

EnviroBlend® has extensive knowledge of the fate and transport of heavy metal contamination, as well as remedial action experience. Our scientists have spent years developing cost-effective chemistries for rendering lead, cadmium, arsenic, hexavalent chromium, zinc and other heavy metal contaminants non-hazardous. This research has resulted in a number of patented products that have been widely applied for heavy metal remediation sites across the country.

Arms Firing Range Remediation

Seymour Johnson AFB – Goldsboro, North Carolina – A&D Environmental

In the summer of 2011, A&D Environmental Services, Inc. (A&D Environmental) was contracted by the engineering firm MMG to remediate this former small arm firing range in Goldsboro, NC. In addition to small arms bullets and debris, the site was screened for munitions and explosives of concern (MEC) including unexploded ordnance (UXO). MMG managed the site and supplied UXO technicians throughout the project duration. A&D Environmental has completed many similar sites and while the Base initially assumed that all materials would be managed as RCRA Hazardous Waste for TCLP lead levels, the state regulators agreed that an on-site treatment step would be allowable.

A&D Environmental excavated and screened over 4,000 tons of lead-impacted soil. The soils were mixed *in-situ* in 100-ton batches utilizing a 3% admix of EnviroBlend 90/10 Coarse. Samples were collected for every 200 cubic yards generated. 100% of the soils were rendered RCRA non-hazardous on the first treatment pass.

The resulting effect to the project's bottom line was a savings of over \$600,000 to the customer by eliminating the RCRA hazardous characteristic. Following removal of the impacted soils, A&D demolished the range concrete retaining walls and graded the former soil mound to match surrounding grades.

Firing Range – Denver, Colorado

The untreated soil contained lead totals of 9,900 mg/kg were leaching at 71.3 mg/L with bullets remaining in the soil. A dosage rate of 3% EnviroBlend 90/10 Coarse reduced lead leachability to 0.20 mg/L (TCLP standard of 5.0 mg/L for lead).

Leaching Results							
Sample Name	Lab ID	EnviroBlend® Dosage		Screening Leaching Test Results			
		Chemical	Percentage	Pretest pH	Solution	Final pH	Lead mg/L
XXXXXXXXX X-2TS	10-06033	Untreated	-	2.14	TCLP 1	5.67	71.3
		EnviroBlend® 90/10 Coarse	3.0%	-	TCLP 1	7.75	0.20

Former U.S. Army Firing Range/Basic Training – Alabama

Treatment at the former Fort McClellan Range 30 site in Anniston, AL, was completed in July 2021. Treatment was provided for 3,000 tons of lead-contaminated soil, up to 8,200 ppm total Pb. The soil was treated *in-situ*. EnviroBlend was used at a dosage rate

of 2% to 3% by weight. Prior to EnviroBlend treatment, TCLP levels were >5 mg/L to 28 mg/L. The soil was disposed of off-site after treatment.

The estimated total savings for this project was roughly \$350,000 between transporting materials to landfills and disposal costs.

With treatment of the soil completed, this space will now be home to an industrial conservation district and open space wildlife habitat.

Munitions

Former Firing Range – Pennsylvania

Treated over 500 tons of lead-affected soil from a former police pistol range with EnviroBlend and rendered soil non-hazardous. Placed treated soil on-site under the direction of the PaDEP under the new progressive Act II guidelines. Placed soil 20 feet below the parking lot of the new Home Depot constructed at the property, which saved transportation and disposal costs.

Army Ammunitions Plant – EPA Region V

In-situ remediation treated approximately 5,000 tons of soil contaminated with lead, arsenic, and barium.

Privately Held Firing Range – Minnesota

Treated approximately 2,000 cubic yards of soil in stockpiles *ex-situ* with backhoes. The material was left on-site.

