



February 25, 2010

MEMORANDUM

TO: Mark Knight (Michael Baker Jr. Inc.)

FROM: Kathleen Anthony (PIKA International, Inc.)

SUBJECT: Draft RAU-2A-21 Boundary Delineation After Action Report

INTRODUCTION

This After Action Report (AAR) documents the field activities conducted and observations made during the boundary delineation of lead slugs in the overshoot area at Field Fire Ranges No.1 and 2 (RAU2A-21), one of the nine small arms ranges (SAR)s ranges that required the remediation of lead-impacted soils as part of the clean-up of Remedial Action Unit (RAU) 2A at the former Camp Bonneville Military Reservation (CBMR). The field activities were conducted in accordance with the *Draft Final RAU2A-21 Boundary Delineation Work Plan* (PIKA International, Inc (PIKA), 2010; see Appendix A) approved by the Washington State Department of Ecology (WDOE).

The field activities were conducted on the Wednesday, 27th January and Thursday, 28th January 2010. Field activities were conducted by PIKA with oversight provided by Michael Baker Jr, Inc. (Baker) and WDOE. Representatives of Bonneville Conservation Restoration and Renewal Team (BCRRT) and Clark County (CC) visited to observe the field activities.

The following field activities were conducted per guidelines provided in the work plan to achieve the delineation of the area containing lead slugs/ bullets:

1. Geophysical test plot - An area known to be free of lead slugs was established for testing the non-ferrous metal detectors;
2. Detector selection – Two types of non-ferrous metal detectors were tested and one was selected to conduct the boundary delineation;
3. Survey transects – The estimated extent points of the distribution of lead slugs were established and transects center lines were positioned as show on Figure



- 2 (included in Appendix A) of the approved work plan using a Global Positioning System (GPS);
4. Geophysical survey – Surface and sub-surface surveys were conducted to determine the horizontal and vertical extent of the lead slugs; and
5. Boundary delineation - A boundary was established around the areas containing lead slugs based on the data from the geophysical surveys.

Appendix B provides a selection of photographs depicting the various field activities.

PROCEDURES

The field activities were conducted under supervision of representatives from Baker and WDOE. Unexploded ordnance (UXO) personnel provided construction support and anomaly avoidance in all areas traversed during the survey.

A summary of the tasks conducted during the delineation process is provided in the following sub-sections.

Geophysical Test Plot

A geophysical test plot was established within the former M203 range prior to the geophysical survey at the overshoot area. The purpose of this plot was to:

- Select the detector best suited to conduct the characterization survey; and
- Perform function tests of selected detector to document settings and capability to detect lead slugs.

The test plot area was approximately 12-feet long and 6-feet wide. The bullets selected for the test plot (combination of .30 caliber/ .30 caliber carbine/ 7.62mm) were obtained from the overshoot area for RAU2A-21 to ensure representation of the actual site conditions to be tested. A total of eight (8) bullets were placed in a grid pattern within the test plot area in the configuration and depth below ground surface (bgs) as shown on Figure 1. The location of the test plot in the M203 Range is shown on Figure 2.

