



3.0 DESCRIPTION, BACKGROUND, AND CURRENT CONDITION OF THE SMALL ARMS RANGES

3.1 General Description of the Small Arms Ranges

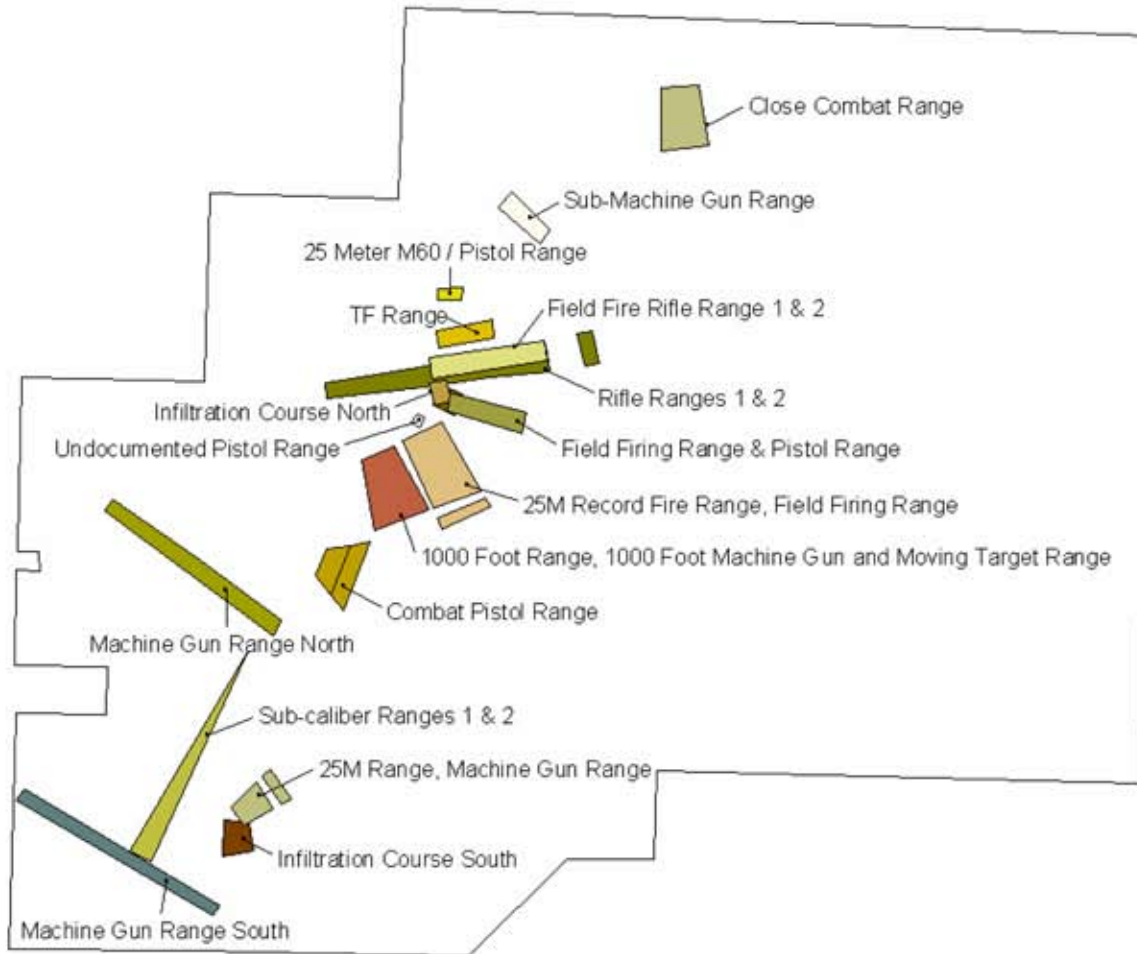
Approximately 25 potential Small Arms Ranges were previously identified within the boundaries of CBMR from maps dating back to 1958. The firing ranges were used for small arms, large-caliber machine guns, rifles, grenades, light antitank weapon rockets, and sub-caliber weapons. Of the 25 potential ranges, it was determined during the RI/FS that eight of the ranges were redundant or double counts from the same range location having different names historically (AEM, 2005 and BCRRT, 207b).

