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Burlington Lead Program (802) 865-LEAD

Facts about Lead in Soil

Background

While lead can occur naturally in soil, typical concentrations of this type of lead are usually low and are not considered hazardous. Naturally occurring lead can normally be found in concentrations ranging from 10 to 50 parts per million (PPM). Prior to 1978 lead was widely used in paint, and gasoline contained lead additives until the mid 1980's. This together with various industrial sources of lead has resulted in heavily contaminated soils in many locations with levels of lead that far exceed natural background levels. Levels of lead near the foundation of a home painted with lead-based paint may be as high as 10,000 PPM. Soil near busy roadways can contain elevated levels of lead as well. Soil lead levels higher than 400 PPM are considered hazardous for contact by children.

Lead is a highly toxic metallic element that will not biodegrade, breakdown, or disappear over time. Soil contaminated with lead will remain contaminated forever without intervention.

What happens when soil is contaminated by lead?

Lead in soil tends to bind tightly to surfaces of fine clay and organic particles. This means that lead will not typically leach or move deeper into the soil. Typically, lead will tend to accumulate in the upper 1 or 2 inches of soil unless the soil has been disturbed by activities such as excavation or tilling for landscaping or gardening. Fine soil particles readily stick to skin and clothes and are easily made airborne when the soil is dry.

Various factors of soil composition will determine whether some or all of the lead can be taken up by plants or humans. This would include how tightly the lead is bound with the soil, solubility of the soil (the ability to dissolve water), soil pH, and amount of organic matter in the soil. If the soil is acidic, (pH <5) soil lead tends to more soluble or readily available. If the soil is

neutral to alkaline (pH >6.5) the soil lead is held much more strongly and is less soluble or readily available. Lead also tends to bind more tightly with the organic components in the soil, so as the organic content increases, lead solubility goes down.

Lead may combine with other elements or minerals in the soil to form lead containing minerals. One such mineral, lead phosphate or pyromorphite is extremely stable and exhibits low solubility. Formation of lead phosphate may occur in conditions of high soil pH and high levels of lead and phosphate. These conditions can be brought about by adding ground agricultural limestone and large amounts of phosphate fertilizer to lead contaminated soil.

Contamination in the soil around your home

Until lead was removed from gasoline, it is estimated that as much as 5.5 million tons of lead was released into the environment from auto exhaust. Because of this, soil near the busiest highways typically contains the highest amount of soil lead. More traffic means higher contamination. Inner city landscapes tend to have the worst soil contamination while rural settings tend to have less. Contamination tends to decrease as distance from traffic sources increase. Areas where vehicles idle (driveways) or where leaded gasoline was spilled may have caused lead contamination hot spots.

Lead was not banned from residential paint until 1978. It is estimated that lead paint may exist on up to 75% of homes built before this date. Lead content of the paint in the oldest homes tends to be much higher than homes built more recently. Paint used prior to 1950 could contain up to 50% lead by weight. An older home with several layers of high lead content paint could contain as much as 250 pounds of lead in the painted surfaces. Exterior lead paint was designed to chalk or wash off during rainfall to keep dirt from accumulating and keep the painted surface clean. Chalking together with loose, flaking, or deteriorated paint typically has caused a band of heavily contaminated soil around the perimeter footprint many older homes.

Exposure to lead in soil and the effects

Exposure to lead can cause serious health problems, especially for infants, children and pregnant women. Too much lead in the human body can cause damage to the brain, kidneys, nervous system and red blood cells. Adults and children can be exposed to lead from soil by direct contact with bare soil, or by contacting dust and fine soil particles that are carried into homes as airborne dust or is tracked in on shoes.

The greatest risk for exposure to soil lead is by ingestion. Children younger than age 6 are at the greatest risk due to the hand to mouth behavior they engage in. Dirty toys, pacifiers, and fingers all go into young children's mouths. Some children also engage in a behavior known as *pica*, or a desire to

eat soil, dust or other non-food items. Children with this behavior may consume large quantities of soil and have a significantly larger exposure to lead. Lead can also be ingested from plants that are growing in contaminated soil. One promising method of removing lead from soil is called *phytoremediation*. Some plants can actually draw heavy metals from the soil. As plants are grown and harvested, soil lead levels are reduced. For this very reason, plants grown for food should never be placed near foundations, busy roadways, or other areas where hazardous levels of lead are known or suspected because they can also draw lead from the soil. Leafy vegetables and root crops tend to accumulate lead faster than fruit crops. Plants grown for food should always be thoroughly washed to remove accumulated soil and dust before being used for cooking or eating.