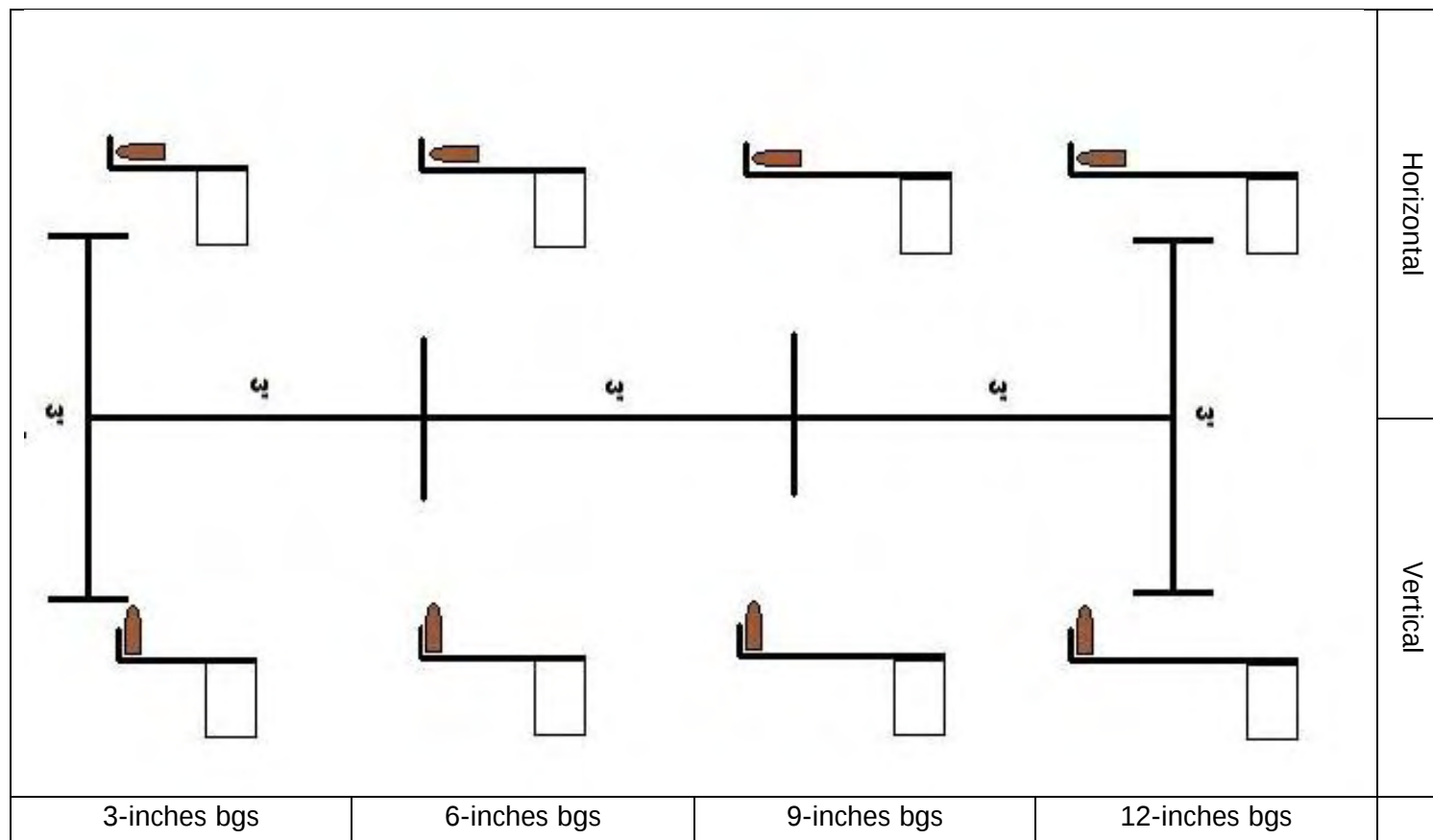
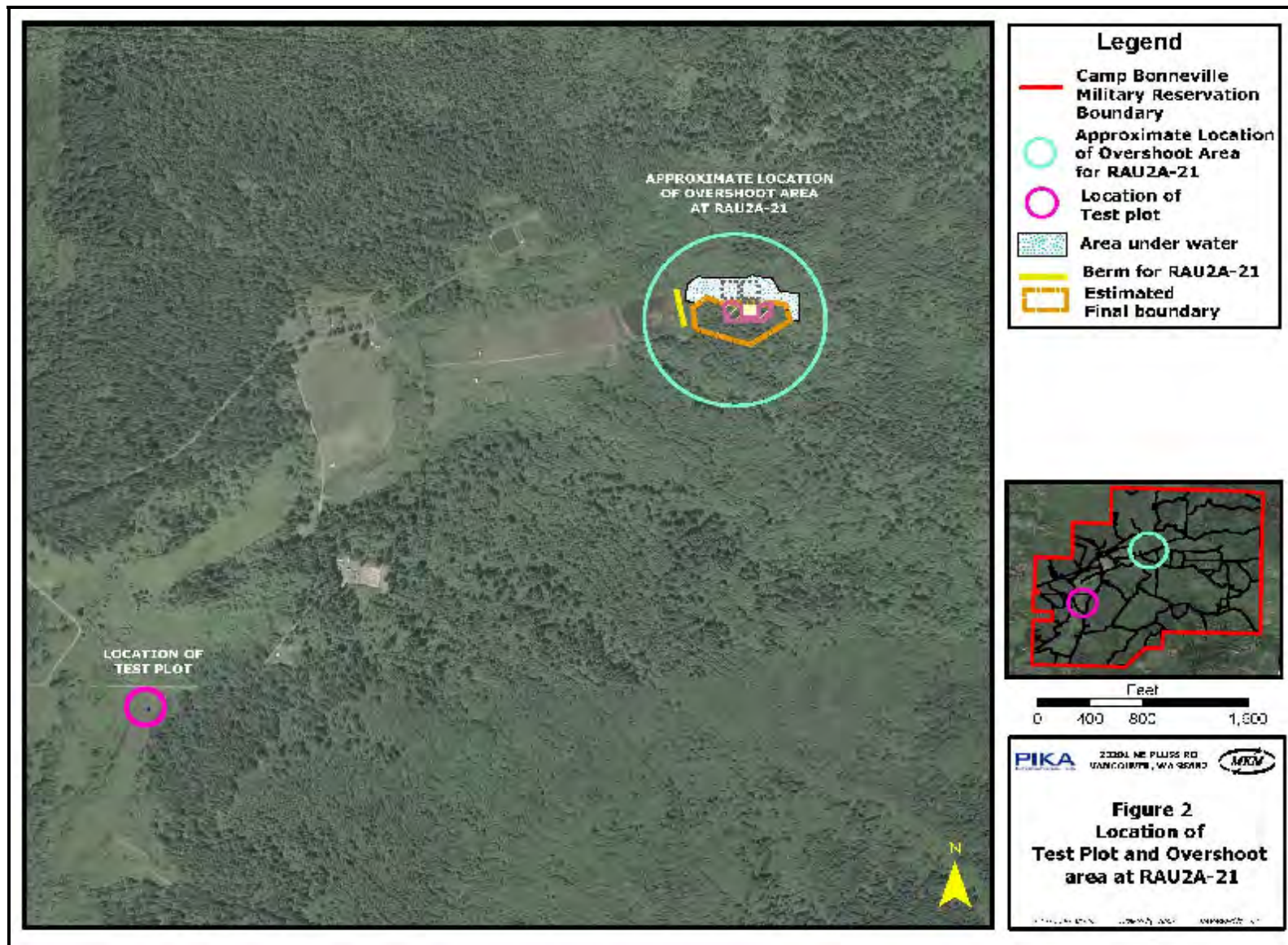


