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EPA

Lead-Safe Yards

Developing and Implementing a Monitoring, Assessment, and Outreach Program for Your Community

EMPACT

Environmental Monitoring for Public Access & Community Tracking

Preface

This technology transfer handbook is intended to serve as: a) a case study of the EMPACT Community-Based Lead Assessment and Educational Pilot Project in Boston (also known as the Lead-Safe Yard Project or LSYP) that highlights the successes and lessons learned from the project, and b) a "hands on" reference for community members, especially community organizations, to use in identifying and reducing risks from residential soil that may be contaminated with lead. The emphasis is on contamination from non-industrial sources, such as the historic use of exterior house paint or gasoline that contained lead. The handbook provides step-by-step guidance for measuring lead levels in soil, interpreting results in terms of potential risks from these levels, and planning and implementing simple and cost-effective landscaping techniques to reduce these risks. While the focus is on community organizations with access to professional assistance, some recommendations may be suitable for the individual homeowner, landlord, or tenant to consider.

Based on the case study from the Pilot Project in Boston, the handbook was written to be complementary to, and used in conjunction with, EPA and HUD regulations and associated guidance. In particular, EPA has proposed a regulation entitled "TSCA Title IV, Section 403 Lead; Identification of Dangerous Levels of Lead." At the time of the handbook's publication, this rule, which establishes standards for lead-based paint hazards in most pre-1978 housing and child-occupied facilities, was not yet finalized. Nothing in the handbook should be construed as official Agency guidance or regulation contradictory to the Final Section 403 Rule.

These simple, low-cost landscape treatment measures are presented as additional options beyond the permanent measures that may be required by state, local, or federal regulations. For cases in which permanent solutions such as soil removal would be preferable and/or required, but are not immediately possible due to cost or other practical considerations, the handbook offers interim controls that may provide an immediate risk reduction, especially when combined with continuing maintenance practices. Users of the handbook should consult applicable state, local, and federal regulations before deciding on any course of action.

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1 Introduction

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Over the past few decades, blood lead levels in children have declined dramatically. However, lead poisoning remains a serious environmental health threat for children today. The legacy of lead-based paint and leaded gasoline will be with us for many years to come. Without further action, large numbers of young children, particularly in older, urban neighborhoods, will continue to be exposed to lead in amounts that could impair their ability to learn and to reach their full potential.

Recent efforts at the state and federal levels to reduce childhood lead poisoning have focused primarily on controlling hazards from lead-based paint. This focus is likely to continue. In February 2000, the President's Task Force on Environmental Health Risks and Safety Risks to Children released a federal, interagency strategy for eliminating childhood lead poisoning. The strategy calls for the control of lead paint hazards in 2.3 million homes where children under age 6 live (you can access the strategy at http://www.epa.gov/children/whatwe/leadhaz.pdf). To support the Task Force's recommendations, the federal budget for 2001 includes a 50-percent increase in lead paint hazard control grants issued by the U.S. Department of Housing and Urban Development (HUD).

While considerable attention has been given to lead-paint hazards in homes, less attention has been paid to lead-contaminated soil that surrounds these homes. Generally, this has been because of the more significant contribution to lead poisoning in children made by deteriorated lead paint and leaded dust on the interiors of homes. However, evidence exists that soil can be a source of exposure. As lead poisoning rates decline and average childhood blood lead levels decline, lead exposure from soil may be a more significant portion of the exposure for children. Therefore, it warrants attention.

This EMPACT technology transfer handbook is designed with two main goals in mind. The first goal is to present a case study showing how one community-based program—the EMPACT Lead-Safe Yard Project (LSYP) in Boston, Massachusetts—is using a variety of low-cost techniques to reduce children's exposure to elevated levels of lead in residential soil. The second—and perhaps more important—goal is to provide you with step-by-step guidance for developing a similar program to address the problem of lead in soil in your own community. The guidance in the handbook is based on the experience of the EMPACT LSYP, as well as that of several other programs. These other programs are highlighted at points throughout the handbook.

The handbook is written primarily for community organizers, non-profit groups, local government officials, tribal officials, and other decision-makers who will implement, or are considering implementing, lead-safe yard programs. At the same time, much of the information will be useful to individual homeowners interested in finding low-cost ways to reduce children's exposure to lead in soil. Before attempting to implement the techniques described in this handbook, however, homeowners need to be aware of the hazards associated with working with lead-contaminated soil. All homeowners should carefully read those passages of the handbook that describe soil-lead hazards,

safety guidelines for working with lead-contaminated soil, and federal and state regulations governing acceptable work practices (in particular, see Sections 3.1, 3.3, 6.2, 6.4, and 7.6).

1.1 About the EMPACT Program

This handbook was developed by the U.S. Environmental Protection Agency's (EPA's) EMPACT Program (http://www.epa.gov/empact). EPA created EMPACT (Environmental Monitoring for Public Access and Community Tracking) in 1997, at President Clinton's direction. It is now one of the programs within EPA's Office of Environmental Information. EMPACT is a new approach to providing timely environmental information to communities across the nation, helping people make informed, day-to-day decisions. By the year 2001, residents in 86 of the largest metropolitan areas in the United States will have an easy way to answer questions such as:

- What is the ozone level in my city this morning?
- What is the water quality at my beach today?
- How high is the ultraviolet radiation in my city today?
- What is the level of contamination at the hazardous waste site in my community?
- What are the levels of lead in the soil in yards in my neighborhood?

To help make EMPACT more effective, EPA is partnering with the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, the U.S. Department of Interior, and the National Partnership for Reinventing Government. EPA will work closely with these federal entities to help achieve nationwide consistency in measuring environmental data, managing information, and delivering that information to the public.

To date, environmental information projects have been initiated in 84 of the 86 EMPACT-designated metropolitan areas. These projects cover a wide range of environmental issues, such as groundwater contamination, ocean pollution, smog, ultraviolet radiation, and ecosystem quality. Some of these projects have been initiated directly by EPA. Others have been launched by the EMPACT communities themselves. Local governments from any of the 86 EMPACT metropolitan areas are eligible to apply for EPA-funded Metro Grants to develop their own EMPACT projects.

Communities selected for Metro grants are responsible for building their own time-relevant environmental monitoring and information delivery systems. To find out how to apply for a Metro grant, visit the EMPACT Web site at http://www.epa.gov/empact/apply.htm.

1.2 About the EMPACT Lead-Safe Yard Project

During the winter of 1998, EPA's EMPACT program funded "A Community-Based Lead Assessment and Educational Pilot Project," also known as the Lead-Safe Yard Project (http://www.epa.gov/region01/leadsafe). The project is a joint effort between EMPACT, EPA's New England Regional Laboratory, and several community partners. The three primary objectives of the project are:

1) To generate real-time data of lead concentrations in residential yard soils using innovative field-portable x-ray fluorescence (XRF) technology, and to communicate these data to residents for the purpose of informing them of the health risks of lead in soil.

City of Boston
Lead Poisoned Children
Venous > 15µg/dL
FY 1985–1993

2) To plan and implement low-cost and sustainable landscape measures in residents' yards that would reduce children's risk of exposure to contaminated soil and that residents would be taught to maintain.

3) To develop a template that other communities and public agencies can use to address the issue of lead in residential soil.

The initial target community selected for the pilot project was a several-block area in the Bowdoin Street neighborhood, consisting of approximately 150 mostly older, wood-framed houses in the North Dorchester section of Boston. This is an inner-city community, with a large minority and immigrant population. Bowdoin Street is situated in the "lead belt" of Boston, where the majority of children in the city with elevated blood levels reside.

During the pilot phases, the project's community partners in the Boston area were Boston University School of Public Health, the Bowdoin Street Community Health Center, and a non-profit landscaping company called Dorchester Gardenlands Preserve. The project team identified five tasks to be carried out by the partners:

- Outreach and education, led by the Health Center.
- Safety training, conducted by staff from the Health Center.
- Sampling and analysis, led by the EPA Regional Laboratory with assistance from a certified industrial hygienist from the Health Center.

- Soil mitigation, performed by the landscaping company.
- Creation of a template for community action, led by Boston University School of Public Health with assistance from all partners.

The pilot project was funded in two phases, which took place in the summers of 1998 and 1999. During these two years, the project addressed 42 residences in the target area, at no cost to the homeowners; conducted a number of seminars on lead-safe yard work; and developed a "Tool Kit" for use by other communities (the materials in the Tool Kit have been incorporated into this handbook).

The third phase of the project, launched in June 2000, is targeting a different community: the Dudley Street neighborhood, which is also located in the "lead belt" of Boston. The partners in this phase include Boston University School of Public Health, the Dudley Street Neighborhood Initiative (a local planning and organizing agency), and several commercial landscapers. The objective of this phase is to use refined landscape measures and an improved educational approach in treating yards of homes that meet requirements for structural lead abatement of interior and exterior paint, or that have already been lead abated and are lead safe. As of September 2000, 18 homeowners had enrolled to have their yards tested for elevated soil-lead levels, and testing had been completed at most of the properties. The project's goal is to complete soil testing and implement landscape treatments at 20 or more properties by the end of the year.

1.2.1 Related Lead-Safe Yard Programs

A key objective of the EMPACT LSYP is to disseminate a template of materials and methods to public agencies whose mission is to prevent childhood lead poisoning. The ultimate goal is to institutionalize soil remediation as part of a comprehensive lead poisoning prevention program in high-risk neighborhoods.

Based on the success of the pilot phase of the EMPACT LSYP, the City of Boston has already initiated two "spinoff" soil-lead programs, using the EMPACT project's template:

- Lead Safe Boston, an office within the Boston Department of Neighborhood Development that assists homeowners financially and technically in home de-leading, is spearheading a HUD-funded lead-safe yard project that will target as many as 25 residential properties by the end of 2000. This demonstration project is meant to show how local government agencies can integrate soil-lead mitigation into ongoing home de-leading work. As of September 2000, Lead Safe Boston had enrolled 20 properties for soil-lead testing and yard treatments, and had completed treatments at nearly half of the properties. Lead Safe Boston has also done extensive work to revise materials in the EMPACT LSYP's template (such as permission forms and contractor agreements) to meet the more rigorous legal standards required of a city agency. Many of the materials developed by Lead Safe Boston appear as samples in this handbook.
- The Office of Environmental Health, part of the Boston Public Health Commission (BPHC), initiated another spinoff lead-safe yard project in the year 2000 to address nine residential properties in an area of North Dorchester. These nine residences have previously undergone structural abatement of lead paint and are slated for yard intervention utilizing the EMPACT LSYP's template. BPHC is leading the outreach effort and funding the landscaping work. EPA's New England Regional Laboratory is providing testing support, and Lead Safe Boston is assisting with contract services.

EMPACT LEAD-SAFE YARD PROJECT RECOGNIZED FOR EXCELLENCE

Because of the EMPACT LSYP's innovative approaches and far-reaching impacts, project partners have received several prestigious awards for their work. These include:

- **1999 Regional Science Award. The EPA Region 1 Science Council selected for this award Rob Maxfield and Paul Carroll, both from EPA's Office of Environmental Measurement and Evaluation, for their work on the EMPACT LSYP. The award noted that these scientists "demonstrated environmental leadership and utilized innovative yet simple solutions to this age old problem while gaining acceptance at the local, municipal, and national levels." The two also received EPA Bronze Medals for this work.**
- **1999 Harvard Award for Excellence in Children's Health. LSYP project partner Bowdoin Street Health Center received this award for its work with the EMPACT LSYP. This annual award, cosponsored by the Harvard Center for Children's Health at the School of Public Health, the City of Boston, and Children's Hospital, recognizes a Boston organization for extraordinary work in the area of child and adolescent health.**
- **2000 Boston University School of Public Health Award for Excellence in Public Health Practice. Patricia Hynes, Professor of Public Health, was recognized during National Public Health Week 2000 for her work with the EMPACT LSYP. Boston University School of Public Health selected this as one of three examples of excellence in public health research and intervention work being done by the school's faculty.**

1.2.2 Lead-Safe Yard Research Study

EPA New England and the National Center for Lead Safe Housing (http://www.leadsafehousing.org) are leading a HUD-funded research study to document the effectiveness of the low-cost interim soil control measures used by the EMPACT LSYP. Other partners in the study include the Boston Department of Neighborhood Development and Boston University. This research study will include a retrospective evaluation of the soil intervention work conducted during the first two phases of the EMPACT LSYP (1998 and 1999). It also will examine data collected during the summer of 2000 by all three Boston-based lead-safe yard projects: the EMPACT project, the Lead Safe Boston demonstration project, and the BPHC project (data will be collected before, during, and after each yard intervention). The principal objective of the study is the preparation of a technical paper that will document the effectiveness of low-cost interim soil control measures in reducing risk to residents and to make this data available to HUD for policy development. The research study will also seek to answer several technical questions about the suitability of field-portable XRF technology for soil-lead testing.

1.3 About This Handbook

A number of cities have expressed interest in beginning lead-safe yard programs, but they are limited by available resources. The Technology Transfer and Support Division of the EPA Office of Research and Development's (ORD's) National Risk Management Laboratory initiated the development of this handbook to help interested communities learn more about the EMPACT LSYP and to provide them with the technical information they need to develop their own programs. ORD, working with the LSYP from Region 1, produced the handbook to leverage EMPACT's investment in the project and minimize the resources needed to implement it in new cities.

Both print and CD-ROM versions of the handbook are available for direct online ordering from ORD's Technology Transfer Web site at http://www.epa.gov/ttbnrmrl. A PDF version of the handbook can also be downloaded from the EMPACT LSYP Web site at http://www.epa.gov/region01/leadsafe. This Web site is in turn hyperlinked to the main EMPACT Program Web site

(http://www.epa.gov/empact) and the ORD Technology Transfer Web site. In addition, you can obtain a copy of the handbook by contacting the EMPACT Program office at:

EMPACT Program
Office of Environmental Information
U.S. EPA (2831R)
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We hope that you find the handbook worthwhile, informative, and easy to use. We welcome your comments; you can send them by e-mail from EMPACT's Web site at http://www.epa.gov/empact/comment.htm.

1.4 Acknowledgments

EPA and the EMPACT LSYP would like to recognize the following people and organizations for their substantial contributions to the contents of this handbook:

- Sandra Duran, a construction specialist with the Boston Department of Neighborhood Development in the City of Boston's Public Facilities Department, for creating many of the forms used during the third phase of the EMPACT LSYP and creating the specifications for construction contracting.
- The EPA New England Lead Program in the Office of Ecosystem Protection, for assistance in reviewing early drafts of the handbook.
- The New England Lead Coordinating Committee (NELCC), funded by EPA New England and the State Lead Programs, and the participants of the Lead in Soils Design Charrette, whose early work developing landscape treatments for lead-contaminated soil provided a foundation for the EMPACT LSYP's low-cost mitigation approach.
- The EPA New England Urban Initiative, whose outreach and capacity-building efforts established many of the community and city partnerships that made this project possible.

1.5 For More Information

Try the following resources for more on the issues and programs this handbook discusses:

The EMPACT Program
http://www.epa.gov/empact

The EMPACT Lead-Safe Yard Project
http://www.epa.gov/region01/leadsafe

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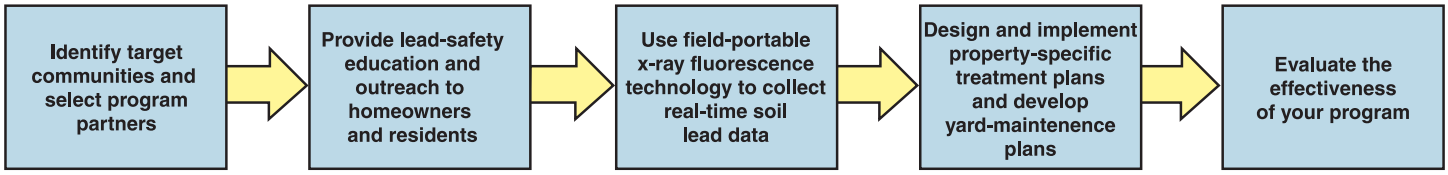
The Dudley Street Neighborhood Initiative
http://www.dsni.org

The National Center for Lead Safe Housing
http://www.leadsafehousing.org

2 How To Use This Handbook

This handbook provides information your community can use to create and implement a lead-safe yard program. It presents detailed guidance, based on the experience of the EMPACT Lead-Safe Yard Project, on how to:



The handbook provides simple "how to" instructions on each facet of planning and implementing a lead-safe yard program, along with important background information on lead poisoning and the hazards of lead-contaminated soil:

- **Chapter 3** discusses why lead in general, and lead-contaminated soil in particular, is a health hazard; what data are available on lead in soil; and what standards and regulations may apply to your program.
- **Chapter 4** describes the steps in beginning a program: identifying potential target communities, getting to know the community, and selecting partners for the program.
- **Chapter 5** provides guidance on education and outreach to homeowners and residents about the problem of lead in soil and the benefits of participating in a lead-safe yard program.
- **Chapter 6** provides detailed information about data collection and management, focusing on the use of the field-portable x-ray fluorescence instrument to collect real-time data.
- **Chapter 7** describes soil mitigation strategies and techniques, including sample specifications, costs, and legal issues.
- **Chapter 8** discusses how to develop and implement a maintenance plan for lead-safe yards, including homeowner education and strategies for ensuring ongoing maintenance.
- **Chapter 9** provides guidance for evaluating the program, stressing the importance of documentation.
- **Chapter 10** outlines the application of lead-safe yard monitoring and mitigation techniques to non-residential settings, such as tot lots, community gardens, and abandoned commercial buildings.

Interspersed throughout the handbook are success stories and lessons learned in the course of the EMPACT LSYP. The handbook also refers you to supplementary sources of information, such as Web sites, guidance documents, and other written materials. In addition, the handbook includes three appendices that present alternatives to the approaches used by the EMPACT LSYP:

- **Appendix A** describes the Safer Soil Pilot Program of Cambridge, Massachusetts, which has used landscaping and other remedial measures to treat residential yards since 1997.
- **Appendix B** proposes four models for less-resource-intensive approaches to implementing lead-safe yard programs.
- **Appendix C** discusses a new option, phytoremediation, being explored to address lead in soil in a cost-effective manner.

Finally, Appendix D presents the EMPACT LSYP Quality Assurance Project Plan.

The handbook is designed for managers and decision-makers who may be considering whether to implement a lead-safe yard program in their communities, as well as for organizers who are actually implementing lead intervention programs. Decision-makers likely will find Chapters 3, 4, 9, and 10 most helpful. The other chapters are written primarily for people who will carry out the program and provide detailed "how to" information. Individual homeowners interested in finding low-cost ways to prevent children's exposure to lead in soil will find Chapters 7 and 8 most useful.

3 Lead in Soil: Why is it a Problem?

This chapter provides an overview of the problems posed by lead in soil. Section 3.1 discusses lead poisoning, its health effects and prevalence, and the pathways through which children and others are exposed to lead. Section 3.2 describes the most common sources of lead in residential soil and summarizes soil-lead levels found in the United States. Section 3.3 reviews evidence indicating that soil is one important pathway for childhood lead exposure. Finally, Section 3.4 describes the national strategy for reducing hazardous exposures to lead and identifies standards and regulations that may affect a lead-safe yard program.

The information in this chapter should be useful to any person interested in soil-lead hazards and mitigation, whether that person be a community organizer responsible for implementing a lead-safe yard program or a homeowner concerned about elevated soil-lead levels in his or her own yard.

3.1 Lead and Lead Poisoning

Lead is a heavy, soft, malleable metal. Due to its physical and chemical properties, people have found countless uses for lead in their daily lives. While certain uses of lead are banned, lead is still found in a myriad of products. Important sources of lead in the environment today include:

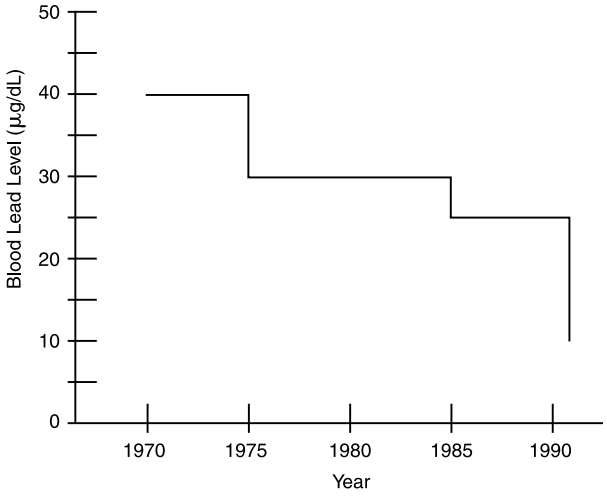
- Lead paint, and resulting lead dust, found in and around homes built before 1978 (when lead-based paint was banned). Lead dust from deteriorated lead-based paint is the most significant contributor to childhood lead poisoning.
- Lead from automobile emissions (before leaded gasoline was finally banned in 1986) that has been deposited on land and surface water.
- Lead in occupational settings (often brought home on clothes or skin).
- Lead from industrial emissions, such as lead smelters, lead mining, hazardous waste sites, and battery-recycling plants.
- Lead in drinking water caused by lead-containing plumbing.
- Lead-containing tableware, such as leaded-crystal glassware and lead-glazed pottery.
- Certain hobbies and activities that use lead (e.g., car radiator repair, target shooting, stained-glass making, glass or metal soldering).
- Certain folk remedies that contain lead (e.g., azarcon, greta).

3.1.1 What Is Lead Poisoning?

Lead poisoning is entirely preventable. However, according to the Centers for Disease Control and Prevention (CDC), nearly 1 million children living in the United States in the early 1990s had lead in their blood at levels high enough to be associated with irreversible damage to their health.

CDC defines elevated blood lead in children as blood lead levels of 10 micrograms of lead per deciliter of blood (µg/dL) or higher. Until the early 1970s, CDC's blood lead levels of concern were 60 µg/dL for children and 80 µg/dL for adults. As the adverse effects of lead became better known,

Blood lead levels considered elevated by the Centers for Disease Control and the Public Health Service.



Source: Centers for Disease Control, 1991, *Preventing Lead Poisoning in Young Children*

CDC lowered the level at which it recommends medical attention, also known as the "blood lead intervention level," on three separate occasions. After research showed that cognitive and developmental damage occurs at blood lead levels as low as 10 µg/dL, CDC lowered the blood lead level of concern to the current 10 µg/dL value in 1991. There is no known safe level of lead in blood.

3.1.2 Health Effects of Lead Poisoning

Lead poisoning affects nearly every system in the body, and often occurs with no noticeable symptoms. Although lead can affect adults, children under the age of six are especially vulnerable to the adverse effects of lead. The incomplete development of the blood-brain barrier in fetuses and very young children (up to 36 months of age) increases the risk of lead's entry into the nervous system. Low but chronic exposure can affect the developing nervous system in subtle but persistent ways. In children, blood lead levels as low as 10 to 15 µg/dL can stunt growth rates, affect attention span, cause learning disabilities, lower IQ scores, impair hearing acuity, and cause behavioral problems. In addition, fetuses exposed to elevated levels of lead can suffer from low birth weight, impaired hearing, and altered gestational age, which can lead to further complications.

In addition to damaging the nervous system, elevated blood lead levels can also affect the kidneys and reproductive system and cause high blood pressure. Very high levels (greater than 80 µg/dL) can cause convulsions, coma, or death. Levels greater than 150 µg/dL are fatal if not treated quickly. Fortunately, exposures resulting in such high levels of lead are rare.

The literature on the health effects of lead is extensive. For more information, see CDC's *Preventing Lead Poisoning in Young Children* (http://aepo-xdv-www-epo.cdc.gov/wonder/prevguid/p0000029/p0000029.htm) and the Agency for Toxic Substances and Disease Registry's *Case Studies in Environmental Medicine: Lead Toxicity* (http://www.atsdr.cdc.gov/HEC/caselead.html). Additional resources and links listed at the end of this chapter provide a wealth of information on this and other lead-related topics.

3.1.3 How Does Lead Enter the Body, and What Happens to Lead in the Body?

Lead enters the body through either ingestion or inhalation. Young children tend to ingest more lead than adults do in a given environment, mainly because of their normal hand-to-mouth behavior. The most common way for a child to ingest lead is by putting objects in the mouth (e.g., toys or hands) that have lead-contaminated dust or dirt on them. Children may also mouth surfaces having lead-based paint (such as window sills) or ingest lead-paint chips or soil (especially children who exhibit pica, a pattern of eating dirt or other non-food substances). Children may also ingest lead if their drinking water contains lead. (Lead in drinking water usually comes from lead-containing pipes, faucets, and solder in the plumbing of older buildings.) Children can also inhale lead via dust from deteriorating paint, dust on clothing brought home by parents exposed to occupational lead sources, or fumes from hobbies or industries that use lead.

Young children tend to ingest more lead than adults do in a given environment, partly because of normal hand-to-mouth behavior. They also take in more food and water per body weight.

The rate at which the body absorbs lead, once it has been ingested, depends on the chemical and physical form of the lead and on the physiological characteristics of the exposed person. Nutritional status and age are the factors having the greatest influence on absorption rates. Adults typically absorb 10 to 15 percent of ingested lead through the gastrointestinal tract, while children and pregnant women can absorb as much as 50 percent. Children are also at higher risk when their nutritional needs are not being adequately met. Calcium, iron, zinc, and protein deficiencies, in particular, increase lead absorption rates. Fasting conditions in adults have a similar impact on the absorption of lead. Lead dust inhaled and deposited into the lower respiratory tract is completely absorbed by both adults and children.

Since lead is an inorganic metal, it is not metabolized and is distributed throughout the body by the bloodstream. Over time, a portion of the lead may be eliminated from the body. The majority, however, remains in the bloodstream, or is absorbed by soft tissue (kidneys, bone marrow, liver, and brain), or mineralizing tissue (bones and teeth). In adults, 95 percent of the lead present in the body is found in teeth and bones, where it remains inert. When the body experiences physiological changes, however—such as pregnancy, lactation, or chronic disease—this inert lead can leach into the bloodstream and raise blood lead levels to dangerous levels. During pregnancy, this mobilized lead can also be transferred to the fetus, which has no defense mechanism against it. This can result in developmental and neurological damage.

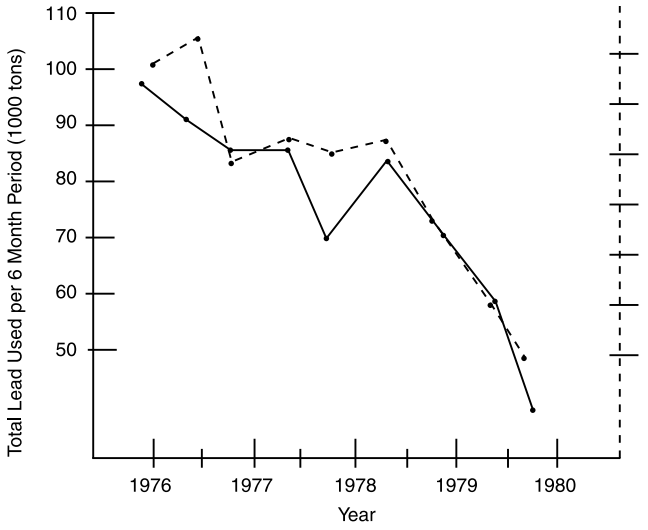
In addition to absorbing a greater proportion of the lead to which they are exposed, children also tend to retain a greater percentage of lead in their blood than do adults. This is partly because a child's body is not as efficient as an adult's at absorbing lead into mineralizing tissue. Consequently, a greater fraction of the lead absorbed remains in the bloodstream and has a toxic effect on internal organs.

3.1.4 How Common Is Lead Poisoning in Children?

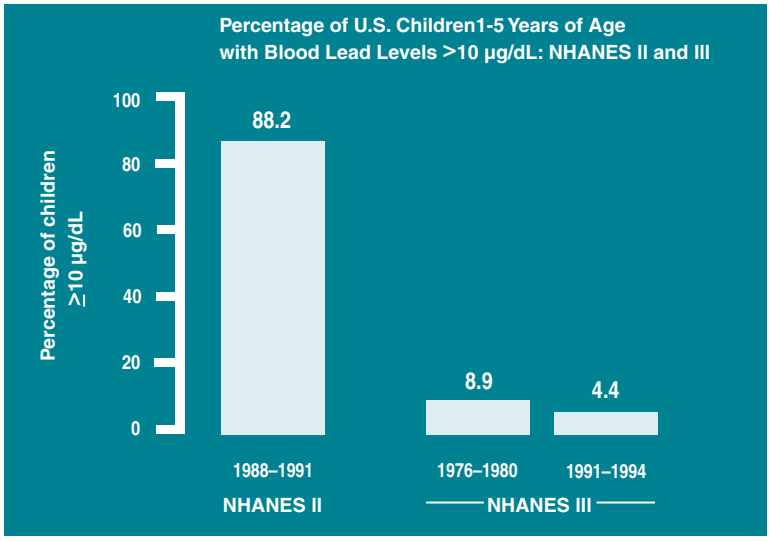
The Second National Health and Nutrition Examination Survey (NHANES II), released in 1980, showed that as recently as 1976, the average blood lead level of the typical American child was 12.8 µg/dL. The survey also revealed that at that time 88.2 percent of American children ages one through five were suffering from some degree of lead poisoning (i.e., over CDC's current level of concern of 10 µg/dL).

In the 1970s, the federal government banned the use of lead-based paint in residential buildings and houses, and phased out the use of lead as an additive in gasoline. These two actions had an immense impact on the blood lead levels of children nationwide. NHANES III reported that by 1988, the national average blood lead level in children had dropped to 2.8 µg/dL and the percentage of children suffering from lead poisoning had dropped to 8.9 percent. By the early 1990s, the average blood lead level of children ages

Change in blood lead levels in relation to a decline in use of leaded gasoline, 1976-1980.



Source: Centers for Disease Control, 1991, *Preventing Lead Poisoning in Young Children*



one through five was 2.3 µg/dL.[1] A fourth NHANES report has recently been completed; though the report has not yet been made public, the survey data apparently suggest that average blood lead levels continue to decrease among children in this age range.

While childhood lead exposure has diminished over the past 25 years, the problem is far from solved. In particular, minority, low-income, inner-city populations continue to lag behind in improvement, relative to national averages:

- 8 percent of impoverished children suffer from lead poisoning compared to only 1 percent of children from high-income families.[2]
- 11.2 percent of all African-American children are lead poisoned compared to 2.3 percent of all white children.[3]
- 50 to 70 percent of the children living in the inner cities of New Orleans and Philadelphia have blood lead levels above 10 µg/dL.[4]

Poor nutrition, deteriorating housing, lack of access to medical care, and language barriers all contribute to placing poor and minority children at risk for lead poisoning. It is important to note, however, that no economic or ethnic/racial group is free from the risk of lead poisoning. A sizable number of affluent families renovating older homes, for example, have placed their children at risk through unsafe lead paint removal techniques.

3.2 Sources and Levels of Lead in Soil

When lead is deposited in soil from anthropogenic sources, it does not biodegrade or decay and is not rapidly absorbed by plants, so it remains in the soil at elevated levels. Lead is estimated to have a half-time of residence in soil of 1,000 years.[5] In soils with a pH of greater than or equal to 5 and with at least 5 percent organic matter (which immobilizes the lead), atmospheric lead is retained in the upper 2 to 5 centimeters of undisturbed soil.[6] Urban soils or other soils that have been turned under or otherwise disturbed may be contaminated to much greater depths.

EPA estimates that 23 percent, or 18 million, of the privately owned homes in the United States built before 1980 have soil-lead levels above 400 parts per million (ppm); that 3 percent, or 2.5 million, have levels exceeding 2,000 ppm; and that 3 percent, or 2.5 million, exceed 5,000 ppm.[7]

[1] Natural Resources Defense Council, *Our Children at Risk: The 5 Worst Environmental Threats to Their Health,* Chapter 3: Lead, Washington, DC, 1997. Available at http://nrdc.org/health/kids/ocar/ocarinx.asp
[2] Ibid.
[3] Ibid.
[4] Mielke, H.W., "Lead in the Inner Cities," *American Scientist,* vol. 87, no. 1, Jan/Feb 1999.
[5] Benninger et al., *The Use of Natural Pb-10 as a Heavy Metal Tracer in the River-Estuarine System,* ACS Symposium Series #18, Marine Chemistry and the Coastal Environment, 1975.
[6] U.S. Environmental Protection Agency, *Air Quality Criteria for Lead,* Research Triangle Park, NC, EPA600-8-83-018F, 1986.
[7] U.S. Environmental Protection Agency, *Distribution of Soil Lead in the Nation's Housing Stock,* 1996.

Lead in residential soil comes from several different sources, including lead-based exterior paint and automobile tailpipe emissions from vehicles burning leaded gasoline. Industrial emissions are also a source of residential soil contamination in some areas. These sources of contamination are discussed in more detail below.

3.2.1 Lead-Based Paint

EPA has found building age to be the strongest statistical predictor of soil lead, with soil around private homes built before 1940 having significantly higher levels of lead in soil than homes built between 1960 and 1979.[8] While the use of lead paint in residential buildings was federally banned in the United States in 1978, many homes built prior to 1978 still contain lead-based paint. Paint used in homes built between 1950 and 1978 contained between 0.5 and 50 percent lead, and the paint used prior to 1950 contained higher concentrations. One estimate is that more than 3 million tons of lead-based paint remain in the 57 million homes built prior to 1980.[9]

Since a large portion of this lead-based paint covers building exteriors, it continues to be a significant source of soil contamination. Lead-based paint contaminates soil as the paint film weathers and reaches the soil in the form of chips and dust. Renovating, remodeling, and performing routine home maintenance will also mobilize this lead if proper precautions are not taken. As the paint on a building's exterior deteriorates, lead paint chips and dust concentrate in the surrounding soil. Dry scraping, sanding, and blasting of lead-based paint can mobilize large amounts of lead in a short time and significantly increase lead concentrations in soil. Lead concentrations in soil are typically highest in the drip zone, or dripline, the area surrounding and extending out about 3 feet from the perimeter of a building.

3.2.2 Leaded Gasoline

The use of lead as a gasoline additive was phased out during the 1970s and banned in the United States in 1986. It has been estimated that 4 to 5 million metric tons of lead, emitted from automobile tailpipes as fine dust particles, remain in the environment in dust and soil.[10] This represents approximately 75 percent of the total amount of lead added to gasoline. The remaining 25 percent was deposited on internal engine surfaces or ended up in the oil. The lead dust that became airborne would migrate until hitting a barrier such as the side of a house or some other structure, to which it would adhere. Subsequent rains washed this lead dust down into the surrounding soil, where it accumulated over time.

Scientists estimate that 4 to 5 million metric tons of lead emitted from automobile tailpipes prior to 1986 remain in the environment in dust and soil.

Soil-lead levels within 25 meters of roadways are typically 30 to 2,000 ppm higher than natural levels, and can sometimes be as

[8] Ibid.
[9] Centers for Disease Control, *Preventing Lead Poisoning in Young Children,* 1991.
[10] Ibid.

high as 10,000 ppm.[11] Some researchers have found that soil-lead concentrations typically are highest in older, inner-city neighborhoods, especially those near high-traffic routes, and that soil-lead concentrations diminish with distance from the city center. Another study found that soil-lead concentrations are 10 to 100 times higher in old communities in large cities than in comparable neighborhoods in smaller cities, perhaps because traffic volume is higher and vehicles remain inside the city longer.[12]

A back yard in Dorchester, Massachusetts, with areas of bare, contaminated soil. When children play outdoors, lead-contaminated dirt and dust can get on hands, clothes, toys, and food.

3.2.3 Industrial Emissions

Communities near industrial and mining activities that release lead (or released lead in the past) may also have elevated levels of lead in residential soils. Examples of such industries and activities are lead smelting or refining plants, lead mining, auto repair, battery recycling or manufacturing, bridge and water tank repainting and reconstruction, plastic manufacturing, shipbuilding, glass manufacturing, printing, and hazardous waste sites. EPA has found lead levels in soils next to smelters as high as 60,000 ppm.[13]

3.3 Soil as an Exposure Pathway for Lead

While deteriorated lead-containing paint in housing is generally accepted as the leading source of lead exposure to children, outdoor activities where individuals come into contact with lead-contaminated soil also represent an exposure pathway that can be significant. When children play outdoors, lead-contaminated dirt and dust can get on hands, clothes, toys, and food. Putting these items in the mouth can lead to ingestion of lead.

Children can also breathe lead dust or lead-contaminated dirt stirred up by the wind or by outdoor play activities. During dry periods, dust from bare patches of contaminated soil can readily become airborne, increasing the chance that it will be inhaled. Also, airborne lead dust and lead-contaminated dirt can settle on play clothes and shoes and can be tracked into homes, further increasing exposure. Pets, as well, can track lead-contaminated soil into homes on their coats and paws.

