PROACT

FACT SHEET

An Environmental Resource sponsored by HQ Air Force Center for Environmental Excellence

Lead Contamination at Small Arms Ranges

What's Inside...

Current as of March 2006

Small arms ranges are essential to weapons training and sustainment of the USAF mission; however, range use often results in soils contaminated with metals. This contamination can create environmental and occupational health problems during range operation and maintenance, as well as during redesign, reuse, and remediation.

Environmental Concerns

The major environmental concern at a small arms range (SAR) is lead. However, other constituents of small arms munitions such as antimony, copper, and zinc should also be considered potential contaminants of concern. The type and amount of munitions used at the SAR along with the range's operational history and environmental setting will greatly influence the potential for metal contamination and its migration.

Lead contamination typically occurs when fired munitions accumulate and/or break apart in backstops, berms, or bullet traps. The lead can migrate through the soil into the groundwater or be carried off site by storm water. In addition to spent munitions, firing a small arms weapon and bullet fragmentation can generate lead vapor and dust. Lead particulates can be inhaled, transported by wind, or precipitate onto soil particles or range structures (i.e., targets, walls, floor, etc). Ingestion or inhalation of lead can accumulate in human, plant, and animal tissue resulting in chronic health effects. Receptor exposure associated with a SAR, is generally through the following mechanisms:

- Leaching to Ground/Surface Waters – At a neutral pH, lead is relatively insoluble. As water becomes more acidic (decreasing pH), lead solubility tends to increase. When storm water (normally slightly acidic) comes in contact with lead contaminated soil, the lead can be dissolved into the water and transported to groundwater or surface water. If sufficient lead is mobilized, environmental receptors can be affected and risk to human health can occur if these sources are used for drinking water.

- Storm Water Transport/Soil Erosion – Storm water runoff has the potential to erode and transport contaminated soil and lead particles away from the normal confines of a firing range. Rainfall intensity, ground slope, soil type, and obstructions such as vegetation and fabricated structures will influence the potential transport of lead to off site receptors.

- Airborne Particulates (Dust/Vapor) – Lead particulates can become airborne if wind, foot traffic, or maintenance activities disturb contaminated soils, targets, or other range structures. Airborne particles smaller than 10 microns (Sincero, 1996) can be inhaled, and fine particles smaller than 250 microns in diameter can be incidentally ingested (Duggan, 1985).

Federal Regulations

Routine maintenance and the environmental assessment/clean-up of ranges are not specifically addressed in any single Federal regulation. However, portions of the following Federal regulations apply in certain situations and should be considered.

Clean Water Act

The Water Quality Act of 1987 created specific provisions for the control of surface water pollution caused by storm water runoff. Runoff from firing ranges can contain elevated levels of dissolved lead and other heavy metals, as well as particulate metal and sediments. Therefore, a National Pollutant Discharge Elimination System (NPDES) permit may be required if the EPA or State determines storm water discharge from a range

contributes to a violation of a water quality standard or is a significant contributor of pollutants to the waters of the U.S.

EPA Munitions Rule/RCRA

The Military Munitions Rule ("EPA Munitions Rule"), identifies when military munitions become hazardous waste for the purposes of the Resource Conservation and Recovery Act (RCRA) Subtitle C, and provides for the safe transportation and storage of such wastes. The EPA Munitions Rule is codified at 40 CFR Parts 260 through 266, and Part 270 (Subpart M "Military Munitions" is in part 266).

CERCLA

Title 40 Code of Federal Regulations (CFR) Part 302, "Designation, Reportable Quantities, and Notification," promulgated in response to requirements of the CERCLA and the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), designates lead as a hazardous substance and requires the reporting of releases to the environment. To be a "reportable" release under 40 CFR Part 302, the amount of the release must equal or exceed, within a 24-hour period, the "reportable quantity" (RQ) for the hazardous substance. Per Section 302.6, "Notification Requirements," notification must be provided to EPA's National Response Center (800-424-8802) if a release of one pound (RQ) or more of solid lead particles less than or equal to 100 micrometers (0.004 inches) in mean diameter occurs. A release of this type would be unlikely at a military small arms range. Regardless of whether the RQ for lead or other contaminants has been exceeded at a range, under CERCLA authority lead contaminated soils and groundwater can be investigated and remediated, including any off-site environmental contamination originating from the range, if such lead contamination has been determined to pose an unacceptable potential risk to human health or the environment.

P2 Opportunities

Pollution prevention techniques employed at small arms ranges include minimizing the amount of lead contained in munitions, preventing the bullets from mixing with soils, and minimizing the migration of lead contaminated soil. Engineering Technical Letter (ETL) 02-11, "Small Arms Range Design and Construction" 22 Nov 2002 provides guidance for the design and construction of Air Force small arms ranges, and applies to both new construction and major renovations.

Lead-free Ammunition

The Department of Defense (DoD) has initiated the Green Bullets program in an effort to eliminate the use of hazardous materials, including heavy metals and organic solvents, in small-caliber ammunitions manufacturing processes, as well as in the ammunition itself. Several alternatives to lead in primers and projectile slugs are being evaluated, including bismuth, molybdenum, tungsten, steel/ iron, and copper. Stock-listed lead-free training ammunition (reduced range) is currently available to the military in 5.56 mm and 0.50 caliber ball, and tracer sizes.

Traps and Berms

Bullet traps and impact berms are designed to stop bullets from leaving the range. However, improperly designed or improperly installed controls could actually increase the potential for lead contamination and risks associated with ricochet.

- Bullet traps are specifically designed to decelerate the bullet and collect the resulting fragments. Some bullet traps are also designed to minimize airborne lead dust created when bullets strike the traps. However, the use of personal protective equipment (PPE) is still recommended when servicing traps.