Figure 1 – Geophysical test plot layout



The grid layout consisted of two rows of four bullets (taped to the bottom of the stem of plastic field flags) placed in 1-inch diameter holes spaced 3-feet apart in each direction. The bullets were taped to the bottom of the stem of plastic field flags as shown in Exhibit 1. The stem of a plastic flag was bent at 90 degrees at varying depths (3, 6, 9, and 12-inches) and the bullet/ flag device was then lowered into the holes within the test plot to establish the varying bullet orientation and depths required for these targets to be employed in the survey.



Bullets and Flags for 3-inches bgs targets



Bullets and Flags for 6-inches bgs targets



Bullets and Flags for 9-inches bgs targets



Bullets and Flags for 12-inches bgs targets

Exhibit 1 – Placement of bullets used for geophysical test plot

The two metal detectors that were tested for use during the survey were:

- White's XLT®; and
- Vallon VMXC1.

The detectors were chosen because of their ability to detect lead slugs. The sensitivity and detection settings on both detectors were tuned to optimize capacity to detect the bullets buried at known locations within the test plot, while compensating



for site conditions (i.e., minerals in soil) that could cause interference or influence their detection capacity.

Both detectors were able to locate bullets at 3, 6, and 9-inches bgs. However, at a depth of 12-inches bgs, the Vallon provided the strongest audible and visual notification of presence of bullets. The Vallon VMXC1 was also the most consistent when approaching the bullets at 12-inches bgs from different directions. The Whites XLT did not respond as consistently as the Vallon VMXC1 at the depth of 12-inches bgs. Accordingly, the Vallon VMXC1 was chosen as the detector for the delineation survey.

Survey Transects

The seven (7) transects identified on Figure 2 of the work plan were located in the field using a Trimble GeoXH handheld unit with an in-built antenna (sub foot accuracy <30 cm). The starting point of each transect (end closest to the edge of excavated step-outs) was marked with a wooden stake. The estimated extent point was identified and marked with a second wooden stake. The center line of each transect was then established by connecting both stakes with a length of rope.

The two transects radiating north-east and north-west of the excavated step-outs were truncated because of standing water, characteristic of the wetlands that border RAU2-21 to the north.

Geophysical Survey

The following procedure was followed for geophysical survey in the overshoot areas using the Vallon VMXC1:

- The detector was set to the optimum detection capacity established during the test plot survey;
- Surface sweeps were conducted starting at the estimated extent point advancing outward from the edge of the previously excavated area;
- Area(s) where detector response indicated the presence of lead bullets on or below surface were marked with plastic flags;
- The survey was discontinued when detector response indicated no lead slugs were present.

Exhibit 2 shows activities performed during the geophysical surveys.



Exhibit 2 – Geophysical surveys to determine area of lead slugs

Field deviation

During the first survey performed the detector response indicated that entire transect (from the edge of excavated area to the estimated extent point) contained lead bullets. In consultation with WDOE, a revised extent point was established along the transect when no lead bullets were detected or adverse field conditions (wetlands) were encountered.

The surveys along the first transect showed evidence of bullets along its entire length. Therefore, subsequent transects were started at the estimated extent points instead of the previous excavated area to establish the extent of lead slugs within the overshoot area. Accordingly, surface sweeps were performed moving away from the excavated area, starting at the estimated extent point on each transect until the boundary of the area containing lead slugs was identified along that transect.