A final total of 17 firing ranges were confirmed and identified for investigation during the RI/FS of the Small Arms Ranges:

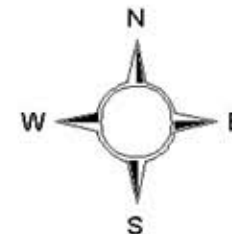
- Close Combat Range
- 25 Meter M60 Range/Pistol Range
- Sub Machine Gun Range
- TF Range
- Rifle Ranges 1 & 2
- Field Fire Rifle Ranges 1 & 2
- Infiltration Course North
- Field Firing Ranges 1 & 2 & Pistol Range
- Undocumented Pistol Range
- 1,000 Foot Range, Machine Gun & Moving Target Range
- Combat Pistol Range
- Machine Gun Range North
- Machine Gun Range South
- M31 Sub-Caliber Ranges 1 & 2
- 25 Meter and Machine Gun Range
- Infiltration Course South
- 25 M Record Fire Field/Field Firing Range

Figure 3-1 shows the geographic locations of the 17 ranges addressed in the RI/FS.

Figure 3-1 General Site Map Showing Small Arms Ranges



- Range Footprints**
- 1000 Foot Range, 1000 Foot Machine Gun and Moving Target Range
 - 25 Meter M60 / Pistol Range
 - 25M Range, Machine Gun Range
 - 25M Record Fire Range, Field Firing Range
 - Close Combat Range
 - Combat Pistol Range
 - Field Fire Rifle Range 1 & 2
 - Field Firing Range & Pistol Range
 - Infiltration Course North
 - Infiltration Course South
 - Machine Gun Range North
 - Machine Gun Range South
 - Pistol Range
 - Rifle Ranges 1 & 2
 - Sub-Machine Gun Range
 - Sub-caliber Ranges 1 & 2
 - TF Range
 - Undocumented Pistol Range
 - Camp Bonneville Boundary



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3.2 History of Small Arms Range Use

CBMR was used by the Army as firing range for small arms, artillery, and other munitions from the approximately 1910 through 1995. CBMR was established in 1909 as a drill field and rifle range. Troops from Vancouver Barracks began to use part of the facility for a target range in 1910. Installation use grew to include a range for assault weapons, and artillery between 1910 and 1995. The original reservation, consisting of approximately 3,020 acres, was acquired by the federal government in 1918. It was officially named CBMR in 1926. The Camp Bonneville cantonment area was built in the late 1920s. The Camp Killpack cantonment area was built and occupied by the Civilian Conservation Corps (CCC) in 1935. The facilities were used for a variety of military training programs, in addition to being used by Vancouver Barracks. During World War II, the facility was also used to house Italian prisoners of war.

In 1950, many of the buildings and systems at the facility were rehabilitated to use for training Army Reserve units. In the early 1950s, an additional 840 acres of land were leased from the State of Washington. Vancouver Barracks, which included CBMR, became a sub-installation of Fort Lewis, Washington, in 1959.

Since World War II, CBMR has been used as a training camp for active Army, USAR, Army National Guard (ARNG), Marine Corps Reserve, Navy Reserve, and Coast Guard Reserve units, as well as other DOD and government personnel. When not required for military training exercises, CBMR was made available until the late 1980s to local equestrians and hunters, as well as for overnight use of the cantonment areas by 4-H groups and school districts for outdoor schools (CBLRA, 2003).

The FBI currently makes frequent use of one of the firing ranges and will be responsible for cleanup of that range. In 1996, following the selection of Camp Bonneville for closure by the BRAC Commission, all active military training units ceased operations at the camp. All out-grants for using the facilities were cancelled, with the exception of the FBI range.