The relative contribution of lead-contaminated soil versus lead-based paint and house dust is the subject of research and debate. Although there are differing opinions among researchers and experts as to the degree of significance of exposure to lead-contaminated soil, evidence does exist that soil is one important pathway for lead exposure among children. Some researchers have shown an asso-

[11] Ibid.
[12] Mielke, H.W., "Lead in the Inner Cities," American Scientist, vol. 87, no. 1, Jan/Feb 1999.
[13] U.S. Environmental Protection Agency, *Air Quality Criteria for Lead.*

ciation between increases in blood lead and increases in soil or dust concentrations. Factors that influence this relationship include access to soil, behavior patterns, presence of ground cover, seasonal variation of exposure conditions, and the particle size and chemical form of the lead. Others have found an association between time spent outdoors and children putting soil or dirt in their mouths, which, in turn, is associated with elevated blood lead levels.[14]

In 1996, EPA published the Integrated Report of the Urban Soil Lead Abatement Demonstration Project. This report assessed the scientific data from studies in three cities (Boston, Baltimore, and Cincinnati) to determine whether abatement of lead in soil could reduce blood lead levels of inner-city children. The report concludes that when soil is a significant source of lead in the child's environment, the abatement of that soil will result in a reduction in exposure that will, under certain conditions, cause a reduction in childhood blood lead concentrations. Important factors in reducing blood lead levels were thought to be (1) the past history of exposure of the child to lead, as reflected in pre-abatement blood lead levels; (2) the magnitude of the reduction in soil-lead concentrations; (3) the magnitude of other sources of lead exposure; and (4) a direct exposure pathway between soil and the child.[15]

CREATING A LEAD-SAFE RESIDENCE

As the various pathways for lead exposure in young children become better understood, the importance of addressing all of the sources of lead in and around the home has also become clearer. For example, even if the interior of a home is certified as deleaded, a lead-contaminated yard can remain a dangerous source of lead exposure for children living there. Conversely, soil mitigation work will be ineffective if nothing is done about heavily leaded exterior paint on a home, because recontamination of the yard is likely to occur.

Because lead in yard soil is only one aspect of a multi-layered problem, the EMPACT Lead-Safe Yard Project decided in Phase 3 to address yards only for residences where structural lead abatement had been completed. Even in such homes, however, some lead probably remains, and precautions must be taken (e.g., using lead-safe renovation techniques) to prevent recontamination of the yard.

Howard Mielke, a leading researcher on lead poisoning and prevention, reviewed other evidence for soil lead as an important exposure pathway in a 1999 article.[16] Mielke demonstrated a strong correlation between soil lead and blood lead in several studies.

3.4 Standards and Guidelines for Lead Poisoning Prevention

This section provides an overview of federal guidelines and standards that may affect a lead-safe yard program. When determining the requirements that apply to your program, it is important to check with the state or tribal agency that addresses lead poisoning prevention. For example, many states have requirements for training and certification of contractors performing lead hazard evaluation and abatement work. For a list of state/tribal lead poisoning prevention agencies, see http://www.ncsl.org/programs/ESNR/pbdir.htm.

3.4.1 The Federal Regulatory Infrastructure

Title X of the 1992 Housing and Community Development Act (available online at http://www.epa.gov/lead/titleten.html) otherwise known as the Residential Lead-Based Paint Hazard Reduction Act (Public Law 102-550), mandated the creation of an infrastructure that

[14] Bruce Lanphear and Klaus Roghmann, "Pathways of Lead Exposure in Urban Children," *Environmental Research,* vol. 74, 63–73, 1997.

[15] U.S. Environmental Protection Agency, *Integrated Report of the Urban Soil Lead Abatement Demonstration Project,* EPA600-P-93-001aF, Office of Research and Development.

[16] Mielke, H.W., "Lead in the Inner Cities," *American Scientist,* vol. 87, no. 1, Jan/Feb 1999.

would correct lead paint hazards in housing. Title X also redefined "lead paint hazards" and how they can be controlled, and created Title IV of the Toxic Substances Control Act (TSCA), under which EPA sets lead hazard standards, work practice standards, and training requirements for lead abatement workers. Based on scientific research in the 1980s, Congress defined "hazard" to include deteriorated lead paint and the lead-contaminated dust and soil it generates. The infrastructure has been developed and includes the following:

- Grant programs to make homes lead safe, now active in over 200 cities.
- Training of thousands of workers doing housing rehabilitation, remodeling renovation, repainting, and maintenance to help them do their work in a lead-safe way.
- Licensing of inspectors and abatement contractors.
- Compliance with and enforcement of lead safety laws and regulations.
- Disclosure of lead paint problems before sale or lease.
- National and local education and outreach programs.
- Promulgation of federal standards of care.
- Worker protection regulations.

The box below lists federal agencies and their programs related to lead poisoning prevention. For a more detailed overview of these federal programs, see "Current and Ongoing Federal Programs and Activities" in *Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards* (http://www.epa.gov/children/whatwe/leadhaz.pdf).

FEDERAL AGENCY ROLES IN LEAD POISONING PREVENTION

Agency	Programs and Duties
Department of Housing and Urban Development **http://www.hud.gov/lea/leahome.html**	Lead Hazard Control Grant Program, enforcement of Disclosure Rule (with EPA and DoJ) and federally assisted housing lead paint regulations, National Survey of Lead Paint in Housing, Lead Hotline (with EPA), Internet listing of lead paint professionals, public education and training of housing professionals and providers and others, technical assistance, research.
Department of Health and Human Services: Centers for Disease Control and Prevention **http://www.cdc.gov/nceh/lead/lead.htm**	Blood Lead Screening Grant Program, public education to medical and public health professionals and others, National Health and Nutrition Examination Survey, quality control for laboratories analyzing blood lead specimens, research.
Health Care Financing Administration **http://www.hcfa.gov**	Covers and reimburses for lead screening an diagnosis, lead poisoning treatment, and follow-up services for Medicaid-eligible children.

FEDERAL AGENCY ROLES IN LEAD POISONING PREVENTION

Agency	Programs and Duties
National Institute of Child Health and Human Development **http://www.nichd.nih.gov**	Conducts and supports laboratory, clinical, and epidemiological research on the reproductive, neurobiologic, developmental, and behavioral processes, including lead poisoning related research.
Health Resources and Services Administration **http://www.hrsa.gov**	Directs national health programs to assure quality health care to under-served, vulnerable, and special need populations including children with lead poisoning.
Agency for Toxic Substances and Disease Registry **http://www.atsdr.cdc.gov**	Studies blood lead in populations near Superfund sites and funds state health agencies to undertake this type of work.
Food and Drug Administration **http://www.fda.gov**	Enforces standards for lead in ceramic dinnerware; monitors lead in food.
National Institutes of Health **http://www.nih.gov**	Conducts basic research on lead toxicity.
Environmental Protection Agency **http://www.epa.gov/opptintr/lead/index.html**	Licenses lead paint professionals (or delegates this responsibility to states); environmental laboratory accreditation; enforcement of Disclosure Rule (with HUD and DoJ) and Pre-Renovation Notification Rule; hazardous waste regulation; public education to parents, environmental professionals, and others; training curriculum design; Lead Hotline (with HUD); research; addresses lead contamination at industrial waste sites, including drinking water and industrial air emissions.
Department of Justice **http://www.usdoj.gov**	Enforces Federal Lead Paint Disclosure Rule (with HUD and EPA); defends federal lead paint regulations; enforces pollution statutes, including hazardous waste laws.
Consumer Product Safety Commission **http://www.cpsc.gov**	Enforces ban of lead paint; investigates and prevents the use of lead paint in consumer products; initiates recalls of lead-containing products that present a hazard; conducts dockside surveillance and intercepts imported products that present a risk of lead poisoning; recommends elimination of lead from consumer products through Guidance Policy on lead.

FEDERAL AGENCY ROLES IN LEAD POISONING PREVENTION

Agency	Programs and Duties
Occupational Safety and Health Administration **http://www.osha-slc.gov/SLTC/lead/index.html**	Enforces worker protection regulations.
Department of the Treasury **http://www.ustreas.gov**	Evaluates financial incentives (such as tax credits) for lead hazard control.
Department of Energy **http://www.energy.gov**	Conducts weatherization activities in a lead-safe manner.
Department of Defense **http://www.defenselink.mil**	Administers lead-based paint/lead hazard management programs in 250,000 family housing and child-occupied facilities worldwide, administers childhood lead poisoning prevention programs on installations worldwide, administers research and development programs to develop new cost-effective technologies for lead paint management and abatement, partners with other federal agencies to develop policies and guidance for lead hazard management on a national level.

3.4.2 The Federal Strategy To Eliminate Lead Poisoning

The interagency President's Task Force on Environmental Health Risks and Safety Risks to Children has proposed a coordinated federal strategy to eliminate childhood lead poisoning, focusing on lead paint hazards (*Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards,* available at http://www.epa.gov/children/whatwe/leadhaz.pdf). The goals of the Strategy are:

- By 2010, to eliminate lead paint hazards in housing where children under six live.
- By 2010, to eliminate elevated blood lead levels in children.

To accomplish these goals, the Task Force makes the following recommendations:

Act before children are poisoned:

- Increase the availability of lead-safe dwellings by increasing federal grants for low-income housing and leveraging private and other non-federal funding.
- Promote education for universal lead-safe painting, renovation, and maintenance work practices.
- Ensure compliance with existing lead paint laws.

Identify and care for lead-poisoned children:

Improve early intervention by expanding blood lead screening and follow-up services for at-risk children, especially Medicaid-eligible children.

Conduct research:

Improve prevention strategies, promote innovative ways to drive down lead hazard control costs, and quantify the ways in which children are exposed to lead.

Measure progress and refine lead poisoning prevention strategies:

Implement monitoring and surveillance programs.

The Strategy notes that research is needed to help develop, evaluate, and market new products, such as x-ray fluorescence technologies. It also notes that research is needed to test the effectiveness of specific actions to reduce exposure to lead in soil and dust. These are areas in which the EMPACT Lead-Safe Yard Project and other similar programs can make significant contributions through their data and experience.

3.4.3 Federal Regulations and Guidelines Affecting Lead-Safe Yard Programs

EPA and the Department of Housing and Urban Development have issued regulations governing lead contamination in residential buildings and soil. EPA regulates lead contamination in homes and yards from lead-based paint under Title IV of TSCA. EPA's Resource Conservation and Recovery Act (RCRA) regulations also regulate lead-contaminated soil in certain situations. HUD's regulations parallel the TSCA regulations and apply to residential buildings that are either federally owned or receive federal assistance under HUD programs.

3.4.3.1 Proposed Rule Under TSCA (40 CFR Part 745)

EPA is currently preparing a final rule under TSCA Section 403, "Lead; Identification of Dangerous Levels of Lead," which will establish standards for lead-based paint hazards, including a hazard level and level of concern for lead-contaminated residential soils. The pending rule is being designed to contribute to the lead hazard identification and abatement mandates specified under Title X, "The Residential Lead-Based Paint Hazard Reduction Act of 1992."

The Section 403 rule is expected to directly affect HUD and other federal agencies that own residential property by requiring soil abatement (such as soil removal or paving) before property sale if soil-lead hazards are identified. It will also indirectly affect property owners who receive federal housing assistance by potentially requiring hazard abatement or reduction. However, this pending rule will not by itself require residential soil abatement, but will instead provide standards for use in other regulations currently being implemented under Title X.

3.4.3.1.1 Are the Treatments in This Handbook Consistent With Federal Regulations?

The EMPACT LSYP was designed before the Section 403 rule was drafted; however, it can be considered to be complementary to the pending Section 403 rule. The project complements the "focus on prevention" objective of TSCA Title IV and the pending Section 403 rule by providing residents (particularly low-income urban minority residents) with practical low-cost yard improvements and landscaping measures that will reduce exposure to lead-contaminated soils. These low-cost measures may be used, in the case of federally owned or assisted properties, as interim shorter-term solutions until permanent, higher-cost solutions are employed. In addition, these low-cost measures may also provide longer-term, but not permanent, protection at non-federally and if needed, federally owned/assisted properties so long as homeowners and/or residents carefully and conscientiously follow specific maintenance procedures developed by the LSYP.

The tables below show the actions recommended for different soil levels by the EMPACT LSYP and the pending Section 403 rule. Following the tables is a discussion of the context for the two sets of recommended actions, as well as a comparison of the sampling plans used in each approach.

EMPACT LEAD-SAFE YARD PROJECT

Soil-Lead Level (parts per million)*	Recommended Interim Action
> 5,000 (very high)	If soil removal or permanent barriers are not possible: • Install semi-permanent barrier, such as a wood-framed dripbox filled with gravel or mulch. • Relocate gardens—unsafe for all types of gardening.
2,000–5,000 (high)	• Relocate gardens—unsafe for all types of gardening. • Relocate children's play area, pet area, and picnic area, if possible. If not, install wood platform or wood-framed raised play and picnic area filled with woodchips. • Install path of walking stones for high-traffic areas. • Seed and fertilize grassy areas, or cover with mulch or woodchips if not suitable for grass.
400–2,000 (moderately high)	• Install raised-bed garden and supplement with clean topsoil. • Install wood-framed raised play and picnic area filled with woodchips. • Install path of walking stones for high-traffic areas. • Seed and fertilize grassy areas, or cover with mulch or woodchips if not suitable for grass.
< 400 (urban background)	• No treatment necessary.

*Based on in situ XRF analysis of surface soils (typically 15 to 25 samples per yard) and lead concentration mapping of the entire yard to include areas of special concern (play areas, gardens, outside eating areas, pet runs, etc.).

PROPOSED SECTION 403
BARE SOIL-LEAD HAZARD IDENTIFICATION

Soil Lead Level (parts per million)**	Recommended Interim Action
> 1,200 (hazard standard)	Eliminate hazard: • Remove contaminated soil install permanent covering.
400–1,200 (level of concern)	Implement interim controls: • Cover bare soil • Use doormats in entryways. • Wash hands, toys, etc., more frequently.
< 400	• No action

** For the yard, concentration is derived from an arithmetic mean of two composite samples, one from the drip line and one from mid-yard. For identified play areas, a single composite sample is used.

The EMPACT LSYP's mitigation strategy currently focuses on application of interim controls, though some permanent measures (blacktop) have been used for car park areas. Clearly, permanent controls are desirable where the resources are available to implement them. The EMPACT LSYP targeted its mitigation measures toward low-cost/no-cost options to address neighborhoods and homes where hazards exist and resources for mitigating these hazards are limited.

It must be noted that the EMPACT LSYP approach to soil measurement is different from the proposed standard in several respects:

1) The EMPACT LSYP maps the entire yard with 15 to 25 field screening XRF analyses; this results in clear identification of hazard areas and the detailed information needed to apply controls in a cost-effective manner.

2) Surface soils are analyzed in situ to provide data on the soil material most likely to come into contact with the residents. Standard protocols would use field collection and offsite analysis of composite grab samples.

3) The proposed 403 rule only applies to bare soil, while the EMPACT LSYP measures all yard surfaces.

4) The proposed 403 rule relies on average measurements (composites) that will most often result in lower lead concentrations than the discrete in situ measurements used to map yards in the EMPACT LSYP.

For these reasons, the proposed 403 standards and the action levels used for the EMPACT LSYP may not be directly comparable. Nonetheless, before applying the EMPACT project's model to your situation, you will need to consult local regulatory authorities to determine the requirements you must meet. State/tribal and local government regulations may be more restrictive than existing federal guidance.

3.4.3.2 Resource Conservation and Recovery Act (40 CFR Parts 240–299)

RCRA regulates the disposal of solid and hazardous waste. EPA's interpretations of RCRA regulations state that soils contaminated with lead-based paint as a result of routine residential maintenance and/or natural weathering or chalking of lead-based paint fall under the household waste exclusion and are not regulated as hazardous waste. This means that material may be disposed of off site in accordance with the regulations governing solid (non-hazardous) waste, known as RCRA Subtitle D, as well as applicable state and local regulations. Lead-contaminated soil that falls under the household waste exclusion need not be tested to determine if it is hazardous waste; if it is tested and found to be hazardous waste, it is still exempt from the RCRA hazardous waste regulations. You should check with state and local authorities, however, to see what testing they require.

3.4.3.3 Lead-Based Paint Poisoning Prevention in Certain Residential Structures (40 CFR Part 35)

This HUD rule establishes procedures to eliminate, as far as practicable, lead-based paint hazards in residential properties that are federally owned or receive federal assistance under HUD programs. The rule requires lead inspection and screening to be performed at all federally owned or assisted target housing, or any time a child under six years of age is found to exhibit an environmental intervention blood lead level (> 20 µg/dL for a single test or 15 to 19 µg/dL in two tests taken at least three months apart). Target housing is defined as any residence built prior to 1978, excluding housing for the elderly or those with disabilities (unless children under the age of six are expected to reside there) or zero bedroom dwellings. Where a soil-lead hazard is found to exist, action is required to reduce the hazard.

The rule establishes six levels of protection: abatement of the lead-contaminated soil, abatement of the lead soil hazards, interim controls, paint stabilization, ongoing lead-based paint maintenance, and safe work practices during rehabilitation.

- When abatement (the permanent elimination of lead) is required for soil, the standards promulgated under TSCA must be followed. Abatement can be achieved through either soil removal and replacement with uncontaminated soil or permanent covering of the contaminated area (e.g., with pavement or concrete).
- Interim controls are steps taken to temporarily reduce lead exposure or hazards. They include impermanent surface coverings (e.g., sod, gravel, bark, artificial turf) and land use controls (e.g., fencing, warning signs, landscaping).
- The remaining actions (paint stabilization, ongoing lead-based paint maintenance, and safe work practices during rehabilitation) are not directly applicable to soil, but can help reduce the potential for increased soil contamination.

The specific level of protection required depends on the type of housing and the type of federal ownership or assistance. Once the required remedial action has been completed, the soil must pass the clearance examinations outlined in the regulations or further action will be required.

3.5 For More Information

3.5.1 Additional Resources

Agency for Toxic Substances and Disease Registry. 1992. *Analysis Paper: Impact of Lead-Contaminated Soil on Public Health.* Available online at http://www.atsdr.cdc.gov/cxlead.html.

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National Research Council. 1993. *Measuring Lead Exposure in Infants, Children and Other Sensitive Populations.* Washington, D.C. National Academy Press. Order online at http://books.nap.edu/catalog/2232.html.

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U.S. Environmental Protection Agency. 1995. *EPA Residential Sampling for Lead: Protocols for Dust and Soil Sampling.* EPA747-R-95-001.

U.S. Environmental Protection Agency. 1996. *Distribution of Soil Lead in the Nation's Housing Stock.* Available online at http://www.hud.gov/lea/lealead.pdf.

U.S. Environmental Protection Agency. 1997. *Reducing Lead Hazards When Remodeling Your Home.* EPA747-K-97-001. Order online at http://www.epa.gov/ncepihom/ordering.htm.

U.S. Environmental Protection Agency. 1997. *Risk Analysis To Support Standards for Lead in Paint, Dust, and Soil, Volumes 1 & 2.* EPA747-R-97-006. Available online at http://www.epa.gov/ncepihom/ordering.htm.

3.5.2 Links

U.S. Environmental Protection Agency

National Lead Information Center
http://www.epa.gov/lead/nlic.htm
A federally funded hotline and clearinghouse that provides information on lead hazard reduction and exposure prevention. To speak with one of the Center's clearinghouse specialists, call 1-800-424-LEAD Monday through Friday, 8:30 a.m. to 6:00 p.m. EST.

Office of Pollution Prevention and Toxics (OPPT)
http://www.epa.gov/opptintr/lead/index.html
Responsible for EPA programs related to lead poisoning prevention and lead regulation. OPPT also provides educational packets for parents, teachers, daycare providers, and librarians, as well as technical information and publications.

Integrated Risk Information System (IRIS)
http://www.epa.gov/iris
An electronic database containing information on human health effects that may result from exposure to various chemicals in the environment. The information in IRIS is intended for those without extensive training in toxicology, but with some knowledge of health sciences.

Lead Poisoning Prevention Outreach Program
http://www.nsc.org/ehc/lead.htm
Funded through a cooperative agreement between EPA and the Environmental Health Center.

Department of Housing and Urban Development,
Office of Lead Hazard Control
http://www.hud.gov/lea/leahome.html
Sets standards for evaluation and management of lead in federally assisted housing, and promotes efforts to reduce lead hazards in privately owned housing. In addition, provides grants to communities to reduce lead hazards in housing.

Centers for Disease Control and Prevention
Childhood Lead Poisoning Prevention Program
http://www.cdc.gov/nceh/lead/lead.htm
Promotes state and local screening efforts and develops improved treatments for lead exposure. CDC also provides a database, 1990 Census Data on Housing and Population—Interactive Query, that allows you to search by county or zip code to find the percentage of houses built before 1950.

Agency for Toxic Substances and Disease Registry (ATSDR)
http://www.atsdr.cdc.gov
An agency of the U.S. Public Health Service established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. ATSDR is required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List to determine if people are being exposed to hazardous substances, which includes lead. The public can search by region to see which health assessments are currently available in an online database located at http://www.atsdr.cdc.gov/HAC/PHA.

National Conference of State Legislatures
http://www.ncsl.org/programs/ESNR/pbdir.htm
Contains NCSLnet Search—a directory of state lead poisoning prevention contacts.

Consumer Product Safety Commission
http://www.cpsc.gov
Identifies and regulates sources of lead exposure in consumer products.

Occupational Safety and Health Administration
http://www.osha-slc.gov/SLTC/lead/index.html
Develops work practice standards and worker exposure limits to protect workers from occupational lead exposure.

4 Beginning the Program

This chapter provides guidance on important first steps that you will need to take as you start your lead-safe yard program. Section 4.1 presents a brief overview of the structure of a lead-safe yard program and outlines the roles and responsibilities of program partners, based on the EMPACT Lead-Safe Yard Project model. Section 4.2 discusses the critical process of selecting program partners who can best help you meet your program's objectives within your target community. Section 4.3 presents guidance on identifying potentially impacted communities that you may want to target with your program. Finally, Section 4.4 provides tips on getting to know your target community in terms of the cultures and languages of residents, the types and conditions of housing stock, and other factors.

The information in this chapter is designed primarily for managers and decision-makers who may be considering whether to implement lead-safe yard programs in their communities, as well as for organizers who are implementing such programs.

4.1 Program Structure: Overview of a Lead-Safe Yard Program

The EMPACT LSYP is a multifaceted project that engages in a variety of activities—everything from distributing flyers to planting grass. These activities can be grouped into four main categories, which make up the main components of the project: education and outreach, soil sampling, yard treatment, and program evaluation.

The following paragraphs summarize these activities to provide an overview of how the EMPACT LSYP works. These activities are described in much greater detail in Chapters 5 through 9.

Outreach During the outreach phase, the EMPACT LSYP approaches homeowners in the target community to educate them about the hazards of lead in soil and to enroll them in the project. Outreach workers make contact with homeowners though flyers, letters, phone calls, and knocking on doors. Lead hazard education is conducted using a variety of tools (printed handouts, videos, quizzes), and then homeowners are asked to enroll in the project by signing a permission form. Finally, outreach workers interview participating homeowners about the activities that take place in their yards; these yard uses are mapped on a plot plan, which is then given to the EMPACT LSYP's soil sampling team and landscaping team.

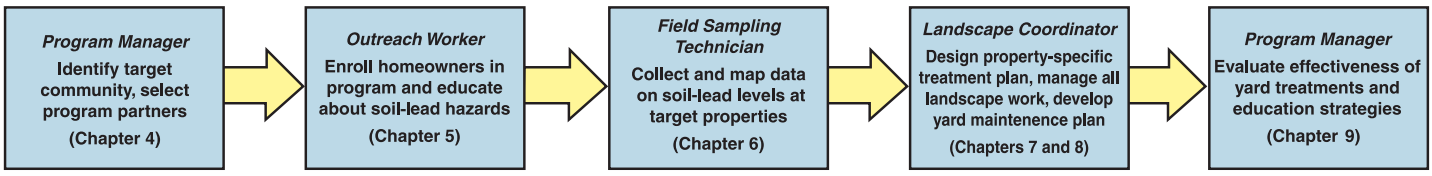
Sampling During the soil sampling phase, a field sampling technician (usually a licensed, trained lead inspector) collects data on soil-lead levels in the yards of participating homeowners, using field-portable x-ray fluorescence technology. Relying on the yard-use map created during the outreach phase, the technician develops a sampling plan that focuses on high-risk and high-use yard areas, where the potential for dangerous exposures to lead-contaminated soil is highest. Sampling results are transcribed onto a color-coded map of the property's lead levels, which is then given to the homeowner and passed on to the landscaping team.

Treatment The EMPACT LSYP provides each participating homeowner with up to $3,000 worth of free landscaping materials and labor for yard treatment. Treatment is

conducted by one or more landscaping teams, headed by a landscape coordinator. This coordinator meets with the homeowner to go over the color-coded map of sampling results and to develop a treatment plan. A typical treatment plan combines various landscaping measures (e.g., wood-framed drip boxes, newly planted grass and shrubs, stone walkways) with changes to the residents' yard use patterns (e.g., moving a children's play area to a safe part of the yard). Once the treatment plan has been implemented by the landscaping team, the coordinator develops a property-specific maintenance manual to help the homeowner maintain the treatment measures.

Evaluation The EMPACT LSYP is currently involved in a major research study to evaluate the effectiveness of its low-cost yard treatment measures. Evaluation is the last phase of the project; however, an effective evaluation process depends on adequate documentation of the project's work during all phases. Key to the EMPACT LSYP's evaluation process is a property-specific case file begun by the outreach worker for each home, and maintained by all members of the EMPACT LSYP team.

The flow chart below summarizes the basic structure of the EMPACT LSYP. The chart identifies the main activities of the project, the team members responsible for these activities, and the flow of work between team members. It also indicates where in this handbook you can go for more information about specific activities.



4.2 Selecting Program Partners

As described in Chapter 1, the EMPACT LSYP is a partnership of several public, private, and non-profit organizations. These include a university, a federal government laboratory, a community planning agency, and private landscape contractors.

Why are so many partners needed for what is essentially a small-scale program? The activities conducted by the EMPACT LSYP demand a number of specialized skills, from communication and language skills to soil sampling training, from landscape design experience to management skills. Each partner plays a different role in the project, based on the specific skills and qualifications that partner has to offer.

For example, EPA's New England Regional Laboratory, a founding partner in the EMPACT LSYP, offers the technical skills needed for analysis of soil-lead levels. The laboratory's staff also have the training to work safely in contaminated soil without endangering their own health. The Dudley Street Neighborhood Initiative, the project's community partner, does not offer these kinds of technical skills, but contributes something just as important: familiarity with the Dudley Street neighborhood and the communication skills necessary to work closely with its multilingual residents.

In starting your own lead-safe yard program, you'll need to assemble a team of individuals or organizations who offer a similar range of skills and qualifications. To select partners or team members,

LESSONS LEARNED: YOUTH EMPLOYMENT AND TRAINING

In its pilot phase, the EMPACT LSYP wished to incorporate youth employment and training into its work. The project hired high school students, who learned on the job while being supervised by adults. This system turned out to be problematic in the pilot phase. It was logistically complex, and costs changed because the on-the-job training meant the work was accomplished more slowly than it would have with trained landscapers. For this reason, it is advisable to get your program organized and running smoothly, then determine which components of the program are a good match for youth training and employment. At that point, you can focus on this aspect of a program.

you should think about how each will fit into the overall program structure, and how different partners can work together to create a successful program. You will also need to consider their relationship to the target community. For example:

- An organization or agency that already has strong ties to the community can be ideal for conducting outreach and education for your program. Neighborhood health centers or community action programs can be a good choice.
- A nearby college or university can help with any research components of your program, or may be able to provide assistance and equipment for the sampling activities. (See Appendix B for a more detailed discussion of this type of approach.) Make sure to check with your state or tribal lead poisoning prevention agency about certification requirements for lead inspectors. See Chapter 6 for more information on finding a qualified person to conduct the sampling and analysis components of your program.
- Landscaping companies are key partners for the design and landscaping components of your program. A non-profit landscaping company specializing in community gardening and small parks can be a good choice. Another approach (being implemented by the EMPACT LSYP in Phase 3) is to develop a pool of small private landscaping companies. Encouraging companies to bid on lead-safe yard work, as described in Section 7.5, is a good way to obtain these services in a cost-effective manner. Landscaping companies should be bonded and insured, and should have the skills to manage the work involved in treating yards to meet your specifications.

As described in Chapter 1, the EMPACT program selected partners who could carry out specific activities. The community partners (Bowdoin Street Health Center, and later the Dudley Street Neighborhood Initiative) led the education and outreach work; the EPA Regional Laboratory led the sampling and analysis activities, with assistance from a certified industrial hygienist from the Health Center; a non-profit landscaping company performed the soil mitigation work; and Boston University School of Public Health led the effort to develop a template for community action for use by other programs.

4.3 Identifying Potentially Impacted Communities

The first step in beginning your lead-safe yard program is to identify communities that may have homes with elevated soil-lead levels. For this purpose, you can determine where the important predictors of lead in soil are present. These predictors include large numbers of children with elevated blood lead levels; a preponderance of older wood-framed housing (generally with wooden clapboard), which is likely to have exterior lead-based paint; and heavy traffic flows, which are likely to have caused deposition of lead from leaded gasoline. These characteristics are discussed in Sections 4.3.1 through 4.3.3. Industrial emissions of lead can also cause elevated soil-lead levels at residences nearby (see Section 4.3.4).

You will also want to consider other characteristics of neighborhood life that can contribute to the success of a program, such as the presence of a community organization that can partner with you and help you get to know the community (see Section 4.3.5).

4.3.1 Children With Elevated Blood Lead Levels

For Phases 1 and 2, the EMPACT LSYP reviewed available blood lead data for children aged six months to six years from the Massachusetts Childhood Lead Paint Poisoning Prevention Program. The target community was within the so-called "lead belt" in Boston (see map on page 3). Your city or state childhood lead program or health department likely has similar blood lead data, organized by census tract or zip code. You can look up state and local lead poisoning prevention contacts in your area on the following Web sites:

The Lead Program of the National Safety Council's Environmental Health Center: http://www.nsc.org/ehc/nlic/contacts.htm

The National Conference of State Legislatures' Directory of State Lead Poisoning Prevention Contacts: http://www.ncsl.org/programs/esnr/pbdir.htm

EMPACT LSYP SITE SELECTION CRITERIA

High incidence of lead poisoning

Pre-1970 painted housing (generally wooden clapboard)

Low-income/immigrant population

Contiguous neighborhood (for neighborhood-wide impact)

An existing health organization focused on the lead issue

Existing neighborhood environmental activities the project could build on and enhance

4.3.2 Older Housing With Lead-Based Paint

Another way to identify potential target communities is to determine which neighborhoods have older, wood-framed housing (generally with wooden clapboard). Such houses are likely to have lead-based exterior paint. As described in Chapter 3, some studies have found a strong link between building age and soil-lead contamination. Therefore, neighborhoods with older housing (especially homes built before 1950) are more likely than newer communities to have a soil-lead problem. The presence of lead-based paint is also considered an important predictor of elevated soil-lead levels. Both EMPACT study areas, the Bowdoin Street neighborhood in North Dorchester and the Dudley Street neighborhood in Roxbury and Dorchester, consist of predominantly older, wood-framed homes with painted exteriors (generally wooden clapboard).

The Centers for Disease Control provides a database, *1990 Census Data on Housing and Population* that allows you to search by county, zip code, or census tract for the percentage of houses built before 1950. The database is at http://www.cdc.gov/nceh/lead/lead.htm.

Keep in mind that some communities may contain vacant lots, greens, and parks in residential areas that may have historical lead contamination from gasoline deposition, past industrial activity, or former housing. See Chapter 10 for tips on applying lead-safe yard mitigation strategies to non-residential sites, such as tot lots, playgrounds, community gardens, and vacant lots.

4.3.3 Heavy Traffic Flows

Some studies stress the concentration of lead-contaminated yards in congested high-traffic, inner-city regions (see Chapter 3), pointing to the importance of lead accumulations from leaded gasoline. Both EMPACT study areas are in heavily traveled inner-city neighborhoods.

4.3.4 Industrial Emissions

Communities near industries that emit lead (or have emitted lead in the past), such as lead smelters, lead mines, battery recycling plants, and incinerators, may also have elevated levels of lead in residential soils. You can find out where such industries are locating by contacting your state environmental agency or EPA Regional office, or by searching EPA's Toxic Release Inventory (TRI) database for facilities in your area that have reported releases of lead to the environment. (http:\\www.epa.gov\enviro\html\toxic_releases.html).

4.3.5 Other Community Characteristics

The EMPACT LSYP took into account several additional factors in potential target communities that would contribute to the project's success. For example, the project targeted homes that were located on adjacent streets rather than in dispersed areas. This made the work more efficient and made it possible that homeowners would become interested in the lead-safe yard activities going on nearby. It also meant that the neighborhood children would be better protected, because children often play in yards near their own.

The project also favored working in service areas of active community-based organizations—first the Bowdoin Street Health Center and later the Dudley Street Neighborhood Initiative (http://www.dsni.org). Both of the selected neighborhoods had a history of environmental health activities. The EMPACT LSYP could, therefore, build upon previous initiatives and take advantage of neighborhood connections already made by these community organizations.

4.4 Getting To Know the Community

Once you have identified your target community, your task is to learn more about it. Make sure you have your target area clearly mapped and marked so that you can begin planning. Next, find out the key "statistics" about the community. Some of the questions you will want to answer about the community include:

- What are the cultures and languages of the people who live there?
- What are the residents' income and education levels?
- What is the percentage of home ownership/owner-occupied dwellings?
- What is the percentage of housing built before 1978?
- What is the condition of the older housing stock?
- What organizations and agencies are active in the community?
- What prior work has gone on in the community to prevent lead poisoning?

- What are the numbers, percentages, and location of lead-poisoned children in the community?
- Have any homes in the area been de-leaded?
- What are the names, addresses, and phone numbers of homeowners in the target area?

Information such as income and education levels and age of housing can be obtained from census data; other questions about the community such as cultural characteristics can be provided by your community partners. All this information will help you form a clear picture of your target community and the best ways to reach them. The EMPACT LSYP, for example, knew that many residents in the Bowdoin Street neighborhood spoke Spanish, Cape Verdean Creole, or Haitian Creole, so that conducting spoken and written outreach and education in these languages would be critical to the success of the program. Sample outreach flyers in four languages are included on pages 41 to 44 in Chapter 5.

5 Communicating About Lead in Soil and Your Lead-Safe Yard Program

This chapter describes how to provide education and outreach to homeowners and residents about the problem of lead in soil and the benefits of participating in a lead-safe yard program. Section 5.1 presents strategies for approaching homeowners and residents to inform them about your program and to develop a sense of trust and credibility within your target community. Section 5.2 discusses methods for educating people about soil-lead hazards and the benefits of your program. Section 5.3 is devoted to establishing an application process for enlisting homeowners in your program and obtaining their consent for the work that will be done on their property.

The information in this chapter is designed primarily for managers who are implementing lead-safe yard programs, as well as for outreach workers who are responsible for communicating about lead in soil and your lead-safe yard program.

5.1 Approaching Homeowners and Residents

Once you have learned the basics about your target community, you can begin your education and outreach efforts.

Walk around your target community on a pleasant day and talk to people face to face.

First, determine who will be conducting outreach and education for your program. If possible, the outreach worker should be a person who lives in the community and is respected and credible. People who do not live in the community can sometimes be very effective, however (such as a lead nurse from a community health center, or someone otherwise familiar with the community and the issues people there are facing).

A good next step is to develop an area-appropriate flyer, such as the EMPACT LSYP's flyer on pages 41 to 44 ("Dorchester Lead-Safe Yard Program"). You can ask area businesses to post the flyer or allow you to do so. You can also distribute flyers to all the homes in your target neighborhood(s), then follow up by calling all the homeowners to inform them of the project and their eligibility. Sending informational letters to the targeted neighborhood homeowners might be an effective alternative. Examples of initial and follow-up letters used by the Lead Safe Boston program (a spinoff of the EMPACT LSYP) are included on pages 45 and 58 to 59. Other ways of increasing awareness of your program within the community include radio promotions and forums at other local promotional events.

The next step is to focus on meeting people face to face. This is important because people need to get to know and trust you before they open their home to your project. Below are some tips for effective ways to approach people in person:

- Walk around the area on a pleasant day or holiday, when people are most likely to be out of doors. Weekend door knocking is recommended.
- Vary the times of day at which you do outreach, but always be respectful of "normal waking hours" for people, unless you have been otherwise invited. Try not to go at family rush hours (around 8 to 10 a.m. or 4 to 6:30 p.m.); going at these times may turn people off to the project.

Residents will need to get to know you before they open their home to your project.

- If the area has a high percentage of non-English speakers and you don't speak the languages spoken in the area, try to get a friend or co-worker who speaks the most prevalent language to walk with you.
- Be sure to take project flyers with your name and number on them, permission slips, and information/referrals about lead testing, treatment, and de-leading programs.
- Attend events and meetings in the neighborhood to give out flyers and get to know people. The EMPACT LSYP outreach worker found that outdoor events such as community picnics are good venues for outreach work. Community garden and food projects may also yield receptive audiences.
- Remember that news about a project like this spreads by word of mouth and visible results. Any negative perceptions will travel twice as fast as positive ones, so try to make only positive impressions!

The EMPACT LSYP engaged in a wide variety of additional activities to promote the project as well as to enhance community lead awareness. These included:

- Participation in a "Lead Expo" at a community center, in the citywide Lead Awareness Week, and in the neighborhood Multicultural Festival.
- Footage about the project on the local cable station (Neighborhood Network News).
- Discussion of the project in a segment entitled "Removing Lead from a Low-Income Community" on National Public Radio's *Living on Earth,* an award-winning environmental news magazine.
- Presentations at workshops and conferences, including the Second Syracuse Lead Conference (October 1999) in Syracuse, New York, and the Toxics Action '99 conference at Boston College in Newton, Massachusetts.