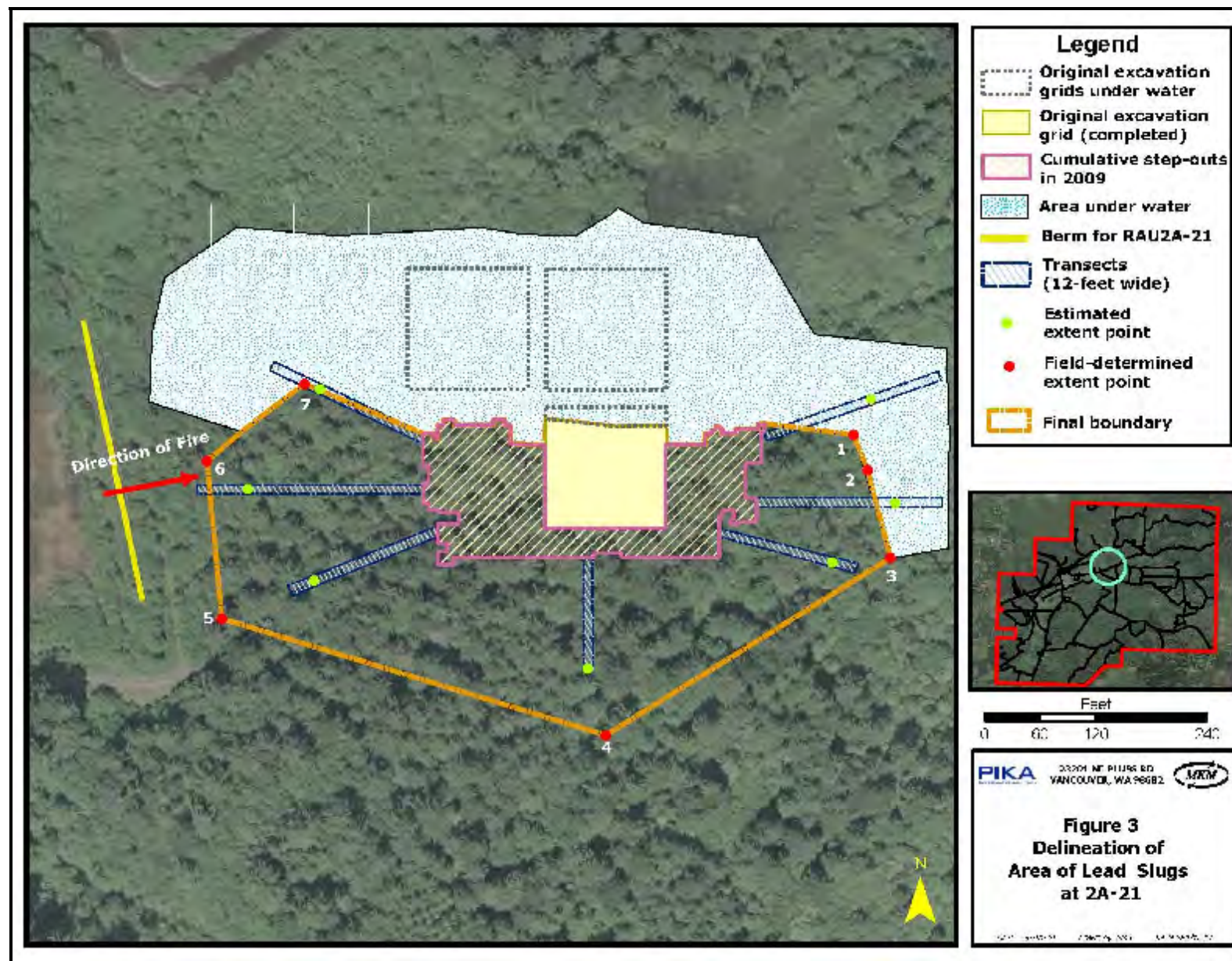
After a new extent point was established along each transect, a sub-surface survey was conducted to ascertain the depth of the lead slugs at each location. The depth of the slugs varied from 6 to 12-inches bgs at each location.

Boundary Delineation

When the revised extent points were identified and investigated, the location coordinates were recorded using a Trimble GeoXH handheld unit. Each location was marked with a wooden stake and numbered in chronological order in a clock-wise direction. A total of seven positions were marked in the field. These stakes indicate



the extent of lead slug findings along each transect and bound the area known to contain lead slugs within the overshoot area at RAU2A-21. The boundary delineated during the geophysical survey is shown on Figure 3. The total area encompassed by the new boundary (including the area excavated in 2008 and 2009) is approximately 4.25 acres.