The only way to find out if a child has been exposed to too much lead is by a blood test. **The Vermont Department of Health recommends that all children be tested for lead at age 1 and 2.** Your health care provider may advise you to have your children tested more often.

Testing the soil around your home for Lead

Soil may be easily tested to determine the presence of lead. A soil test may help determine what if anything needs to be done to reduce the potential for exposure to lead. Because lead levels in soil can fluctuate dramatically from one area to the next, several samples should be collected. One or two samples are not usually enough to determine the extent of contamination at a location. Homeowners may collect samples, but for accurate results, a specific routine for collecting the samples should be followed, and the samples should be sent to a laboratory certified to analyze lead in soil.

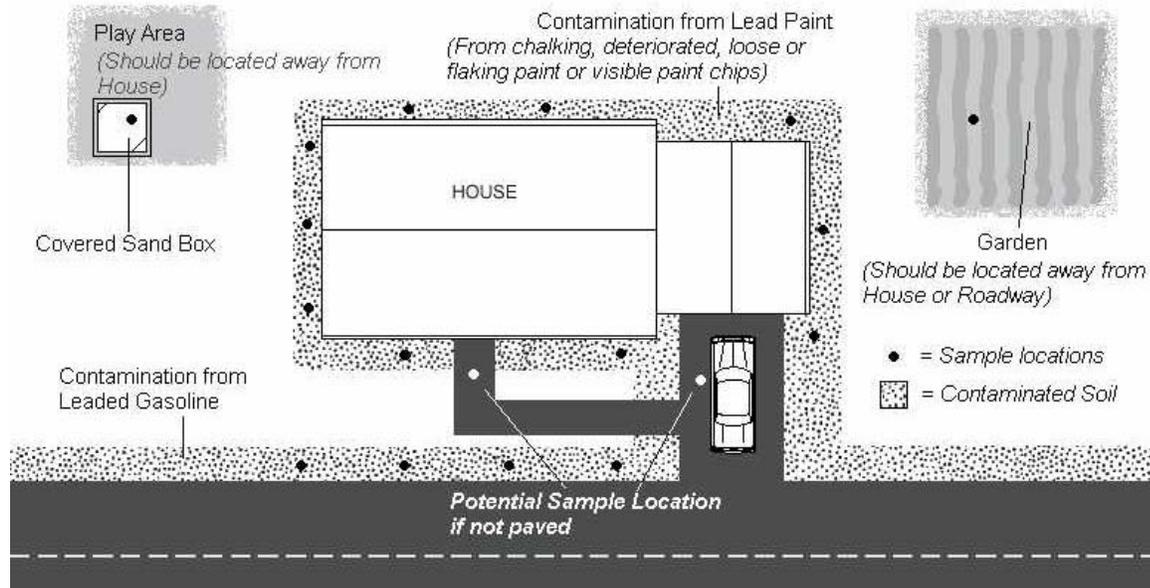
Before collecting samples, contact the laboratory conducting the analysis for specific instructions, sampling supplies, forms, or other things that may be required. Some homeowners find it easier to hire a certified testing consultant to collect soil samples. This usually costs quite a bit more, but testing consultants will be able to perform a more comprehensive survey of the extent of possible soil contamination. The Vermont Department of Health can provide a list of certified laboratories and testing consultants that perform this type of testing. Contact them at 1-800-439-8550

Where to sample

The following steps describe typical procedures used when sampling for lead in soil.

1. Select the sample locations

Samples should be collected from areas where lead contamination is suspected or likely to be found. This would include locations near the foundation; children's play areas, driveways, and gardens. (See figure below)



2. Collect the samples

Typically samples are collected from the top 1-2 inches of soil either by a sample auger, coring tool, or by scraping the surface soil into a sample container. When using an auger or coring tool, usually several soil cores (subsamples) are collected from a location and combined into one sample. Large stones and debris should not be included in the sample. All samples collected should be clearly and uniquely labeled. When scraping, about a cup of soil should be collected from the surface soil. If the soil has been disturbed, as is typical in gardens, the sample may be collected a little deeper, but usually no more than 6 inches deep. A map should be drawn that shows areas where samples have been collected from. This will make it easier to interpret the analysis results

3. Send for analysis

Send the samples to the laboratory for analysis. The lab will typically use EPA method 3050 or 3051 or its equivalent for analysis of lead in soil. It may also be helpful to request an analysis of soil pH, total phosphorus, and lime requirements.

What do the soil test results mean?

Laboratories will usually report soil lead concentrations as either $\mu\text{g/g}$ (micrograms per gram), mg/kg (milligrams per kilogram) or PPM (parts per million). These are all equivalent of the same measurement. Soil with a lead content greater than or equal to 400 milligrams of lead per kilogram of soil (mg/kg or PPM) is considered hazardous for contact by children. (See following.)