Soil Remediation Project

Winston-Salem Police Firing Range – Winston-Salem, North Carolina

The project consisted of remediating 2,400 tons of lead-contaminated soil from the municipal firing range by stabilizing the soil with the use of EnviroBlend and transporting stabilized soils to local landfill. The stabilized lead-contaminated soil was required to pass a series of tests, TCLP, MEP, and SPLP Metals prior to removal. Working in the different areas and concentrations of lead contamination, CST teamed with Premier Chemical to evaluate and pretest the soil to best determine the proper mixing of EnviroBlend. This enabled CST to provide a competitive bid and win the award of the job. Working as a team with the city and Premier Chemical, CST was able to complete work under budget and ahead of schedule. The finished product not only met but exceeded the city's expectations allowing the city to continue to use the site for future training rather than abandoning the site.

Golf Course Reclamation - Midwest

The suburban golf club was constructed on a former firing range. Site soil was mainly impacted with handgun and rifle rounds. During course construction, urban fill and firing range soils were introduced to native site soils for ground leveling and physical improvement.

For reclamation, soils were not screened to remove bullets or urban fill inclusions. Untreated soil composite sample Bulk 2 contained 37,100 mg/kg of total lead leaching at 1,900 mg/L. A dosage rate of 4% EnviroMag Coarse reduced lead leachability to 0.47 mg/L (TCLP standard of 5.0 mg/L). The soil was disposed of off-site in a Subtitle D landfill.

Leaching Results							
Sample Name	Lab ID	EnviroBlend® Dosage		Screening Leaching Test Results			
		Chemical	Percentage	Pretest pH	Solution	Final pH	Lead mg/L
Bulk 2	10-07025	Untreated	-	1.82	TCLP 1	4.77	1,900
		EnviroMag® Coarse	3.0%	-	TCLP 1	7.82	1.77
			4.0%	-	TCLP 1	9.25	0.47

Former Skeet and Trap Shooting Range – California

20,000 tons of lead-contaminated soil was remediated to below TCLP treatment standards using EnviroBlend CS. The soil was excavated into stockpiles and batch-treated. The remediated soil was removed offsite to a non-hazardous landfill.

Florida Remediation Sites – EnviroBlend 20/80

Alamonte Shooting Range – Florida

Remediation action was required to treat lead-impacted backstop soil. EnviroBlend 20/80 coarse was used to stabilize lead to TCLP standards.

Babcock Ranch/Shooting Range – Punta Gorda, Florida

Remediation action was required for lead contamination at this shooting range. The project was conducted by WRS. EnviroBlend 20/80 coarse was used to stabilize lead to TCLP standards.

Stabilization Case Studies

Twin Cities Army Ammunition Plant – Arden Hills, Minnesota

The form Twin Cities Army Ammunition Plant (TCAAP) is a 4-square mile site located in New Brighton/Arden Hills, Minnesota. The extent of the contamination covers a 25-square mile area. Land use in the area consists of residential, commercial, and industrial with on-site wetlands and woodlands surrounding Rice Creek watershed. From 1941 to 1981, the site was used to manufacture, store, and test small arms ammunition and related equipment. Waste materials such as VOCs, heavy metals, corrosive materials, and explosives were disposed of at 14 source areas, several of the source areas impacted by test-firing activities were targeted for remediation to remove metals and reduce the toxicity characteristics concentrations of the soil.

The remedial objective for this work included on-site stabilization of contaminated soil to below the Toxicity Characteristics Leaching Procedure (TCLP) criteria for lead and antimony and off-site disposal.

Phytoremediation and lead-extraction processes were implemented in earlier remediation phases of the TCAAP project. In 1998 EnviroBlend was selected in a competitive bid process to stabilize additional soil. Total lead concentrations in the soil were between 113,000 and 330,000 mg/kg. Stabilization with EnviroBlend achieved results below the TCLP criteria of 5.0 mg/L for lead.

Contaminated soil at the TCAAP site was characterized, excavated, and stockpiled. A coarse granular EnviroBlend was thoroughly mixed in the stockpiles using conventional construction equipment at a recommended dosage rate of 3%. The EnviroBlend stabilization process does not require the use of water or a curing period. The treated material was then analyzed using the TCLP test. All stabilized material passed the TCLP criteria and was disposed of in a Subtitle D landfill. Ethylenediamine tetra-acetic (EDTA) acid was found in soil at a portion of the site, potentially leftover from former lead-extraction processes implemented at the site. EDTA complexes lead and other heavy metals and increase their leachability. Through a quick-turnaround treatability study in a chemistry laboratory, it demonstrated treatment effectiveness using EnviroBlend on a representative sample of soil contaminated with lead and EDTA.