CONCLUSIONS

The following conclusions were made based on observations during the surveys:

- The Vallon VMXC1 detector demonstrated the ability to detect lead slugs (0 to 12-inches bgs) in the overshoot areas for RAU2A-21.
- Lead slugs in the overshoot area at RAU2A-21 extend beyond areas previously identified for remedial actions. The total area encompassed by the new boundary (including the area excavated in 2008 and 2009) is approximately 4.25 acres.
- Lead slugs in the overshoot area at RAU2A-21 are not limited to the surface and can be found at depths of up to 18-inches bgs in the eastern and 12-inches bgs in the southern portion of the overshoot areas.
- The depth of the lead slugs is shallower (0-6-inches) in the western portion of the overshoot area based on sub-surface investigation performed around the extent point.
- During the sub-surface survey of one of the extent points (Point No.2 on Figure 3), a difference in soil color was observed with darker surface soil overlaying lighter sub-surface soils. This may be indicative of the presence of non-native soil in and around that extent point.
- The northern portion of the overshoot area could not be investigated because of standing water (wetlands).
- The following slugs and blank cartridges were recovered during the survey and investigations of the extent locations:
 - o Nineteen .30 caliber(7.62mm);
 - o Six .30 caliber carbine;
 - o Two .223 caliber (5.56 mm);
 - o One .357 caliber; and
 - o Four expended blank cartridges (7.62 mm).



Exhibit 3 shows a collage of the various slugs and cartridges recovered during the survey.



Exhibit 3 – Bullets recovered during geophysical survey

ENCLOSURES:

Appendix A - Draft Final RAU2A-21 Boundary Delineation Work Plan (PIKA International, Inc (PIKA), 2010).

Appendix B – Photo log of field activities.

Sincerely

A handwritten signature in cursive script that reads 'Kate Anthony'.

Kate Anthony
Senior Project Manager

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Draft Final RAU-2A-21 Boundary Delineation Work Plan

1.0 Introduction

The remediation of nine of the twenty one small arms ranges (SAR)s ranges at the former Camp Bonneville Military Reservation (CBMR) were conducted as described in the *Operations Plan For The HTW Remediation of Remedial Action Unit 2A- Small Arms Firing Ranges* (BCRRT, 2008). The decisions and rationale for the remedial actions are documented in *Final Remedial Investigation Feasibility Study (RI/FS) Report for RAU-2A* (Baker, 2007) and the *Final Cleanup Action Plan for RAU-2A* (CAP) (Baker, 2008). These documents were developed using the data included in the Final Site Investigation Report, Small Arms Ranges and Demolition Areas 2 and 3, Camp Bonneville (AEM, 2005).

The remedial actions at the SARs began in October 2007 and continued during the summers of 2008 and 2009. After completion of remedial actions within the original areas identified in the CAP, and based on previous characterization (AEM, 2005), confirmation samples determined the need for further excavation (step-outs). In September of 2009, during the implementation of step-outs at Rifle Range Numbers 1 and 2 (RAU-2A-21), surface contamination (bullet slugs) were observed east and south of existing step-outs.

This work plan describes the geophysical techniques that will be used to establish the horizontal and vertical (to 1-foot below ground surface [bgs]) extent of lead slugs at RAU-2A-21. The delineation will be conducted under supervision of the Washington State Department of Ecology (WDOE). Figure 1 provides an overview of past and proposed actions for the area within RAU-2A-21 and RAU-2A-22 identified for additional characterization. Figure 2 shows the 2009 excavation boundary and the proposed investigational transects.

2.0 Background

The remedial actions conducted in 2008 and 2009 consisted of several rounds of excavation, followed by confirmation sampling and subsequent step-outs. There were six grids identified for remedial actions within RAU-2A-21 (three 130-foot x 130-foot and three 29-foot x 29-foot grids) (Figure 1). Of the six original grids, two of the 130-foot x 130-foot grids (underlying the polygon marked as 'area under water' in Figure 2) were under a minimum of 2 feet of standing water. With WDOE's concurrence these grids will not be excavated. Additionally, the northern portion of the third 130-foot area was also partially submerged and was not excavated with WDOE's concurrence.

Draft Final RAU-2A-21 Boundary Delineation Work Plan

Given these site conditions, the remedial actions were implemented in the four locations as identified in yellow on Figure 2. After several rounds of excavations and step-outs, the concentration of total lead in the soil was less than 118 mg/Kg. According to the work plan, the excavation activities were complete. However, during a site visit conducted on October 21, 2009 at RAU-2A-21 to observe the status of the ongoing cleanup work, WDOE representatives discovered scattered clusters of lead slugs on the surface (0-3 inches bgs) in and around the excavated areas.

During a meeting held on November 18, 2009 with representatives from BCRRT, Baker, Clark County, MKM, and PIKA, it was decided that further characterization was necessary. All parties agreed that the following actions would be conducted to determine the extent of the lead bullets at RAU-2A-21:

1. Use non ferrous detector to identify lead slugs on the surface and subsurface (0-12 inches bgs);
2. Delineate boundary of the area containing lead bullets at RAU-2A-21 by investigating transects extending from boundary of step-outs conducted in 2009; and
3. Delineate the boundary using wooden stakes and modify existing maps and geographical information system (GIS) database.