5.2 Educating People About Lead and Lead in Soil

Once you have identified people interested in the program and willing to speak with you at greater length, you will have the opportunity to provide education about the problem of lead exposure, explain the benefits of your program, and answer questions. The EMPACT LSYP's Education and Outreach Plan is presented in the box on page 39.

In conducting education, you should convey the basic dangers of lead first—how and why lead is dangerous to families' health, as well as what people can do to protect themselves (de-leading, proper nutrition, cleaning, etc.) Remember that you need to educate people not only about lead in soil, but about all the sources of lead in and around the home. It is important to follow up on the advice you give about these issues, so that people don't get frustrated and give up on slow-moving assistance programs.

Many city or state childhood lead programs have developed excellent written materials on lead poisoning prevention that you can use with residents. Examples of some used by the EMPACT

program, from the Boston Childhood Lead Poisoning Prevention Program, are included on pages 46 to 55. Using the Internet, you can also access educational materials developed by EPA and other federal agencies. These materials include:

Protect Your Family From Lead in Your Home (EPA 747-K-99-001, http://www.epa.gov/opptintr/lead/leadpdfe.pdf) is a 16-page educational pamphlet that provides general information about lead and lead hazards. A Spanish-language version can be found on HUD's Web site at http://www.hud.gov/lea/leadpdfs.pdf.

Lead in Your Home: A Parent's Reference Guide (EPA 747-B-98-002, http://www.epa.gov/lead/leadrev.pdf) is a more comprehensive guidebook, 67 pages long, that recommends steps parents can take to reduce their family's risk of lead exposure and prevent lead poisoning.

What Every Parent Should Know About Lead Poisoning in Children (http://www.cdc.gov/nceh/lead/faq/cdc97a.htm) is a one-page fact sheet from the Centers for Disease Control and Prevention that provides basic information about lead poisoning and lead-paint hazards.

Keep in mind that written materials are not always enough to get the message across. The EMPACT LSYP has found that outreach workers need to develop creative ways of emphasizing and reinforcing the lead hazard message (e.g., by using tools such as films and quizzes), and to create repeated opportunities for homeowner re-education. For tips on creative education strategies, see "Lessons Learned: Education and Outreach" on page 38, and Sections 8.4 and 8.5.

For your lead-safe yard program, you will want to give special emphasis to why addressing lead in soil can help protect health. You will need to explain how lead gets into soil, how children playing in yards with contaminated soil are exposed to lead, and how dirt and dust containing lead can also be tracked into the home. Once the levels of lead in a yard's soil are tested, you can go over the recommended actions (based on these levels) for the yard (see Section 7.4). Finally, the residents need to understand that landscaping measures do not remove the contaminated soil; the landscaping needs to be properly maintained to control exposure to the lead hazard, and future home improvements need to be done safely to prevent recontamination.

5.3 Next Steps: Enlisting the Homeowner in the Program

If a homeowner has shown interest in your program based on your initial outreach and education, you can encourage him or her to take the next steps. The EMPACT LSYP found that at this point in the process it was important to reassure homeowners that they would not be penalized if they did not participate, and that there was no catch to the free landscaping provided.

The process of enlisting the homeowner into your program can be as formal or informal as you want to make it. One option is to establish a formal application process that the homeowner will complete before participating in the program. Lead Safe Boston, a spinoff of the EMPACT LSYP run by the City of Boston (see Section 1.2.1), requires homeowners to fill out an application form and submit copies of their insurance policy, their water and sewer payment plan, and a recent real estate tax bill. Lead Safe Boston's application form is included on pages 56 to 57.

Once accepted into the program, the homeowner should sign a "permission slip" or consent form that establishes an agreement between the program and the homeowner to allow testing of the

LESSONS LEARNED: EDUCATION AND OUTREACH

A key to the success of a lead-safe yard program like EMPACT's is that residents understand why lead in soil is harmful to their children. Without this understanding, it is more likely that the landscaping measures will not be maintained, greatly reducing their effectiveness in protecting children from lead exposure.

In its first two phases, the EMPACT LSYP followed a model commonly used for community education and outreach: a bilingual outreach worker from the community health center conducted typical outreach activities, including walking in the neighborhood, door knocking, distributing flyers, speaking at community meetings, and talking with people one on one. These efforts were culturally specific to the neighborhood and conducted at an appropriate literacy level.

After Phase 2 was completed, the project returned to the residences where yard work had been done to evaluate how the work had held up and what had been learned. They found that people had not really taken in the problem of lead in soil, but viewed the project as more of a landscaping program.

To remedy this shortcoming, in Phase 3 the project implemented a more comprehensive education program, using several new approaches. The community outreach worker received more extensive training on the lead issue. She helped devise a new plan to show community residents a video, "The Thief of Childhood," as a teaching tool about the hazards of lead. After watching the video, residents were given a short quiz (see box on page 40). The quiz motivated the resident to pay attention to the video, whose key messages were reinforced by the questions. The outreach worker graded the quizzes and discussed the answers with the residents. Thus, the education work used three different modes of learning: visual (the video), written (the quiz), and oral (discussion of the video, quiz, and educational flyers). The quiz will be used again when the yard mitigation work is completed, to see whether the residents have retained the information.

So far, the project has judged this new approach to be more effective than using literature alone. The video and quiz seem to be an engaging, interactive "hook" to promote a better understanding of the lead problem and the health benefits of a lead-safe yard.

Another video that could be used for the same purpose is EPA's "Little Moccasins" Lead Safety Program video, created for day care centers, clinics, and families. This 22-minute animated video was developed by the Houlton Band of Maliseet Indians with funding from EPA's Lead Program. An interactive "First Steps" CD-ROM is also available, presenting helpful information on lead poisoning prevention in the form of video clips, games, and songs. Ordering information for the CD-ROM and both videos is found in Section 5.4. Ask your community or state lead officials to recommend other videos appropriate for your audience.

property, participation in a design session, and subsequent remediation through landscaping. The permission form should include language regarding the homeowner's duty to have their property in testable and workable condition (removal of trash, debris, and old cars; notification about/relocation of pets). Again, the permission form can be formal or informal, depending on the needs of your program. A very simple form, used by the EMPACT LSYP during Phases 1 and 2, is shown on page 60. A more detailed consent form, developed by Lead Safe Boston, is shown on pages 61 to 62.

At this point you should establish a case file that contains all the information related to application, testing, mitigation, and follow-up for the property. The EMPACT outreach worker keeps all this information, including "before and after" photographs, in a binder, which is given to the homeowner when the work is completed.

Next, the outreach worker conducts a homeowner interview. The interview is designed to obtain information about the activities that take place in the yard and the ages and numbers of people who use the yard. The questionnaire that the EMPACT outreach worker uses is shown on pages 63 and 64 (filled out for a hypothetical home).

To map out yard use patterns, the outreach worker uses a house plot plan, as shown on page 65. Plot plans can be developed in one of several ways. For example, the outreach worker can visit the municipal assessor's office to photocopy official drawings showing the footprint of the house and all property lines. A plot plan can also be developed using a geographic information system (GIS), or the outreach worker can simply draw one by hand, using a measuring tape and pen and paper. The plot plan developed during this outreach phase will be used later as a guide for the field testing crew and for the landscape coordinator, as described in Chapters 6 and 7.

The next step in the process is testing of the yard soil, followed by a design session with the homeowner if the yard is found to have high levels of lead. These steps are described in detail in Chapters 6 and 7 of this handbook.

5.4 For More Information

Your local or state childhood lead poisoning prevention program may have good educational materials on lead issues.

Lead education materials developed by EPA's Office of Pollution Prevention and Toxics can be accessed at http://www.epa.gov/lead/leadpbed.htm.

The following Web sites list state and local lead poisoning prevention contacts:

> The Lead Program of the National Safety Council's Environmental Health Center:
> http://www.nsc.org/ehc/nlic/contacts.htm

LEAD-SAFE YARD EDUCATION AND OUTREACH PLAN

1. **Make appointment with interested applicants to discuss the problem of lead poisoning and the lead-safe yard and home program.**
2. **Home visit: First, ask them if they have had experience with lead poisoning. Have they had a child, relative, or neighbor who was lead poisoned? Using theeducational pamphlet, discuss five key points about lead poisoning:**
   - **—How does a child usually get lead poisoned? (Paint chips, dust and dirt on hands and toys, lead in water)**
   - **—How do you avoid lead in drinking water? (Run tap water until it is cold)**
   - **—How do you avoid lead in the home? (Specific lead-safe home cleaning and maintenance procedures)**
   - **—Why is dust on children's hands and toys, as well as on window sills and floors, a problem, especially if the house is not de-leaded? (Children may put hands, fingernails, toys, or food dropped on floor in their mouths)**
   - **—What foods are good for preventing lead poisoning? (Foods high in iron, calcium, and vitamin C, and low-fat foods)**

   This is a good time to show the photos of the LSYP.
3. **Give the homeowner the video which is available in multiple languages, explores the dangers of lead paint poisoning, its adverse health effects, and practical measures for protecting children (see Section 5.4 for ordering information). Also give the homeowner the set of questions to answer after viewing the video. (The answer sheet can be returned immediately after watching the video, or later, with the lead-safe yard and home application.)**
4. **Explain the application process and documentation needed for the lead-safe yard program.**
5. **Leave the application, video, and sheet of questions (if the homeowner hasn't returned it already) with your business card.**

The National Conference of State Legislatures' Directory of State Lead Poisoning Prevention Contacts: http://www.ncsl.org/programs/esnr/pbdir.htm

For guidance on writing clearly and effectively for a general audience, try http://www.plainlanguage.gov.

Video: "Lead Paint Poisoning: The Thief of Childhood" (20 minutes, 1996)

This video explores the dangers of lead-paint poisoning and its adverse health effects. It provides information, education, and practical advice on protecting children, using interviews and discussions with educators, health care providers, and culturally and linguistically diverse parents whose children have been lead poisoned. The video is available in English, Spanish, Cape Verdean Creole, Haitian Creole, and Vietnamese. Available for $10 from: City of Boston, Office of Environmental Health, 1010 Massachusetts Avenue, Boston, MA 02118. Phone 617-534-5966, Fax 617-534-2372.

Video: "Little Moccasins" Lead Safety Program Video (22 minutes)

This lead poisoning prevention video was developed for day care providers, clinics, and families by the Houlton Band of Maliseet Indians, with funding from EPA's Lead Program. The video is available in English, but may soon be available in Spanish and some Native American languages. Available free of charge from Philip Quint, Lead Director, Houlton Band of Maliseet Indians, at 1-800-545-8524 or 1-207-532-4273. **E-mail quint@ainop.com**.

CD-ROM: "First Steps"

This CD-ROM, developed by the Houlton Band of Maliseet Indians with funding from EPA's Lead Program, presents helpful interactive information on lead poisoning prevention in the form of video clips, games, and songs. Course manuals are available on the CD in English, Spanish, and Native American motif. Available free of charge from Philip Quint, Lead Director, Houlton Band of Maliseet Indians, at 1-800-545-8524 or 1-207-532-4273. **E-mail quint@ainop.com**.

QUIZ TO ACCOMPANY FILM, "THE THIEF OF CHILDHOOD"

1. **By what year was lead no longer used in new house paint?**
2. **How can a child get lead poisoned?**

   a) paint chips **b) dust**

   c) drinking water **d) all of these**
3. **Name some foods that are good for children and that help decrease blood lead poisoning.**
4. **How can you avoid lead in drinking and cooking water?**
5. **How can you avoid lead hazards from home interiors?**
6. **Name two ways in which lead has gotten into yard soil.**
7. **Give three suggestions for protecting children in the home and yard from becoming lead poisoned.**

DORCHESTER LEAD-SAFE YARD PROGRAM

FREE SOIL TESTING IN YOUR YARD FOR LEAD

WE ARE LOOKING FOR 50 YARDS IN YOUR NEIGHBORHOOD
WITH HIGH LEVELS OF LEAD
IF YOUR YARD MEETS A CERTAIN LEVEL, YOU COULD BE
ELIGIBLE FOR $700 WORTH OF FREE MATERIALS AND LABOR
WHICH WILL MAKE YOUR YARD SAFER AND ATTRACTIVE
WITHOUT ANY COST TO YOU!

The Dorchester Lead-Safe Yard Program is a collaboration of the Bowdoin Street Health Center, the New England Environmental Protection Agency Laboratory, Boston University School of Public Health and Garden Futures. The purpose of this pilot program is to show that low cost methods exist which will make your yard safer. By improving the safety of your yard, we hope this will further reduce the risk of our children six years of age and younger becoming lead poisoned.

Your neighborhood has been chosen for this pilot project because there are a number of children with high levels of lead in their blood. Lead is especially hazardous to children. This is the main reason we want to conduct this pilot program. Because children play in many parts of this neighborhood, you do not have to have children six years of age or younger to participate.

We will first test your yard for lead content and if your yard qualifies, we will work with you on certain methods of reducing exposure to elevated lead levels. Staff from Garden Futures will provide landscape materials and labor to complete the work in your yard.

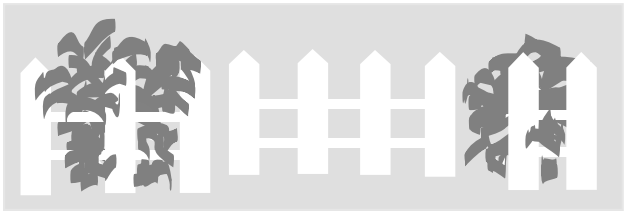
If you are interested in participating in this program, please call the number listed at the bottom of this page. We will be in the neighborhood speaking with you and your neighbors about this program. If you have questions, please do not hesitate to call.

FOR MORE INFORMATION OR TO PARTICIPATE IN THIS PROJECT, CALL

Bowdoin Street Health Center, (617) 822-5318

PROGRAMA DE PATIOS SIN PLOMO DE DORCHESTER

(Dorchester Lead-Safe Yard Program)



PRUEBAS DE PLOMO GRATUITAS EN SU PATIO

ESTAMOS BUSCANDOS 50 PATIOS EN EL VECINDARIO CON ALTOS NEVELES DE PLOMO EN LA TIERRA.

SI SU PATIO CONTIENE PLOMO, USTED PUEDE SER ELEGIBLE PARA RECIBIR 700 DOLARES, ENTRE MATERIALES Y TRABAJO, PARA REMOVER EL PLOMO DE LA TIERRA Y EMBELLECER SU PATIO SIN COSTO ADICIONAL PARA USTED.

El Programe de Patios sin Plomo de Dorchester es una colaboración del Centro de Salud de Bowdoin Street, el Laboratorio de la Agencia de Protección Ambiental de Nueva Inglaterra, la Escuela de Salud Pública de Boston University y Garden Futures. El objectivo de este programa piloto es il mostrar que existen métodos a bajo costo que harán sus patios más seguros. Mejorando los patios esperamos reducir el riesgo que corren los niños de seis años y menores de acabar envenenados com plomo.

Su vecindario ha sido escogido para este programma piloto debido al alto número de niños envenenados o con altos niveles de plomo en la sangrue. El plomo es realmente perjudicial para los niños, y eelo es la razón por la que queremos realizar este programa. Debido a que los niños juegan en diferentes partes del vecindario, usted no tiene que tener niños de seis años o menores para participar.

Primero mediremos la tierra de su patio para ver si esta contiene plomo, y si es elegible trbajaremos con uste par mostrarle ciertos métodos para reducir el nivel de plomo en la tierra. Personal de Garden Futures trabajaran proveyendole materiales jardineria y trbajarán para completar el trabajo en su patio.

Si usted está interesado en participar en este programa, por favor llame a la persona listada más abajo en esta página. Estaremos en el vecindario hablando con usted y sus vecinos sobre este programa. Si tiene alguna pregunta, por favor llamenos.

Para Más información o Para Participar en este Programa, Llame
Bowdoin Street Health Center, (617) 822-5318

Dorchester Lead-Safe Yard Program

Um teste gratuito para detectar veneno de chumbo no seu pátio/quintal. Procuramos 5 pátios, na vizinhança, com nível de veneno de chumbo elevado. Se o seu pátio/quintal mostrar um nível elevado de veneno de chumbo no solo você se qualificar a receber uma quantia de $700 no valor de materiais e mão-de-obra, o que lhe irá ajudar a tornar o seu quintal mais atractivo e seguro. Este programa lhe será ofericido sem nenhum custo monetário.

Este programa e uma colaboraçao de Bowdoin Street Health Center, New England Environmental Protection Agency Laboratory, Boston University School of Public Health e Garden Futures. O propósito do programa e para mostrar que existen meios, a preços accessíveis, para remover o veneno de chumbo do solo, e tornar o seu pátio/quintal mais seguro. Ao reduzir o nivel de chumbo no solo, esperemos que ira diminuir a possibilidade dos seus filhos, menores de seis anos di idade, contrairem veneno de chumbo no sangue.

A sua vizinhança foi escolhida para este programa porque existe un numero elevado de criancas contaminadas de chumbo no sangue, o que é bastante projudicial, e pode causar graves problemas de saúde. Porque as crianças brincam em varios lugares, não e necessario que você tenha filhos/as para poder participar neste programa.

Faremos un teste para detectar resdios de chumbo. Se o seu pátio qualificar, entraremos em contacto consigo para discutirmos meios de como reduzir o nível do chumbo. O pessoal de Garden Futures providenciará materiais e mão-de-obra. Se você está interesada/o em participar neste programa, por favor contacte:

Bowdoin Street Health Center, (617) 822-5318

Pwogram Ki Okipe Lakou Kont Plon

Tes Gratis Nan Lakou Pou Plon

Nap Chache Sinkant Pie Nan Lakou Ki Nan Zòn Nan

Ki Genyen Yon Nivo Plon Ki Wo.

Si lakou a genyen Yon nivo plon, ou kapab elijib pou yon zafe de set san dola an mateiyo & men dèv sak ka fè lakou bel, san danje e gratis.

Pwogram sila ki pou kimbe lakou san danje. Marè avek Bowdoin St. Sant pou Sante, N.E. EPA, B.U.S. of P.H. & Garden Futures. Rezon pwogram sa se pou montre ou metod bon mache ki egziste pou fè lakou san danje ak plon. Pake timoun yo ap jwe tout kote. Ou pa bezyen gen timoun sizan ou byen timoun pi piti pou patisipe.

Nap Teste lakou pou plon, si lakou a kalifye nap travay ak ou pou redwi nivo plon an. Nap ba ou materyo ak zouti pou travay sila.

Si ou enterese patisipe nan pwogram nan souple rele moun sa ke ou we nan an ba fey la. Nap pale ak ou e ak vwazen ou o sijè pwogram nan.

Si yon gen keksyon pa ezite rele:

Bowdoin Street Health Center, (617) 822-5318

Department of Neighborhood Development

Boston's Public Facilities Department

Thomas M. Menino, Mayor
Charlotte Golar Richie, Chief and Director

January 5, 2000

Dear Property Owner:

The City of Boston's Lead Safe Boston program, in conjunction with the National Center for Lead Safe Housing and the Environmental Protection Agency, would like to offer you the chance to improve the quality of the grounds surrounding your home through a unique program:

Low Level Soil Treatment Demonstration Project

There is no cost involved or work required on the part of the property owner!

Properties meeting project criteria and enrolled in the program will be part of an effort to demonstrate low-cost soil interventions through the use of landscape treatments that will enhance the appearance of your home!

What the Program Can Offer You!

Up to **$3000** to cover the design, acquisition and installation of landscape elements.
Comprehensive testing/sampling of soil surrounding your home.
Scaled drawings of your property identifying lead hazard areas.
Fully developed plans showing proposed treatments and plantings.
Supervised construction and installation of all landscape treatments.
Detailed educational information.

What We Ask Property Owners To Do!

Answer a questionnaire concerning Lead Paint Hazards.
Allow project staff to sample the soil surrounding your home.
Participate in and provide feedback during the landscape design process.
Enjoy your newly landscaped yard!!!

A representative of Lead Safe Boston and The National Center for Lead Safe Housing will soon be contacting you about your possible involvement in this program.

We hope you decide to join us in this important endeavor!

Please call the Lead Safe Boston office at (617) 635-0190 with any questions regarding the program.

Fact Sheet: LEAD

What is Lead?

Lead is a poisonous metal found in nature. Because it is durable and persistent, it was used in house paint, pipes, cans, old toys, cribs, and furniture.

If a house was built before 1978, it probably has lead paint. Lead dust can be created by just opening and closing windows.

What does lead poisoning do to my child?

Lead poisoning can damage your child's brain, cause hearing loss and learning disabilities, and impair motor skills.

How can my child be exposed?

Your child can be exposed to lead by touching window sills, ledges, and other areas which have lead dust, and then putting their fingers in their mouths. This is normal behavior for children.

Finding the Lead

The only way to find out where the lead is in the house is to have a lead inspection done by a licensed inspector. If the inspector finds lead, then a licensed contractor must come in and make the house safe. You cannot live in the house while this is happening.

Lead Dust is Invisible

The most common way for children to be poisoned is by exposure to lead dust.

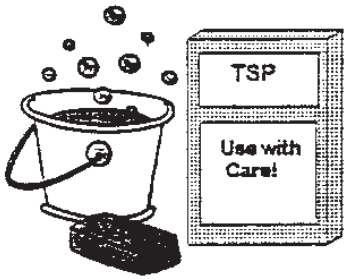
What Can I Do?

Make sure your child has a well-balanced diet, which includes milk (for calcium), dark green, leafy vegetables (for iron), and vitamin C. Have your child's blood tested regularly.

Wash Hands and Toys Often!

Wash your child's hands and toys often, and keep fingernails short.

Run the tap water for a few minutes every morning. Use only COLD water for cooking and drinking. Hot water concentrates the lead.



Keep It Clean!

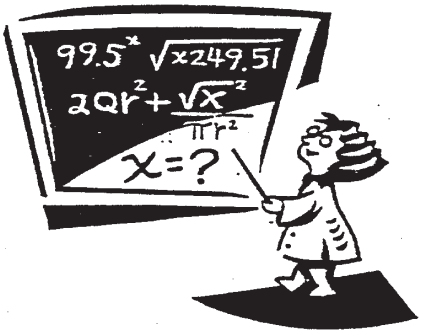
Wipe windows, windowsills and dusty surfaces with warm water and TSP. Throw used paper towels away after wiping.

Don't Disturb Leaded Paint!

Make sure that there is no loose or flaking paint. NEVER scrape painted surfaces.

For more information, contact the Boston Childhood Lead Poisoning Prevention Program at the Boston Public Health Commission
1010 Massachusetts Avenue, 2nd Floor, Boston, MA 02118
(617) 534-5966

How Much Do You Know About Lead Poisoning?



MYTH
There is no way to prevent children from being lead poisoned.

FACT
Lead poisoning is completely preventable Get the facts and learn how to protect your child by getting lead out of your home safely.

MYTH
Children have to eat paint chips, or chew on walls, to be lead poisoned.

FACT
Children can be poisoned simply by breathing lead dust. They can also be poisoned by having lead dust on their toys or fingers and then putting their fingers in their mouths.

MYTH
Only children with very high levels of lead in their blood will be hurt by the lead.

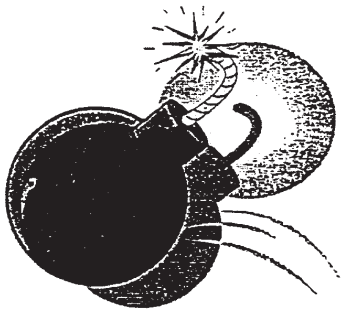
FACT
Low levels of lead in a child's blood can cause long term problems and permanently affect learning and behavior.

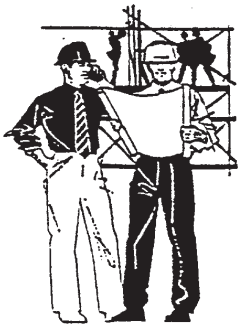
MYTH
Only children who live in the inner city can be lead poisoned.

FACT
Any child, from any neighborhood, can be lead poisoned. Lead paint can be in any home built before 1978.

MYTH
Lead poisoning is not a real problem. Many people grew up in homes with lead paint and are perfectly healthy.

FACT
The lead paint that existed in homes twenty years ago is much more dangerous now. As lead paint gets older, it is likely to peel, chip, and create lead dust. This is a real health hazard.





MYTH
Having a home deleaded is much more dangerous than just leaving the lead paint there.

FACT
Lead removal must be done by a licensed deleader who will use safe techniques and who will clean up properly.

For more information, contact the Boston Childhood Lead Poisoning Prevention Program at the Boston Public Health Commission
1010 Massachusetts Avenue, 2nd Floor, Boston, MA 02118
(617) 534-5966

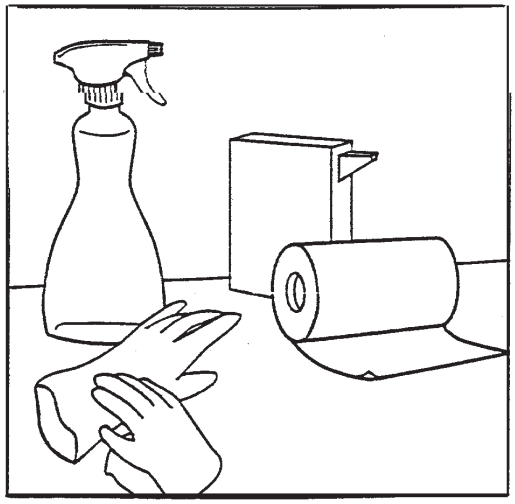
TEMPORARILY REDUCING LEAD PAINT HAZARDS BY CLEANING

1 Wear plastic gloves to clean
Protect yourself from exposure to lead.

2 Pick up all chips by hand or use a damp paper towel (Window areas often have lots of paint chips)
- Seal chips and paper towels in a plastic bag and throw out. ***Do not use a household vacuum or broom to clean up lead paint chips or dust!***

3 Wash household surfaces
- Use TSP, a lead-specific detergent, or any all-purpose, non-abrasive cleaner.
- Scrub well for best results. (Don't scrub hard enough to remove the intact paint.)
- Clean window wells, window sills, play areas, and floors at least once or twice a week.
- Keeps children away when cleaning.
- Keep all cleaners safely away from children.

4 Use a spray bottle to keep dust levels down
- Use a cleaner already in a spray bottle, or put the cleaner into a spray bottle.
- If you must use a bucket, keep the wash water clean. Never put dirty paper towels into the wash water.



5 Use paper towels
- Don't use dish cloths or sponges to clean.
- Use a new paper towel to clean each area.
- Seal the used paper towels and gloves in a plastic bag and throw them out.

6 Rinse after cleaning
Use clean water and paper towels for rinsing each area.

7 Clean up properly
- Wash your hands when cleaning is done.
- Pour any wash and rinse water down the toilet, not the sink.

***Important!* Do not use a household vacuum or broom to clean up lead paint chips or dust. This could spread the lead dust into the air and into your vacuum cleaner or broom.**

Massachusetts Department of Public Health • Childhood Lead Poisoning Prevention Program

TEMPORARY WAYS TO KEEP CHILDREN SAFE FROM LEAD PAINT HAZARDS

Under the Lead Law, the property owner is responsible for having his or her home deleaded or brought under interim control if it was built before 1978 and a child under the age of six lives there. Deleading permanently reduces the risk of lead poisoning. Until deleading occurs, here are some temporary ways to reduce lead hazards:

1 **Clean often**

Wet wiping regularly reduces lead dust levels in the home. See other side.

2 **Put duct tape or contact paper over peeling paint and plaster**

Put duct tape or contact paper on window wells, window sills, walls or other surfaces with peeling paint or plaster. Clean these areas often. Window wells and sills can be cleaned more easily when contact paper or duct tape are put down first. See other side.

3 **Keep the lower part of the window closed (if possible)**

If a window well is in bad condition, keep the lower part of the window closed and open only the upper part. This will prevent your children from putting their hands or objects in the window well where the lead dust collects. It also helps keep lead dust from blowing into the house.

4 **Move furniture to block contact with peeling paint and plaster**

By moving a sofa in front of a crack in a wall, you can block a child's access to lead hazards. Never place furniture where a child may climb on it and fall out of a window.

5 **Change child's bedroom (if possible)**

If your child's bedroom has chipping paint or plaster, consider using another room without chipping paint for the bedroom.

6 **Other ideas**

Regularly have your child tested for lead poisoning; wash your child's hands and toys often; if you are renovating or repainting call CLPPP for more information on how to do the work safely before you begin; feed your child food high in iron, calcium, and vitamin C and low in fat.

Lead Poisoning and your child health

Lead pain is the most common cause of childhood lead poisoning. When old paint cracks or peels, or when lead paint surfaces rub against each other or are bumped, lead paint dust or chips are created. Children typically become poisoned by putting their fingers which have touched lead dust into their mouths. Lead poisoning can cause lasting damage to children's brains, kidneys and nervous system. Even lower levels of lead can slow children's development and cause learning and behavioral problems. Children under six are at greatest risk.

Keep your child safe

Remember, these are only temporary ways to reduce the risk of lead poisoning from lead paint hazards. The only permanent way to reduce the risk of lead poisoning is to have the home deleaded. The owner of a home built before 1978 is responsible for having it deleaded or brought under interim control when a child under the age of six lives there.

FOR MORE INFORMATION, CONTACT:

or your local lead program at

Massachusetts Department of Public Health
Childhood Lead Poisoning Prevention Program
617-753-8400 or 800-532-9571 (toll free)
www.magnet.state.ma.us/dph

BOSTON CHILDHOOD LEAD POISONING PREVENTION PROGRAM

UNDERSTANDING WHAT BLOOD LEAD (PB) TEST RESULTS MEAN:

IF THE CHILD HAS A PB LEVEL OF:	THEN:
9 ug/dL or below	A child with a blood lead level below 9 is not considered to be poisoned.
10 - 14 ug/dL	The CDC defines a level over ten as a "level of concern." The child should be tested again frequently. Check with your pediatrician. He or she may prescribe multi-vitamins and iron.
15 - 19 ug/dL	The child's pediatrician should be involved in helping bring this blood lead level down by managing the child's diet and increasing nutrition. In addition, the child should be tested frequently. An environmental assessment should be done to find out where the lead is coming from. Prevention measures should be implemented immediately.
20 - 24 ug/dL	Get a complete medical evaluation, and have the child's home inspected for lead. Find and get rid of lead hazards in the child's home, school, and play areas.
25 ug/dL and above	**A child with a blood lead level above 25 is considered poisoned.** A lead inspection in the home is required, and it is essential that the child visit the doctor immediately. This is very serious. Medical treatment such as chelation may be used.
70 ug/dL and above	A child with this level is considered a medical emergency.

For help understanding your child's test result, talk with your pediatrician or health care provider. For information and assistance regarding inspections and removing lead hazards from your home, in Boston contact: **The Boston Childhood Lead Poisoning Prevention Program at (617) 534-5966.**

Outside of Boston, call **The Massachusetts Department of Public Health's Childhood Lead Poisoning Prevention Program at (800) 532-9571.**

For more information, contact the Boston Childhood Lead Poisoning Prevention Program at the Boston Public Health Commission
1010 Massachusetts Avenue, 2nd Floor, Boston, MA 02118
(617) 534-5966

PROGRAMA DE PREVENCIÓN DEL ENVENENAMIENTO INFANTIL CON PLOMO

COMPRENDA EL SIGNIFICADO DE LOS RESULTADOS DEL EXAMEN DE PLOMO EN LA SANGRE (PB):

SI SU NIÑO TIENE UN NIVEL DE:	ENTONCES:
9 ug/dL o menos	Se considera que un niño con un nivel de plomo en la sangre con menos de 9 no está envenenado.
10 - 14 ug/dL	El Centro de Control de Enfermedades (CDC) define un nivel mayor de 10 como un "nivel de interés." El niño debe ser chequeado frecuentemente. Consulte con su pediatra, este le puede recetar multi-vitaminas e hierro.
15 - 19 ug/dL	El pediatra debe colaborar y ayudarle a reducir el nivel de plomo en la sangre de su niño, através de cambios en la dieta y nutrición. También, el niño debe ser chequeado frecuentemente y el ambiente tiene que ser examinado para encontrar la fuente del plomo. Medidas de prevención tienen que ser implementadas inmediatamente.
20 - 24 ug/dL	Su niño necesita una completa evaluación médica. El pediatra puede recetarle hierro. Localize el lugar de donde proviene el plomo y aleje a su niño de este lugar. Recuerde que la fuente de plomo puede estar en su casa, en la escuela y donde juega su niño.
25 ug/dL y mayor	Se considera que un niño con un nivel de plomo en la sangre mayor de 25 está envenenado. Intervenciones ambientales y médicas tienen que ser implementadas inmediatamente. Un tratamiento médico y medicinas pueden reducir el nivel de plomo en la sangre.
70 ug/dL y mayor	Un niño con este nivel es considerado una emergencia médica.

Si necesita más ayuda para comprender los resultados de su niño, hable con su pediatra. Para más información sobre como puede remover el plomo de su casa en Boston, llame al: **Programa de Prevención del Envenenamiento Infantil Con Plomo al (617) 534-5966.**

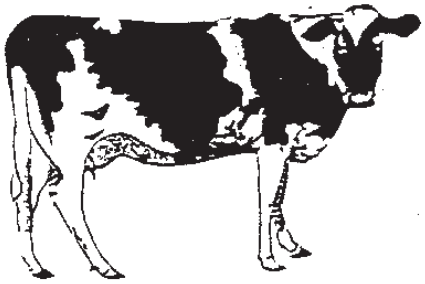
Si usted vive fuera de Boston, llame al **Programa de Prevención del Envenenamiento Infantil Con Plomo del Departamento de Salud Pública de Massachusetts al (800) 532-9571.**

LA COMISIÓN DE SALUD PÚBLICA DE BOSTON
1010 MASSACHUSETTS AVENUE, 2DO PISO / ◆ BOSTON, MASSACHUSETTS ◆ 02118
◆ (617) 534-5966 (VOICE) ◆ (617) 534-2372 (FAX) ◆

Foods That Help Reduce the Harmful Effects of LEAD

Lead is poisonous to the body. Infants, children under six, and pregnant women are at the greatest risk for lead poisoning.

Calcium is very important for growing bodies. Extra calcium will help protect children from lead poisoning!



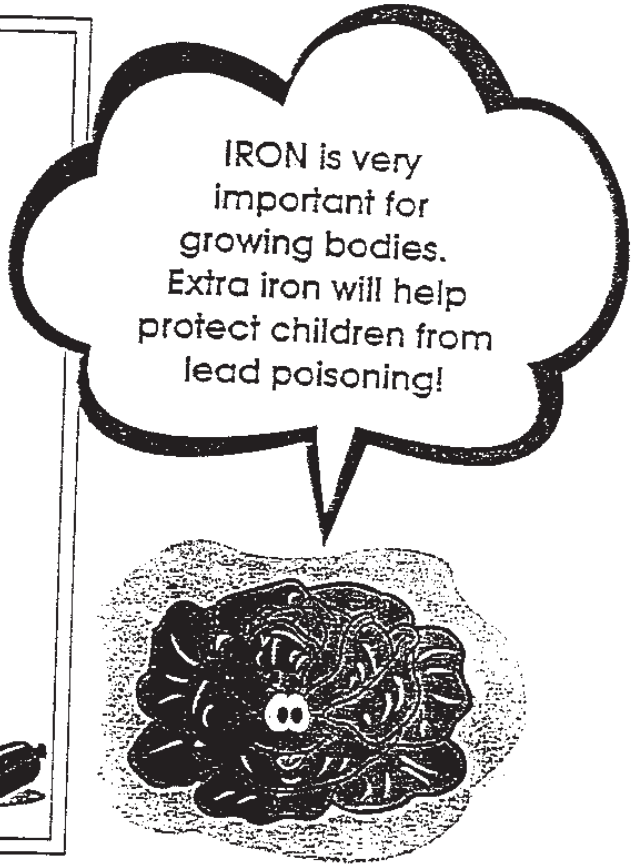
Foods to Eat for Calcium

Milk
Yogurt
Tofu
Cheese
Sardines and Tuna
Green leafy vegetables
(Collard greens, broccoli, kale)

Lead looks like calcium, zinc and iron to the body. The body absorbs lead just like these important minerals, but lead is harmful, not helpful, to normal development. This is why it is important for you and your children to eat a balanced diet.

When you don't have enough vitamins and minerals in your diet, your body will absorb more lead. Lead is stored in the bones, just like calcium and iron.

Foods to eat to get IRON
Lean meats
Chicken, Turkey
Black beans
Kidney beans
Rice
Cereal with added iron
Dried fruits
Peanut Butter
Corn Tortillas
Dark green leafy vegetables
(like spinach and kale)



Iron works better with Vitamin C. Eat oranges, mangos, green peppers, tomatos, and drink real fruit juices (not fruit punch or kool aide) to help your body absorb iron.

