Implementing A Shooting Range Best Management Practices Plan: A Focus on Risk Assessment and Risk Management (2012)

Cohen, S.Z. and N.L. Barnes
Presented at the IWLA Annual Convention July 19, 2012

PRESENTATION OUTLINE

I. Basic Risk Assessment Principles
   - Lead and arsenic toxicity and exposure
   - Lead and arsenic mobility
   - Hydrology and hydrogeology 101

II. A Risk-Based Approach for Sampling and Analysis of Soil and Water

III. Soil Amendments

IV. Drainage Controls

V. Recycling of Shot, Bullets, and Target Fragments

VI. Implementation Schedules

VII. Conclusions and Recommendations

The Science Underlying Best Management Practices for Shooting Ranges: A Focus on Lead and Arsenic (2004)

Stuart Z. Cohen, Ph.D., CGWP
Invited presentation before the World Symposium on Lead in Ammunition, Rome, Italy, September 9, 2004.

Active shooting ranges are a land use that can be managed in an environmentally responsible manner as long as site-specific, scientifically sound Best Management Practices (BMPs) are used. In the U.S., there have been an increasing number of guidance documents and state initiatives, beginning ca. 1997, that adopt this approach. Lead and arsenic are the heavy metals of prime concern at shooting ranges. The principal factors that can limit the mobility of dissolved lead in soil are elevated pH, phosphate, iron content, and organic matter (OM) content, although high OM can enhance lead mobility at elevated pH. Unfortunately, under certain conditions, the mobility of dissolved arsenic can be enhanced at high pH and in the presence of phosphate, which indicates great care must be taken in selecting appropriate soil amendments. A variety of civil engineering BMPs has generated favorable efficiencies regarding mass removal and/or concentration reductions of lead and total suspended solids. Vegetation can play a key role in erosion control (controlling the loss of contaminated sediments) and plant uptake of heavy metals. Shooting directly into fertilized areas and sensitive water resources can lead to enhanced metal mobility and distribution.

A New Tool to Predict Lead Mobility in Shooting Range Soils (2000)

Reid, S. and S.Z. Cohen
Poster presented October, 2000 at the 15th Annual International Conference on Contaminated Soils & Water -- University of Massachusetts at Amherst

EPA's Science Advisory Board, among others, has expressed concern that the frequently used TCLP test has been misapplied in many situations. A more appropriate test to assess lead mobility in soils from active shooting ranges is the Synthetic Precipitation Leaching Procedure (SPLP; EPA 1312). However, the SPLP test is significantly more costly and time consuming than the total lead analysis. Therefore we evaluated total soil lead and SPLP lead analytical results from five east coast shooting ranges (n=27) to develop a predictive relationship based on commonly analyzed, inexpensive parameters. Soil textures and pH varied from sand to clay loam and from 4.6 to 7.1, respectively. Lead sources were bullets and shot. The most optimal predictive relationship was obtained from the equation, -log SPLP Pb = 2.28 pH - 0.209 pH2 + 0.0902 CEC - 2.50 x 10-5 Pb - 6.23, where SPLP Pb = lead concentration (ppm) from the SPLP test; CEC = cation exchange capacity (meq/100gm); and Pb = total soil lead (ppm). For this relationship, R2 = 0.730 and the standard error of the estimate (SEE) = 0.349. This regression equation is acceptable considering the diversity in the soils and the lead concentrations. The nonlinear relationship between SPLP Pb and pH is nearly identical to what was presented by Sauvé et al. (1997) at this conference and subsequently published (SSSAJ 62, 618 - 621, 1998). The relationship was not significantly improved with the addition of sand, clay, and dissolved organic matter as independent variables (R2 = 0.754, SEE = 0.369). This regression equation can be useful for reducing, but not eliminating, SPLP analyses in east coast shooting range studies. More soil analyses from a broader range of locations would be desirable to improve its applicability, as well as test and improve its reliability.

Testing Your Outdoor Range - Using the Right Tools (2000)

Stuart Z. Cohen, Ph.D., CGWP
Presented at the Fourth National Shooting Range Symposium, Phoenix, AZ (June, 2000) and published in the Proceedings

Abstract
Lead and arsenic are the principle contaminants of concern at shooting ranges. Compounds of both elements are analyzed easily and relatively inexpensively. For outdoor ranges, measurement of soil properties relevant to the retention of metals and water also is an important component of the following activities: preparing a Best Management Practices program; conducting a risk assessment for lead and arsenic in soils, water and aquatic sediments; and as part of a range cleanup action. Total lead and arsenic residues should be analyzed in addition to soil properties such as pH, cation exchange capacity, phosphorus content and organic matter. Outdoor ranges have suffered unnecessarily when the Toxicity Characteristic Leaching Procedure (TCLP) is misused to exhaustively extract lead and arsenic from active shooting range soils. These results often exceed the 5 parts per million regulatory limit, which could classify the soil as a hazardous waste. A more desirable method to measure the mobility of lead and arsenic in shooting range soils is the Environmental Protection Agency’s (EPA) Synthetic Precipitation Leaching Procedure, EPA Method 1312. This method simulates acid rain. Costs for single tests are minimal, but a complete site assessment can be quite expensive.

Environmental Compliance and Liability for Outdoor Shooting Ranges - - Potential Problems and Feasible Solutions (1997)

Stuart Z. Cohen, Ph.D., CGWP
Outdoor Range Source Book, A Publication of The National Rifle Association of America

A focus on environmental compliance for outdoor shooting ranges should begin prior to land purchase. During the due diligence period, an audit should be done for potential/hidden environmental hazards. As part of an overall feasibility study, it should be determined whether development of the range will trigger the need for a costly and time-consuming environmental impact statement. Three federal environmental statutes and dozens of regulations typically have relevance to outdoor ranges. Environmental regulatory scrutiny of outdoor ranges usually focuses on lead and arsenic (components of shot and bullets). Arsenic can be mobile in sandy soils, but it is present in ammunition at very low concentrations. (Mobility in this context means the ability to run off to surface water or leach through soil to ground water.) Lead has very low mobility in most environments. Scientifically, the greatest risk concern is the potential exposure of children to lead-contaminated soil after an outdoor range is closed. Politically, concern about surface water, wetlands, and ground water is often a more visible concern, particularly as subjects of citizen lawsuits under the Clean Water Act and the Resource Conservation and Recovery Act (the waste disposal law). A Best Management Practices program should be developed in advance that is based on sound science and engineering and that contains one or more of the following elements: recycling, vegetation management, soil amendments, and stormwater management. The goal of the BMP plan is not to eliminate all lead and arsenic; rather, the goal is to keep in place and limit exposure to any lead and arsenic that migrates into backstop soil or surficial soil.