- Impact berms are usually constructed of mixtures of sand, silt, and clay soils located behind the target line. The floor of the firing range in the area of the target line may also consist of similar soils. Bullet fragments should be periodically removed from the range if their buildup poses a risk of ricochet. The berm material should also be of a texture (e.g., clean sand), which maximizes the ability to separate spent fragments during range clearance or maintenance activities.

Lead Migration

Each firing range site is unique in terms of background lead levels, climate, soils, and topography. Methods for prevention of lead migration include, but should not be limited to, implementing the following concepts where practical and safe:

- Reduce or eliminate rain water and snow melt from coming into contact with lead contaminated soils.

- Construct water flow retarding structures, such as terraces and berms, to reduce the velocity of runoff water exiting firing range areas.

- Use impoundments, traps, or other structures to catch lead particles in sediments transported away from the shooting area by runoff.

- Elevate slightly acidic soils to a more neutral pH in areas where lead may come in contact with water by supplementing the soil with high-alkaline materials such as limestone, gypsum, and dolomite.

Remediation

The removal of lead and lead contaminated soil at firing ranges, either as part of operational maintenance actions or site closure activities, does not differ significantly. However, development of clean-up goals will depend upon whether the proposed action is maintenance or remediation supporting a potential change of land use. The following paragraphs provide a brief discussion on occupational health, clean-up standards, clearance/ remediation techniques, and disposal options.

Worker Protection

Worker protection is based on the potential for inhalation and ingestion of lead. Since it is common for lead to be in particulate form in air or soils at a firing range, dust control, protective clothing, and safe work practices should be specified. The installation Bioenvironmental Engineer or an industrial hygienist should be involved in the development of clearance/maintenance activities and approve remedial safety and health plans. Training, record keeping, and medical monitoring requirements for workers potentially exposed to particulate lead are outlined in Federal Occupational Safety and Health Administration (OSHA) regulations and standards.

Clean-up Goals for Lead

Remediation goals should be developed to be protective of receptors consistent with planned future land use. Examples of receptors and future land use include: range workers for continued operation as a firing range, adult workers for commercial redevelopment of the site, and preschool-age children for residential reuse.

In July of 1994, the EPA issued "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities." This memorandum provides "screening levels" to be used as a tool to define a level of lead contamination above which there may be enough concern to warrant further site-specific study. The guidance encourages the risk manager to select, on a site-specific basis, the most appropriate combination of remedial measures, from intervention to abatement, needed to address lead exposure threats. The memorandum, which is directed toward protection of children and assumes residential future land use, sets a screening level in soils of 400 mg/kg, below which no corrective action is recommended, and a screening level in soils of 5,000 mg/kg, above which corrective action is recommended. Concentrations falling between these levels could warrant implementation of engineering controls and corrective measures depending on site-specific risk assessments.

Physical Separation

These processes use techniques designed to separate particles based on particle size and/or density. Sifting is one method that can significantly reduce the quantity of soil that may require off-site disposal, stabilization, or further treatment by acid leaching. To determine whether such techniques would satisfactorily remove lead fragments from soil, a pilot study may be warranted to determine the volume of lead that could be removed, the lead concentrations, and characteristics of the remaining soil.

Off-Range Disposal

Soil that is hazardous due to the lead toxicity characteristic (exceeds 5 mg/L when subjected to TCLP analysis) cannot be placed in an ordinary solid waste landfill. These soils will not require pre-treatment before disposal, but must be placed in a hazardous waste landfill. Costs associated with hazardous waste disposal can exceed ordinary landfill costs by ten to 100 times. Therefore, removing lead fragments for recycling or other approaches to reduce the overall leachable lead content of the soil should be evaluated to determine whether the cost of disposal can be reduced.

Stabilization/Solidification

Stabilization and solidification is another treatment/disposal option for soil contaminated with lead in excess of the hazardous waste threshold. This technology involves adding ingredients to contaminated soils that coat the soil grains and/or fill inter-granular pore spaces, permanently sealing off the lead contamination from the environment. This technology immobilizes contaminants in the soil and results in a solid or granular material. Several techniques for stabilizing and solidifying contaminated soils exist; each should be evaluated with respect to site-specific environmental factors. If soil stabilization and solidification processes are performed on-site, the State may require the facility to obtain a RCRA permit for operation of a treatment, storage, and disposal (TSD) facility. If the stabilized soil mixture does not exceed the hazardous waste threshold as determined by TCLP testing, it may be possible to dispose of it in an ordinary solid waste landfill. Depending on the

applicable State regulations, the stabilized soil may be considered safe to remain in-place on site, or to be reused, depending on the results of TCLP testing.

Soil Washing

A soil washing process has been successfully used to reduce lead concentrations in soils to background levels at a U.S. Army Superfund site. After sifting the soil and separating the munitions particles from the sand and gravel, the soil is washed in an aqueous acid solution to dissolve and remove the lead from the sand and gravel. Although the process is cost effective, the spent acid solution requires treatment and disposal as a hazardous waste.

Summary

There are potential regulatory issues that must be considered when operating, maintaining, closing, remediating, or transferring a small arms range. Prior coordination with representatives of the following organizations is recommended:

- Bioenvironmental Engineering, to assess the potential occupational health risks associated with lead exposure and to obtain recommendations on the necessary protective equipment and training for maintenance workers or clean-up crews.
- Environmental Management, to assess the regulatory requirements associated with the potential generation and disposal of solid and/or hazardous waste. This is recommended even if the material(s) to be removed are destined for recycling.
- Judge Advocate, to assess Federal, State, and local regulatory requirements to ensure all operations are in compliance.

Many aspects of small arms range maintenance and clean-up are subject to local interpretation and site-specific application. Active interaction and coordination by AF personnel with regional and local agencies will ensure efficiency and compliance.