For more information, contact the Boston Childhood Lead Poisoning Prevention Program at the Boston Public Health Commission
1010 Massachusetts Avenue, 2nd Floor, Boston, MA 02118
(617) 534-5966

CITY OF BOSTON
DEPARTMENT OF NEIGHBORHOOD DEVELOPMENT
LEAD SAFE BOSTON PROGRAM

38 Winthrop Street
Hyde Park, Ma 02136
(617) 635-0190

LEAD SAFE BOSTON YARD PROGRAM APPLICATION

APPLICANT (Owner of Property)

Name: _____

Property Address: _____

I live here _____ I do not live here ____ # units in building _____

Mailing Address (Investor-Owners only):_____

Phone: (home) _____ (work) _____ SS #_____

Identify your ethnic/racial category _____ Female Head of Household Yes____ No____

Contact person _____ Phone (home) _____

CO-APPLICANT (Co-owner of property only if listed on deed)

Name: _____

Mailing Address: _____

Phone: (home) _____ (work) _____ SS #_____

Identify your ethnic/racial category _____

Please check the appropriate answer	Yes	No
1. Do you have a current homeowner's insurance policy in place? (If yes, attach a copy of the insurance certificate to application)	_____	_____
2. Are you current with your Boston Water and Sewer Payments?	_____	_____
If no, do you have a payment plan in place?	_____	_____
3. Are you current with you real estate taxes?	_____	_____

4. Please complete the child information below (use additional sheets if necessary).

Name of Child(ren) Who live on the property	Date of Birth	Unit # where child(ren) lives
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

****

AUTHORIZATION TO PROCEED WITH
LEAD SAFE YARD PROGRAM APPLICATION

I am interested in participating in the Low level Soil Treatment Demonstration and Evaluation Project, as outlined in the Homeowner Consent Form. I understand in order to be eligible for this grant program I, as the Owner of the Property, must be in good standing with my Boston Water and Sewer account, be current on my real estate taxes and have a homeowner insurance policy in place. I also understand that this program is being offered to protect children and that there must be young children living here: either the child/ren who lived here during the Round 1 evaluation or at least one child under the age of 6 years old.

I hereby certify that the information that is provided in this application is true and complete to the best of my knowledge. I will make this information available for review upon request by the City of Boston's Department of Neighborhood Development, the U.S. Department of Housing and Urban Development, or its designee. I authorize the program to proceed with my application.

Applicant's Signature:_____ Date:_____

Co-Applicant's Signature:_____ Date:_____

TERMS SUBJECT TO CHANGE WITHOUT NOTICE
MISSING INFORMATION WILL DELAY PROCESSING THIS APPLICATION AND MAY JEOPARDIZE FUNDING AVAILABILITY!

Department of Neighborhood Development

Boston's Public Facilities Department

Thomas M. Menino, Mayor
Charlotte Golar Richie, Chief and Director

March 28, 2000

Homeowner Name
Homeowner Address
Mattapan, MA 02126

Dear Homeowner:

Thank you for your interest in our Lead Safe Boston Yards Program. As you know from visiting with our outreach person Yvonne Illich of Silver Linings, if you participate in this program you will receive at **no cost to you**, comprehensive testing/sampling of the soil surrounding your home; drawings of your property identifying lead hazard areas; fully developed landscape plans showing proposed treatments; supervised construction and installation of all landscape treatments and detailed educational information about how to maintain your lead safe yard!

On March 6, 2000 we sent you a letter requesting the following documents. As of today, we have not received the documents listed below. It is important to note that we need these items before we can enroll you property in our program. Please use the enclosed self-addressed stamped envelope to send copies of the following documents to our office.

__✓__ Boston Water and Sewer written approved payment plan.

_____ Copy of current insurance policy for the property that will receive yard treatments.

Since this program will begin in early spring and funding is limited, it is very important that the document(s) be forwarded to our office as soon as possible. If your application is still incomplete after April 6, 2000, we will not be able to enroll you in our lead in soil grant program.

We are looking forward to working with you on this Low Level Soil Treatment Demonstration Project. Yvonne Illich will be contacting you later this week to offer you assistance in sending this information to our office. If you have any questions, please contact me at 617/635-0193.

Sincerely,

Sandra R. Duran
Lead Safe Boston

Cc: File

Department of Neighborhood Development

Boston's Public Facilities Department

Thomas M. Menino, Mayor
Charlotte Golar Richie, Chief and Director

June 12, 2000

Homeowner Name
Homeowner Address
Dorchester, MA 02124

Dear Homeowner:

Congratulations, you have been officially enrolled in the Lead Safe Boston Yards Program!

As a participant in our Lead Safe Boston/National Center for Lead-Safe Housing Low Level Soil Treatment Demonstration and Evaluation Project, you will receive a grant of up to $3,000 worth of design and landscaping work to reduce the exposures to lead in soil on your property. For your files, we have attached a copy of the consent form that you signed. This form details the terms of our program that you are required to comply with in exchange for this granted scope of services. This is a very important project and your participation is vital to our efforts to demonstrate that low cost soil treatments are instrumental in reducing dust lead levels found inside homes.

Now that your property has been enrolled, EPA will sample the soil around your home and analyze the samples for their lead content. Once the results are available, one of our landscape contractors will set up an appointment with you to review your current yard use. With your input he or she will design a landscape plan that will abate the lead hazards found around your home.

Once the design is approved, the landscape contractor will schedule another appointment to review the design with you and determine the start date of your project. It is important to note that any debris that the landscape contractor determines needs to be removed in order to facilitate his work must be completed before work can begin.

Once the new landscaping work is complete, the landscape contractor will schedule a convenient time to meet with you to review the work and to explain the information contained in a Homeowner Maintenance Manual that will be yours to keep. Over the course of the following year, there will be times when our outreach person will return to your property to take dust wipes inside the entrance to your home and your tenant's units. We would like to thank you in advance for your cooperation in providing access to these areas.

If you have any questions regarding the program please feel free to contact me at 617/635-0193.

Sincerely,

Sandra R. Duran
Lead Safe Boston

HOMEOWNER PERMISSION FORM

Most homes in Boston have lead in the yard soil. This comes mainly from leaded paint flaking or being scraped off houses and leaded gasoline which was used in cars until recently. Lead in soil can harm children because dirt and dust get on children's hands, toys and other objects that they often put in their mouths. Lead in soil can also be tracked into the house.

PURPOSE OF THE PILOT PROGRAM

The Lead-Safe Yard Program is a project to make yards in your neighborhood safer for residents, especially children. We plan to do this by making low-cost and easy-to-install landscape improvements in yards with high lead levels in soil.

PROGRAM ELEMENTS

1. **Analysis.**
   As part of your voluntary participation in the Lead-Safe Yard Program, the soil around your property at_____
   will be analyzed for lead content. We will provide the analysis free of cost.

2. **Improvements.**
   If the lead in your soil is above certain levels, we will suggest different kinds of landscaping options for you to choose. These may include covering the soil with barriers such as: mulch, wood chips, crushed stone, and shrubs. We will discuss options for children's play areas and vegetable garden sites also. We will make the improvements that you choose, with materials and labor provided free of cost.

VOLUNTARY PARTICIPATION

Your participation is voluntary because there is no obligation to reduce or protect against the lead in your soil. If you wish to be part of the Lead-Safe Yard Program, we will make an appointment to analyze your soil and make the results available to you If your soil has high levels of lead, we will make a second appointment to discuss the yard improvements and to plan a schedule for the landscaping work.

Value

If the levels of lead in your soil are above 400 parts per million, you are eligible to receive materials, services, and labor in landscape improvements free of cost from the Lead-Safe Yard Program.

I understand the conditions of this agreement and I agree to participate in the program.

_____ _____

Signature Date

Homeowner Consent Form
Lead-Safe Boston/National Center for Lead-Safe Housing
Low Level Soil Treatment Demonstration and Evaluation Project

I am interested in participating in the Low Level Soil Treatment Demonstration and Evaluation Project. If I meet the criteria for this project and if my property is accepted for the project, I understand that I will receive up to $3,000 worth of design and landscaping work to reduce the exposures to soil lead on my property in exchange for my participation in the program. The work will be completed in the year 2000 or 2001.

I will receive the following:

1. Up to $3,000 worth of design and landscaping work for my property.
2. Comprehensive testing/sampling of soil surrounding my home.
3. Scaled drawings of my property identifying the lead hazard areas in my yard.
4. Fully developed landscape plans showing proposed treatments and plantings.
5. Results of limited dust testing taken before, immediately after and one year after the work has been done.
6. Detailed educational information about how to maintain my yard.
7. A new door mat after all dust collection activities have been completed.

I agree to do the following:

1. Complete an application form and provide a copy of my homeowner's insurance policy to project staff.
2. Remove any debris, trash, old cars or other identified items that would make soil sampling or landscape work difficult or not possible.
3. Participate in an initial interview to identify my current or planned uses of the yard.
4. Meet with the landscape designer to provide input into the plan.
5. Allow access to my yard for site testing by Region 1 EPA, prior to starting and after completion of the landscape work.
6. Allow access to my home for dust testing by Silver Linings, Inc. Dust testing will take place three times (immediately before the work is done, after work is done, and one year after work is done) and include wipe sampling and laying down a dust collection mat to better measure accumulation of lead dust over time. I will allow Silver Linings, Inc. access to my home to pick up the mats about two weeks after each has been put in place.
7. Meet with the landscape designer after the plan has been developed, to review and approve the plan.
8. Allow the landscape designer access to my yard to complete planned treatments.
9. Cooperate with the landscape designer and allow him/her to use at no cost my utilities (such as lights, heat, power and water) as needed to carry out and complete the work.
10. Meet with the interviewer and landscape designer after work is completed to review my Homeowner Maintenance Manual, conduct dust testing, and complete project evaluation forms.
11. If a one year evaluation of this project is funded, allow one more site visit approximately one year after the yard work has been completed by the interviewer who will conduct dust testing and complete project evaluation forms.
12. Speak with the press and/or participate in a press event and/or publicity related to the Lead Level Soil Treatment Demonstration and Evaluation Project.

I will formally sign off on the proposed scope of work, Form #09 Owner Approval of Scope of Work, and Form #19 Homeowner Education and Project Completion Certificate, indicating that the work has been successfully completed.

I understand that Lead-Safe Boston will oversee the landscape work done in my yard and that the project's interviewer, Yvonne Illich of Silver Linings, will coordinate collection of most of the data for this project. Soil-lead measurements of my yard will be taken by the EPA as soon as it is feasible to sample, depending on weather conditions; I do not need to be present during this sampling. Because of changes in field conditions such as weather, I will not be notified in advance of the EPA sampling date.

If I have any questions about the construction work for this project, they will be answered by Sandra Duran, Lead-Safe Boson at 617-635-0193. If I have questions or concerns about the evaluation aspect of this project, they will be answered by Pat McLaine, National Center for Lead-Safe Housing at 1-800-624-4298.

_____ _____

Homeowner #1 signature Date

_____ _____

Homeowner #2 signature Date

_____ _____

Interviewer signature Date

1 copy to homeowner

1 copy to Evaluation Files

HOMEOWNER YARD USE/TREATMENT OPTIONS INTERVIEW

Name: _____

Address: _____

Using a "clean" copy of the plot plan with house footprint:

1. Show me where people walk through the yard going to and from the house. (exposed soil?) _____
2. Show me where children play (how many and how old?) _____
3. Show me where people raise vegetables (or do other gardening) _____
4. Show me where people eat outside _____
5. Show me where pets (especially dogs) spend their time _____
6. Show me where cars or other vehicles are parked or repaired _____
7. Show me where people walk to hang out clothes _____
8. Show me other areas for:
   - Sunbathing _____
   - Garbage cans _____
   - Recycling bins _____
   - Composting _____
   - Hobbies _____
9. Tell me any other places and ways children or adults spend their time in the yard. _____

HOMEOWNER YARD USE/TREATMENT OPTIONS INTERVIEW

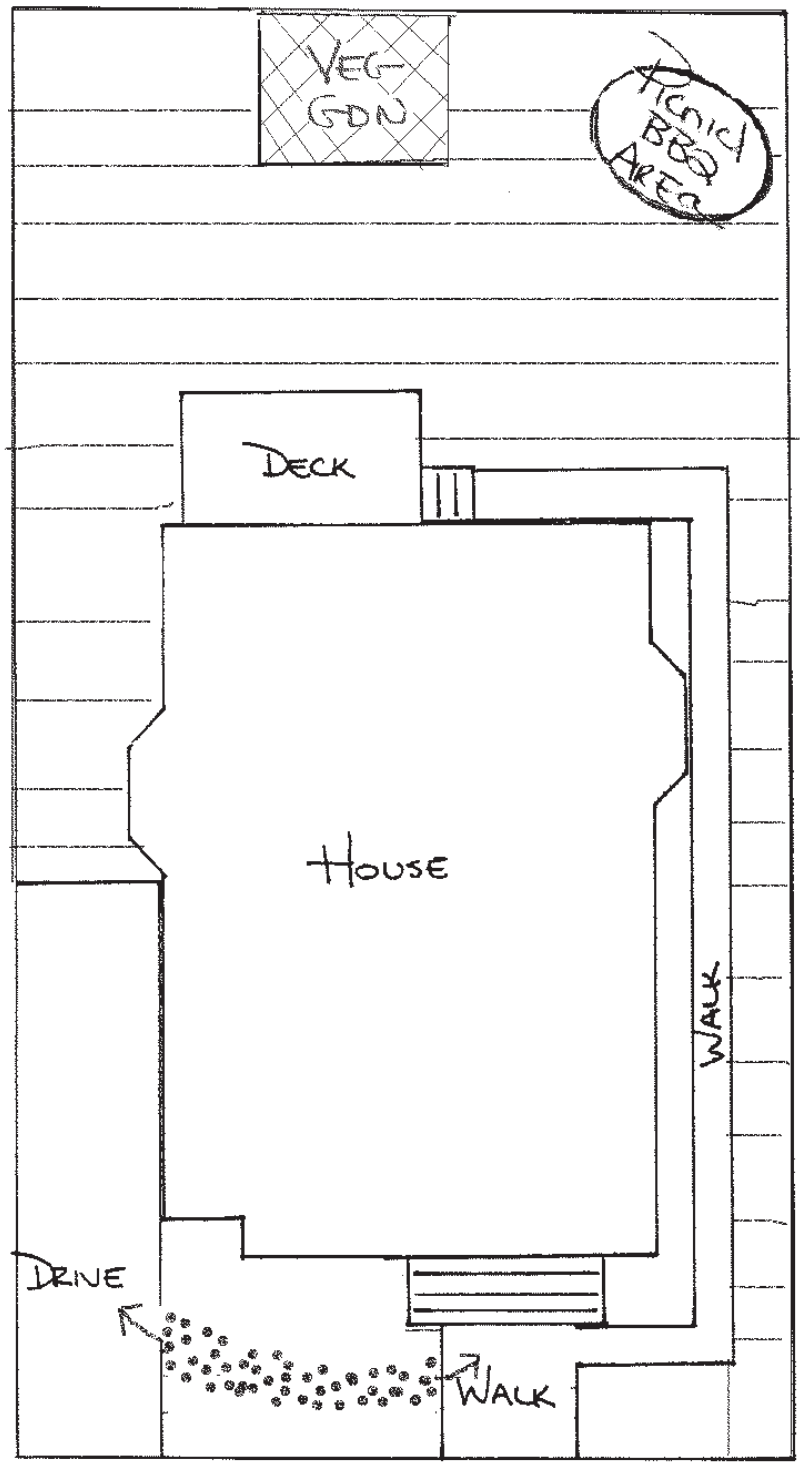
Name: _____

Address: 10 Home Street

Using a "clean" copy of the plot plan with house footprint:

1. Show me where people walk through the yard going to and from the house. (exposed soil?) from driveway to deck + across grass in front. Soil exposed in front.
2. Show me where children play (how many and how old?) backyard 3 kids (3, 7, 9) and lots of friends
3. Show me where people raise vegetables (or do other gardening) backyard veg garden (see plot plan)
4. Show me where people eat outside on deck + in backyard (see plot plan)
5. Show me where pets (especially dogs) spend their time no pets
6. Show me where cars or other vehicles are parked or repaired driveway (blacktop)
7. Show me where people walk to hang out clothes backyard
8. Show me other areas for:
   - Sunbathing deck
   - Garbage cans driveway
   - Recycling bins back walk
   - Composting no
   - Hobbies no
9. Tell me any other places and ways children or adults spend their time in the yard. outdoor parties in the summer (backyard)

10 HOME STREET



SCALE: 1" = 1'-10"

YARD USE PATTERN KEY

DOTS
High Traffic Area (Exposed Soil)

LINES
High Risk Use Area
(Play Area or Vegetable Garden)

CROSS HATCH
Recreation Area (Picnic or BBQ)

6 Collection and Managing Data on Lead in Soil

This chapter describes a state-of-the-art technique, using field-portable x-ray fluorescence technology, for collecting and managing data on lead in soil. This technique allows inspectors to discern patterns of contamination in a property quickly and accurately. The technology can be used only by trained, certified inspectors who meet federal, state, and local requirements for collection of environmental samples, as described in Section 6.4. This chapter is not intended to provide guidance for inspectors, but to give you, as a program organizer or decision-maker, an overview of the data collection and management process.

Section 6.1 is an overview of data collection and management techniques used by the EMPACT Lead-Safe Yard Project. Section 6.2 provides information on how to find the necessary equipment and laboratories for testing and how to cut costs. Section 6.3 is a step-by-step description of testing, quality control, and data management procedures that are used by professional inspectors; Section 6.4 discusses health and safety precautions for inspectors; and Section 6.5 is devoted to equipment maintenance.

If you mainly want a general idea of what data collection and management entails, you can focus on Section 6.1 alone. Sections 6.2 through 6.5 present more detailed material for those who are responsible for implementing a lead-safe yard program. Such readers may also be interested in the reproducible site worksheets at the end of this chapter.

6.1 Collecting and Managing Data: An Overview

A key component of the EMPACT Lead-Safe Yard Project is the use of field-portable XRF technology. This technology allows inspectors to provide residents with onsite, real-time data about lead contamination in yards, without having to wait for the results of laboratory analysis. Field-portable XRF requires a substantial capital investment, as noted in Sections 6.2 and 6.5. On the other hand, programs committed to soil inspection for the long haul may find that the investment more than pays for itself. The EMPACT LSYP has conducted XRF analysis on roughly 2,000 soil samples over the past three years, which makes the cost per sample far less than it would have been for laboratory work. After all, sending samples to a lab involves not only charges for the analysis itself but also the expense of sample collection, shipping, and handling.

The XRF is a hand-held field-portable device that allows inspectors to get a lead-level reading within seconds.

Studies have affirmed the accuracy of XRF, and it has received EPA verification as well. (For example, EPA's Environmental Technology Verification Program has conducted field demonstrations to test several XRF technologies. Verification Reports and Statements from these tests are available online at

http://www.epa.gov/etv/verifrpt.htm#monitoring.) What makes XRF technology especially valuable for a lead-safe yard program is that it offers real-time results with a hand-held, battery-powered device. This means that inspectors, while on site, can get parts per million (ppm) lead levels for individual soil samples within seconds, and, if necessary, adjust their testing strategy for the property as a whole accordingly. Experience has shown that lead concentrations in properties often vary significantly and unpredictably. With XRF, inspectors can learn about any unusually high lead levels right away and then take more closely spaced readings in the area from which the high reading came. The result is a clearer delineation of how soil contamination differs from one part of the property to another.

Inspectors mark the location of each XRF reading on a plot plan and record lead levels on a site worksheet.

One concern that has been raised about field-portable XRF is that it tests for lead only at the surface level. Many experts, however, are convinced that this is usually where the lead level in soil actually is highest. Also, the top layer of soil clearly poses the greatest potential health risk because of its accessibility.

When the EMPACT LSYP conducts XRF testing, the first step is to determine some rough guidelines by interviewing the homeowner and observing current conditions in the yard. Several high-risk or high-use areas may be identified. As the sample interview form in Chapter 5 suggests, these could include gardens, picnic areas, and children's play areas, in addition to areas of bare soil and heavy foot traffic. Such parts of the property are singled out for careful inspection. Another target is the drip line, generally a 3-foot-wide strip around the foundation of a house where lead tends to have been washed into the soil by rain.

The EMPACT LSYP's procedure for taking XRF readings is straightforward. The XRF and test guard are placed on the exposed soil surface and depressed to open the shutter. A 30- to 60-second measurement should yield reliable results. As inspectors take these readings, they mark the location of each on a plot plan of the property and record the lead levels on a site worksheet. Also recorded on the worksheet are measurements that fix the location of the reading somewhat more precisely. Any other relevant descriptive information, such as the weather and the general condition of the yard, is noted on the worksheet as well.

The ppm lead levels from different locations within a particular area—say, the east drip line—are averaged to yield a mean value. Depending on this value, the EMPACT LSYP assigns each area to one of its four categories (see Section 3.4.3.1 for a comparison with proposed categories under TSCA Section 403):

- Very high (5000 ppm or more)
- High (2000 to 5000 ppm).
- Moderately high (400 to 2000 ppm).
- Low (400 ppm or less)

Detailed guidance about mitigation strategies for each of these categories is provided in Chapter 7 of this handbook.

The EMPACT LSYP takes several quality control measures to back up XRF readings on every property. Accuracy and reproducibility are checked periodically using continuing calibrations

(against a known standard) and replicate measurements, respectively. Inspectors also collect a small number of soil samples for confirmatory lab analysis. Since XRF is still a new technology, its results need to be judged against the gold standard of accepted practice, in this case inductively coupled plasma (ICP) or atomic absorption (AA) methods, both of which are conducted in a laboratory and take about 2 to 4 weeks.

Nevertheless, inspectors often have enough confidence in their XRF findings to give homeowners and landscapers a provisional color-coded map of a property's lead levels well before the results of confirmatory lab tests are available. The map on page 81 is an example. Inspectors may prepare such a drawing before they even leave the site, using markers or colored pencils and a copy of the plot plan. This hand-drawn method is simple, immediately interpretable, and readily accessible to the homeowner. Alternatively, the XRF readings may be taken to an office and used to produce a computer-generated map, as shown on page 82. Either way, homeowners and landscapers can gain a general understanding of what areas of a yard need remediation and start making plans.

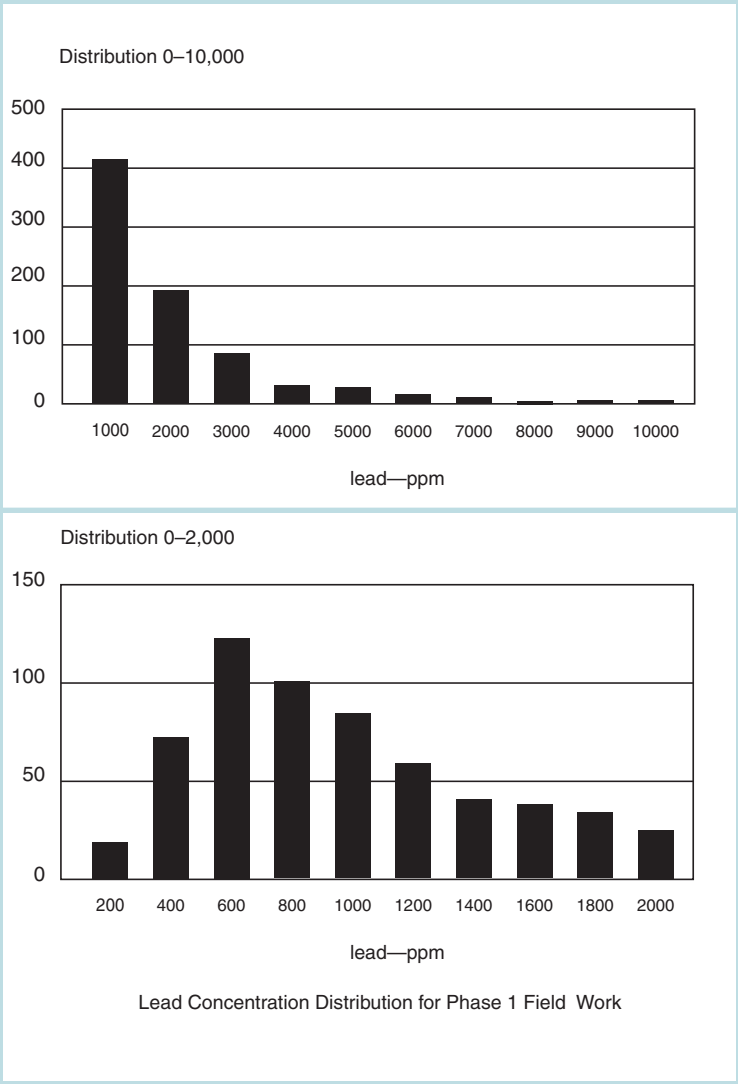
Once a lead-safe yard program has tested a sizable cross-section of properties in a city, it might be useful to record the results on a map to see if a geographical pattern emerges. If such a pattern does emerge, the information could be made available to the public, perhaps on a Web site, to promote awareness of the lead-in-soil problem and help homeowners and communities make more informed decisions.

As an example, maps showing the lead content of soil in various parts of New Orleans, Louisiana, are available online at http://www.tmc.tulane.edu/ecme/leadhome/soil.html. Environmental

EMPACT LSYP 1998 ANALYTICAL PROGRAM FINDINGS

In Phase I of the EMPACT Lead-Safe Yard Project, lead in surface soil concentrations measured in the Bowdoin Street neighborhood ranged from 103 to 21,000 ppm.

The mean value for these data was 1,632 ppm (n=781). Twenty-two percent of the measurements were above 2,000 ppm, and 87 percent were above 400 ppm.



Lead Concentration Distribution for Phase 1 Field Work

toxicologist Howard Mielke of Xavier University in New Orleans analyzed 3,074 surface soil samples representing 283 census tracts. The data indicate that the most contaminated areas usually lie in the central part of the city, where traffic is heaviest.

6.2 Getting Started

Individual homeowners or groups planning a very limited lead-safe yard program will probably just want to hire a risk assessor certified for use of XRF for soil analysis. In any case, local authorities regulating lead abatement activities should be consulted.Those seeking to implement an extensive program will probably want to buy their own field-portable XRF to be used by trained/certified inspectors working with the program. The EMPACT LSYP uses an instrument manufactured by Niton Corporation[17], which also provides training. For information, call 1-800-875-1578 or visit http://www.niton.com. See Section 6.4.2 for information about XRF use licenses and certification.

An XRF similar to the one used in the EMPACT LSYP, a field portable Niton Model 702, costs about $26,500, making it the most substantial expense a program will face. Day-to-day maintenance of the XRF is generally not costly, though programs will face the additional expense (around $2,600) for replacement of the instrument's radioactive source at least once every two years, if not more frequently (see Section 6.5). Some savings are possible, however. The box below provides some suggestions; for example, it describes a less costly XRF instrument that was not available when the EMPACT LSYP purchased its instrument.

HOW TO CUT COSTS

Recently, Niton has developed a field portable XRF that tests for lead alone, not the wide range of other metals detectable with a 700-series Niton. This instrument, the XL309, costs just $17,000, and a version exclusively for lead in soil is available for $15,000. The main reason the XL309 is so much less expensive is that it lacks a high-resolution silicon pin detector. But this feature is useful largely for measuring levels of elements such as arsenic, which require a great deal of precision. Lead levels, by contrast, are fairly broad measurements. A high-resolution silicon pin detector is not necessary.

A lead-safe yard program may also save money if it can align itself with a university, which is much more likely if the work has a research component. In this case, the school might pick up some or all of the cost of the XRF, and interns paid by the school might conduct inspections under the supervision of a faculty member. This type of approach is described in more detail in Appendix B, which presents less-resource-intensive approaches to implementing lead-safe yard programs.

6.3 Testing Step by Step

This section describes the procedures used by professional inspectors in the EMPACT LSYP for soil testing, quality control, and data management. In developing these procedures, the EMPACT LSYP relied on two primary sources: 1) Method 6200 from EPA publication SW-846 (entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*), EPA's compendium of methods on evaluating hazardous waste; and 2) the Quality Assurance Project Plan (QAPP) that was developed for the EMPACT program. What follows is mainly a summary of the directives from these two sources, along with recommendations and insights from the program's inspectors themselves. You can go to http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm to learn more about SW-846 and obtain a copy online. The EMPACT LSYP's QAPP is provided in Appendix D.

6.3.1 Before Beginning

The inspectors should plan to allot about two hours for testing a typical residence. Homeowners need not be present, but they do have to have signed a permission form (see Chapter 5). Ideally, all

[17] Mention of trade names or commercial products in this publication does not constitute endorsement or recommendation for use.

the information about yard use gained from observations and homeowner interviews will have been incorporated into the plot plan prepared during outreach and education. This plot plan will be used as a guide for testing. See Section 5.3 for guidance on conducting homeowner interviews and developing a plot plan. A sample interview form and plot plan can be found on pages 63 to 65.

Favorable weather conditions are necessary for testing. Experience shows that XRF testing does not work well when the ground is frozen or when the air temperature falls below 40 degrees Fahrenheit. And while high temperatures usually pose no problem, direct sunlight can cause the instrument to overheat. Inspectors should take care to shade it on sunny days, even in relatively cool weather.

Inspectors take at least two readings along the property border on each side of the house.

Soil moisture can not only interfere with readings but also damage the XRF, so soil that is saturated with water should not be tested. This condition is most likely to occur in early spring, when the ground absorbs water inefficiently because it hasn't yet thawed and dried out from the winter months. Inspection should be delayed in the event of rain as well; even after the rain has stopped, testing may still be inadvisable for several hours, because of standing water on the grass. The XRF can generally tolerate humidity, however.

If conditions are favorable, and all the necessary paperwork is in place, inspectors may prepare the property for testing. Debris such as rocks, pebbles, leaves, and roots should be removed, and the ground should be made flat enough to allow uniform contact with the XRF. In some cases grass or plant material may need to be moved aside to expose the soil surface. As they do this, inspectors must remember that lead in soil is mostly a surface phenomenon, and that readings may not be accurate if the ground is disturbed too much.

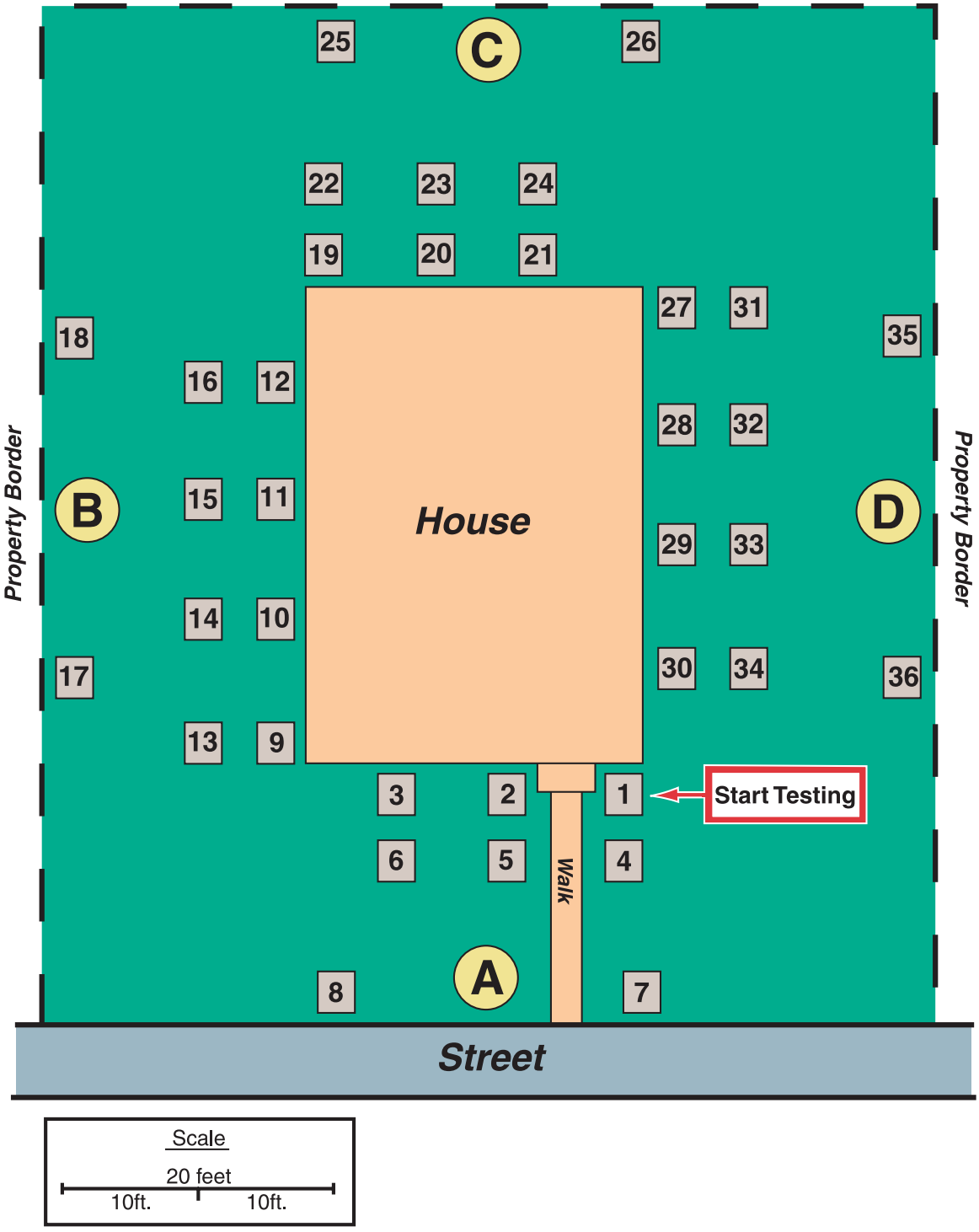
6.3.2 Testing Strategy

Although each property is different and must be approached with its unique characteristics in mind, testing typically focuses on four main concerns: the drip line, play areas, areas of exposed soil, and areas that may be contaminated with lead from sources other than the house, such as structures on abutting properties. In the EMPACT LSYP, if play areas are found to have lead levels greater than 400 ppm, they are tested further to determine the extent of contamination. Other areas are subjected to extra testing if they are found to have levels greater than 2000 ppm.

A variety of formats for testing are possible, but data collection is generally more systematic and efficient if inspectors decide on one format and use it consistently. In the EMPACT LSYP, the sides of the house on a property are labeled A, B, C, and D. The A side is that which bears the house's address, and the B, C, and D sides follow in a clockwise fashion. Inspectors start at the corner where the A and D sides meet, then cover the whole A portion of the yard, and after that the whole B, C, and D portions, until finally they arrive at the A-D corner again.

The pattern for testing a particular area on any of the sides of the house depends on the size and shape of that area. In long, narrow areas such as drip lines, initial XRF readings are generally taken at 10-foot intervals along an imaginary line that extends from one end of the area to the other. If an area is not long enough to yield at least three readings with this method, inspectors mentally divide the imaginary line into thirds and take a reading from each third.

Generic Testing Pattern



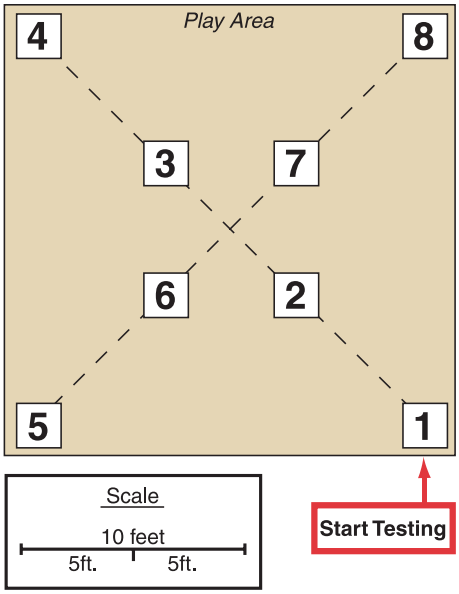
Inspectors then take a second series of XRF readings along an imaginary line that is parallel to the first one but 2 to 5 feet away from it. If the area is in fact a drip line, this second imaginary line usually falls outside it, so lead levels are expected to drop off. If they don't, further testing is conducted to ascertain whether and where they do.

Before completing testing on any one side of the house, inspectors take at least two readings along the property border. These readings are generally evenly spaced. If either reading shows elevated lead levels, additional reading are taken along the border.

For other areas of concern, including play areas, an imaginary X is usually superimposed on the ground. Readings are taken at 5- to 10-foot intervals along each line of the X. If the area is too small to yield at least five readings with this method, inspectors mentally divide the lines of the X into thirds and take a reading from each third.

When sufficient readings have been obtained from a given area, the lead levels are averaged to produce a mean value, and on the basis of this value, the area is assigned to a specific lead-level category, as explained in Section 6.1.

Testing Pattern for Play Areas, Gardens, and Other Areas of Concern



NOTE!

Borderline mean values for an area are judged to fall into the more toxic category rather than the less toxic one. For example, a mean value of 1,980 ppm would earn an area a "high" rating (2,000 to 5,000 ppm). The idea is to avoid the risk of undertreating a contaminated area. Measurements of lead levels are broad, and a difference of just 20 ppm is insignificant.

6.3.3 Quality Control

Niton XRFs are factory calibrated, so site-specific calibration is not necessary. Regular checks of the instrument's calibration are an essential aspect of quality control, however. Before inspectors from the EMPACT Lead-Safe Yard Project begin to test a property, they take readings on standard reference materials (SRMs) whose lead levels are known to be 400 ppm, 1,000 ppm, and 5,000 ppm, the anticipated range for lead in urban soil. They also take a reading on a blank—a soil sample whose lead level is less than 100 ppm, which is the detection limit for the XRF instrument they use. If any of these readings fails the quality control criteria (+ 30% for SRMs; < 50 ppm for field blank), possible problems are investigated and the check is re-run until the instrument passes. If it never passes, it is sent back to Niton to be recalibrated. These same calibration checks are conducted at the end of testing on a property, to ensure that the instrument's calibration has remained intact throughout.

