

Urban Soil Health Remediation Guide



Getting to the Root of Soil Lead

Reducing Soil Lead Exposure Through Standardized Remediation

Agricultural producers with lead soil contamination need scalable solutions to address soil heavy metals. Allegheny County Conservation District (ACCD), alongside partners PASA Sustainable Agriculture and Chatham University, created the Urban Soil Health Remediation (USHR) recipe that uses a "dilute and lock-up" strategy to reduce soil lead concentration and risk of exposure.

While soil lead will not leach or breakdown over time, the level of associated risk of exposure can be lowered through dilution. This is achieved through deep tillage of subsoil and addition of organic matter which changes soil conditions and "locks-up" the lead through immobilization and reducing bio-availability.

This method creates slightly alkaline or basic soil conditions, increases cation exchange capacity, and addresses phosphorous deficiencies, creating stable lead phosphate. When lead is unavailable in the soil, it's less likely to be taken up by plants or absorbed by the body if accidentally inhaled or ingested. ACCD provides direct support to farmers during this process.



Allegheny County
Conservation District[™]
Trusted Soil & Water Conservation Partner

Urban Soils Program

Soil and water our most essential natural resources. What happens on land directly affects the health and stability of our communities.

Since 2016, ACCD's Urban Soils Program has worked with urban growers and community partners to test and map soil lead across Allegheny County. Addressing contamination linked to the region's industrial legacy, aging infrastructure, and residential vacancy, ACCD is the trusted soil and water conservation partner in Allegheny County.



Scan the code
to learn more
about ACCD's
Urban Soils
programs.



Purpose of This Guide

This resource explains the step-by-step process piloted by ACCD and partners at Urban Soil Health Remediation projects while sharing results through site-specific case studies. This is an ongoing research project and methodology should only be implemented in close consultation with technical assistance providers.

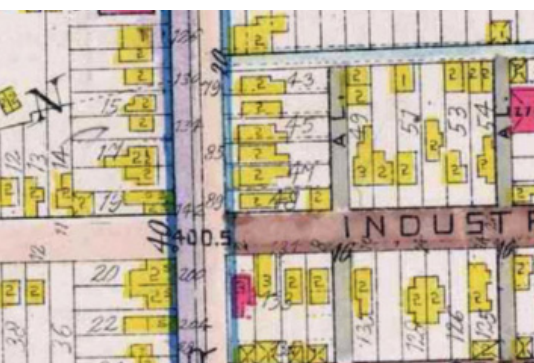
Remediation Recipe



STEP 1: Screen and Test Soil

To establish baseline soil conditions, soil samples are collected using Heavy Metal Micro-Mapping protocol and screened for lead via pXRF analysis. Representative soil samples are collected and submitted for lab testing to gauge initial chemical, biological, and physical characteristics. Sites with average soil lead content of medium or high risk are selected as Urban Soil Health Remediation (USHR) projects.

Photos: Soil lead concentration is measured using pXRF technology.



STEP 2: Assess Historic Site Use

Online satellite imagery and historic mapping resources are used to conduct a desktop analysis of previous land use. This investigation can reveal anticipated underground obstacles, that when paired with Heavy Metal Micro-Mapping, can assist with remediation area selection.

Photo: A map from 1910 indicates vacant lot previously included seven residential structures.



STEP 3: Accumulate and Spread Carbon Amendment

Carbon dense soil amendments including wood chips, compost or leaf mulch are spread at a depth of 6-8" across the intended remediation area.

Photo: A mini skid is used to spread wood chips sourced from local tree care companies.



STEP 4: Apply Probiotic Soil Treatment

A soil probiotic treatment is applied to the woodchip layer. Soil probiotic treatments, such as diluted compost tea or fermented cultures, are rich in microbes and nutrients which encourage quick decomposition of wood chip material, keeping essential nitrogen available for plant uptake.

Photo: Pasa Sustainable Agriculture project partner applies a soil probiotic.



STEP 5: Complete Double Dig and Remove Debris

The double dig method employs a backhoe working backward across the site at a 24-inch digging depth to achieve three outcomes simultaneously: rubble removal, deep tillage that surfaces cleaner subsoil and relieves compaction, and thorough mixing of organic amendments through the full soil profile. Developed based on urban soil research from Cornell University and Michigan State University, the process relies on equipment operators experienced with small urban job sites.