The observations and recommendation for further characterization are to be conducted in the general area identified in Figure 2 (red polygon) for range RAU-2A-21. The following section provides details of the procedures and instrumentation that will be used to determine the extent of the lead bullets at RAU-2A-21.

3.0 Procedures

The survey will be conducted along 12-foot wide transects starting at the boundary of the step-outs conducted in 2009. The approximate locations of the seven transects that will be used to delineate the boundary are shown on Figure 2. The transects will radiate from the existing excavation boundary and will extend eastward (towards the Central Impact Target Area (CITA)), westward (towards the firing line) and southward (towards the road leading to the CITA).

The transects will be established using either global position system (GPS) or line and tape measure if satellite reception is unavailable. The center line of

Draft Final RAU-2A-21 Boundary Delineation Work Plan

each transect will be marked with stakes and the distance traveled will be written on each stake in the direction of movement.

A UXO Technician will visually inspect all areas where personnel will travel during placement of the transects and conduct anomaly avoidance using a magnetometer (Schonstedt) check of each location where stakes will be placed into the ground. Before using the Schonstedt, a verification test will be conducted (in the established test plot area in the CVF) to ensure that the instrument will detect target munitions at 1 foot below ground surface.

3.2 Geophysical Test Plot

A new geophysical test plot will be established within the vicinity of RAU-2A-21 prior to the start of site operations. The purpose of this plot is to:

- Select the instrument best suited to conduct the characterization survey;
- Perform function tests of selected instrument to document instrument capability to detect lead slugs; and
- To provide a daily quality control check.

The instrument test plot will be established in an open area that is free of non-ferrous metal. A surface sweep of the proposed test plot area will be conducted using a White's or Vallon's detector and the plot boundaries staked out and visually marked.

Lead slugs will be buried to assure that instruments can detect the target munitions at depths up to one foot bgs. The instruments will be checked against the known buried items. The instrument's gain control will be adjusted to the setting that allows detection of the seeded items. The instrument that demonstrates the highest accuracy in the test plot will be used for the boundary delineation.

3.3 Geophysical Survey

Once each transect has been established, it will be further sub-divided into two (2) six-foot lanes. The instrument selected will be then be used to perform surface sweeps of the area within each lane. Any visible surface lead

Draft Final RAU-2A-21 Boundary Delineation Work Plan

slugs will be documented and removed. Subsurface anomalies identified to one foot bgs will be marked with pin flags.

Each transect will be surveyed until the extent of lead contamination along the transect (extent point) is determined and marked. The four extent points will then be connected to delineate the lead contaminated boundary as shown in Figure 2.

The instruments selected for boundary delineation will be checked daily before operation and any time there is reason to believe there is a degradation of the instrument's capability. Instruments or equipment failing to meet the standard will be replaced. Replaced instruments will meet the same specifications for accuracy and precision as the item removed from service.

3.4 Report

The results of the survey will be documented in a letter report that includes a map on the modified boundary.

4.0 Schedule

The schedule for field activities and documentation associated with the additional characterization of lead contamination within RAU-2A-21 is provided in Attachment A.