3.3 History of Investigations of Small Arms Ranges

In July of 1995, CBMR was selected for closure under the 1995 BRAC process. Since the installation was officially closed, investigations were conducted by the Army and its consultants in order to characterize the nature and extent of contamination at the site and to develop a plan for potentially transferring ownership.

The Army implemented RI activities at the Small Arms Ranges in 2002 and 2003. The general investigative approach at each of the 17 Small Arms Ranges collected the following data:

- The concentration of lead residues in the top 0-6 inches of soil at 307 sample areas (one-half acre grids) within the firing ranges.
- The background concentrations of lead in 20 samples from the top 0-6 inches of soil at undisturbed/unused locations within CBMR, and



- The concentrations of explosive residues in soil in 12 muzzle blast areas within the firing ranges, where the firing location was known.

3.3.1 Document and Map Reviews

The following documents and maps were incorporated into this CAP:

- Site Investigation Report – Small Arms Ranges and Demolition Areas 2 and 3, by Atlanta Environmental Management, Inc. (AEM), September 2005
- Draft Final Work Plan for the Interim Actions at the Small Arms Range Berms and Fire Support Areas by Calibre Systems, March 2005
- Final Remedial Investigation/ Feasibility Report (RI/FS) Small Arms Ranges (RAU 2A) by Bonneville Conservation Restoration & Renewal Team (BCRRT), January 2007
- Geology and Groundwater Conditions in Clark County Washington, Mundorff (U.S. Geological Survey), 1964
- Geologic Map of the Vancouver Quadrangle – Oregon and Washington, Phillips (Washington Division of Geology and Earth Resources), 1987

3.3.2 Initial Investigations

A Site Investigation (AEM, 2005) became part of the U.S. Army's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) investigation of lead-contaminated ranges and Demolition Areas (DA) 2 and 3 at CBMR. This investigation was conducted under a WDOE Enforcement Order and in accordance with the MTCA.

3.3.3 Remedial Investigation and Feasibility Study (RI/FS)

The RI (BCRRT, 2007b) at the Small Arms Ranges was designed to evaluate the potential for soil contamination from the firing lines of the ranges to the berms and/or potential impact areas. Previous investigations at other ranges had detected lead and explosives in the range soils. The RI included the soil investigation of the 17 Small Arms Ranges, 12 muzzle blast zones (within the ranges where the firing location was known), and background soil sampling. The RI was conducted to characterize soils at these areas at CBMR in order to provide data upon which to base decisions for further actions.

Based on the results of the RI, the FS (BCRRT, 2007b) was conducted to identify and evaluate cleanup action alternatives and select a cleanup action for the Small Arms Ranges. The initial RI/FS was conducted by the Army in accordance with the requirements of the MTCA regulations, which are contained in Chapter 173-340 of the WAC (WAC 173-340).

3.4 Summary of Soil Contamination Information by Range

Variable concentrations of lead were known to exist at CBMR within the surface and near-surface soils at firing ranges. The sources of this lead were the bullets from the firing of small arms, assault weapons, artillery, and field artillery. Most of the lead bullet mass deposited in the impact area



was in the form of intact bullets or large fragments; however small fragments were also present. The majority of lead bullets were likely to have impacted the range berms; however, lead could be present between the firing line and the range berms. Over time elemental lead may corrode and form oxidized products consisting primarily of lead hydroxide and lead carbonates (ITRC 2003). Due to the low mobility of lead in soil, the majority of the lead contamination was expected to have remained near the surface of the soil. The major risk posed by any metal residues arises from direct contact and ingestion of surface soil or fragments.

Sampling of the berms for lead was not included since the berms were identified for remedial action prior to the RI/FS.