In addition, 10 percent of the XRF readings are replicate measures. That is, a particular location is tested a second time, to see if the reading on it falls into the same range. If it doesn't, inspectors try to find out what the problem is and fix it, and calibration checks and further repeat readings are performed until the XRF results are clearly reliable.

The final quality control measure is to collect soil samples for confirmatory ICP or AA analysis. At evenly spaced intervals within a particular area, inspectors scoop up a subsample, which is about a tablespoon of the top half-inch of soil. These subsamples are emptied into a common ziplock bag to create a composite for the area. An XRF reading is then taken on the composite, after which it is ready to be sent to the lab.

Typically, a perimeter composite sample is created by taking twelve subsamples—three from the drip line on each side of the house. Composite samples are also created for every other area designated as high use or high risk, such as gardens and play areas. As in XRF testing, an imaginary X is superimposed on the area. Subsamples—a total of five, if possible—are taken along each line of the X.

6.3.4 Data Management

The two main data management tools, the plot plan and the site worksheet, are versatile and easy to use. As shown on page 81, the plot plan can be converted into a color-coded map of a property's lead levels to help homeowners and landscapers discuss plans for remediation. The plot plan can also be used to formulate a guide for testing, and during the inspection itself, test locations can be recorded on the plot plan, as shown on page 80. Information on developing an initial plot plan can be found in Section 5.3.

The site worksheet offers a simple way to identify the locations marked on the plot plan more closely. It also allows inspectors to keep track of the lead levels found at each location. Finally, it provides convenient spaces to write down any relevant descriptive information: a short form at the top and a "comments" column on the right side. On page 78 is a clean worksheet that groups implementing a lead-safe yard program can reproduce. On page 79 is an example of a site worksheet that has been filled out.

The letters A, B, C, or D in the "sample I.D." column of the filled-out site worksheet tell which side of the house a particular XRF reading came from. The number immediately after each letter corresponds to the testing location noted on the plot plan. The last letter in the "sample I.D." column tells how many feet the testing location was from the foundation of the house.

The number in the "location" column of the worksheet tells how many feet the testing location was from the corner that would be on someone's right when facing the A, B, C, or D side of the house. Thus the right corner on the A side would be the A-D corner; on the B side it would be the A-B corner; on the C side it would be the B-C corner; and on the D side it would be the C-D corner.

The "ppm-lead" column tells the lead levels measured at each testing location. The comment "repeat" in the "comments" column indicates where a second reading was taken on a test location as a quality control measure.

6.4 Health and Safety Precautions

Testing for lead in soil entails two different kinds of risk. The first comes from the soil itself, which frequently does contain high levels of lead. The second comes from the XRF, which employs radioactive material. Inspectors must guard against both these kinds of risks.

6.4.1 Guarding Against Lead Hazards

The important point to keep in mind is that lead can enter the body through ingestion, which occurs as a result of routine hand-to-mouth activities such as eating, drinking, and smoking. Therefore, inspectors should wear gloves and refrain from hand-to-mouth activities on the job. When their work is done, they should wash their hands and faces and clean off their work shoes after leaving the site. On a windy day, inspectors may need to use face masks to avoid breathing airborne lead-contaminated dust when working at dry, dusty sites.

6.4.2 Guarding Against Radiation Hazards[18]

Portable XRF instruments used for lead-based paint inspections contain radioactive isotopes that emit x-rays and gamma radiation. Proper training and handling of these instruments is needed to protect the instrument operator and any other persons in the immediate vicinity during XRF usage. The XRF instrument should be in the operator's possession at all times. The operator should never defeat or override any safety mechanisms of XRF equipment.

For a discussion of required (and recommended) licenses, certifications, and permits for portable XRF instruments, see the box on page 76.

6.5 Maintaining Equipment

Day-to-day maintenance of the XRF is generally not difficult. The instrument's display window should be cleaned with cotton swabs. The case should be cleaned with a soft cloth. Batteries should be recharged as directed in the owner's manual. Beyond that, inspectors usually just need to take care not to drop the instrument, not to get it wet, and not to neglect the calibration checks described under "Quality Control" in Section 6.3.3.

Over the long term, however, XRF owners face the very significant maintenance concern of replacing the instrument's radioactive source, a cadmium-109 isotope. Like all radioactive isotopes, cadmium-109 decays at a fixed rate. Its half-life, or the amount of time needed for the activity of the radioactive source to decrease by one half, is about fifteen months. After that, the XRF can still be used, but the instrument becomes progressively less efficient. Readings that once took 30 to 60 seconds take progressively longer. Eventually the wait becomes burdensome, and a new cadmium-109 isotope must be purchased from Niton, at a cost of about $2,600.

Niton recommends replacing the isotope source every fifteen months, as soon as its half-life is spent, but most inspectors find that they can postpone the job for another three to nine months. After all, readings are no less accurate, just somewhat less prompt. When inspectors do decide to replace the cadmium-109 isotope, they simply send the XRF to Niton. The corporation not only puts in a new isotope but disposes of the old one, upgrades the instrument's software, and provides whatever preventive maintenance is needed.

SAFE OPERATING DISTANCE

XRF instruments used in accordance with manufacturer's instructions will not cause significant exposure to ionizing radiation. But the instrument's shutter should never be pointed at anyone, even if the shutter is closed. Also, the inspector's hand should not be placed on the end plate during a measurement.

The safe operating distance between an XRF instrument and a person during inspections depends on the radiation source type, radiation intensity, quantity of radioactive material, and the density of the materials being surveyed. As the radiation source quantity and intensity increases, the required safe distance also increases. Placing materials, such as a wall, in the direct line of fire reduces the required safe distance. According to NRC rules, a radiation dose to an individual in any unrestricted area must not exceed 2 millirems per hour. One of the most intense sources currently used in XRF instruments is a 40-millicurie 57Co (cobalt-57) radiation source. Other radiation sources in current use for XRF testing of lead-based paint generally produce lower levels of radiation. Generally, an XRF operator conducting inspections according to manufacturer's instructions would be exposed to radiation well below the regulatory level. Typically, XRF instruments with lower gamma radiation intensities can use a shorter safe distance provided that the potential exposure to an individual will not exceed the regulatory limit.

No people should be near the other side of a wall, floor, ceiling or other surface being tested. The inspector should verify that this is indeed the case prior to initiating XRF testing activities, and check on it during testing.

Finally, the effectiveness of the instrument's radiation shielding should be assessed every six months through a leak test. The XRF manufacturer or owner's manual can be consulted to obtain vendors of leak test kits.

If these practices are observed, the risk of excessive exposure to ionizing radiation is extremely low and will not endanger any inspectors or occupants present in the dwelling.

[18] Adapted from *HUD Guidelines for the Evaluation and Control of Lead Based Paint Hazard Evaluation and Reduction Activities,* Chapter 7: Lead Based Paint Inspection, 1997 Revision. Available at http://www.hud.gov/lea

XRF USE LICENSES AND CERTIFICATION

In addition to training and any required accreditation, a person using a portable XRF instrument for inspection must have valid licenses or permits from the appropriate federal, state, and local regulatory bodies to operate XRF instruments. (These are needed because XRF instruments contain radioactive materials.) All portable XRF instrument operators should be trained by the instrument's manufacturer (or equivalent). XRF operators should provide you with information about their training, licensing, permitting, and certification before an inspection begins. Depending on the state, operators may be required to hold three forms of proof of competency: a manufacturer's training certificate (or equivalent), a radiation safety license, and a state lead-based paint inspection certificate or license. To help ensure competency and safety, HUD and EPA recommend hiring only inspectors who hold all three.

The regulatory body responsible for oversight of the radioactive materials contained in portable XRF instruments depends on the type of material being handled. Some radioactive materials are federally regulated by the U.S. Nuclear Regulatory Commission (NRC); others are regulated at the state level. States are generally categorized as "agreement" and "non-agreement" states. An agreement State has an agreement with NRC to regulate radioactive materials that are generally used for medical or industrial applications. (Most radioactive materials found in XRF instruments are regulated by agreement states). For non-agreement states, NRC retains this regulatory responsibility directly. At a minimum, however, most state agencies require prior notification that a specific XRF instrument is to be used within the state. Fees and other details regarding the use of portable XRF instruments vary from state to state. Contractors who provide inspection services must hold current licenses or permits for handling XRF instruments, and must meet any applicable state or local laws or notification requirements.

Requirements for radiation dosimetry by the XRF instrument operator (wearing dosimeter badges to monitor exposure to radiation) are generally specified by state regulations, and vary from state to state. In some cases, for some isotopes, no radiation dosimetry is required. However, it should be conducted even when not required, for the following five reasons:

- The cost of dosimetry is low.
- XRF instrument operators have a right to know the level of radiation to which they are exposed during the performance of the job. In virtually all cases, the exposure will be far below applicable exposure limits.
- Long-term collection of radiation exposure information can aid both the operator (employee) and the employer. The employee benefits by knowing when to avoid a hazardous situation; the employer benefits by having an exposure record that can be used in deciding possible health claims.
- The public benefits by having exposure records available to them.
- The need for equipment repair can be identified more quickly.

6.6 Alternative Approaches

A number of organizations that conduct lead-safe yard activities rely on laboratory analysis rather than field-portable XRF for testing of yard soil. For example, Lead-Safe Cambridge, described in Appendix A of this handbook, sends soil samples to a state laboratory for analysis.

A homeowner in an area where no lead-safe yard program exists may also wish to determine whether there is a lead problem in his or her yard. In this case, the homeowner can collect soil samples in ziplock bags and send them to a laboratory for analysis. To determine sampling locations, a homeowner can follow the guidance in Section 6.3, or refer to HUD Guidelines for the Evaluation and *Control of Lead Hazards in Housing, June 1995 (Title X, Section 1017) Appendix 13.3,* available at http://www.hud.gov/lea/learules.html#download.

Homeowners can contact their state or local childhood lead poisoning prevention program for more information about obtaining soil-lead testing. The following Web sites list state and local lead poisoning prevention contacts:

The Lead Program of the National Safety Council's Environmental Health Center: http://www.nsc.org/ehc/nlic/contacts.htm

The National Conference of State Legislatures' Directory of State Lead Poisoning Prevention Contacts: http://www.ncsl.org/programs/ESNR/pbdir.htm

6.7 For More Information

6.7.1 XRF Accuracy

Verification Reports and Statements on the accuracy of several XRF technologies are available on the Web site of the EPA Environmental Technology Verification Program: http://www.epa.gov/etv/verifrpt.htm#monitoring.

Clark, Scott, William Menrath, Mei Chen, Sandy Roda, and Paul Succop. *Use of a Field Portable X-Ray Fluorescence Analyzer to Determine the Concentration of Lead and Other Metals in Soil and Dust Samples*. Call the University of Cincinnati Department of Environmental Health at 1-513-558-1749.

Shefsky, Stephen. *Comparing Field Portable X-Ray Fluorescence (XRF) to Laboratory Analysis of Heavy Metals in Soil.* Call Niton Corp. at 1-800-875-1578.

6.7.2 Test Methods

Methods 6200, 6010B, and 7420 from EPA's SW-846 (entitled Test Methods for Evaluating Solid Waste, Physical/Chemical Methods). For ordering information, or to obtain a copy online, go to http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm.

Sackett, Donald and Kenneth Martin. *EPA Method 6200 and Field Portable X-Ray Fluorescence Analysis for Metals in Soil.* Call Niton Corp. at 1-800-875-1578.

6.7.3 Quality Control

Shefsky, Stephen. *Sample Handling Strategies for Accurate Lead-in-Soil Measurements in the Field and Laboratory*. Call Niton Corp. at 1-800-875-1578.

SITE WORKSHEET

Site Name:_____ Date:_____

Site Address:_____ Weather:_____

Building Type:_____ Lot Condition:_____

Yard Uses:_____

SAMPLE I.D.	LOCATION	PPM-LEAD	COMMENTS

A = front, B = left, C = rear, D = right
Location = distance from right corner of house

SITE WORKSHEET

Site Name: _____ **Date:** 10-27-98

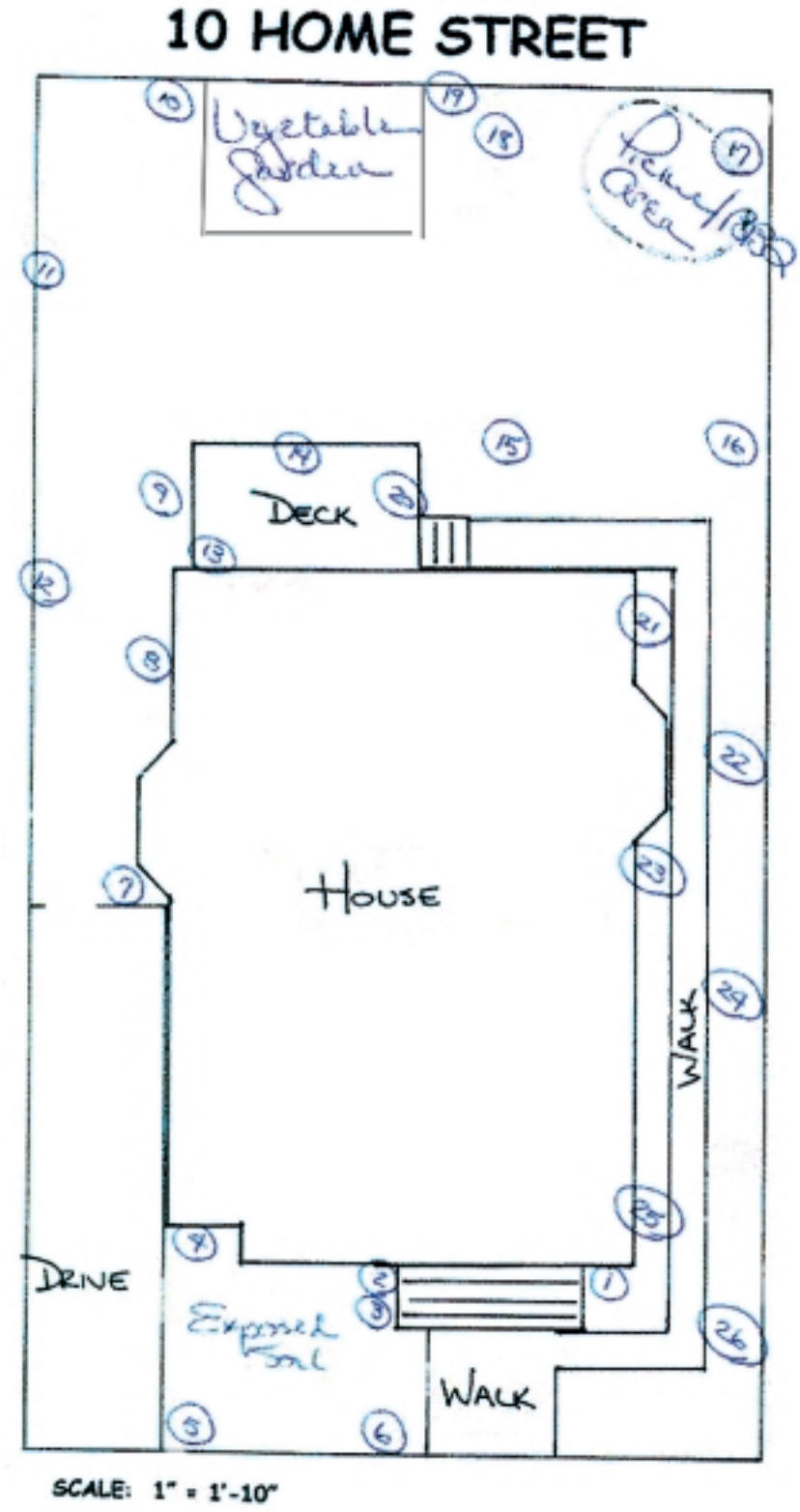
Site Address: 10 Home Street **Weather:** Clear/Cool 55°

Building Type: 2 Family **Lot Condition:** Very Clean

Yard Uses: Picnic Area/Vegetable Garden

SAMPLE I.D.	LOCATION	PPM-LEAD	COMMENTS
A-1-9	0	1772 ± 303	
A-2-9	11	2510 ± 262	
A-3-9	11	3104 ± 287	Repeat
A-4-1	25	400t ± 309	
A-5-15	25	435 ± 113	
A-6-15	12	705 ± 129	
A-7-4	21	3987 ± 426	
B-8-1	39	3657 ± 305	
B-9-1	60	1432 ± 175	
B-10-1	84	643 ± 118	
B-11-9	69	550 ± 106	
B-12-9	38	1141 ± 137	
C-13-1	0	2940 ± 267	
C-14-18	10	532 ± 118	
C-15-18	26	518 ± 122	
C-16-18	39	738 ± 130	
C-17-32	26	527 ± 109	
C-18-32	10	466 ± 95	

A = front, B = left, C = rear, D = right
Location = distance from right corner of house



LEAD LEVELS COLOR KEY

5000 or more ppm (Very High)

Must be treated with a permanent barrier.
Unsafe for all types of gardening.

2000-5000 ppm (High)

Treatment is necessary for any recreational use by children or adults and for pet areas.
Unsafe for all types of gardening.

400-2000 ppm (Moderately High)

Treatment is recommended for use as a children's play area and for gardenin especially vegetable gardening.

400 or less ppm (Low)

No treatment is necessary for most uses by children, adults, and pets.

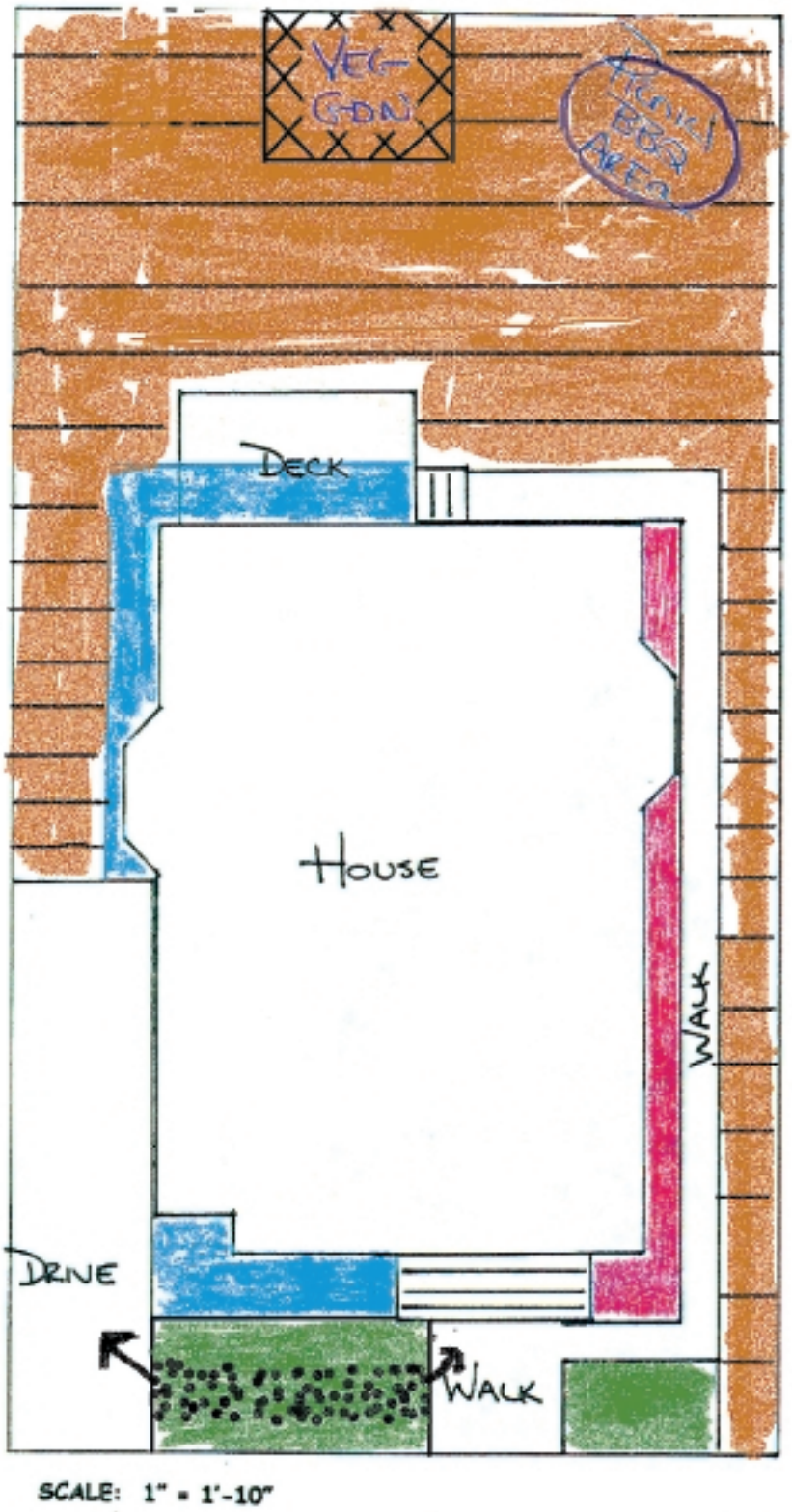
YARD USE PATTERN KEY

DOTS
High Traffic Area (Exposed Soil)

LINES
High Risk Use Area
(Play Area or Vegetable Garden)

CROSS HATCH
Recreation Area (Picnic or BBQ)

10 HOME STREET



LEAD LEVELS COLOR KEY

5000 or more ppm (Very High)

Must be treated with a permanent barrier.
Unsafe for all types of gardening.

2000-5000 ppm (High)

Treatment is necessary for any recreational use by children or adults and for pet areas.
Unsafe for all types of gardening.

400-2000 ppm (Moderately High)

Treatment is recommended for use as a children's play area and for gardening, especially vegetable gardening.

400 or less ppm (Low)

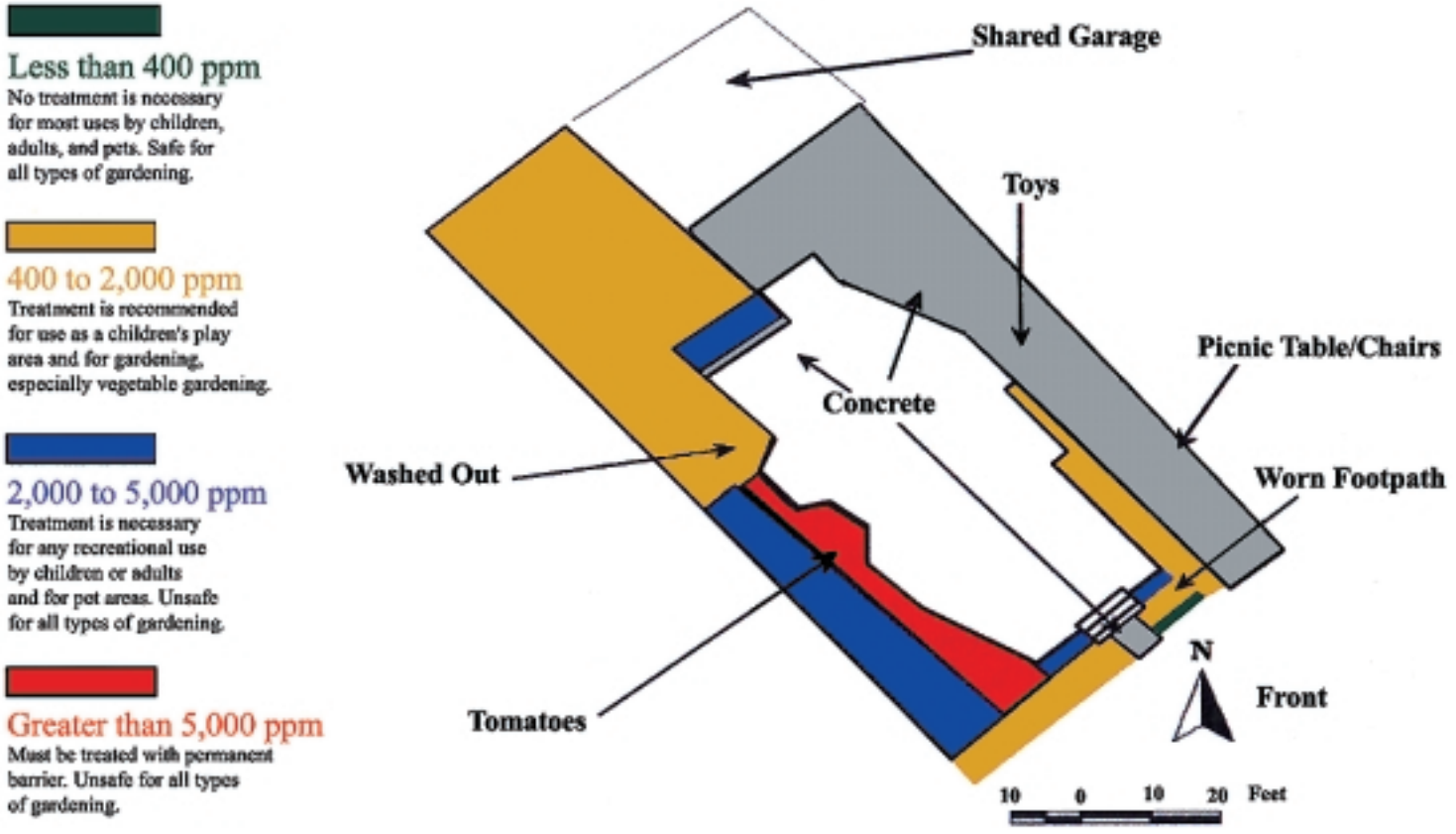
No treatment is necessary for most uses by children, adults, and pets.

YARD USE PATTERN KEY

DOTS
High Traffic Area (Exposed Soil)

LINES
High Risk Use Area
(Play Area or Vegetable Garden)

CROSS HATCH
Recreation Area (Picnic or BBQ)



7 Yard Treatments

Once you have sampled and analyzed a property's soil and determined that a lead hazard exists, the process of designing and implementing landscape treatments can begin. This chapter provides guidance on matching treatments to the hazards you've identified (Section 7.1), and describes specific low-cost treatment measures used by the EMPACT Lead-Safe Yard Project (Section 7.2). The chapter also covers the many "nuts and bolts" issues involved in the treatment process, including:

- Developing a budget for each yard treatment (Section 7.3).
- Meeting with the homeowner to explain the sampling results and areas of concern and to develop/review the treatment plan (Section 7.4).
- Contracting with a landscaper to complete all design and landscaping work on the property (Section 7.5).
- Establishing guidelines to ensure landscaper health and safety (Section 7.6).
- Securing the homeowner's approval and signoff on completed work (Section 7.7).
- Reviewing and approving landscaping work prior to final contractor payment (also in Section 7.7).

If you are a homeowner interested in learning about low-cost landscaping measures for reducing children's exposure to lead in soil, you can focus on Sections 7.1, 7.2, and 7.6. (**Section 7.6, Health and Safety for Landscapers, is essential reading for anyone who intends to do landscaping work in a lead-contaminated yard.**) You should also read Chapter 8, which covers the development of a maintenance plan for the finished yard—a critical part of the treatment process.

Sections 7.3, 7.4, 7.5, and 7.7 present detailed information for those responsible for implementing a lead-safe yard program.

7.1 Matching Treatments to Hazards

There are many ways of protecting children and other people from the hazards of lead-contaminated yard soil. Possible methods include removing and disposing of the contaminated soil, covering it with a permanent barrier such as asphalt, covering it with a non-permanent barrier such as mulch or grass, or changing the way people use their yard to reduce exposures.

To select the best method or methods for a particular property, you need to consider a number of factors, including the level of lead contamination, the frequency and extent of potential exposures, the homeowner's esthetic preferences, the cost of the protective measure, the amount of maintenance it will require, and its likely effectiveness. Protective measures can vary greatly both in the level of protection they provide and in their associated costs. Soil removal, for example, can completely eliminate a soil hazard, whereas use of a non-permanent barrier such as grass cannot. However, soil removal can be prohibitively expensive for many people due to the high cost of soil excavation, transportation, and disposal.

The EMPACT LSYP was created to develop low-cost landscape measures that protect children against exposure to high lead levels in yard soil. The landscape measures described in this handbook were selected for four main reasons:

- They are relatively inexpensive.
- They can be implemented by the homeowner or a program partner with a minimum of tools and experience.
- They are attractive and enhance the value of the yard.
- They are effective in reducing lead concentrations at the yard surface, and they therefore effectively reduce the potential for children's exposures.

All of the measures presented here could be characterized as interim controls. None provide the sort of permanent protection you could achieve through soil abatement (that is, by removing or paving contaminated soil), nor are they meant as a substitute for abatement. In fact, in circumstances where soil-lead levels are greatly elevated (i.e., above 2,000 ppm) and the possibility of children's exposure is high (i.e., in residential settings), federal regulations recommend or require abatement of the soil hazard (see Section 3.4.3).

The EMPACT LSYP encourages homeowners to follow all federal and state requirements and guidance for soil abatement that apply to them. But the project also recognizes that there will be many situations where homeowners and community organizations cannot afford the cost of abatement measures. In such situations, these landscape measures can provide some degree of long-term, effective protection so long as they are properly applied and well maintained. The key is selecting the right measures based on the existing lead hazards.

7.1.1 Combining Treatment Measures

So how do you choose among the treatment measures presented in this handbook? Your goal in developing a treatment plan is to achieve a delicate balance between the safe use of the yard and the existing lead levels. To do this, you should combine two main approaches:

- **Altering the surface cover.** Select landscape measures that provide a sufficient barrier, based on the soil-lead levels and the types of yard use.
- **Altering the yard use patterns.** Encourage safe yard uses, and discourage certain activities (e.g., gardening, children's play) in the areas of highest contamination. These activities may need to be relocated to a safer part of the yard.

In many cases, you will need to design different treatments for each of the yard areas evaluated during the sampling process: the house dripline, areas of bare soil, areas of unique use such as children's play areas and picnic and gardening areas, and other areas. The illustration on page 86, Characteristics of a Lead-Safe Yard, shows how a number of treatment measures can be combined to create a yard that is safe and attractive and meets the needs of the homeowner and/or residents. In other cases, you may only have to address a single yard area, such as the dripline (where soil-lead levels are usually found to be highest).

The table on page 85 presents a list of treatment measures used by the EMPACT LSYP at specific soil-lead levels. Each measure is described in greater detail in Section 7.2. However, before incorporating these measures into your own program, you should refer to Section 3.4.3 for a discussion of how the EMPACT treatment approach compares with the approach recommended under the

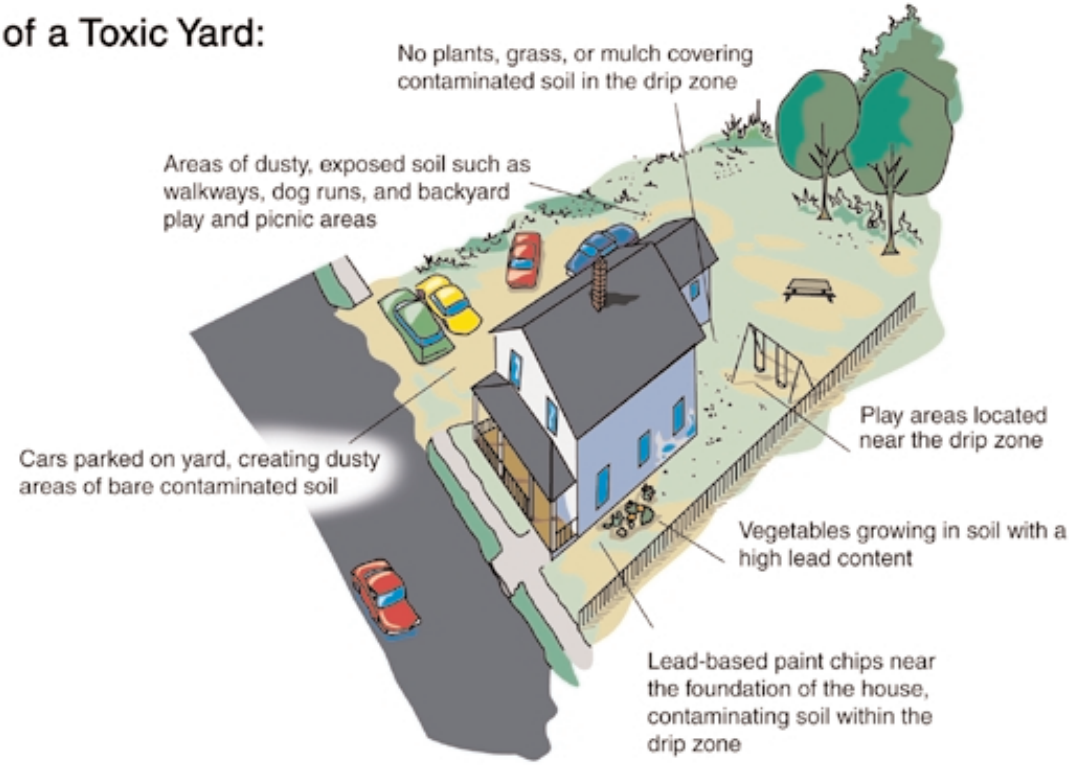
EMPACT LSYP TREATMENT MEASURES

Soil-Lead Level (parts per million)	EMPACT LSYP Treatment Measures
> 5,000 (very high)	If soil removal or permanent barriers are not possible: • Install semi-permanent barrier, such as a wood-framed dripbox filled with gravel or mulch. • Relocate gardens—unsafe for all types of gardening.
2,000–5,000 (high)	• Relocate gardens—unsafe for all types of gardening. • Relocate children's play area, pet area, and picnic area, if possible. If not, install wood platform or wood-framed raised play and picnic area filled with woodchips. • Install path of walking stones for high-traffic areas. • Seed and fertilize grassy areas, or cover with mulch or woodchips if not suitable for grass.
400–2,000 (moderately high)	• Install raised-bed garden and supplement with clean topsoil. • Install wood-framed raised play and picnic area filled with woodchips. • Install path of walking stones for high-traffic areas. • Seed and fertilize grassy areas, or cover with mulch or woodchips if not suitable for grass.
< 400 (urban background)	• No treatment necessary.

Characteristics of a Lead-Safe Yard

Signs of a Healthy Yard:

Signs of a Toxic Yard:



pending TSCA Section 403 rule (information about the rule can be found at http://www.epa.gov/lead/leadhaz.htm). Also keep in mind that decisions on specific landscape measures (e.g., choosing between mulch or grass, or between types of grass) must be made on a yard-by-yard basis to account for variables such as regional climate, yard topography, the amount of available sunlight, and the homeowner's esthetic preferences. These factors will often play a major role in shaping the final treatment plan for a property.

7.2 Treatment Options and Detailed Specifications

This section presents the specific landscape treatments used by the EMPACT LSYP. The treatment measures described here represent a suite of tools that the landscaper can use to address elevated soil-lead levels in specific yard areas: drip zones, grassed areas, parking areas, walkways, recreation and children's play areas, gardens, pet areas, and porches. As mentioned in Chapter 6, these are the high-risk and high-use yard areas where children are most likely to experience dangerous exposures to soil lead. For most of these yard areas, the EMPACT LSYP has developed two or more treatment options, giving the landscape designer some flexibility in selecting treatments that match both the homeowner's esthetic preferences and other variables such as yard topography and the amount of available sunlight.

It is important to keep in mind that not all treatments will be appropriate and/or effective at all locations. The treatments described here were selected by the EMPACT LSYP because they address the conditions found at a majority of sites in the project's target neighborhoods in Boston: high to very high soil-lead levels; inner-city homes that are typically wooden and covered with lead paint; high rates of yard use by children and families; and many areas of bare and partially bare soil. These landscaping measures also work well given Boston's variable climate, with its cold, wet winters and relatively hot, humid summers.

As you develop your own lead-safe yard program, you will no doubt want to pick and choose among the treatments presented here, rejecting some, revising others to fit your specific needs, and devising some entirely new treatments. The work you have done to get to know your target community (see Section 4.4) will help you in this process. In addition, you may want to consult local garden centers, nurseries, landscapers, and arborists for help selecting plants and grasses that will thrive in your area. If you live in an arid or semi-arid climate, for example, you may find yourself using plants that are very different from those used in the Northeast.

Once you have assembled a suite of treatment options that will work in your program area, you should develop detailed specifications that define exactly how the landscaping work should be done and what

PHYTOEXTRACTION: AN EXPERIMENTAL APPROACH

All of the treatment measures used by the EMPACT LSYP focus on employing grass, plants, and other materials as a barrier to reduce children's exposure to lead-contaminated soil. None of these treatments, however, remove the lead from the soil. Today, researchers are experimenting with another approach for using plants to actually extract lead and other contaminants from soil: phytoextraction.

As a technology, phytoextraction is still in its infancy. Researchers are still struggling with a number of questions, such as which plants best absorb certain contaminants, and how to make the technology affordable. The EMPACT LSYP does not use phytoextraction at this point, but may consider it in the future, as more information becomes available about its applicability in residential settings. See Appendix C for a detailed discussion about this promising technology.

materials should be used. These specifications should be provided to the landscaper and included with the landscaping contract (see Section 7.5.1) if you intend to engage a contractor. A set of sample specifications, developed by Lead Safe Boston and used by the EMPACT LSYP, is provided on pages 99 to 100.