Soil lead level Hazard Level

($\mu\text{g/g}$, mg/kg , PPM)

< 150 None or Very Low

150 – 400 Low

400 - 1200 Hazardous if children present
>1200 Very Hazardous

How can I reduce the hazard and protect children?

There are several ways to reduce the hazard and your children's potential exposure to lead in soil. The level of lead found during testing determines appropriate treatments. Many methods to reduce exposure are inexpensive and easy to do.

<150 PPM (None or very low)

No treatment is necessary however there may be other sources of lead exposure to consider if the building is older than 1978.

150 – 400 PPM (Low)

Children should always wash hands after playing outside. When possible, children should be taught not to put their fingers in their mouth. Keep children's fingernails clean. Establish play areas away from locations where contamination has been found. Install a sandbox with clean sand and a cover. Keep areas of bare soil planted with sod or ground cover, or mulch bare soil areas. Vegetable gardens should be located as far away from contaminated soil as possible. Increase the organic content of garden soil by adding peat moss, compost, or manure. Ground limestone should be added to the soil to obtain a soil pH level of 6.5 - 7.0. Vegetables should be washed thoroughly before use. Root crops should be peeled and older outer leaves of leafy vegetables should be discarded. (These should not be added to the compost heap). If foot traffic pathways or driveways are contaminated, shoes should be removed prior to entering the house. Walkways may be covered with clean fill, gravel, or paving stones.

400 – 1200 PPM (hazardous if children are present)

In addition to the measures listed above, limit children's and pet's access to contaminated areas. Installing fencing, planting shrubs, planting ground covers, and mulching with bark or gravel can do this. Because the contamination is usually found in the top 1-2 inches of soil, tilling may reduce the hazard level at the surface by diffusing the lead in a greater amount of soil. Some agricultural extension services recommend applying triple or super phosphate fertilizer at a rate of 11 pounds per 100 square feet and till thoroughly. Because phosphate fertilizer lowers the soil pH, additional lime may be needed to keep the soil at a pH of 6.5-7.0. After this treatment, fruit type vegetables may be planted like tomatoes, peppers, squash cucumbers, peas, beans and corn. Leafy vegetables such as lettuce, spinach, kale, or cabbage should not be planted. Root crops such as carrots, radishes, turnips, or beets, also should not be planted. Leafy Vegetables and Root crops should only be planted in raised beds or pots filled with non contaminated soil. A layer of plastic sheeting should be placed over the contaminated soil before construction of the raised bed.

> 1200 PPM (Very Hazardous)

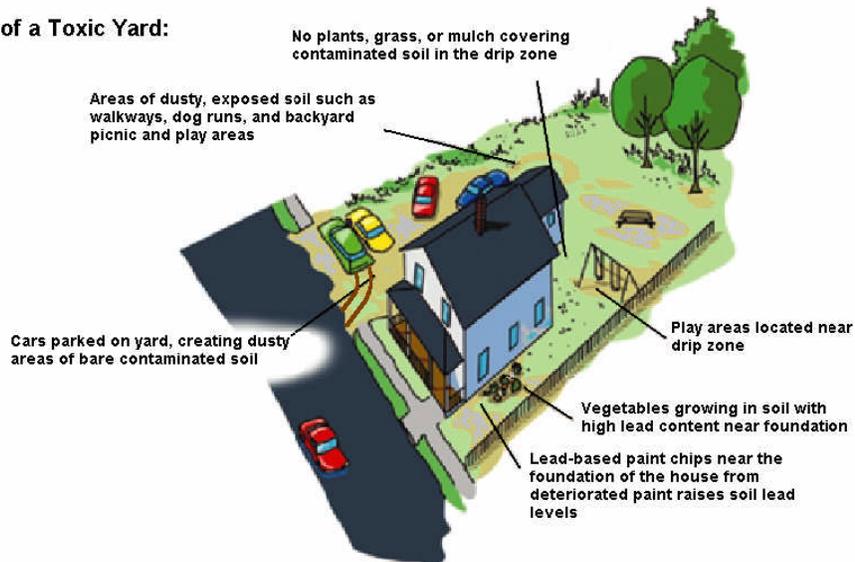
Do not let children or pets come in contact. Do not plant any edible plants in this soil. For lead levels greater than 2000 PPM consider installing permanent coverings like concrete or paving or contact the Vermont Department of Health for a list of certified lead abatement companies that can provide for removal of the contaminated soil.

Characteristics of a Lead-Safe Yard

Signs of a healthy yard:



Signs of a Toxic Yard:



For Further Information Contact:

Burlington Lead Program

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