Photo: 4th River Workers Guild working at Rebecca Ave Community Garden.

STEP 6: Incorporate Additional Soil Amendments

Additional soil amendments are applied such as compost, biochar, dolomitic lime, etc. Application rates are based on laboratory test results. Priorities include amending to an optimum level of phosphorous to help bind lead into a stable lead phosphate form while also adjusting pH to neutral or slightly basic (above 7), making soil lead less bio-available to plants and reducing the likelihood of phyto-accumulation.

Photo: Compost application at be.wild.er farm.



STEP 7: Plant Non-Edible Cash Crop

A non-edible crop is selected and planted in the remediation area based on the farmers' production goals and the crop's ability to generate a high volume of biomass residue after harvest. Suitable crops include cut flowers, flax for fiber, broom corn, and ornamental gourds.

Photo: Cut flowers serve as a non-edible cash crop at Rebecca Ave Community Garden.



STEP 8: Harvest, Incorporate, and Sow Winter Cover Crop

After the non-edible crop is harvested, the remaining plant residue is incorporated into the soil as green manure. This process builds soil organic matter, helping dilute soil lead, increase the soil's cation exchange capacity, and reduce lead mobility within the soil profile. If seasonality allows, a winter cover crop is planted and terminated the following spring.

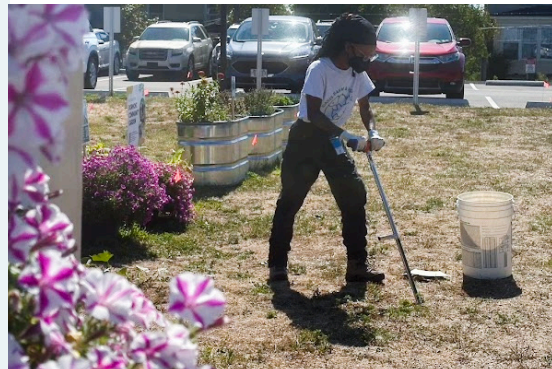
Photo: Sorghum Sudan Grass at be.wild.er farm.



STEP 9: Re-Screen and Test for Final Results

In the spring, a final field assessment uses the same gridded sampling method and pXRF analysis to evaluate changes in soil lead concentrations. Soil samples are submitted to a laboratory to assess changes in soil characteristics, with particular attention to pH and phosphorus levels. Pre- and post-treatment results are analyzed for statistical significance, and any remaining medium- or high-risk lead hot spots are identified for targeted remediation as needed.

Photo: ACCD staff collecting soil samples in 10 ft x 10 ft plotted grids.



Investing in Soil Health

Cost of Urban Soil Health Remediation varies based on site size, site use history, and intended end use. Published case studies provide detailed views of cost variables. ACCD compensates urban growers through stipends for the labor and the ecosystem services their agriculture sites provide for the duration of the project, while also covering cost of implementation.



Growing Impact

ACCD broadly shares challenges and lessons learned from Urban Soil Health Remediation projects in the form of case studies and farmer experiences, enabling urban growers, technical assistance providers, and conservation agencies to build on this work—successfully scaling soil remediation solutions for urban agriculture.

ACCD is dedicated to advancing soil health by:

- Replicating the Urban Soil Health Remediation project on two sites per year as funding allows.
- Exploring modifications to remediation to address additional heavy metal, such as arsenic and other emerging contaminants.
- Sharing findings broadly with partners and interested audiences.

Keys to Success



Technical Assistance

Relationship building and collaboration between farmers and technical service providers are central to project success. Farmers are supported with resources before, during, and after the soil remediation process.



Farmer Compensation

The all-in cost of building soil health is steep. Farm viability is supported by compensating farmers for lost revenue during this process and providing the resources they need to sustain long-term success.



Land Access

Land access is a beginning urban farmer's greatest challenge. Acquiring land can take years and cause significant financial strain. Urban Soil Health Remediation is a significant investment; this method is best reserved for land that is owned or has a long-term lease.



Photos courtesy of Ezra Jones Photography, ACCD, be.wilder farm, Touch of Green, Pasa Sustainable Agriculture, Soil Sisters Plant Nursery, Fourth River Workers Guild.