5.0 References

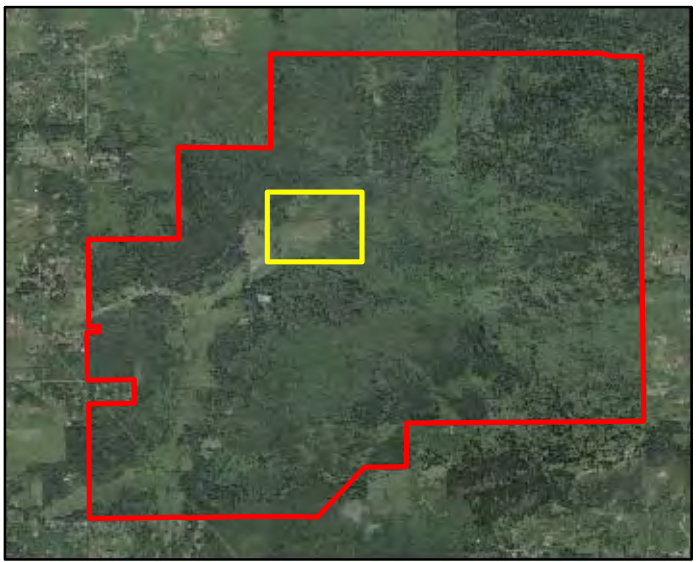
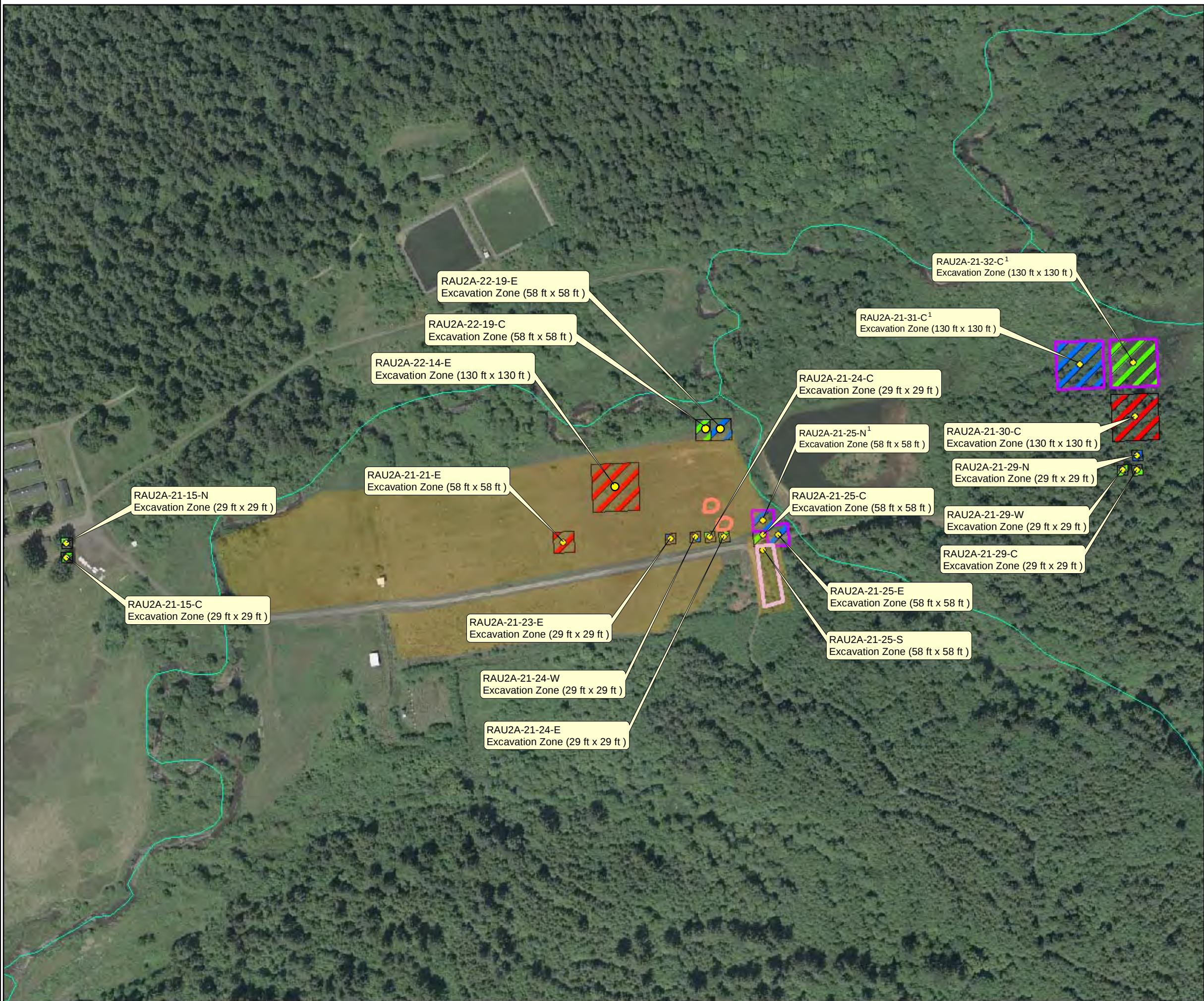
Atlanta Environmental Management, Inc. (AEM, 2005). *Final Site Investigation Report, Small Arms Ranges and Demolition Areas 2 and 3, Camp Bonneville, Vancouver, WA*. September.

Bonneville Conservation Restoration & Renewal Team, LLC. (BCRRT, 2008). *Operations Plan For The HTW Remediation of Remedial Action Unit 2A- Small Arms Firing Ranges, Camp Bonneville, Vancouver, WA*. July

Draft Final RAU-2A-21 Boundary Delineation Work Plan

Michael Baker Jr. Inc. (Baker, 2007). Final Remedial Investigation Feasibility Study Report for RAU-2A, Camp Bonneville, Vancouver, WA. August.

Michael Baker Jr. Inc. (Baker, 2008). Final Cleanup Action Plan for RAU-2A, Camp Bonneville, Vancouver, WA. January.