7.2.1 Drip Zones

A perimeter mulch bed covering the drip zone.

The drip zone is the narrow 3-foot strip around the foundation of the house. There, soil-lead levels are usually highest, because lead-based paint on the outside of older homes weathers over time and falls into the top layer of soil adjacent to the foundation, contaminating it. Play areas, picnic areas, and vegetable gardens must be located away from the drip zone. In addition, covering the zone with a permanent or semi-permanent barrier provides long-term protection from the contaminated soil.

The EMPACT LSYP uses raised perimeter boxes that not only cover the contaminated soil in the drip zone, but also prevent erosion and offsite transport of the soil and allow for continued weathering of the exterior. Built from 2" by 6" ACQ (Alkaline Copper Quaternary) pressure-treated lumber, the boxes are lined with a filter-fabric weed barrier and then filled with either gravel or mulch and plantings, depending on the homeowner's preference. Plantings, such as evergreen shrubs, azaleas, boxwoods, holly, or thorny bushes, help keep children and pets away from the drip zone. Plantings used by the EMPACT LSYP are listed in the sample specifications on page 99. Consult a local garden center, nursery, or arborist to select plantings appropriate for your area.

7.2.2 Grassed Areas

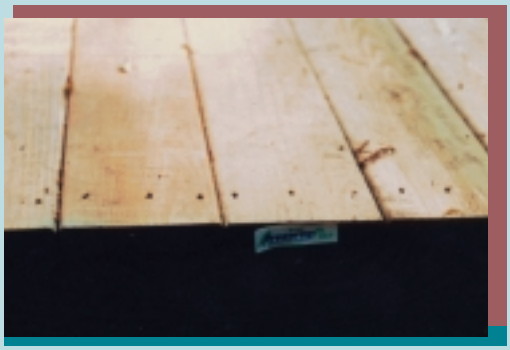
Maintaining a healthy lawn is one of the best ways to reduce exposure to lead-contaminated soils. A healthy lawn acts as a natural barrier between people and contaminated soils, and provides a safe outdoor space for play and relaxation. Lawns require routine maintenance with water and fertilizer, and should be protected from foot traffic for the first 3 to 4 weeks after seeding. Consult a local garden center or lawn care professional to select grasses that will grow in the soil and climate conditions found in your region. In areas of heavy foot traffic or low light where grass won't grow well, install a stone path or raised mulch bed to cover all bare soil.

Top: Before—bare soil in drip zone (1660 ppm).
Bottom: After—mulched planting bed covering soil.

- **Existing lawn improvement.** Improvement of an existing lawn can be accomplished quite inexpensively. Rake bare areas to loosen the soil, apply seed mix at the rate specified by the manufacturer, then apply ¼" of top soil over new seed. Water thoroughly.
- **New lawn installation (at existing grade).** Where little or no grass exists on a lawn, the entire lawn area should be rototilled and reseeded (apply water to contain dust during rototilling). Spread ¼" of loam (soil composed of sand, clay, silt, and other organic matter) on top of the seed, then water thoroughly.

Two months post treatment. Lawn growth over previously bare, contaminated soil (1,770 ppm).

- **New lawn installation (raised bed).** For sloped yards, the EMPACT LSYP sometimes uses raised grass beds to create a terraced effect and limit runoff and erosion. A raised grass bed can also be installed in areas where roots or rocky soil prevent grass from growing. In a perimeter box made of 2" by 6" ACQ pressure-treated lumber, install 6" of loam over filter fabric weed barrier. Apply seed mix, then spread ¼" of loam on top of seed and water thoroughly.



Wood platform built with ACQ lumber.

LESSONS LEARNED: USING ACQ PRESSURE-TREATED LUMBER FOR ADDED SAFETY

Over the past 30 years, pressure-treated lumber has become standard for outdoor construction because it deters rot, decay, and termite destruction. The EMPACT Lead-Safe Yard Project used pressure-treated wood for these reasons during its first two years of yard treatments. Recently, however, there has been a growing awareness of the dangers posed by chemicals used in the traditional wood-treatment process. There is some evidence that these chemicals, which include the EPA-listed hazardous compounds arsenic and chromium, can leach out of pressure-treated wood and into the environment.

During its third phase of yard treatments, the EMPACT LSYP began using a relatively new type of pressure-treated lumber: ACQ Preserve. ACQ-treated lumber contains no EPA-listed hazardous compounds and is guaranteed to protect against rot, decay, and termites. In other words, it offers all of the values of traditional pressure-treated lumber with fewer hazards. This is especially important when you use wood in and around gardens and children's play areas, as the EMPACT LSYP does. Costs of ACQ-treated wood vary, though the EMPACT LSYP has found these costs comparable to the costs of traditional pressure-treated wood. For an information sheet on ACQ-treated wood, go to http://www.conradwp.com/acq.htm.

- **Raised mulch bed (with or without plantings).** Raised mulch beds can be used to cover areas of bare soil where grass won't grow well. The beds can serve as children's play areas, or can be filled with various plantings to form an attractive garden area. Install a perimeter box made of 2" by 6" ACQ pressure-treated lumber to completely cover bare soil area. Install 4" of loam and 2" of pine bark mulch over filter fabric weed barrier. Select plantings that are appropriate for the area (e.g., shade, partial shade, full sun; arid or semi-arid soil). Provide recessed egress stepping-stones from the bed to an existing walkway.

7.2.3 Parking Areas

Cars parked on yards destroy grassed areas, turning them into dusty areas of bare contaminated soil. Cars should be confined to designated parking areas covered with gravel or asphalt. Heavy landscape timbers can be sunk at the perimeter of the parking area to define the edge and prevent stones from spreading into grass areas. All lots, whether gravel or asphalt, should have at least a 2-percent pitch across the surface to ensure that water will not puddle. Detailed specifications for creating a gravel or asphalt parking area are included on page 99.

A stone driveway.

Install stepping stones to prevent contaminated soil from being tracked into the house.

7.2.4 Walkways

Worn dirt paths create dust. By installing stepping stones in areas where people regularly walk, you keep contaminated soil from being tracked into the house. Alternatives include concrete walks, cement stepping stones, gravel over filter fabric, recycled concrete, and brick paths.

7.2.5 Recreation and Children's Play Areas

If possible, swing sets, sand boxes, and other children's play areas should be relocated away from the drip zone and other areas of highly contaminated soil. The same is true for picnic, barbecue, and other family recreation areas that receive heavy use. If relocation is not possible, the EMPACT LSYP uses one of two options:

- **Wood Platform**. A wood deck, made from ACQ pressure-treated 2" by 6" stock, can serve as a site for picnics, cook-outs, and children's play, and provides long-term protection from contaminated soil. Decking should be installed with a ¼" pitch to drain rainwater off the surface.

- **Raised bed filled with mulch or woodchips.** Raised beds can be used to cover areas of bare and/or highly contaminated soil. The beds provide an effective barrier and a safe, attractive place for children's play and family gatherings. Install a perimeter box made of 2" by 6" ACQ pressure-treated lumber, then install 4" of loam and 2" of pine bark mulch or woodchips over filter fabric weed barrier.

7.2.6 Gardens

Homeowners and residents should take precautions when gardening in or around lead-contaminated soil. Though plants generally do not accumulate lead, it is possible for a plant to absorb some lead in settings where soil-lead levels are very high. In addition, lead-contaminated dust can settle on the surface of garden plants.

Basic precautions include washing all vegetables with a vinegar-water solution, locating gardens away from roads and highly contaminated yard areas, and planting crops that are less likely to absorb or accumulate lead. In general, this means planting fruiting crops (e.g., corn, beans, squash, peppers, cucumbers, tomatoes, strawberries, apples) and avoiding root crops and leafy vegetables (e.g., carrots, radishes, lettuce, collard greens, spinach) since they are more likely to absorb lead from soils or become coated with lead-contaminated dust. Two excellent resources on lead in gardens are:

Lead in the Home Garden and Urban Soil Environment,
by Carl J. Rosen and Robert C. Munter
http://www.extension.umn.edu/distribution/horticulture/DG2543.html

Lead Contamination in the Garden, a fact sheet by Terry Logan
http://ohioline.ag.ohio-state.edu/hyg-fact/1000/1149.html

The EMPACT LSYP recommends relocating gardens away from the drip zone and other areas of highly contaminated soil. The EMPACT LSYP treatment approach recommends using raised beds in areas of moderate contamination (400 to 2,000 ppm). (Please refer to Section 3.4.3 for a discussion of how the EMPACT treatment approach compares with the approach recommended under the pending TSCA Section 403 rule.) Beds should be framed with 2" by 8" ACQ pressure-treated wood, lined with a filter-fabric weed barrier, then filled with 6" of loam that has been tested for lead levels (levels over 400 ppm are unacceptable). Gardening is considered safe in yard areas where lead levels are below 400 ppm.

7.2.7 Porches

The soil found underneath porches is often contaminated with lead from paint chips and with other chemicals that leach from pressure-treated wood used in outdoor construction. Because it receives little sunlight, this soil is also naturally bare. The EMPACT LSYP has developed two strategies to discourage children from playing in contaminated soil beneath porches:

- **Lattice and Trim Barricade.** All exposed soil under porches is to be barricaded by ACQ wood framing, lattice, and pine trim. Prep, prime, and paint pine trim or apply two coats of wood sealant. Install a framed access door of like material. If loose soil is likely to be blown out from under porches, a covering of gravel or pea stone over bare soil would be appropriate.
- **Raised bed filled with mulch or gravel.** Install a wood box made from 2" by 6" ACQ pressure-treated lumber along footprint of porch. Line the box with filter-fabric weed barrier, then fill with either 2" of loam and 3" of pine bark mulch or 3" of loam and 2" of crushed stone.

Top: Before—bare soil under porch deck.
Bottom: After—area barricaded with lattice and trim.

7.2.8 Pet Areas

By tracking lead-contaminated soil and dust indoors, dogs and other pets can be a major source of lead exposure for humans. Pets that play regularly in certain parts of the yard can also create dusty areas of bare contaminated soil. If possible, pet areas should be located away from areas of highly contaminated soil. If not, install a wood box made from 2" by 6" ACQ pressure-treated lumber to completely cover the bare soil area. Line the box with a filter-fabric weed barrier, then fill it with 4" of loam and 2" of pine bark mulch or woodchips.

7.3 Developing a Budget for Each Yard Treatment

Once you have selected a suite of treatment measures for your program, you may want to develop a standard budget that can be used to guide each yard treatment. This budget will represent the maximum amount that the landscaper is authorized to expend in designing and implementing a treatment plan for each home.

Three main factors will drive the budget development process: the amount of funding available to your program, the number of yards you hope to treat, and the actual costs of materials and labor needed to create a lead-safe yard. Some yards will obviously cost more than others to treat. Your goal is to establish a reasonable budget for an average yard, with the possibility of authorized cost overruns at certain yards where treatments turn out to be unusually expensive.

A sample budget developed by the EMPACT Lead-Safe Yard Project is shown on page 101. The budget was developed in two steps. First, the project team calculated an allowance for each individual treatment measure by estimating the total cost of labor and materials. There are a number of reference books that can help with this process. The RSMeans Company, for example, offers several such books, including *Means Site Work & Landscape Cost Data 2000* (ISBN 0-87629-547-2) and *Landscape Estimating, 3rd Edition* by Sylvia H. Chattin (ISBN 0-87629-534-0). These books can be found in some libraries and bookstores or ordered online (http://www.rsmeans.com). Keep in mind that labor and material costs vary by region. You may want to consult a local landscaper as you develop allowances for each measure.

Second, the project team identified ways in which the individual measures might be cost-effectively combined to create a lead-safe yard. The goal was to make the yard lead safe by addressing as many areas as possible within a set budget (in this case, $3,000), while giving homeowners some freedom to choose the types of landscape measures they prefer. Note that the budget includes a standardized construction management allowance of $500, which allows the landscaper to cover costs such as landscape design, permits and fees, a workmanship and materials warranty, insurance, construction oversight, and the development of a maintenance manual for the completed yard.

SOURCES OF FREE MATERIALS

- **Parks departments**
- **Recycling centers**
- **Tree services**
- **Corporate sponsors**
- **Local nurseries**

Remember that the standard budget you develop represents the maximum amount that the landscaper is authorized to expend for each yard. Some yard treatments will cost less than the maximum. For this reason, you should consider developing a standard cost estimate sheet that the landscape coordinator can complete for each yard. A sample cost estimate sheet is shown on page 102.

LESSONS LEARNED: ESTIMATING TREATMENT COSTS

The experience of the EMPACT Lead-Safe Yard Project illustrates the importance of accurately estimating the per-yard costs of materials and labor. At the inception of the project, the project team set a target of treating 70 yards over the first two years, with a goal of expending about $750 per yard in landscape labor and materials that would be offered free to the participating homeowners. However, the project quickly found that treatment costs were running much higher than expected, partly because the project had chosen to employ a landscape team of city youths who were learning on the job (see also Section 4.2, "Selecting Program Partners"). The average cost per yard was roughly $2,100, with $300 going toward materials and $1,800 toward labor. Project management and indirect costs amounted to another $900 per yard. Because of these unexpected costs, the project was forced to scale back its objectives, though it still managed to treat 42 yards over the two-year period.

The EMPACT LSYP is currently investigating alternative models for organizing a lead-safe yard program that could reduce current average costs, in particular costs for labor, management, and overhead. For example, the EMPACT LSYP is investigating a model based on the principles developed by Habitat for Humanity, in which the work involved in achieving a lead-safe yard is carried out with the help of the homeowner by using volunteer labor and donated materials. See Appendix B for more information on this and other proposed models.

7.4 Homeowner Design Session

The EMPACT LSYP has found that it is critical to include the homeowner in designing landscape treatments for his or her yard. Why? First, the homeowner is the person who can best verify that the selected treatments provide enough actual protection from the lead-contaminated soil, based on the way the yard is used. Second, the homeowner is there to ensure that the selected landscape treatments meet his or her approval in terms of their esthetic value. A homeowner who is unhappy with the appearance or layout of his or her yard is unlikely to commit the money and effort needed to maintain the landscape treatments year after year.

Chapter 5 of this handbook described the necessity of creating a permission form to document the homeowner's participation in your lead-safe yard program. That permission form should also specify the homeowner's role in choosing treatment options, should soil-lead levels on his or her property turn out to be elevated. The homeowner design session is where these choices are made.

The EMPACT LSYP has tried using both the outreach worker and the landscape coordinator for the design session. The landscape coordinator is the better option. However, the outreach worker should facilitate a smooth transition for the homeowner from the outreach/sampling phase to the design phase. For example, the outreach worker should convey names, numbers, and any linguistic barriers to the landscape coordinator soon after the soil sampling is complete. The outreach worker may also want to attend the initial meeting between the landscape coordinator and homeowner to maintain a sense of familiarity, trust, and continuity for the homeowner. During the design session, the landscape coordinator will do three things:

1) **Communicate with the homeowner about the testing results.** Using the color-coded map developed during the data-collection phase, the landscape coordinator should describe the testing results, the areas of concern, and the need for changes.

2) **Ask follow-up questions about yard uses.** During their initial meeting, the outreach worker should have interviewed the homeowner about the activities that take place in the yard and the ages and numbers of people who use the yard. Yard uses should have been mapped on a plot plan using colored markers or crayons (see Section 5.3). During the design session, the landscape coordinator should review the yard uses with the homeowner and ask any follow-up questions.

3) **Work with the homeowner to select appropriate treatments based on the lead levels, the yard uses, and the homeowner's esthetic preferences.** The selected treatments should be mapped on the plot plan showing yard uses, and this treatment plan should be used by the landscaper as a blueprint for work to be done. A sample treatment plan is shown on page 103. See Section 7.1 above for guidance on matching treatments to hazards.

You may wish to develop a legally binding form that the homeowner can sign at the conclusion of the design session, stating that he or she understands and approves of the final treatment plan. A sample homeowner's approval form is included on page 104.

7.5 Contracting With a Landscaper

Early in the development of your lead-safe yard program, you will want to identify a program partner for the design and landscape components of your project (see Section 4.2, "Selecting Program Partners"). This could be a non-profit landscaping company, a private landscaping company, or even a team of youth volunteers who have been trained in landscaping techniques. Another option, currently being tested by the EMPACT LSYP, is to develop a pool of landscaping contractors trained at designing and implementing landscape treatments that can reduce exposure to lead-contaminated soil. Why create a contractor pool? By training and partnering with multiple contractors, you create competition—a market—for the work you have to offer, and you also build "capacity" within your community for this type of work. This is an important goal of your program: to increase your community's base of knowledge about soil-lead hazards and strategies for yard treatment.

No matter who you use for the design and landscape components of your project, you will need to develop a contract for the work. If you have chosen to use only a single landscaper, this process will be relatively straightforward: you will simply negotiate an agreement for the property or properties requiring treatment, and then capture the agreement in the form of a contract. Guidance on developing a contract is provided below.

If you have succeeded in creating a contractor pool, you will need to develop a system for choosing which contractor to use at a particular property. Here are two possible ways of doing this:

- **Group the properties geographically, then assign several to each contractor.** Under this scenario, each contractor is given a budget for each property he or she is assigned, and is asked to develop and implement a treatment plan within the budget. This method is relatively noncompetitive, in that contractors are not asked to bid against one another. However, over time, you can determine which contractors do the best and most cost-effective work, and then increase their workload.

- **Solicit bids for the property (or properties) requiring treatment.** This works best if you (or a professional landscape designer) have already developed a treatment plan for each property, identifying which landscape measures will be used. Each contractor is then given a copy of the treatment plan(s), along with detailed specifications for the work to be done, and is asked

to submit a bid. The work goes to the lowest bidder. The disadvantage of this method is that the landscape contractor is not included in the development of the treatment plan.

Whatever method you use, you should consider assigning or awarding several properties at a time to each contractor, rather than one at a time. This allows contractors to benefit from the economies of scale when buying materials and planning their work.

7.5.1 Developing a Contract

To simplify the contracting process, you should develop a standardized contract for use at every property. This contract should define the scope of services the contractor will perform, the timeframe for the work, the contractor's legal responsibilities, and the details of compensation. The sample contract on pages 105 to 108 shows some of the details that should be incorporated into a standardized contract, including:

- **Warranty**—Contractors should provide a warranty guaranteeing their work from defects in workmanship and materials for a specified period. The EMPACT LSYP requires a one-year warranty from its contractors.
- **Draws**—The term "draws" refers to the timing of compensation. Many contractors will want one-third of their compensation up front, one-third at the halfway point, and the final third upon completion of the project. You should attempt to negotiate a payment schedule that is mutually acceptable, though you should keep in mind that draws are typically market-driven.
- **Insurance**—Each contractor should be required to maintain general liability and workman's compensation insurance to protect against claims due to bodily injury or property damage and claims under state workman's compensation acts.
- **Pollution insurance**—Most general liability insurance policies do not cover injury or illness caused by pollution (for example, illness caused by lead exposure). You should look into the costs and the potential necessity of pollution insurance in your state and consider encouraging contractors to purchase such insurance.

7.6 Health and Safety for Landscapers

Before any field work begins, your program should develop safety guidelines that protect your soil sampling team and landscape workers from the risks associated with working with lead-contaminated soil. All field workers should be educated about lead hazards, health effects, safe work practices, and any federal or state regulations that apply to their work.

OSHA regulation 1926.62, the "lead in construction standard," applies to all private sector workers, no matter how few are employed. Although it does not apply to workers in the public sector, it is nevertheless a useful reference on responsible practices. The regulation, available online at http://www.osha-slc.gov/OshStd_data/1926_0062.html, requires a written description of the work to be done, an estimate of the anticipated exposure to lead, and a statement detailing the precautions to be taken. If the anticipated exposure to lead reaches the "action level"—30 micrograms per cubic centimeter of air, averaged over an 8-hour day—extensive guidelines come into play to protect workers.

Since the lead to which landscapers in the EMPACT LSYP are exposed falls below the action level, compliance with the lead in construction standard has not been difficult. However, to be on the

LEAD-SAFE YARD PROGRAM HEALTH AND SAFETY

I. Primary route of entry of lead into the body is ingestion:

- **A. Lead can enter the body through normal hand-to-mouth activities.**
- **B. Small amounts of lead left on hands or clothing can impact blood lead levels.**
- **C. Lead-contaminated soil can be transferred to the interior of dwelling (by pets, shoes, clothing).**

II. Preventive measures:

- **A. Avoid dust-generating activities.**
- **B. Dampen soil to minimize dust generation.**
- **C. Keep children and pets away from area where work is being done.**
- **D. Wear leather or comparable work gloves to minimize hand contamination.**
- **E. Do not smoke* or eat while in work area.**
- **F. Wash face and hands before smoking* or eating.**
- **G. Remove shoes/boots before entering a dwelling to limit contaminated soil transfer.**
- **H. Wash work clothing separately from other clothing.**

*** Do not smoke at all.**

safe side, the project has adopted an important contract requirement that goes beyond what OSHA stipulates for enterprises whose employees are exposed to lead below the action level. This requirement is health and safety training for landscapers. One of the main points conveyed in the training is that lead enters the body chiefly through ingestion, which happens as a result of routine hand-to-mouth activities such as eating, drinking, and smoking. An information sheet used in the training is shown in the box, "Lead-Safe Yard Program Health and Safety."

Even small amounts of lead on the hands can affect blood lead levels. Also, lead on clothing is easily transferred to the hands, and then from the hands to the mouth. Another danger is that lead will be brought into the home on landscapers' clothing, especially their boots or shoes.

A key precaution is to avoid activities that generate dust. When the ground must be disturbed, as is often the case in landscaping, it should be dampened to minimize the dust that may be generated. Leather or comparable work gloves should be worn to cut down on hand contamination, and landscapers should not eat, drink, or smoke in the work area. After they leave, they should wash their face and hands before doing any of these activities. They should remove their boots or shoes at the door of their home to keep from tracking in contaminated soil, and they should wash their work clothing separately from their other clothing.

Blood lead tests are advisable to make sure such measures are effective, and in fact are mandated by OSHA for employees exposed to lead at or above the action level. Almost any doctor at almost any clinic can perform this service, but an occupational health physician and an occupational health clinic are recommended, primarily for skillful interpretation of test results.

Landscapers should have their lead levels taken before doing any work and then every two months for the next six months. If levels are still less than 40 µg/dL, the time between tests can increase to six months. If levels are between 40 and 50 µg/dL, testing should continue every two months. Levels above 50 µg/dL should trigger monthly testing, and if they don't decrease, the landscaper should be removed from the work area. However, this step may well be avoided. As soon as blood lead levels rise, employers should try to find out why and remedy the situation. Often the cause is some break in the accepted work practices, which can be handled by re-educating the employee.

The EMPACT LSYP has not seen any elevated blood lead levels among its team members as a result of exposure to lead in soil during landscaping work.

7.7 Approval and Signoff on Work Complete

After all landscape work and construction is complete, both you and the homeowner should inspect the property. You should look for the following things:

- That all landscape treatments have been successfully implemented as per the scope of work agreed to during the design session.
- That, for each treatment measure, the landscaper has followed the detailed specifications defining exactly how the work should be done and what materials should be used.
- That the property has been left in a clean state. The homeowner must approve any material remaining on site after completion of the landscape work.

This process of approving the completed work can be as formal or informal as you want to make it. During Phases 1 and 2, the EMPACT LSYP approved each yard treatment during an informal visit between the outreach worker and the homeowner (the outreach worker also used these visits to reinforce the lead hazard education delivered during previous visits). On the other hand, Lead Safe Boston, a spinoff of the EMPACT LSYP run by the City of Boston, has developed a legally binding project completion certificate (see page 109) to be signed by the homeowner and the landscape contractor after the property has been inspected and all work approved. The certificate also serves as a lien waiver, in which both the homeowner and contractor discharge Lead Safe Boston from any legal claims that may arise in connection with the work performed under the program.

Lead Safe Boston has also created an additional form (see page 110) for the contractor to sign upon receipt of final payment. The form certifies that the contractor:

- Has paid all debts associated with the work done on the property.
- Discharges the program and the homeowner from any claims made by subcontractors, material suppliers, or workers, in connection with the work performed under the program.
- Has completed all work on the property according to the terms of the contract.
- Warrants the completed work against workmanship and material defects for the period stipulated in the contract.
- Has been paid in full for all work complete.

7.8 Handing Over the Case File

At the conclusion of the yard treatment process, after all landscape work has been inspected and approved, you should present the homeowner with the case file that has been developed for his or her property. This file should be a binder containing all information related to the property, including copies of application and permission forms, testing results, treatments plans, and approval forms. The binder should also contain a copy of the maintenance manual that the landscape coordinator develops for the property (see Chapter 8). Keep a copy of each case file for your program's records.

A finished project.

7.9 For More Information

For information on U.S. EPA's proposed standards (TSCA 403) for lead-based paint hazards (including lead-contaminated residential soils), visit the Office of Pollution Prevention and Toxics at http://www.epa.gov/lead/leadhaz.htm.

The Department of Housing and Urban Development's Requirements for Notification, Evaluation and Reduction of Lead-Based Paint Hazards in Federally Owned Residential Property and Housing Receiving Federal Assistance (24 CAR Part 35) can be found online at http://www.hud.gov/lea/.

For an information sheet on ACQ pressure-treated lumber, go to http://www.conradwp.com/acq.htm.

Two excellent resources on lead in gardens are:

Lead in the Home Garden and Urban Soil Environment, by Carl J. Rosen and Robert C. Munter, http://www.extension.umn.edu/distribution/horticulture/DG2543.html

Lead Contamination in the Garden, a fact sheet by Terry Logan, http://ohioline.ag.ohio-state.edu/hyg-fact/1000/1149.html

The RSMeans Company publishes two reference books that can help with the process of estimating landscaping costs. The books, *Means Site Work & Landscape Cost Data 2000* (ISBN 0-87629-547-2) and *Landscape Estimating, 3rd Edition* by Sylvia H. Chattin (ISBN 0-87629-534-0), can be ordered online at http://www.rsmeans.com.

Information on OSHA's "lead in construction standard" (OSHA Regulation 1926.62) can be found online at http://www.osha-slc.gov/OshStd_data/1926_0062.html.

Sample Specifications for Yard Treatments

Suggested Plantings

Azalea evergreen hybrid (2 gallon)
Torch azalea (2 gallon)
Japanese boxwood (1 gallon)
Common boxwood (2 gallon)
American holly (2'-3')
Regal privet (18"-24")
Columbine (1 gallon)
Chrysanthemum (1 gallon)
Foxglove (1 gallon)
Day lily (1 gallon)
Black-eyed susan (1 gallon)
Hosta (1 gallon)

Drip Zone

Raised perimeter box filled with gravel (no plantings). Install 2" x 6" ACQ pressure-treated wood box 3' from foundation wall. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground to a minimum depth of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 3" of loam and 2" of ¾" crushed stone over filter fabric weed barrier.

Raised perimeter box filled with mulch and plantings. Install 2" x 6" ACQ pressure-treated wood box 3' from foundation wall. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground to a minimum depth of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 4" of loam and 3" of pine bark mulch over filter fabric weed barrier. Install a minimum of ten perennials per the list of plantings or approved equal.

Grassed Areas

Existing lawn improvement. Rake bare areas to loosen soil. Apply rye, fescue, and bluegrass seed mix at the rate specified by manufacturer. Apply ¼"of top soil over new seed and water thoroughly.

New lawn installation (at existing grade). Rototill existing lawn bed 6" deep. Apply water to contain dust during rototilling. Apply rye, fescue, and blue grass seed mixture at the rate specified by manufacturer. Spread ¼" loam on top of seed. Water thoroughly.

New lawn installation (raised bed). Install 2" x 6" ACQ pressure-treated wood box at owner-approved location. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 6" of loam over filter fabric weed barrier. Apply rye, fescue, and blue grass seed mixture at the rate specified by manufacturer. Spread ¼" loam on top of seed. Water thoroughly.

Raised mulch bed (with plantings). Install 2" x 6" ACQ pressure-treated wood box to completely cover bare soil area. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 4" of loam and 2" of pine bark mulch over filter fabric weed barrier. Install a minimum of ten perennials per the list of plantings or approved equal. Provide recessed egress stepping-stones from bed to walkway.

Parking Areas

Gravel parking areas. Install 6" of compacted gravel/crushed stone base to all areas designated as parking areas. Top of base shall be 2" to 3" below finish grade of surrounding area. Install a top layer of 1-1/2" to 2" of processed gravel or crushed stone (3/8" or ¾" size) over gravel/crushed stone base. Final grade is to have a minimum of 2% pitch across the surface to ensure that water will not puddle.

Asphalt parking areas. Level surface by preparing a 6" gravel base over a uniformly graded and compacted subgrade. Form, spread, and roll 2" of bituminous base coat and 1" topcoat to create a driveway 10' wide. Final grade is to have a minimum of 2% pitch across the surface to ensure that water will not puddle.

Walkways

Stone path. Install round or square red patio stepping stones at all egresses from front to rear yard. All stones shall protrude no more than ½" above the existing or new grade.

Recreation and Children's Play Areas

Raised play area. Install 2" x 6" ACQ pressure-treated wood box. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 4" of loam and 2" of pine bark mulch or woodchips over filter fabric weed barrier.

Wood platform. Install a 10' x 12' ACQ wood platform built from 2" x 6" stock, 16" on center with 5/4" x 6" radius edge decking. All decking and joints to be mechanically fastened with 3" galvanized screws. Platform shall be installed with a ¼" pitch to drain rainwater off of surface.

Garden Areas

Raised vegetable garden bed. Install 2" x 8" ACQ pressure-treated wood box at owner approved location. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 6" of loam over filter fabric weed barrier.

Pet Areas

Raised pet area filled with mulch or woodchips. Install 2" x 6" ACQ pressure-treated wood box to completely cover bare soil area. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 4" of loam and 2" of pine bark mulch or woodchips over filter fabric weed barrier.

Porches

Bare soil under porches (lattice and trim). All exposed soil under porches is to be barricaded by ACQ wood framing, lattice, and pine trim. Prep, prime, and paint pine trim or apply two coats of wood sealant. Install framed access door of like material. Include galvanized metal hasp and hinges.

Bare soil under porches (mulch bed). Install 2" x 6" ACQ pressure-treated wood box along footprint of porch. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 2" of loam and 3" of pine bark mulch over filter fabric weed barrier.

Bare soil under porches (gravel bed). Install 2" x 6" ACQ pressure-treated wood box along footprint of porch. All joints and corners shall be mechanically fastened with 3" galvanized wood screws to a 1-1/2" square stake driven into the ground a minimum of 12". All corners shall be braced with triangular exterior grade plywood keystones mechanically fastened directly to the wood box with 3" galvanized wood screws. Install 3" of loam and 2" of ¾" crushed stone over filter fabric weed barrier.

SAMPLE BUDGET FOR YARD TREATMENTS

	Allowance
House perimeter (drip zone) Each house receives approximately 150 l.f. of perimeter raised boxes installed 3' from foundation wall where feasible. (Exceptions to perimeter boxes are existing asphalt/concrete paving, bulkhead, under rear porches, etc.). Fill perimeter boxes with homeowner's choice of:	
Option #1: 6" of pine bark mulch, filter fabric, and ten 1-gallon plantings (i.e., common boxwoods, azaleas, holly, or equal). Plantings to include compost/top soil/manure.	$1060.00
Or Option #2: 4" of gravel, filter fabric (no plantings).	$1060.00
Bare soil area under rear porch area (all areas matching this criteriaon to receive treatment)	
Option #1: Barricade exposed soil by wood framing and lattice secured to porch framing/supports. Install access door of like material with hasp.	$350.00
Or Option #2: Area under porch to received raised perimeter boxes, filter fabric, and installation of 6" of pine bark mulch or 4" of gravel.	$ 350.00
Back yard (homeowner to choose one option)	
Option #1: Each house shall receive a 10' x 12' wood platform built from 2" x 6" ACQ stock, 16" o.c. with 5/4" x 6" radius edge decking.	$780.00
Each house shall also receive approximately 10' x 12' area of lawn. Treatment to include rototilling soil 6" deep, installing filter fabric, adding 6" of conditioned top soil to be spread by hand, perimeter edging to be constructed of 2" x 6" ACQ stock, and a 6# shade mix to be installed by push spreader.	$250.00
Or Option #2: Each house shall receive a 10' x 12' wood platform built from 2" x 6" ACQ stock, 16" o.c. with 5/4" x 6" radius edge decking.	$780.00
Each house shall also receive approximately 10' x 12' garden area. Treatment to include rototilling soil 6" deep, installing filter fabric, adding 6" of conditioned top soil to be spread by hand, perimeter edging to be constructed of 2" x 6" ACQ stock.	$250.00
Or Option #3: Each house shall receive approximately 20' x 24' area of woodchips. Treatment to include installation of filter fabric, adding 2" of topsoil spread by hand and covered with 6" of woodchips, and installation of perimeter edging to be constructed of 2" x 8" ACQ stock.	$905.00
Each house shall also receive misc. treatments to adjoin mulched area to egresses. Misc. treatments to include up to 30 additional 12" x 12" red patio stepping stones, misc. plantings, additional mulching, etc.	$125.00
Walkways	
Each house shall receive up to 30 red patio stepping stones, 12" x 12", to be used at major egresses.	$60.00
SUBTOTAL (house perimeter, rear porch, back yard, and walkways)	$2500.00
CONSTRUCTION MANAGEMENT ALLOWANCE (general requirements; landscape design and site development; construction oversight; homeowner education and maintenance manual development)	$500.00
TOTAL (APPROXIMATE) COST PER LOT	$3000.00

SAMPLE COST ESTIMATE SHEET

Property address: _____

_____

House perimeter (homeowner to choose one option)

Option #1 _____l.f.
Perimeter box with pine bark mulch, filter fabric, and plantings. $_____
Or Option #2 _____l.f.
Perimeter box with gravel, filter fabric; no plantings. $_____

Bare soil area under rear porch area (all areas matching this criteria to receive treatment)

Option #1
Wood framing, lattice, access door, stepping stones. $_____
Or Option #2
Raised perimeter boxes, filter fabric, and mulch or gravel. $_____

Back yard (homeowner to choose one option)

Option #1
Installed 10' x 12' x 6" ACQ wood platform. $_____
New 10' x 12' area of lawn with ACQ perimeter edging. $_____
Or Option #2
Installed 10' x 12' x 6" ACQ wood platform. $_____
New 10' x 12' x 6" garden area framed with ACQ wood. $_____
Or Option #3
New 20' x 24' x 8" area of woodchips framed with ACQ wood. $_____
Stepping stones, misc. plantings, additional mulching, etc. $_____

Walkways

Egress stepping stones. $_____

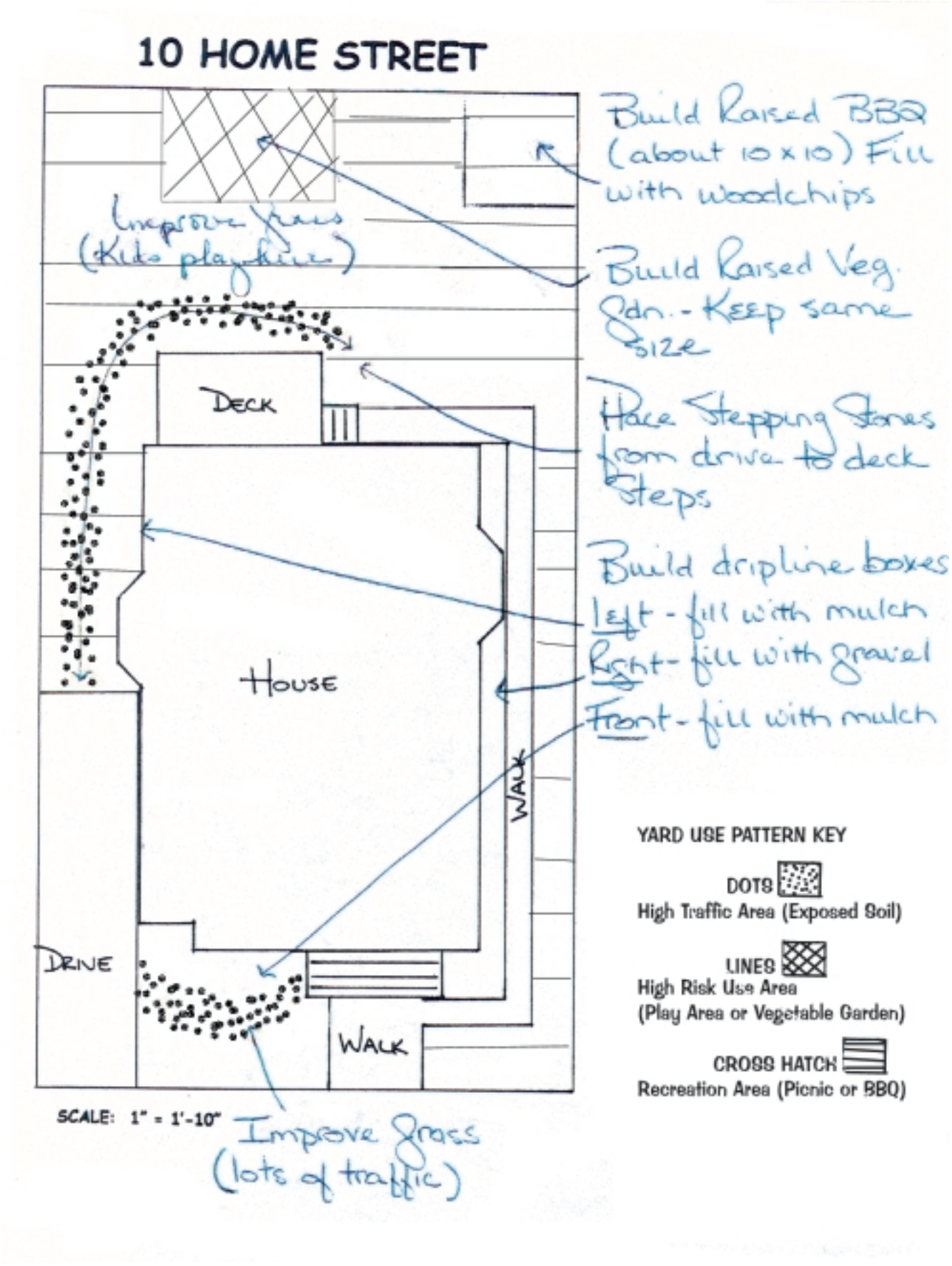
Misc. treatments:

Existing lawn improvement. $_____
Additional edging, material, plantings, etc. $_____

Total (Approximate) Cost $_____

Cost Estimate Submitted by: _____ Date: _____

Company name: _____



SAMPLE FORM:
HOMEOWNER'S APPROVAL OF TREATMENT PLAN

Date: _____

Property Owner: _____

Property Address: _____

_____

I/We have reviewed the construction documents (specifications, plans, drawings, etc.) for the proposed treatment of the soil around my/our property and attest that they are complete, accurate and conform to my/our wishes.