3.4.1 RI Sampling

RI soil samples were collected from 307 approximately half-acre grids across all the Small Arms Ranges, in accordance with the approved Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) (AEM, 2003a). All of the range samples were analyzed for lead. The range berms and backstops (where bullets have accumulated) were excluded from this soil sampling program since they were identified for remedial action prior to the RI/FS.

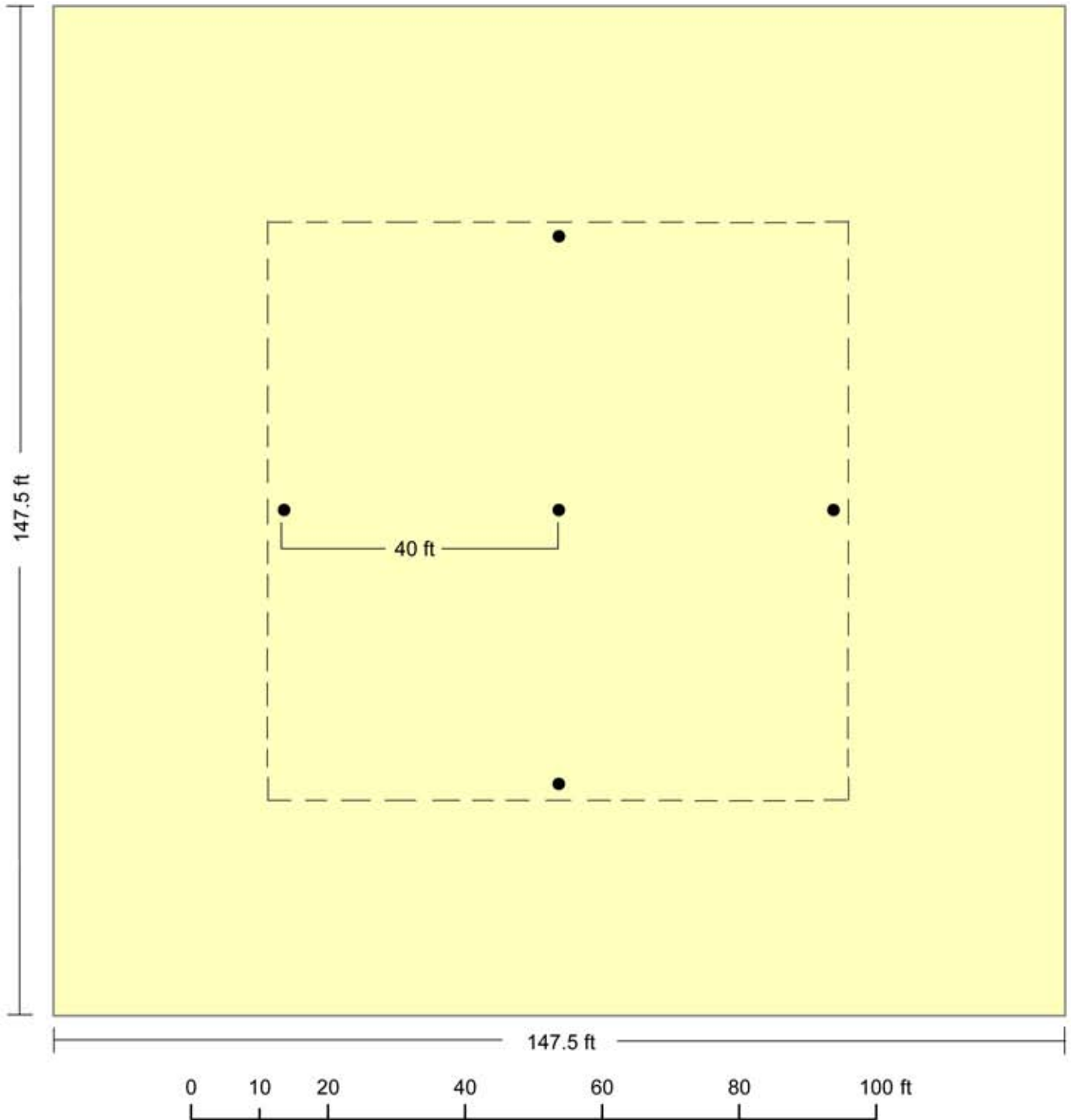
RI Grid Samples - Soil samples in each of the 307 half-acre grids (established in the firing ranges) consisted of five grab soil samples that were collected from 0 – 6 inches in depth below ground surface (bgs). Specific locations were determined by latitude and longitude coordinates, as presented in the approved Sampling and Analysis Plan - Soil (SAP) and the center point of each grid was determined using a GPS unit. After a center point was determined, the field team measured approximately 40 feet north (magnetic), south, east, and west of the grid center. A soil sample was taken at each of these four compass and center point locations. The total sampling area size in each ½ acre grid was approximately 80 feet by 80 feet and covered an area approximately 6,400 square feet (see **Figure 3-2**).