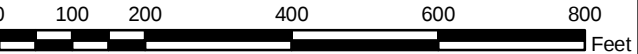


Legend

- Camp Bonneville Property Perimeter
- Firing Ranges
- Staging Piles
- Berm
- Excavation Hot Spot
- Stream
- Special Condition
- Excavation Categories**
- MTCA 1 - 50-118 ppm lead
- MTCA 2 - 119 to 250 ppm lead
- RCRA - >250 ppm lead

Note:

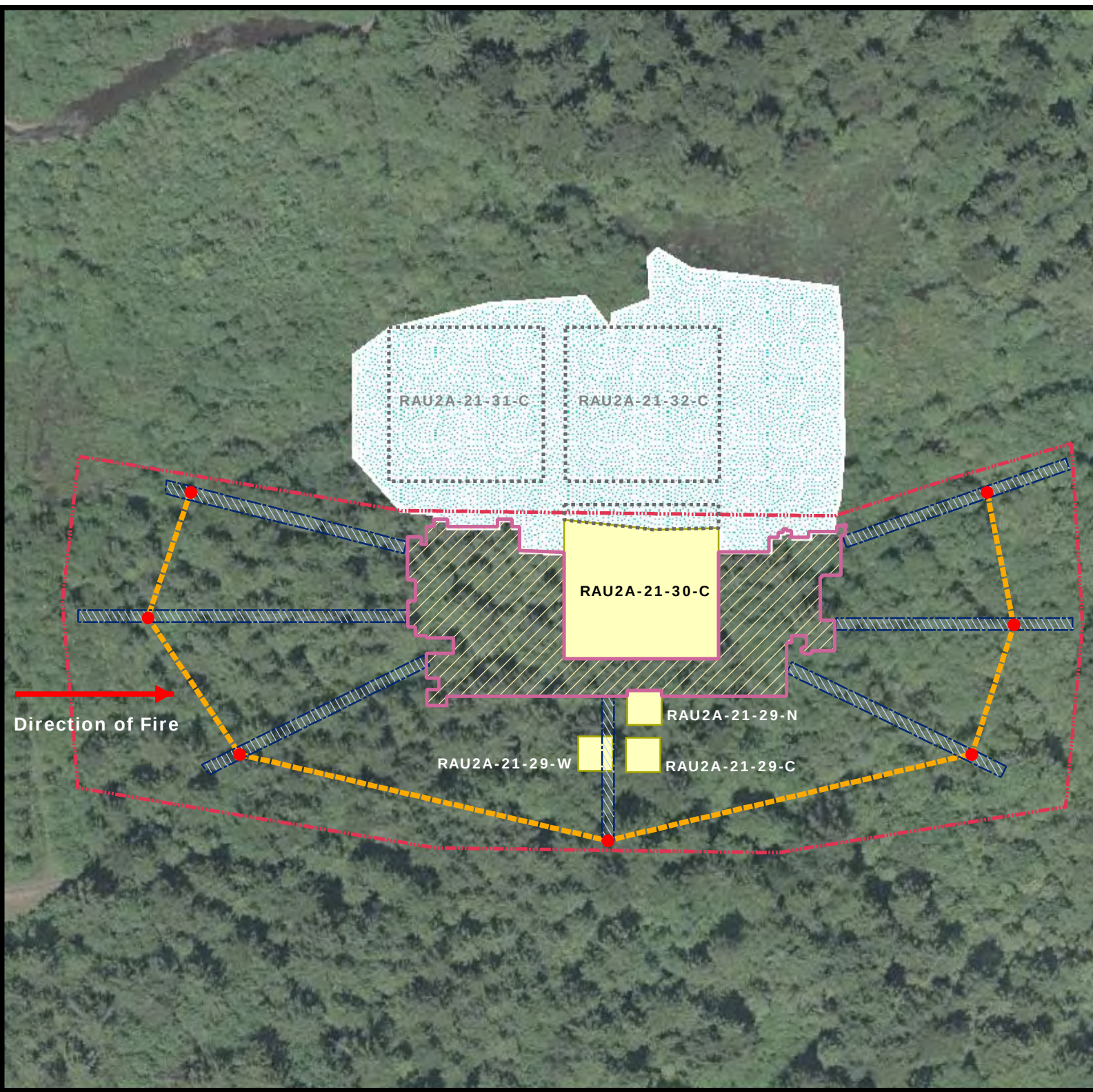
- All excavation are 6 inches unless noted otherwise



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Figure 1
Removal Actions at Field Fire Ranges No. 1 and No. 2
(RAU 2A-21 and RAU 2A -22)



Legend

- Original excavation grids under water
- Original excavation grids completed
- Cumulative step-outs in 2009
- Area under water
- Proposed delineation
- 12-foot wide transects
- Extent of contamination along transect
- Contamination boundary

N

0 40 80 160
Feet

Figure 2
Overview of Boundary
Delineation at 2A-21
(Draft Final)



PIKA personnel reviewing the test plot area



Establishing estimated extent point



Estimated extent point (in foreground) was extended away eastward from excavated areas



Conducting survey at new extent point



Extending estimated extent point westward



Conducting survey at new extent point