I/We authorize the program to proceed with my/our application using said construction documents fully aware that said documents may change. I/We understand that any changes to the documents will be reviewed by me/us and I/We shall approve such changes prior to commencement of the work by the landscaper. I/We also understand that [the lead-safe yard program coordinator] must approve all changes to the proposed scope of work before work begins.

Date of Specifications/Plans: _____

Date Landscaper can begin scope of work: _____

Number of days required to complete scope of work: _____ Calendar Days

_____	_____	_____	_____
Owner #1	Date	Landscaper	Date
_____	_____	_____	_____
Owner #2	Date	Program Coordinator	Date

CONSULTANT CONTRACT

THIS CONSULTANT CONTRACT (the "Contract") is made as of this ____ day of _____, 200__ between (Organization Name), with its principal office located at (Organization Street Address, City, State, Zip, hereinafter called "(Organization acronym)", and (Contractor Name), the principal place of business of which is located at (Contractor Street Address, City, State, Zip).

WHEREAS, the (Organization acronym) desires to engage the Consultant as an independent contractor, and the Consultant desires to accept such engagement on the terms and conditions set forth hereinafter;

NOW, THEREFORE, in consideration of the covenants and agreements herein contained, the (Organization acronym) and the Consultant agree with each other as follows:

1. **Scope of Services.**

- Obtain completed Homeowner Yard Use Interview and plot plan, developed by the Environmental Protection Agency, from (the organization acronym).
- Design and landscape (number of) properties recruited and enrolled from (Target Area). All landscaping designs shall include but not be limited to the attached Attachment A Lead Safe Boston/National Center for Lead Safe Housing Standard Plan for Low Level Lead Soil Treatment dated December 29, 1999.
- Meet with homeowner within ten business days after receipt of testing results and homeowner use questionnaire from (Organization acronym/name) to complete Landscaper Information Sheet and to discuss current and future use of yard.
- Generate landscape design within five business days from the date of meeting with the homeowner. Obtain (Organization acronym/name) approval of design; obtain homeowner approval of same. Provide (Organization acronym/name) with four copies.
- Generate property specific cost proposals and submit to (Organization acronym/name) for approval.
- Secure planting stock and materials required for specific project(s).
- Pay for and post all necessary fees/permits.
- Install landscapes as per owner and (Organization acronym) approved designs within thirty days from the date of landscape plan approval.
- Generate homeowner maintenance manual specific to each property. Provide (Organization name) with three copies and homeowner with one copy.
- Conduct 30-minute educational session with homeowner to review homeowner maintenance procedures and manual.
- Obtain homeowner and (Organization acronym) final approval of landscape work.
- Leave property in a clean state. Owner must approve any material remaining on site after completion of landscape installation.
- Provide a 1-year workmanship and materials warranty from date of final homeowner approval. This warranty is limited to defects in workmanship and materials attributable to the consultant only and does not cover losses caused by: acts of God, third parties or failure of the homeowner to comply with the maintenance procedures and manual.
- Coordinate with Lead Safe Boston representatives and/or other applicable agencies in the execution of this contract.
- Complete all work as per local, state and federal rules and regulations.

1. **Compensation.** The (Organization acronym/name) shall reimburse Consultant on a semimonthly basis for (Contractor name) services on receipt of itemized invoices as follows:

- $(Negotiated amount)/ea. On completion of initial visit with homeowner to discuss landscape design
- $(Negotiated amount)/ea. On completion and approval of landscape design and maintenance manual.
- Half of property specific cost proposal (less design fee) on commencement of landscape installation.
- Balance on completion and approval of installation and 30-minute educational session with homeowner to review homeowner maintenance procedures and manual.
- No one property shall exceed $3,000 including general conditions, design work and maintenance manual without prior approval from (Organization acronym/name).
- Invoices shall reflect actual costs per property and are to be submitted semimonthly to (Organization acronym/name) for processing and payment.

2. **Term.** The term of this Contract shall be from (Start Date) to (End Date). Either party on 30 days notice may terminate this contract. In the event of premature termination by the (Organization acronym/name), the Consultant shall be paid for all work completed prior to the termination as well as the reasonable value of all work partially completed and all materials obtained and stored on-site.

3. **Benefits.** The (Organization acronym/name) is not responsible for any insurance or other fringe benefits, including, but not limited to social security, worker's compensation, income tax withholdings, retirement or leave benefits, for Consultant or employees of Consultant. The Consultant assumes full responsibility for the provisions of all such insurances and fringe benefits for himself or herself and all Consultant's employees.

4. **General Liability and Workman's Compensation.** The contractor shall purchase and maintain such insurance as will protect him/her from claims under the Workman's Compensation Acts (chapter 152 of the Massachusetts General Laws) and from claims for damages because of bodily injury, including death and all property damage including, without limitation to, damage to the buildings and adjoining the site of construction which might arise from and during operations under any Contract, whether such operations be by himself/herself or by any subcontractor or anyone directly or indirectly employed by either of them. The Contractor shall, without limiting the generality of the foregoing, conform to the provisions of the Section A of Chapter 149 of the Massachusetts General Laws, which Section is incorporated herein by reference and made a part hereof.

General Liability Insurance Minimum bodily injury limits of $100,000 per person and $300,000 per accident, and $300,000 aggregate during any twelve-month period, shall include the following:

a. Public Liability (bodily injury and property damage)

b. Independent Contractor's Protective Liability

c. All Risk Insurance - covering all contractor equipment with provisions of waiver of Subrogation against the Owner

d. Comprehensive All Risk Motor Vehicle Liability Insurance—minimum bodily injury limits of $100,000 per person, per accident, and property damage limit of $300,000 per accident

5. **Arbitration.** Any controversy or claim arising out of, or relating to, this Contract or the breach thereof, shall be settled by arbitration in accordance with the rules then obtaining of the American Arbitration Association. Judgement upon the award rendered may be entered in any Court having jurisdiction thereof. Any award rendered hereunder shall be final and binding on all parties thereto.

6. **Construction.** This Contract shall be construed, interpreted and applied under and in accordance with the laws of Massachusetts.

7. **Parties Bound.** The terms and provisions of this Contract shall be binding upon the parties hereto, their legal representatives, successors and assigns.

8. **Federal Requirements.** The Consultant's services may be reimbursed in part from funds under a contract funded directory or indirectly by the U.S. Department of Housing and Urban Development. Consultant is bound by the provisions of that contract.

9. Entire Agreement. This instrument contains the entire agreement between the parties. No statement, promises or inducements made by any party hereto, or agent of either party hereto, which is not contained in this written contract, shall be valid or binding; and this contract may not be enlarged, modified or altered except in writing and signed by the parties.

IN WITNESS WHEREOF, the parties have caused to be properly executed on their respective behalf, this Consultant Contract, effective for all intents and purposes as of
(Month, Day, Year).

(Organization Name)

By: _____

Title: _____

(Contractor's Name)

By:_____

Title:_____

ATTACHMENT A—Narrative
Lead Safe Boston/National Center for Lead-Safe Housing
Standard Plan for Low Level Lead Soil Treatment
December 29, 1999

Goals of the Low Level Soil Treatments
The goal of this project will be to improve the lead safety in homes by the reduction of exposure to high levels of lead in soil. All work will be based on soil assessments conducted by EPA. EPA will conduct all soil testing and provide to the vendor/contractor a plot plan indicating areas of concern.

Abatement strategies shall be designed to change the use of the yards while providing a lead safe area for children and families to enjoy.

Outreach and Enrollment
The outreach and enrollment component of the project will be undertaken by a contractor already in use by The National Center (Silver Linings). Outreach will focus on a pool of properties deleaded under Lead Safe Boston's Round 1 Evaluation project. These properties will be targeted primarily because of the extensive data collected to date.

Typical Yard
When the deleading of a home was complete, the single soil treatment conducted by Lead Safe Boston deleading contractors included a final cleanup of the soil by hand raking after abatement of the structure as per the Massachusetts Lead Law. The properties averaged 4000 s.f. and the footprint of the home averaged 1000 s.f. In addition, the yards are mostly flat, compacted soil with evidence of tree roots and shade. Most properties do not have driveways.

General Requirements
The General Requirements are to include but are not limited to: permits/fees, a 1 year workmanship and material warranty period, general liability and worker's compensation requirements (see attached).

Landscaping and Site Development
Landscaping and Site Development is to include generation of the initial Landscape design based on use and the plot plan provided by EPA. Also to be included is the generation of the maintenance manual for the homeowner education component.

Construction Oversight
The construction oversight allowance is to include construction monitoring, final inspection/sign off and homeowner final approval. The date of final homeowner approval will be the starting date of the 1 year warranty period.

Homeowner Education
The homeowner education allowance is to include two on-site meetings: initial meeting to obtain homeowner approval and a final meeting to review all site specific maintenance manuals and work completed by the vendor/contractor.

Design
The Consultant shall use this document as a guideline for all landscape design decisions.

SAMPLE PROJECT
COMPLETION CERTIFICATE

Date: _____ Building ID: _____

Property Owner: _____

Property Address: _____

_____

I/We have inspected my/our property and found that the work conducted to make our yard lead safe has been successfully completed according to the scope of work I/we approved dated _____. I/We have met with [Contractor name] and attended a 30-minute educational session to review the Lead Safe Yard Maintenance Procedure Manual. [Contractor Name] has provided me/us with a copy of this manual for my use.

In accordance with the scope of work and in connection with the final payment made to the contractor, I hereby agree to discharge, and hold [Your Program] harmless from any and all claims which arise against the Owner and/or his/her property, in connection with the work performed under this Program.

_____ _____ _____ _____

Homeowner Name Date Homeowner Name Date

Inspection has been made of the yard made lead safe through the [Your Program]. I have examined the work and found all the work to be completed in a satisfactory manner and in accordance with the scope of work dated _____.

_____ _____

Program Representative Date

_____

In accordance with the contract dated _____ and in connection of the final payment made thereunder, I hereby agree to discharge, and hold the Owner and [Your Program] harmless from, any and all claims (including all liens resulting therefrom) which arise against the Owner of his/her property the contractor as its assignee now has or ever had by virtue of, or in connection with the work performed under, said Agreement.

That also in consideration of said final payment I hereby agree to discharge, and hold the Owner harmless from, any and all claims (including all liens resulting therefrom) which may be brought within forty (40) days of the date hereof by all sub-contractors, all suppliers of materials and equipment, and performers of work, labor or services arising by virtue of, or in connection with the work performed under, said Agreement.

That I warrant same for one (1) year from the date hereof, against workmanship and materials defects. One-year warranty does not cover losses caused by: acts of God, third parties or failure of the homeowner to comply with the maintenance procedures and manual.

_____ _____

Contractor Name Date

SAMPLE FORM:
CONTRACTOR'S AFFIDAVIT OF PAYMENT OF DEBTS, RELEASE OF CLAIMS, WARRANTY OF WORKMANSHIP AND RECEIPT OF PAYMENT

Property Address: _____

_____

Pursuant to the Agreement between [Contractor Name] and [Your Program], dated ____/____/, for the scope of work conducted at the above listed property, the undersigned, acting on behalf of the contractor, hereby certified and agrees as follows:

1) That he/she has paid in full, or has otherwise satisfied obligations for all materials and equipment provided, and for all work, labor, and services performed and for all known claims for all damages arising by virtue of, or in connection with the work performed under, said Agreement for which the owner of his/her property might in any way be held responsible.

2) That in accordance with said Agreement and in connection of the final payment made thereunder he/she hereby releases the Owner and [Your Program] of any lien, or claim or right to lien on said property resulting therefrom, which against the owner of his property the contractor or its assignee now has or ever had by virtue of, or in connection with the work performed under, said Agreement.

3) That also in consideration of said final payment he/she hereby agrees to discharge, and hold the Owner and [Your Program] harmless from, any and all claims (including all liens resulting therefrom) which may be brought within forty (40) days from the date hereof by all subcontractors, all suppliers of materials and equipment, and all performers of work, labor, or services arising by virtue of, or in connection with the work performed under, said Agreement.

4) That all work in connection with said Agreement has been performed in accordance with terms thereof.

5) That he warrants same for one (1) year from the date hereof, against workmanship and materials defects. The one-year warranty does not cover losses caused by: acts of God, third parties, or failure of the homeowner to comply with the maintenance procedures and manual.

6) That he/she has received from [Your Program] all sums of money payable to the contractor under said Agreement and any modifications or changes thereof.

By: _____ _____

Contractor Name **Date**

8 Yard Maintenance

Since the start of the EMPACT Lead-Safe Yard Project in 1998, the project's leaders have gained a heightened appreciation of the importance of yard maintenance to the project's overall success. It is safe to say that good maintenance is as critical as gathering accurate soil samples or selecting appropriate treatment measures.

This chapter explains the importance of yard maintenance (Section 8.1) and provides guidance on making maintenance an integral part of your lead-safe yard program. Section 8.2 presents specific maintenance guidelines for the landscape treatments found in Chapter 7. Section 8.3 describes the development of a property-specific maintenance manual and presents a sample manual used by the EMPACT Lead-Safe Yard Project. Section 8.4 provides tips on homeowner education, while Section 8.5 suggests creative ways of encouraging ongoing maintenance.

All of these sections will be useful to someone responsible for implementing a lead-safe yard program. Homeowners interested in applying landscape treatments to their own yards can focus on Sections 8.1, 8.2, and 8.3.

8.1 The Importance of Yard Maintenance

Why is yard maintenance such an important part of a successful lead-safe yard program? The answer is quite simple. All of the landscape measures used by the EMPACT LSYP are interim controls: that is, they are designed to protect children and other people from existing soil-lead hazards without permanently abating the hazards. These landscaping measures provide protection only so long as they are kept in good repair. Evergreen shrubs, for example, will discourage children from playing in the drip zone only if the shrubs are kept alive. Grass serves as a protective barrier only if it is healthy and well maintained. Likewise, a mulch-filled pet area must be raked regularly to maintain a 6-inch mulch barrier and keep pets from contacting lead-contaminated soil.

The good news is that all of these landscape measures can provide effective, continuing protection if well maintained. And most maintenance tasks are relatively simple—as easy as tightening a screw, watering a lawn, or raking a gravel drive.

8.2 Maintenance Requirements for EMPACT Treatment Measures

The table on pages 114 to 116 summarizes all maintenance tasks required for the landscape treatments described in Section 7.2 of this handbook. The table includes information on the optimum frequency of maintenance and the tools needed for each task.

8.3 Developing a Property-Specific Maintenance Manual

For each completed yard treatment, the landscape coordinator should prepare a property-specific maintenance manual that can be provided to the homeowner as part of the case file for his or her property (see Section 7.8). This maintenance manual should tell the homeowner what maintenance tasks need to be performed, when it is best to do them, and what tools (if any) are required for each job.

The maintenance manual used by the EMPACT LSYP during its Phase 1 and 2 treatments is shown on pages 117 through 122. The manual has several features that make it effective and easy to use:

- It is easily customized for each yard treated. The landscape coordinator simply places a checkmark next to each treatment measure used in that particular yard.
- It is easy to read. The homeowner simply looks for the checkmarks identifying the treatments used, then follows the maintenance guidelines provided.
- It is keyed to correspond with the treatment plan developed during the design session. The letters identifying particular treatment measures match up with those shown on the site worksheet (see page 79 in Chapter 7).
- It includes a list of materials used for yard maintenance, their typical costs, and places they can be obtained (including sources of free materials).

8.4 Educating Homeowners About Yard Maintenance

At the conclusion of each yard treatment, the landscape coordinator should meet with the homeowner to review all landscape work that has been completed in the yard, pass on the property-specific maintenance manual, and explain the information it contains.

This meeting provides a perfect opportunity to educate the homeowner about the importance of yard maintenance and to re-emphasize some of the key lessons of your program. The EMPACT LSYP has found that homeowners often don't retain the information on soil-lead hazards that was presented to them by the outreach coordinator (see Lessons Learned below). For this reason, the landscape coordinator should use this opportunity to review the following:

- The results of the soil-lead sampling and the areas of concern.
- Why lead-contaminated soil is harmful to children and other people.
- The landscape treatments that were employed and how they protect against harmful exposures.
- The homeowner's responsibility in maintaining the landscape installations.

Throughout the meeting, the landscape coordinator should emphasize that the landscape treatments will only be effective if well maintained. He or she should also emphasize that all involved maintenance is easy and inexpensive to perform.

8.5 Strategies for Encouraging Ongoing Maintenance

Once you have finished treating a yard, met with the homeowner one last time, thanked him or her for participating, and said goodbye, the success of that yard treatment is almost entirely in the homeowner's hands. If he or she completes all maintenance tasks as outlined in the maintenance manual, the treatments that have been installed can provide ongoing protection for many years. On the other hand, if the homeowner neglects all maintenance, the benefits of the yard treatment will be limited.

LESSONS LEARNED: RE-EDUCATING HOMEOWNERS ABOUT SOIL-LEAD HAZARDS

During Phases 1 and 2 of the EMPACT Lead-Safe Yard Project, the project team made focused efforts to educate homeowners about the need for maintaining the landscape treatments that were installed in their yards. These efforts included the creation of a homeowner packet for each completed property; the packet contained a record of the soil-lead sampling results, a color-coded plot plan showing treatments used, and a property-specific maintenance manual identifying maintenance tasks needed for that yard.

In the spring of 2000, less than two years after the first Phase 1 treatments were completed, members of the EMPACT team revisited several of the Phase 1 and 2 properties to evaluate the level of maintenance that had taken place. The results were disappointing. Their observations indicated that, at some properties, little or no maintenance had occurred. Many of the landscape installations (especially those requiring frequent attention from the homeowner, such as grassed areas and plantings) had degraded to the point where they no longer appeared to provide effective protection. Some homeowners were unable to locate their maintenance manuals when asked.

In assessing the reasons for these disappointing results, the project team found that many of the homeowners perceived the LSYP as a "yard beautification" project rather than as a risk-prevention program designed to protect children from dangerous lead exposures. Though each homeowner had been given extensive information about soil-lead hazards and how landscape measures could help protect their family's health, the homeowners had not always retained this message. The project team concluded that they needed to find new strategies for emphasizing the lead hazard message during Phase 3 of the project, and for creating repeated opportunities for homeowner re-education.
The strategies devised by the project team included sending out reminders about the need for yard maintenance, holding community-wide lead-safe yard maintenance days, and offering annual educational events about soil-lead hazards. These strategies are presented in Section 8.5. Additional strategies are described in Section 5.2, "Educating People About Lead and Lead in Soil."

Organize a presentation on lead poisoning and soil-lead hazards to encourage ongoing yard maintenance within the community.

Here are three strategies for encouraging ongoing maintenance over time:

- **Send out reminders.** Try developing a standard maintenance reminder that can be sent out annually to all homeowners who have participated in your program.
- **Hold community maintenance days.** Once or twice a year (perhaps in spring and/or fall), organize a community-wide "Lead-Safe Yard Maintenance Day." Such an event could be combined with community clean-up days.
- **Offer annual educational events within your community about soil-lead hazards.** For example, you might want to organize a presentation on lead poisoning and soil-lead hazards at a local community center or community college.

Above all, remember to be creative in communicating your message about soil-lead hazards, and repeat it at every opportunity.

Yard Area	Treatment Measure	Maintenance Tasks	Frequency	Tools Needed
Drip zone	Raised perimeter box filled with mulch and plantings	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Three times a year	None
		Replenish mulch to 6" depth	Every two years	Mulch fork or rake, shovel, wheelbarrow
		Water plantings	Regularly	Sprinkler, garden hose
	Raised perimeter box filled with gravel	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Annually	None
Grassed areas	Existing lawn improvement OR New lawn installation (at existing grade)	Apply grass fertilizer	Twice a year (spring and fall)	None
		Water lawn	Regularly	Sprinkler, garden hose
		Reseed bare spots	Annually (spring or early fall)	Rake, seed mixture
	New lawn installation (raised bed)	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Apply grass fertilizer	Twice a year (spring and fall)	None
		Water lawn	Regularly	Sprinkler, garden hose
		Reseed bare spots	Annually (spring or early fall)	Rake, seed mixture
	Raised mulch bed (with plantings)	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Three times a year	None
		Replenish mulch to 6" depth	Every two years	Mulch fork or rake, shovel, wheelbarrow
		Water plantings	Regularly	Sprinkler, garden, hose

Yard Area	Treatment Measure	Maintenance Tasks	Frequency	Tools Needed
Parking areas	Gravel parking area	Remove weeds and debris	Twice a year (spring and fall)	None
		Rake to maintain evenly spread top layer of 1 ½ " to 2"	As needed	Rake
	Asphalt parking area	No maintenance needed	None	None
Recreation and children's play areas	Wood platform	Check that all screws and other connections are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Sweep to maintain cleanliness	As needed	Broom
	Raised bed filled with mulch or woodchips	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Three times a year	None
		Replenish mulch to 6" depth	Every two years	Mulch fork or rake, shovel, wheelbarrow
Pet areas	Raised pet area filled with mulch or woodchips	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Twice a year	None
		Rake to maintain 6" depth	As needed	Rake
		Replenish mulch or woodchips to 6" depth	Every two years	Mulch fork or rake, shovel, wheelbarrow
Bare soil under porches	Install lattice and trim	Check that all screws, nails, and other connections on installation are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Scrape, sand, and paint or apply additional coats of sealant	Annually	Scraper, sandpaper, paintbrush, paint or sealant

Yard Area	Treatment Measure	Maintenance Tasks	Frequency	Tools Needed
Bare soil under porches	Raised bed filled with mulch or gravel along footprint of porch	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Remove weeds and debris	Annually	None
		Rake to maintain evenly spread top layer	As needed	Rake
		For mulch beds, replenish mulch to 6" depth	Every two years	Mulch fork or rake, shovel, wheelbarrow
Garden areas	Raised vegetable garden bed	Check that all screws and other connections on box are secure	Annually	Screwdriver, hammer
		Look for and remove splinters	Annually	None
		Add additional loam (or compost)	Annually	Shovel, wheelbarrow
Walkways	Stone path	Sweep to maintain cleanliness	As needed	Broom

LEAD-SAFE YARDS
MAINTENANCE MADE SIMPLE

Dorchester Lead Safe Yards Program

1999

LOOK FOR THE ☑ THAT SHOWS THE TREATMENTS USED IN YOUR YARD AND FOLLOW THE GUIDELINES

☑ **A. Pressure Treated Wood Dripline Boxes**

MAINTENANCE
Once a year:
Check to make sure that all screws and other connections are secure

Look for and remove splinters

Tools Needed:
Screwdriver and/or hammer

Dripline Boxes are Lined with Perforated Plastic or Landscape Film Then Filled with One of the Following:

☑ **Mulch**

MAINTENANCE
Three times a year:
Remove weeds and debris spring and summer

Tools Needed:
None

Every two years:
Replenish mulch to 6" depth

Tools Needed:
Mulch fork or rake
Shovel
Wheelbarrow

☑ **Gravel**

MAINTENANCE
Once a year:
Remove weeds and debris

Tools Needed:
None

☐ **Mulch Over Gravel**

MAINTENANCE
Three times a year:
Remove weeds and debris spring and summer

Tools Needed:
None

Every two years:
Replenish mulch to 2" depth

Tools Needed:
Mulch fork or rake
Shovel
Wheelbarrow

B. Pressure Treated Wood Raised Picnic/Play Areas

MAINTENANCE
Once a year:
Check to make sure that all screws and other connections are secure

Look for and remove splinters

Tools Needed:
Screwdriver and/or hammer

Pressure Treated Wood Raised Play or Picnic Areas are Lined with Perforated Plastic or Landscape Fabric and then Filled with One of the Following:

Woodchips *

MAINTENANCE
Three times a year:
Remove weeds and debris spring and summer

Tools Needed:
None

Every two years:
Replenish wood chips to 6" depth

Tools Needed:
Mulch fork or rake
Shovel
Wheelbarrow

Gravel

MAINTENANCE
Once a year:
Remove weeds and debris

Tools Needed:
None

Mulch

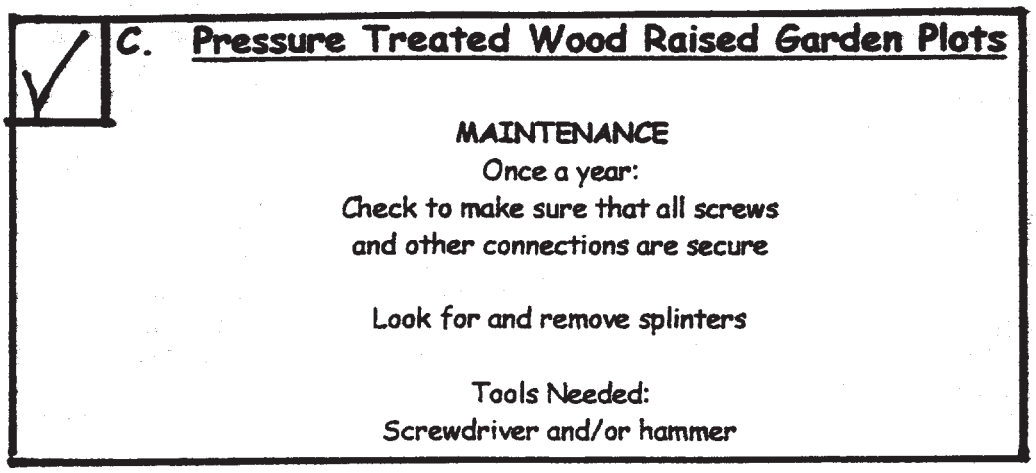
MAINTENANCE
Three times a year:
Remove weeds and debris spring and summer

Tools Needed:
None

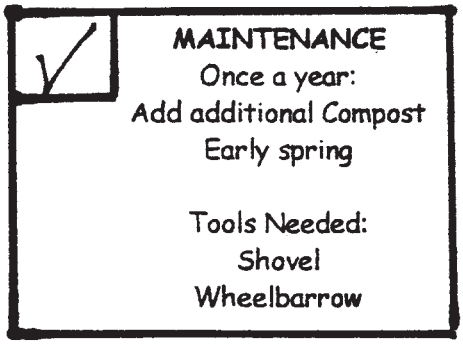
Every two years:
Replenish mulch to 6" depth

Tools Needed:
Mulch fork or rake
Shovel
Wheelbarrow

* See Resource List for Sources of Free Materials



Pressure Treated Wood Raised Garden Plots are Lined with Landscape Film and then filled with Loam and Compost: *



D. Covered Surface Areas for People, Cars and Pets

✓ Stepping Stone Paths

MAINTENANCE

Sweep as needed

Tools Needed:
Broom

✓ Grassed Areas

(Recommended for sunny spaces)

MAINTENANCE

Twice a year:
Apply grass fertilizer
spring and fall

Tools Needed:
None

Water regularly especially
during hot, dry weather

Tools Needed:
Sprinkler
Garden hose

Every Year:
Reseed bare spots
spring or early fall

Tools Needed:
Rake

Gravel Driveways and Paths

(Gravel spread to 2"depth)

MAINTENANCE

Twice a year:
Remove weeds and debris
spring and fall

Tools Needed:
None

Rake as needed to
maintain 2" depth

Tools Needed:
Rake

Areas For Pets

(Woodchips spread to 6" depth)

MAINTENANCE

Twice a year:
Remove weeds and debris
spring and summer

Tools Needed:
None

Rake as needed to
maintain 6" depth

Tools Needed:
Rake

Every two years: *
Replenish woodchips to
maintain 6 " depth

Tools Needed:
Mulch fork or rake
Shovel
Wheelbarrow

* See Resource List for Sources of Free Materials

RESOURCES AND TYPICAL COSTS

Prepared for Dorchester Lead Safe Yards Program 1999

MATERIAL	SOURCE	TYPICAL COST
Gravel	Building Supply or Garden Center	$20.00 per cubic yard plus delivery
Mulch	Garden Center	$25.00 per cubic yard $6.00 per 3 cubic foot bag plus delivery
Woodchips	Tree Service or Recycling Center or Parks Department	FREE FREE FREE
Pressure Treated Lumber (2"x 6")	Lumber Yard	$.75 per linear foot plus delivery
Grass Seed	Garden Center	$10.00 per 3 lb. bag (covers 1700 sq. ft.)
Grass Fertilizer	Garden Center	$10.00 per bag (covers 5000 sq. ft.)
Plastic in Rolls	Hardware Store	$3.00 per 3'x50' roll
Landscape Fabric	Garden Center	$15.00 per 3'x50' roll
Compost	Garden Center or Recycling Center or Parks Department	$5.00 per 50 lb. bag FREE FREE
Stepping Stones	Building Supply or Garden Center	$2.00 per 12" pre-cast square or round stone

9 Evaluating Your Lead-Safe Yard Program

This chapter provides guidance on evaluating the effectiveness of your lead-safe yard program. Section 9.1 suggests questions that you may want to focus on during your evaluation. Section 9.2 discusses the need for documenting your program's work at key evaluation points.

The information in this chapter is designed primarily for managers and organizers who are responsible for running lead-safe yard programs.

9.1 Focusing Your Evaluation

How effectively does your program reduce young children's exposure to lead? To answer this, you will need to evaluate your program.

As described in Section 1.2.2, EPA New England and the National Center for Lead Safe Housing (http://www.leadsafehousing.org) are currently leading a HUD-funded research study to document the effectiveness of the low-cost interim soil control measures used by the EMPACT Lead-Safe Yard Project. The study will include a retrospective evaluation of the soil intervention work conducted during Phases 1 and 2 of the EMPACT LSYP. It also will examine data collected during the summer of 2000 by all three Boston-based lead-safe yard programs: the EMPACT project, the Lead Safe Boston demonstration project, and the Boston Public Health Commission project. Soil-lead data will be collected before, during, and after each yard intervention, mainly to document the effectiveness of the landscape treatment measures in reducing risk to residents.

In designing an approach to evaluating your own program, you can focus on any of a number of criteria. Some of these are easily measurable, others are not. Here are four questions you may want to look at in your evaluation:

- How effective were the yard treatments in reducing soil-lead levels?
- How well did the yard treatments hold up over time?
- What effect did the yard treatments have on children's blood lead levels?
- How well did your program educate residents about lead poisoning?

9.2 Documenting Evaluation Points

An effective strategy for evaluating mitigation work is to compare the yard at three points in time: pre-treatment, immediately after treatment, and one year after treatment. Key to conducting an evaluation is adequate documentation of the program's work. Throughout this handbook, tools for documenting lead-safe yard activities have been identified. The following documentation should be contained in the case file you began upon initial contact with the homeowner:

- Homeowner application materials and consent form (Chapter 5).
- Results of educational 'quiz' (Chapter 5).
- "Homeowner Yard Use/Treatment Options Interview" Form (Chapter 5).
- "Before and after" photographs of the yard.

- Site worksheet (with monitoring results) and color-coded plot plan (Chapter 6).
- Treatment plan (Chapter 7).
- Contract (Chapter 7).
- Cost estimate sheet (Chapter 7).
- "Homeowner's Approval of Treatment Plan" Form (Chapter 7).
- Project Completion Certificate (Chapter 7).
- Any information available about blood lead levels of children living in the home.

When you return a year later, you should again obtain the homeowner's permission for inspecting the yard and taking additional measurements and photographs. A sample form is shown on page 126 ("Homeowner Permission Form—One Year Follow Up"). Your photos and notes from the follow-up visit will help document how well the landscaping measures have been maintained. You should also get input from the owner on:

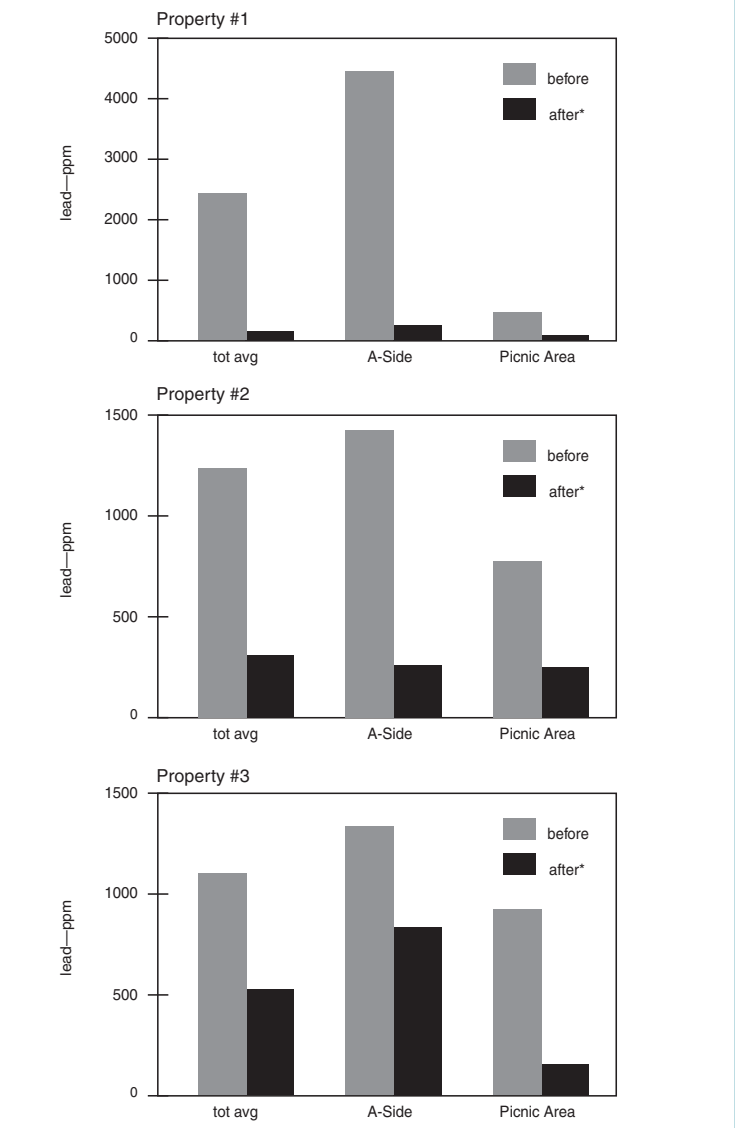
- His or her impressions of the benefits and/or drawbacks of the landscaping done at the home.
- How hard or easy it was for the homeowner (or another resident) to maintain the landscaping measures and whether the maintenance plan was clear and easy to follow.
- How your lead-safe yard program could be improved (e.g., through better treatment measures or better maintenance procedures).

You can also try to evaluate how well your educational efforts worked; the EMPACT outreach worker, for example, plans to readminister the quiz that she gives following the educational video, 'Lead Poisoning: The Thief of Childhood.' Finally, you can ask the residents if they are willing to give you the results of any lead testing done on children who live at the home.

All of this information will help you document and assess the various aspects of the program. This evaluation will be of value to your project team, your funders, the community, and each family involved in the program.

ASSESSING REDUCTIONS IN SOIL-LEAD LEVELS

In the summer of 1999, the EMPACT Lead-Safe Yard Project returned to several residences in the Bowdoin Street neighborhood to assess changes in surface soil-lead levels. All of these residences had been treated one year earlier, during Phase 1 of the project. Retesting efforts focused on play areas and/or areas that had been found to have high soil-lead levels during the initial testing. As illustrated in the graphs below, the results of the retesting showed that lead concentrations in the yard surfaces were significantly lower at each site. This indicated to the project team that the landscape barriers installed at the sites during the yard treatments were effectively covering the contaminated soil below. In the year 2001, the EMPACT LSYP intends to do another round of retesting at 25 sites.



Lead Concentration Before and After Mitigation for Three Phase 1 Properties

*Soil-lead concentrations were sampled 10 to 13 months after mitigation.