Some sample grids were not square due to obstructions such as target berms/ backstops, and natural barriers such as streams, standing water, and boulders. In those cases, the distance to samples from the center of the grid varied and the modified location was measured with a GPS unit and the compass direction and distance from the planned location was noted.

The number of half-acre plots sampled, the number of muzzle blast zones sampled, and the QA/QC samples collected at each of the 17 locations are detailed in **Table 3-1**.

Figure 3-2 Small Arms Ranges Grid Sampling Example

0.50 acre = 21,780 sq. ft.





Muzzle Blast Zones - For ranges where the firing line has been determined, a muzzle blast zone has been designated as a strip in front of and parallel to the firing line. Samples were collected along that strip at approximately 30-foot intervals within 10 feet of the firing line. A point at the end of the firing line was designated and sampled. A line was then run parallel to the firing line from that first sample and subsequent samples taken every 30 feet.

The muzzle blast samples were grab samples of soil from 0 – 6 inches in depth bgs. Samples collected in muzzle blast zones were analyzed in the laboratory for explosives (via USEPA Method 8330 Modified). The muzzle blast zone samples included collection of 68 grab samples from the 12 ranges where the firing lines were known. The ranges and number of muzzle blast zones sampled are presented in **Table 3-1**. There were no contaminants of concern in the muzzle blast zones sampled.

Table 3-1 Grids and Samples from Small Arms Ranges, Muzzle Blast Zones, and QA/QC

Small Arms Range	Number of Half-Acre Grids Sampled	Number of Samples from each Range	Number of Muzzle Blast Zones Samples	QA/QC Samples (duplicates)	Total Number of Samples
Close Combat Range	24	120	-	11	131
25 Meter M60 Range/Pistol Range	4	20	6	1	27
Sub Machine Gun Range	7	35	-	3	38
TF Range	8	40	2	4	46
Rifle Ranges 1 & 2	32	160	7	14	181
Filed Fire Rifle Ranges 1 & 2	22	110	2	10	122
Infiltration Course North	4	20	2	2	24
Field Firing Range & Pistol Range	14	70	6	16	92
Undocumented Pistol Range	1	5	5	0	10
1,000 Foot Range, Machine Gun & Moving Target Range	30	150	-	15	165
Combat Pistol Range	17	85	6	9	100
Machine Gun Range North	33	165	-	16	181
Machine Gun Range South	26	130	-	13	143
M31 Sub-Caliber Ranges 1 & 2	25	125	6	12	143
25 Meter and Machine Gun Range	13	65	10	7	82
Infiltration Course South	7	35	14	4	53
25M Record Fire Field/Field Firing Range	40	200	2	20	222
Total	307	1,535	68	157	1,760



Background Soil Samples - Soil samples were also collected from 20 background locations using the following criteria:

- Within the CBMR site boundary;
- Within similar geology/geomorphology as range grid samples;
- Not within small arms ranges in the Work Plan or SAP;
- Not within small arms range fan as shown on Plate 30 of July 1997 *Final Archives Search Report – Report Plates* (USACE, 1997);
- Not downslope of range or fan (locate upslope of range or fan if possible);
- Not downrange of firing line; if the firing line is not indicated in the SAP, it was assumed that the firing line was at the low-elevation end of the range and that the direction of fire was toward higher ground surface elevations;
- Not in demolition areas; and
- Not in artillery impact area (for Unexploded Ordnance [UXO] safety reasons).

