extracted metals and acid volatile sulfide:** An approach used in the field of aquatic toxicology to assess the potential for metal ions found in sediment to cause toxic effects in organisms dwelling in the sediment. In this approach, the amounts of several heavy metals in a sediment sample are measured in a laboratory. At the same time, the amount of acid volatile sulfide (sulfide that can be liberated from the sediment by treatment with hydrochloric acid) is determined. Based on the chemical interactions between heavy metals and acid

volatile sulfide, the concentrations of these two components can be used to assess the potential for toxicity to sediment-dwelling organisms.

**Site Inspection (SI):** Typically, an investigation to confirm or deny the presence of contamination, but not necessarily delineate magnitude and extent.

**Smoke projectiles:** A bomb, shell, or grenade that bursts when fired and releases a cloud of smoke that is used for screening, obscuration, spotting, and signaling purposes.

**Stokes mortar:** The 3-inch Stokes mortar is also called a trench mortar. Depending on the type of mortar, the filler will either be trinitrotoluene (TNT), black powder, or sand. The mortar was fired from a barrel at steep angles so it would fall straight down on the target. The 3-inch Stokes mortar was mostly used during World War I (1914-1918) until 1939.

**Streamlined Risk Evaluation (SRE):** A review of current or potential exposures to humans at a site that should be prevented and justification for choosing a removal action. The streamlined component is that the evaluation considers fewer factors than a conventional baseline risk assessment for remedial actions and more aspects than the limited risk evaluation undertaken for emergency removal actions.

**Surface danger zone:** The ground and airspace designated within the training complex (including associated safety areas) for vertical and lateral containment of projectiles, fragments, debris, and components resulting from the firing, launching, or detonation of weapons systems, including explosives and demolitions.

**Time-Critical Removal Action (TCRA):** TCRA's are situations where cleanup activities must begin within 6 months of the discovery of hazardous materials to protect public health and safety.

**Total hardness:** Total hardness is the level of calcium and magnesium salts in water. These salts are dissolved from geologic deposits through which water travels. The length of time water is in contact with hardness-producing material determines how much hardness there is in raw water.

**Total lead:** In laboratory analysis of concentration levels of lead in water, the term total lead refers to nonfiltered samples of water. (See: dissolved lead.)

**Toxicity characteristic leaching procedure (TCLP):** A laboratory process designed to predict whether a

particular waste is likely to leach chemicals at dangerous levels.

**Transect:** Lines for measurements; a strip of ground along which measurements are made at regular intervals.

**Unexploded ordnance (UXO):** Includes military munitions that have been primed, fused, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in a manner that constitutes a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

**Upper trophic level:** A trophic level is a set of species occupying one level of the ecological food chain. The lowest trophic level, Level 1, is that set of organisms that can manufacture their energy using only sunlight, drawing nutrients from the soil or water. Feeding upon this lowest tier of organisms are Level 2 organisms in the food chain, often classified as herbivores (animals that only eat plants). Levels 3 and 4, the upper trophic levels, consist of carnivores (animals that feed on other animals).

**Validated samples:** Specimens (or samples) that were submitted to a process of examining and confirming that correct methods/techniques were implemented when those specimens/samples were collected at the site.

**X-ray fluorescence:** The process used for routine, relatively non-destructive chemical analyses of rocks, minerals, sediments, and fluids using an X-ray instrument. The analysis of major and trace elements in materials (i.e., rocks, minerals, sediments, and fluids) is by noting the behavior of atoms when submitted to radiation from the X-ray equipment.

**Zinc:** Zinc is a chemical element. Corrosion-resistant zinc plating of iron is the major application for zinc. Zinc is used in munitions as an explosives component.

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