Homeowner Permission Form
Boston Lead Safe Yard Program
One Year Follow Up

Your yard has been made more safe for children to play in and for you to enjoy by the landscaping improvements that we have done through the Lead Safe Yard Program. Thank you for your cooperation during this community effort.

Now that we have finished a large number of yards in your neighborhood, we would like to inspect the work to see how well the improvements are holding up over time. We would like your permission to talk with you and to visually inspect all of the landscape improvements made by our program. During the visual inspection, we would also make some measurements and take a few photographs of the work. The inspection will take about an hour. This evaluation is funded by Lead-Safe Boston and the U.S. Department of Housing and Urban Development (HUD) and coordinated by the National Center for Lead-Safe Housing.

I give my permission for a visual inspection and measurements of the landscape improvements made by the Boston Lead Safe Yard Program.

_____ _____
Homeowner #1 signature Date

_____ _____
Homeowner #2 signature Date

_____ _____
Lead-Safe Yards Evaluation staff or Interviewer Date

10 Non-Residential Applications of Lead-Safe Mitigation Strategies

Many of the mitigation strategies and approaches incorporated into a lead-safe yard program can be applied to non-residential properties as well. Properties such as tot lots, playgrounds, community gardens, and vacant lots where children play may contain high levels of lead in their soil. Also, while children should not be playing at abandoned industrial sites or commercial buildings, these properties can be sources of increased exposure if children have access to areas of lead-contaminated soil. Specific mitigation approaches that have proven successful in reducing lead exposure risk at residential properties can be just as effective when applied to certain non-residential properties.

At tot lots and playgrounds, for instance, raised sand boxes can be constructed. The bottoms of these boxes should be lined with perforated plastic, landscaping fabric, or even indoor-outdoor carpeting to create a barrier between the lead-contaminated soil and the clean sand in which the children play. Clean sand should be tested to ensure that it does not contain lead levels of concern (i.e., greater than 400 parts per million). Similar raised boxes can be built around playground equipment and play areas and filled with sand, gravel, or mulch. Another alternative is to lay down rubber matting in play areas, or even paving lots. Planting and maintaining healthy grass cover is yet another option for play areas. Planting evergreen shrubs in areas with especially high lead levels can also be effective in keeping children from playing in these areas.

Community gardens can also incorporate lead-safe yard principles to protect against lead exposure. Raised garden boxes can be constructed, lined with perforated plastic or landscaping fabric, and filled with clean loam and compost. Loam should be tested to ensure that it does not contain lead above the 400-ppm level. Clean compost should be added yearly to replenish nutrients and help control lead levels.

Vacant lots where children play can be made lead-safe by covering exposed areas of soil. Planting grass is one approach, but other materials such as woodchips, mulch, or even gravel could be used. To keep children from playing in areas with high levels of lead in the soil, plant evergreen bushes and shrubs.

For abandoned industrial sites and commercial buildings, construct barriers (such as fences or walls) to keep children out of these potentially dangerous areas.

Appendix A

Safer Soil Pilot Program of Cambridge, Massachusetts

About the Program

The Lead-Safe Cambridge (LSC) program works to make the homes of income-qualified people in Cambridge, Massachusetts, lead safe through interior and external lead hazard control. It began the Safer Soil Pilot Program in 1997 to build on this effort by making the yards of participants in its interior de-leading program lead safe as well.

After soil sampling was initiated for the Safer Soil Pilot Program, LSC found that over 95 percent of the yards it investigated contained soil with lead levels above 400 parts per million. Currently, all homeowners participating in LSC are eligible for additional assistance under the Safer Soil Pilot Program. However, after September 2000, participation in the Safer Soil Pilot Program will be required, in keeping with new federal regulations.

Under the pilot program, soil samples are taken from select areas of a home and tested to determine their lead content. If elevated lead levels are found, a landscape planner works with the homeowner and/or tenants to develop an appropriate landscape remediation plan. The Safer Soil Program provides homeowners free soil sampling and grant support to reimburse them for the cost of implementing LSC-recommended soil remediation and landscaping plans. Specifically, the program offers:

- Free soil testing.
- Training on the dangers of lead exposure.
- Free technical advice on preventing lead exposure.
- Grant support of up to $2,000 per unit and $6,000 for three or more units toward the cost of approved materials used to make the yard leadsafe.

Partner Organizations

LSC receives funding for its Safer Soil Pilot Program from the U.S. Department of Housing and Urban Development. LSC collaborates with a number of local non-profit housing groups, including Just-A-Start and Homeowner's Rehab, as well as with the U.S. Environmental Protection Agency and the Massachusetts Department of Environmental Protection.

Outreach Barriers and Strategies

Cambridge is a diverse community. Its residents come from many different cultural backgrounds—English is not always their primary language. Successful communication with homeowners and residents often requires close cooperation and coordination with their English-speaking relatives, as well as the help of multilingual LSC staff members.

Homeowners and tenants are recruited to participate in the program through newspaper ads, Web announcements, property owner workshops (such as Cambridge Homefair), and word of mouth.

As part of its soil education strategy, LSC distributes flyers to educate homeowners about the soil-lead problem and inform them about the program, disseminates fact sheets via the Internet

(http://www.ci.cambridge.ma.us/~LeadSafe), and presents lead-safety materials at public meetings throughout Cambridge. In addition, LSC offers two annual Safer Soil workshops, free and open to the public, at which people can learn why lead in soil is a problem, find out how to landscape a yard to make it safer, and get technical advice from a landscape planner. LSC also enlists the help of local garden centers, which sponsor the workshops and offer coupons to workshop participants.

Soil Sampling and Analysis

After their units have been de-leaded under the LSC program, homeowners interested in participating in the Safer Soil Pilot Program sign an agreement with LSC to have their soil tested for lead. LSC takes soil samples from different use areas in each yard—such as driplines, play areas, gardens, walkways, and other bare areas—and sends them to a state laboratory in Jamaica Plain for analysis.

All samples are analyzed using the atomic absorption method (microwave digestion followed by flame atomic absorption spectroscopy). LSC relies on laboratory analysis, as opposed to onsite analysis using field portable x-ray fluorescence technology, because of cost and liability issues. A new XRF costs $15,000 or more (see Section 6.2); because an XRF contains radioactive materials, only a trained technician can use it. Getting sample results back from the laboratory takes about 7 to 10 days, but this has not been a problem.

Once LSC receives the sample results, it reviews them and consolidates them in the form of hand-drawn plot diagrams. These are then presented to (and interpreted for) the homeowners and/or tenants. If the test results reveal that soil on a property exceeds EPA-recommended levels for lead, an LSC landscape planner works with the homeowner and/or tenants to design attractive, usable lead-safe urban yards, providing them with plans, product recommendations, and cost estimates. The landscape planner works with homeowners in the design and construction of these plans. LSC believes that close cooperation with homeowners helps to create a sense of ownership, community, and most importantly, safety for children. In addition, this cooperation makes for longer-term compliance and better maintenance.

Remedial Measures and Yard Treatments

The Safer Soils Pilot Program favors a combination of techniques for remediating lead-contaminated soil around a residence. These include selectively paving contaminated areas, using softer paving materials (such as gravel with brick edging), and incorporating plants and shrubs in the yard. The program often recommends placing plants and shrubs around house driplines to reduce access to these areas while making the yard more attractive.

The program also works to reduce lead toxicity in the soil by rototilling organic matter (such as composted cow manure) and rock phosphate, which bind with lead, into affected areas. Once organic material has been introduced, the Safer Soil Pilot Program recommends taking the additional step of putting down landscape fabric over the contaminated area and covering the fabric with 3 to 4 inches of bark mulch or pea gravel to create a natural barrier. Sodding is another effective option, although its drawbacks include its high cost relative to other treatments and the need for routine watering in its early stages of establishment.

In areas where lead levels in the soil are found to be greater or equal to 5,000 ppm, LSC follows current EPA recommendations for remediating high-lead-content soil by covering the area with an impermeable surface (such as concrete or pavement) or, in extreme cases, removing the soil altogether. However, the Safer Soil program generally tries to avoid complete soil removal, in large part because of its cost and the difficulty of disposing of lead-contaminated soil.

Participants in the Safer Soil program are offered grants to help them pay for the materials they need to remediate their properties. The standard grant is $2,000 per unit and up to $6,000 for three or more de-leaded units. In order to make full use of an available grant, the homeowner (or a landscape contractor) must implement the program's recommendations for the property. Work must be done according to the landscape planner's recommendations; soil must be kept damp in order to prevent unnecessary lead dust exposure. Homeowners can use landscape contractors to execute their Safer Soil landscape plans if they are unable to do the work themselves. If the homeowner chooses to use a landscape contractor, he or she takes the landscape plan and specifications developed by the landscape planner and obtains three estimates for the landscaping work. The landscape planner approves the selected contractor, who then begins work. Homeowners save all receipts for materials and labor and submit them to the landscape planner for reimbursement (up to the total grant amount) after work has been completed.

The Safer Soil program also offers homeowners and tenants guidance on preliminary steps they can take to mitigate children's exposure to lead-contaminated soil. These tips include:

- Establishing a play area away from areas once exposed to old paint, such as the house or a fence.
- Covering leaded dirt with clean gravel or grass (preferably sod).
- Buying or creating a sandbox to cover leaded soil (making sure that the bottom is sealed away from the soil).

Results

To date, 27 yards have been landscaped through the Safer Soil Pilot Program, with 106 yards tested for lead. Landscaping plans and specifications have been developed for an additional 11 yards, and will be implemented in the near future.

Awards and Recognition

In 1999, LSC's Safer Soil Pilot Program was presented a National Merit Award from the American Society of Landscape Architects for its innovative approach to addressing lead in residential soil.

For More Information

Ann Stroobant
Landscape Planner
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astroobant@ci.cambridge.ma.us

Appendix B Some Proposed Models for Less-Resource-Intensive Approaches to Implementing Lead-Safe Yard Program

To develop feasible working models that can be applied in other communities, the issues of cost-effectiveness and homeowner participation need to be addressed. In the absence of a HUD-funded municipal program, or for those homeowners or residents not eligible for grants or loans from such a program, less costly approaches can be considered. In Boston, the EMPACT Lead-Safe Yard Project is currently investigating the following possibilities, several of which could be drawn upon in carrying out a lead-safe yard program at the local level:

- Using a model based on the principles developed by Habitat for Humanity, in which the work involved in achieving a lead-safe yard is carried out by the homeowner with the help of community volunteers (possibly other residents in the area who would then receive help with their yards). Habitat for Humanity is a non-profit organization that builds and rehabilitates low-cost homes through volunteer labor and donations of money and materials, with the help of homeowner (partner) families.
- Offering courses/workshops for homeowners and for landscapers through a local community college or other adult education program. Such a course would include information on building and landscaping techniques and materials, as well as maintenance required to achieve lead-safe yards. This could be part of a longer course on home maintenance or a course for new homeowners.
- Training environmental science students at a local community college to carry out sampling of yards for lead contamination. Students would be trained in how to draw plot plans, how to take samples, and how to interpret and write up the results, as well as in health and safety issues surrounding the handling of lead-contaminated soil. This would substantially reduce sampling costs, while providing an educational experience for the students concerned.
- Involving youth volunteers from a program such as City Year in carrying out the construction and landscaping work for lead-safe yards. City Year, a program of AmeriCorps (the domestic Peace Corps), engages young people aged 17 to 24 in youth development, human services, public health, and environmental programs. Another option would be to contract with a training and construction program such as Youth Build. Youth Build is a youth and community development program that offers job training, education, counseling, and leadership development opportunities to unemployed and out-of-school young adults, aged 16 to 24, through the construction and rehabilitation of affordable housing in their own communities.

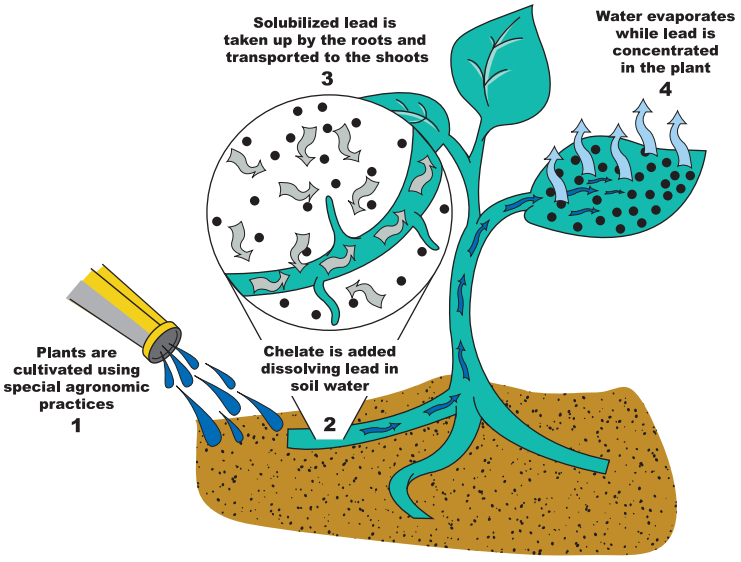
Appendix C

Future Options—Using Plants to Treat Lead-Contaminated Soils

This handbook focuses on measures that can keep children safe by reducing their risk of exposure to lead. The fact is, though, that unless the lead is permanently removed, exposure can reoccur (for example, if landscaping measures are not maintained).

The most frequently used method of removing the lead is to dig up the contaminated soil and haul it to a hazardous waste facility. This method is costly and requires intensive labor. However, some promising and innovative experiments explore how to minimize lead exposure by actually extracting it from the soil. This angle of research explores how nature itself, through a process called phytoextraction, might hold a potent solution for removing lead and other hazardous metals from contaminated soils.

Phytoextraction involves using living green plants for removing contaminants, such as lead, from soil and water. The term refers to the uptake of metal contaminants by the plant's roots and the subsequent transport of the contaminants to various parts of the plant. In general, plants do not absorb or accumulate lead.[19] But certain plants, such as the sunflower and Indian mustard, absorb remarkably large amounts of metals compared to other plants and actually survive. After the plants are allowed to grow on a contaminated site for a period of time with proper soil amendments to mobilize the metal, they are harvested. After this, they are either disposed of as a hazardous waste or incinerated (and the metals recycled). The schematic below illustrates phytoextraction processes (adapted from http://aspp.org/public_affairs/briefing/phytoremediation.htm).



[19] Carl Rosen and Robert Munter. 1998. *Lead in the Home Garden and Urban Soil Environment.* University of Minnesota Extension Service. FO-2543-GO. http://www.extension.umn.edu/distribution/horticulture/DG2543.html

Scientists have studied phytoremediation (the use of plants to recover contaminated soils and water) extensively. It is slowly becoming an acceptable, and even preferred, technology. Numerous demonstration projects have shown the promise of phytoremediation. For example:

- In Trenton, New Jersey, the Gould National Battery site was home to commercial lead-acid battery manufacturers from the 1930s to the 1980s. In those years, the land became heavily contaminated with lead. Under the Brownfields Initiative, the U.S. Environmental Protection Agency awarded Trenton a grant to restore the site. In 1995, Phytotech Inc. (now Edenspace Systems Corporation) approached the city about using "green technology" to clean up the site. Three crops of plants over a summer reduced lead levels on 75 percent of the treated area to below the New Jersey residential standard of 400 parts per million. See http://www.edenspace.com/CaseStudies.htm.

- In Chernobyl, a team of scientists from Rutgers University headed by plant biologist Ilya Raskin tested phytoextraction to remove radioactive cesium and strontium from a contaminated pond. Sunflowers were set floating on small polystyrene rafts so that their roots dangled in the water. Despite the poisons, the plants thrived. So far, Raskin has used phytoextraction techniques in sites in New Jersey, Massachusetts, and Connecticut.

Only a handful of demonstration projects focused on removal of lead from residential soils. Here's an example from the Boston metro area:

- The Boston Health Department sought a comprehensive strategy to remove lead from a small Dorchester neighborhood that hosted a cluster of childhood lead poisoning cases. Excavation and removal simply cost too much, so the department sought other methods. They teamed with Edenspace Systems Corporation to explore phytoextraction using Indian mustard plants on a 1,000-square-foot test site in the neighborhood. They spread a soil amendment that would loosen the lead so it dissolves in the moisture. They planted Indian mustard, which is well suited for metal removal because it accumulates the metal in its leaves rather than its roots. After six weeks, they harvested the plants and analyzed the soil. Lead concentrations decreased 47 percent, and after a second growing, the overall lead reduction was 63 percent (from 1,500 ppm to under 300 ppm). The harvested plants were incinerated, and the metals in the ash were recycled. Based on the results of the demonstration, Tom Plante of the Boston Health Department feels this method is very effective in reducing lead levels in soil and has the potential for a wide array of applications including brownfields—and now urban residences (if there is enough sunlight and moisture). For more information on this demonstration project, visit the Boston Childhood Lead Poisoning Prevention Program at http://www.tiac.net/users/bdph/oeh/leadhome.htm.

Edenspace Systems Corporation is continuing research on residential soil-lead remediation. One of the challenges of lead remediation in residences is that the plantings can put an entire yard out of use and out of sight for months or even years. Therefore, the company is researching the potential of turf grasses to extract lead from the soil. Making the technology affordable, ensuring proper sunlight and irrigation, bringing heavy machinery into residential neighborhoods, and reaching lead that is too far for plant roots to reach might pose additional challenges. However, research will continue to build on existing knowledge of phytoextraction and help address the potential challenges.

For more information on phytoextraction and other forms of phytoremediation, see the following online resources:

Edenspace Systems Corporation
Edenspace now owns or licenses an array of proprietary techniques used in removing lead, arsenic and other metals from the environment. The resources page provides many useful links to articles on phytoremediation.
http://www.edenspace.com/newpage4.htm

Phytoremediation: using plants to remove pollutants from the environment
An overview of phytoremediation written by Rutgers University plant biologist Ilya Raskin.
http://aspp.org/public_affairs/briefing/phytoremediation.htm

Rutgers University Center for Agriculture and Environmental Technology
One of the pioneer research institutions for phytoremediation.
http://aesop.rutgers.edu/~biotech/brochure/index.html

U.S. EPA Citizen's Guide to Phytoremediation
http://www.epa.gov/swertio1/products/citguide/phyto2.htm

Appendix D

Quality Assurance Project Plan for:

A COMMUNITY BASED ENVIRONMENTAL LEAD ASSESSMENT AND REMEDIATION PROGRAM

Prepared for: _____

Lead Safe Yard Program
USEPA New England Lab
60 Westview Street
Lexington, MA 02421

Prepared by: _____

Paul Carroll, Chemist
Investigations and Analysis Unit, OEME

Approved by: _____

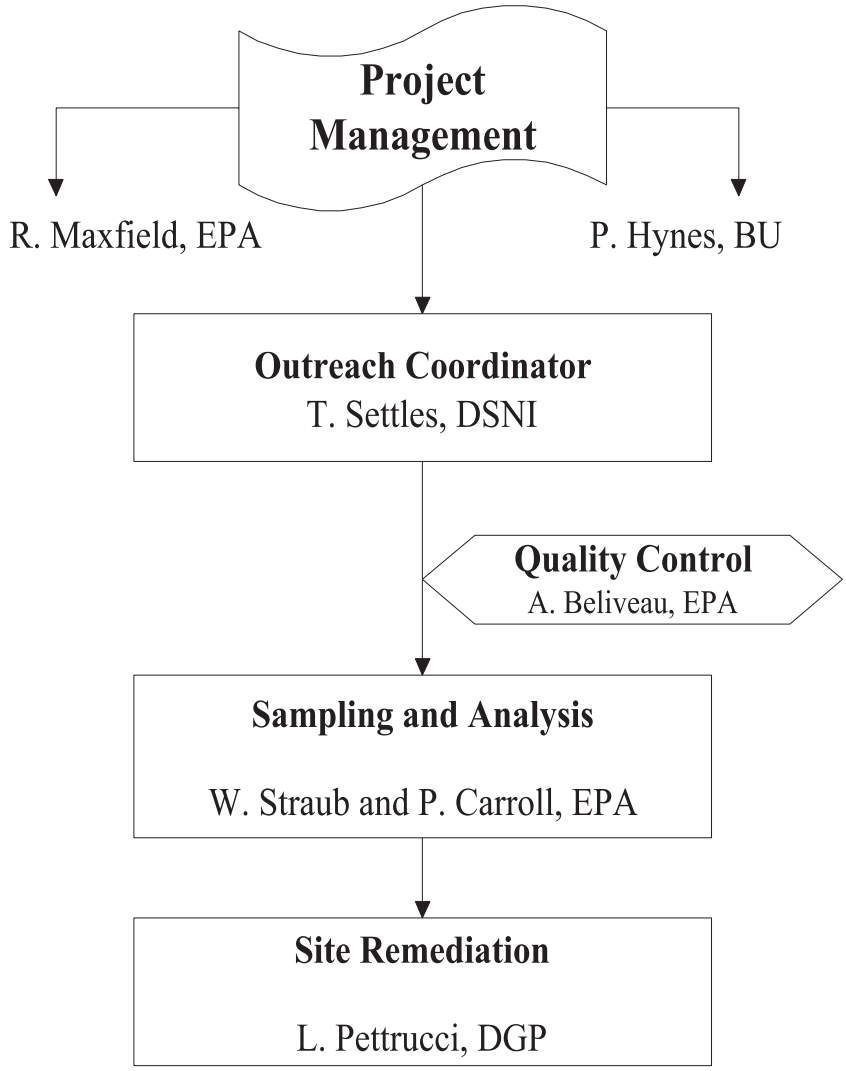
Robert Maxfield, Chief
Investigations and Analysis Unit, OEME

Approved by: _____

Andy Beliveau, QA Officer
Quality Assurance Unit, OEME

1.0 Scope and Application

This QAAP outlines procedures for the field analysis of lead in soil using the Niton 700 Series Field Portable X-Ray Fluorescence Spectrometer. These methods are designed as part of the sampling and analysis protocol for the Lead Safe Yard Program and are applicable to the measurement of lead in urban soils.



2. Project Organization and Responsibility

The Project Managers are in charge of coordinating, maintaining and monitoring all activities, including direction for preparation of work plans, sampling plans, and analytical procedures relative to the project. The Quality Assurance personnel will evaluate and approve QA/QC plans through the course of the project and oversee all data quality assurance aspects of the project. The Outreach Coordinator will be responsible for locating potential properties for sampling and analysis, contacting property owners and gaining consent to work on the property. The sampling and analysis team will be responsible for scheduling and conducting data collection and data reduction procedures, properly maintain samples, develop site sketches and other observations, generate

required QA/QC records and implement corrective actions. The site remediation group will apply innovative and cost effective landscape techniques for site improvements.

3. Problem Definition

Lead poisoning continues to be an extremely serious environmental health issue for youth, particularly in poorer inner city neighborhoods with older wood framed housing. While considerable attention has been focused on the lead contaminated paint prevalent on the surfaces of homes in these neighborhoods, less attention has been paid to the lead contaminated soil that surrounds each home. The reasons for this lack of attention by regulators stems from a variety of concerns: perhaps foremost is the cost of soil removal and disposal.

4. Project Description

The overall objective of the proposed project is to produce a summary report documenting the effectiveness of low cost residential soil intervention. The project will incorporate two sampling plans to accomplish this goal. One sampling strategy will be to measure surface soil lead at residential properties in the Greater Boston area. Properties that exceed project specific action levels will be mitigated with simple, low cost methods that are designed to minimize the risk of human exposure to the contaminated soil. Soil surfaces will then be measured to evaluate the effectiveness and durability of the intervention measures over time. A second sampling strategy involves measuring tracked-in soil Pb (house dust) to compare pre and post intervention Pb levels inside the residence. This Quality Assurance Project Plan outlines protocol for the residential soil surface sampling program that will be used in this project.

4a. Project Timeline

Activity	Start	End
Review existing data Determine target community	11/99	2/00
Community Outreach	2/00	9/01
Site Investigations Meet with property owners	3/00	11/01
Site Remediation	3/00	11/01

5. Sampling Design

The sampling strategy is designed to assess the potential of excessive lead exposure to humans from soil on the property. Each property will be evaluated with focus on four areas of concern: the dripline along the house foundation, play areas in the yard, areas of exposed soil in the yard, and any other potential sources of soil lead contamination including those from abutting properties. Play areas found to contain greater than 400 parts per million (ppm), and other areas that are found to contain greater than 2000 ppm lead will be further characterized to determine the nature and extent of contamination (note Appendix 1, the Sampling Logic Tree). Two soil sampling strategies,

in situ and bag sampling, will be used to determine lead content in these residential soils. Descriptions of each along with QA/QC protocol follow.

In-Situ Sampling. Samples will be analyzed with a Niton Model 702 XRF Spectrum Analyzer. The 702 is a field portable multi-element, multi-functional x-ray fluorescence analyzer (FPXRF) equipped with a 10mCi cadmium-109 source and a high resolution Silicon-Pin detector. The hand held, battery powered FPXRF is capable of in-situ analysis techniques. Based upon a minimum detection limit study (MDL), the detection limit for this method is approximately 100 ppm. These data are attached as Appendix 4. This instrument is factory calibrated, has been found to hold calibration quite well, and is software compensated for any deterioration of the source. In addition to the MDL, precision and accuracy studies (1998 and 2000) are attached as Appendix 5.

Soil lead measurements will be taken *in-situ* during the screening phase provided that the surface is not inundated with water. Large nonrepresentative debris, including rocks, pebbles, leaves and roots, will be removed from the soil surface prior to sampling. The area will be smooth enough to allow uniform contact between the FPXRF and the ground surface. The initial sample locations will depend upon the size and shape of the region of interest. A line pattern will be used when the area is linear (e.g. dripline). In-situ measurements will be taken at approximate 10 foot intervals along the line depending upon the length of the building. Additional lines are tested at 2 to 5 foot sampling intervals away from the original sampling area to characterize the extent of any lead contamination. Target patterns will be used for sampling larger, nonlinear areas of potential exposure (e.g. play areas). A large "X" will be superimposed upon the space to be analyzed. In- situ measurements will be taken at 5 to 10 foot intervals along each line of the "X" unless the samplers determine that additional (or less) resolution is required. Screening data and descriptive information about each site will be recorded on the Site Worksheet (Appendix 2).

Quality control checks will consist of replicate measurements, standard reference material (SRM) checks and confirmation samples as defined in Section 10, Acceptance Criteria for Soil Lead by XRF. Replicate measurements will be conducted over a minimum of 10% of the screen samples to indicate the precision of analysis and the homogeneity of the sample matrix. Three point SRM measurements and a blank measurement will be conducted at the beginning and end of each sampling day to ensure linearity over the expected sampling range (e.g. 400-5000 ppm) and to determine that the instrument is operating contaminant free. SRMs (NIST 2586 @ 432 ppm lead in soil) will be used as continuing calibration checks after every 10th screen sample. A minimum of one confirmation sample will be collected from each site. Approximately 4 tablespoons of surface soil, to no more than the approximate depth of 0.5 inches, will be collected into a soil sample container and thoroughly mixed for each confirmation sample. The sample will be properly labeled and returned to the laboratory for analysis by EPA Method 6010A.

Bag Sampling. If site conditions are such that *in-situ* sampling is not appropriate and sampling activities must continue, this bag sampling method will be used to evaluate soil lead conditions on the residential properties. The sampling strategy will be a scaled down version of the *in-situ* strategy. The focus will still be on the dripline of the building on the property, play areas, bare soil and other concerns such as sources from abutting properties. The bag approach involves collecting soil samples into a sampling container and returning them to the laboratory for preparation, XRF analysis and ICP confirmation.

Typically, a minimum of 4 discreet soil samples will be collected from each side of the building perimeter within 1 to 3 feet of the foundation (dripline). These samples will be collected at the very minimum of 2 feet from each other. Bare soil areas are the preference (vs. covered areas).

Composite samples from play areas will consist of aliquots collected along an X shaped grid. These subsamples will be collected at a minimum of 1 foot from each other. Bare soil areas are preferred. This method will also apply to bare areas of soil, vegetable gardens and high use areas noted on the subject property.

The decision to sample along the property boundary will be determined by the samplers at the time of the site visit. If conditions exist on an abutting property that would appear to present a risk of soil lead contamination to the subject property, the following protocol will be followed. Aliquots of surface soil will be collected along the property line(s) of interest. These subsamples will be collected no closer than 1 foot apart and will be located within 1 to 5 of the property line. Subsamples will only be collected on the subject property.

Quality control for the composite method measurements will be identical to QA/QC for the in situ method. Three point SRM measurements and a blank measurement will be conducted at the beginning and end of each sampling day to ensure linearity over the expected sampling range (e.g. 400-5000 ppm). SRMs will be used as continuing calibration checks after every 10th screen sample. A minimum of one confirmation sample will be collected from each site.

All bag samples will be collected according to protocol outlined in Section 7 *(Sample Handling and Chain of Custody Requirements).* The samples will be returned to the EPA laboratory where they will be dried, screened to remove nonrepresentative debris, and analyzed using XRF technology. Select samples will be designated for confirmation analysis by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP).

Confirmation Samples. Confirmation samples are collected during sampling activities to be analyzed at the University of Cincinnati, Hematology and Environmental Laboratory by Atomic Absorption Spectrometry. These samples are collected in selected intervals around the house perimeter (designated HC for house composite), any play areas (PC), from any on-site vegatable gardens (GC) and from any high use areas (HUC).

Typically, 12 subsamples are collected for each perimeter composite sample (3 from each side of the house). If possible, 5 subsamples are collected for each play area composite, garden composite and/or each high use area composite using the target pattern approach. The samples are returned to the EPA laboratory, sieved with a number 10 sieve (U.S.A. Standard Sieve Series) to removed any coarse debris, rebagged and analyzed for lead content using the Niton XRF. Each sample is then labeled (street number and name and composite designation), recorded on a chain of custody form and sent to the U. of C. Lab for the extraction and AA analysis for lead content.

6. Sampling and Analytical Methods Requirements

Parameter	Matrix	# of Samples	Analytical	Containers	Preservation	Hold Time
Lead (XRF) insitu	Soil	TBD	EPA 6200	N/A	N/A	N/A
Lead (XRF) confirmation	Soil	TBD	—	ziplock bags	4°C	1 year
Lead (ICP) confirmation	Soil	TBD	EPA 6010A	ziplock bags	4°C	1 year

7. Sample Handling and Chain of Custody Requirements

The majority of the soil lead measurements will be taken in situ during the site characterization phase. Sample handling and chain of custody requirements will not apply to these procedures. Soil will be collected as confirmation samples and as discreet bag samples. Chain-of-custody (COC) procedures will be followed for these samples to maintain and document possession from the time they are collected until they are delivered to the laboratory for analysis. A sample COC form is attached. The sample handling and COC predator will include:

— sample information on the jar/bag with sample ID, time and date of collection and technician ID, all written in unerasable ink.

—a sample seal attached firmly to the sample cover as soon as possible after collection when using sample jars.

—a chain of custody record containing the project name and number, the sampling station ID, date and time of collection, a brief description of the type of sample collected, parameters for analysis, the samplers name and signature, adequate space for any transferee's name and signature and a comment section to describe any special conditions associated with the samples.

All sample sets will be accompanied by a COC document. Any time the samples are transferred, both the sample custodian and the receiver shall sign and date the COC document. COC documentation will be maintained in the project folder.

8. Quality Control Requirements

Analyte	Analytical Method	Detection Limit*	Quantitation Limit**	Precision***	Accuracy****
Lead	EPA 6200	~ 75 ppm	~225	±50	±25
Lead	EPA 6010A	42 ppb	~120	±20	±10
Lead	Kevex XRF	50 ppm	~150	±20	±20

**Typically 3 times the MDL
***Precision determined by replicate sample analyses
****Accuracy determined by analysis of SRMs

9. Data Management and Documentation

A field log book, dedicated to the project, and field data sheets will be maintained during sampling events. There will be separate field sheets for the screening and additional site characterization phases. Each sheet will include the date, time, property name and address, sample locations, a site sketch that includes sampling locations, sample description, important details about how the sample was collected, analyst(s) names, along with the respective measurement data, and any additional comments that would accurately and inclusively describe the sampling activities. Care will be taken to maintain the logbook and field data sheets neatly with factual, objective language that is free of personal feelings and other terminology that may be deemed inappropriate.

These field data sheets, along with confirmation sample data received from the laboratory will be kept on file at the EPA Region 1 Lab. The confirmation information will include results of sample analyses, method blanks, matrix spike/spike duplicates and acceptance criteria. Copies of the field data sheets and validation information from the confirmation samples will be distributed to members of the remediation team to help determine where remediation activity will take place.

10. Assessment and Response Actions

ACCEPTANCE CRITERIA FOR SOIL LEAD BY XRF(*IN-SITU*)

Audit	Frequency	Limits	Corrective Action
Initial Calibration (SRM) @ 50, 500, 5000 ppm	Run prior to daily sampling events	%RSD=30	Investigate problem and re-run initial calibration until an acceptable calibration is obtained
Continuing Calibration	Sample data must be bracketed every 10th sample (or less) using SRM	%D <±25%	Re-analyze CC and if passes continue sample analysis. If fails investigate problem and re-analyze all samples following the last acceptable CC starting with a new initial calibration.
Field Blank	Varies by site	<100 ppm	Corrective action determined by end user.
Replicate Analysis (Accuracy)	Varies by site	%D <±50%	
Confirmation Samples	Site Dependent, minimum 1/site	Variable	Intrusive sample for conformation and/or confirmation analysis
MDL	When there is a change in the method or instrument.	Instrument Specific	Action taken at data validation level.
IDC	When there is a change in sampling method or instrument	± 30% recovery*	Investigate problem and correct. Re-run.

APPENDICES

Appendix 1.....Sampling Logic Tree

Appendix 2.....Site Worksheet

Appendix 3.....IDC Study

Appendix 4.....MDL Studies

Appendix 5.....Accuracy Studies

Appendix 6.....Results of Confirmation Samples

Attached.....Sample Chain of Custody Form

APPENDIX 1

Sampling Logic Tree

Appendix 2: Site Worksheet

Site Name: _____ Date: _____

Address: _____

_____

Building Type: _____

Condition: _____

Lot Condition: _____

Yard Uses: _____

Sample ID	Location	PPM-Lead	Comments	Distance

Appendix 3

INITIAL DEMONSTRATION OF CAPABILITY FOR LEAD IN SOIL BY NITON XRF

	ppm—lead
IDC1	1123
IDC2	1144
IDC3	1127
IDC4	1225
IDC5	1076
IDC6	1036
IDC7	1095
IDC8	1235
IDC9	1208
IDC10	1228
IDC11	1140
True Value	1162
Average Concentration	1148.8
% True Value	98.9
Standard Deviation	67.2
%RSD	5.9

Criteria: %RSD<30%
%TV<±30%

Appendix 4

MINIMUM DETECTION LIMIT STUDY OF LEAD IN SOIL BY FIELD PORTABLE XRF

	H.P. 600703 5/12/98	H.P. 600703 2/29/00	LCS 0996 2/29/00	NIST 2586 2/29/00
	PPM-Lead	**PPM-Lead**	**PPM-Lead**	**PPM-Lead**
MDL1	190	170	235	365
MDL2	151	209	246	357
MDL3	170	179	303	398
MDL4	177	161	242	355
MDL5	188	220	320	423
MDL6	196	164	254	392
MDL7	170	137	250	422
MDL8	138			
MDL9	138			
MDL10	128			
True Value	129	129	224	432
Avg. Conc.	164.6	177.1	264.3	387.4
% True Value	127.6	137.3	118.0	89.7
Standard Deviation	24.3	28.7	33.2	29.1
MDL	**68.7**	90.3	**104.3**	**91.4**
%RSD	14.8	16.2	12.6	7.5

Criteria: %RSD<30%
%TV<±30%

Appendix 5

ACCURACY DATA (1998) FOR LEAD IN SOIL BY FPXRF

	NIST 2710	NIST 2711	LCS 0996	HP 69073	Cleve-1
	5427	1123	268	204	426
	5632	1144	283	190	554
	5651	1127	269	151	526
	5587	1225	280	170	440
	5657	1076	291	177	488
	5372	1036	202	188	490
	5516	1095	383	196	456
	5769	1235	343	170	494
		1208		138	456
		1228		138	441
		1140		128	
				203	
True Value	5532	1162	224	129	433
Average Concentration	5576.4	1148.8	289.9	171.1	477.1
% Recovered	100.8	98.9	129.4	132.6	110.2
Standard Deviation	122.5	64.1	50.3	25.6	38.8
RSD	2.2	5.6	17.4	15.0	8.1

ACCURACY DATA (2000) FOR LEAD IN SOIL BY FPXRF

	NIST 2710	NIST 2711	NIST 2586	LCS 0996	HP 690703	Lot 217
	5580	1070	365	235	170	241
	5780	1140	357	246	209	220
	5590	1190	398	303	179	230
	5970	1290	355	242	161	159
	5490	1110	423	320	220	144
	5610	1070	392	254	164	135
	5530	1160	422	250	137	211
	5780	1170	397	275	242	175
	5460	1090	388	391	232	173
	5750	1140	408	277	146	126
True Value	5532	1162	432	224	129	101
Average Concentration	5654.0	1143.0	390.5	279.3	186.0	181.4
% Recovered	102.2	98.4	90.4	124.7	144.2	179.6
Standard Deviation	152.4	62.8	23.4	45.5	35.1	39.4
RSD	2.7	5.5	6.0	16.3	18.9	21.7

Appendix 6 Confirmation Sample Results