Table 3-2 lists the locations of the background samples.

Table 3-2. Location Description of Background Samples

Location Description
Up slope from Close Combat Course
Up slope from 25 Meter M60/Pistol Range
Side slope from Close Combat Course
Side slope of TF record Fire and behind firing line
Side slope from Rifle Range and behind firing line
Flat area on east side of creek in vicinity of Rifle Range, Infiltration Course, Field Firing Range, and Undocumented Pistol Range
Same as S506YMMDDC on west side of creek
Flat area on south side of creek behind firing line of 1000 Foot Range, 1000 Foot Machine Gun and Moving Target Range
Side slope from 1000 Foot Range, 1000 Foot Machine Gun and Moving Target Range
Side slope from Combat Pistol Range
Side slope from Machine Gun Range and Combat Pistol Range
Side slope of Machine Gun Range, side slope from and behind firing line of Sub-caliber Artillery
Side slope from 25M Range, Machine Gun Range and up slope from Sub-caliber Artillery
Side slope from Infiltration Course, Machine Gun Range
Up slope from Machine Gun range
Up slope from Machine Gun range
Up slope from Machine Gun range
Side slope from Sub-Machine Gun range
Side slope from Sub-Machine Gun range
Flat area on south side of creek behind firing line of 25M Range, Record Firing Range, Field Firing Range



3.4.2 Sampling and Analysis Results

A total of 1,535 samples, not including duplicate samples, were collected and analyzed for lead from 307 grids sampled. Soil samples collected from the Small Arms Range grid locations were analyzed for lead. Results of the lead analyses were reported on a dry-weight basis.

At ten of the Small Arms Range grid locations, ten samples were randomly selected from the range soils and analyzed for the nine Priority Pollutant Metals. No concentrations of metals were detected in the ten range grid samples at concentrations above MTCA Method A for unrestricted land use, or if no MTCA criteria were available, the USEPA Region 9 Preliminary Remediation Goals (PRGs).

Samples collected from the 12 Muzzle Blast Zones were analyzed for explosive residues, including picric acid and pentaerythritol tetranitrate (PETN). The explosive residue 2,4-dinitrotoluene (2,4-DNT) was detected in 8 of the 10 muzzle blast zone samples from the 25 –Meter and Machine Gun Range. Concentrations of 2,4-DNT detected ranged from 4.9 to 20 mg/kg and were significantly below the PRG value of 120 mg/kg for residential soil.

Background soil samples were analyzed for lead and two randomly selected background samples were also analyzed for Priority Pollutant Metals. Concentrations of lead detected ranged from 9.7 mg/kg to 80.8 mg/kg. The average lead concentration detected was 24.3 mg/kg and were below the most stringent MTCA or PRG value for lead. The 95th percentile upper confidence limit (UCL) on the mean lead background concentration is 33.6 mg/kg. Metals detected were within normal background ranges.

Concentrations of lead were larger than at least one of the benchmark values (BMV) at 12 of the 17 small arms ranges sampled during the SI.

3.4.3 Quantity Estimates by Lead Concentrations

Concentrations of lead in Small Arms Range grid samples exceeded the lowest screening level (50 mg/kg) at 14 of the 17 ranges. Approximately 12% of the samples collected at the 17 firing ranges had concentrations above 50 mg/kg. The number of samples with lead concentrations exceeding 118 mg/kg was 78 (approximately 5%). The percent of samples exceeding 250 mg/kg, 500 mg/kg, and 1,000 mg/kg were approximately 2.5%, 1.7%, and 1%, respectively.