EnviroBlend was used for the stabilization of 47,000 tons of soil. The total project cost was \$777,000 for soil stabilization assistance, including treatability studies, technical assistance, pilot studies, and reagent supply.

Cedar Rapids Firing Range – Cedar Rapids, Iowa

The site is an active firing range in Cedar Rapids, Iowa for police officer training. The backstop berm area was reconstructed to address environmental concerns with high-lead concentrations in the soil and to provide additional protection for neighboring properties.

The remedial objectives at this site were to stabilize the lead-impacted soil to meet the Toxicity Characteristic Leaching Procedure (TCLP) criteria for lead, recycle lead bullets, and restore the berm for future use.

Prior to screening lead from the berm soil at the gun range, the soil was stabilized using EnviroBlend, a dry, coarse chemical delivered to the site in dump trucks. EnviroBlend was applied superficially to site areas requiring treatment, then mechanically blended into the soil using a tracked excavator. The soil was blended until a homogenous mixture was achieved. *In-situ* treatment of the soil prior to excavation allowed the material to be rendered non-hazardous prior to further management, avoiding the generation of an unpermitted hazardous waste pile. Following treatment of the soil, two samples were collected for Toxicity Characteristic Leaching Procedure (TCLP) lead analysis. The TCLP results demonstrated lead concentrations below 5 mg/L in the stabilized material.

After the soil was treated and confirmed to be non-hazardous, the contractor screened lead bullets from the soil using a MKII PowerScreen with a 3-inch upper deck and a ¼ -inch lower deck. The soil was fed into the hopper on the screen, and three material piles were generated:

1. Material retained on the 3-inch screen – typically large soil clods, debris, and rocks
2. Material retained on the ¼ -inch screen – expected to be lead material
3. Material passing through both screens – fine soil particles

Lead recovered from the soil was to be transported to the Doe Run Resource Recovery Facility in Boss, Missouri, for recycling. Analysis of the lead-containing material screened from the soil indicated it was approximately 50% lead by weight and not suitable for recycling. EnviroBlend stabilized the soil, and the treated material was stable over a wide range of conditions and is protective of leaching to groundwater. Because of this quality, the screened and stabilized material could be used as a backfill for reconstructing the core of the backstop berm.

The total project cost for EnviroBlend stabilization and screening was \$45,000 which provided significant savings over hazardous waste disposal.

Nahant Marsh – Davenport, Iowa

The Nahant Marsh site in Davenport, Iowa is a former shooting range with lead-contaminated soil and sediment. Heavy-metal contamination consisting of lead, arsenic, silver, and antimony was found in soil and sediment surrounding the five shooting platforms on site. An additional shooting area was identified and appeared to have been used early in the history of the site. An estimated 9 tons of lead shot was deposited on the site annually for 27 years for a total of 243 tons of lead shot.

The source area was identified as the area impacted by the past shooting activities. The U.S. Fish and Wildlife Service conducted sampling of the marsh area and found up to 283 lead pellets per grab sample in sediment samples collected between 109 and 177 yards from the shooting platforms. Local waterfowl were diagnosed with lead poisoning from lead shot. Since arsenic, silver, and antimony concentrations did not exceed RCRA Toxicity Characteristic Leaching Procedure (TCLP) limits, lead was the only constituent of concern.

The remedial objectives for the site included the development and implementation of a stabilization approach to meet the Toxicity Characteristic Leaching Procedure (TCLP) criteria of 5.0 mg/L for lead, followed by off-site disposal of stabilized materials.

Through bench-scale treatability study analysis, it was determined that a 2% dosage rate by weight of EnviroBlend CS would effectively reduce TCLP-lead concentrations in the soil to below 5.0 mg/L. EnviroBlend was applied to stockpiled materials, then thoroughly mixed using conventional construction equipment. After receiving confirmational results from a certified laboratory, the stabilized material was disposed of at an off-site landfill.

The cost per treated ton on this project was \$6.75 using EnviroBlend.