

Soil Sampling & Safety Guidance

for People Concerned about Arsenic & Lead



Dirt Alert website

www.ecology.wa.gov/DirtAlert

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Special accommodations

To request Americans with Disabilities Act (ADA) accommodation, or printed materials in a format for the visually impaired, contact the Ecology ADA Coordinator at 360-407-6831 or ecyadacoordinator@ecy.wa.gov, or visit <https://ecology.wa.gov/accessibility>. People with impaired hearing may call Washington Relay Service at 711. People with speech disability may call TTY at 877-833-6341.

Who should read and use this guide?

- Everyone who plays a role in keeping children safe in counties with arsenic and lead soil pollution
- Gardeners, landscapers, construction workers, and others who frequently contact soil
- Anyone wanting to better understand the potential for harmful arsenic or lead in soil on their property or residence

Young children are more at risk than adults. They are more sensitive because their bodies are smaller and still growing. Also, they normally put their fingers and other things in their mouth, even if they are dirty.

Do I live in an affected area?

Large areas of Washington state have soil polluted with arsenic and lead from historic smelter stack emissions or lead-arsenate orchard pesticides in use in the early- to mid-1900s. Enter your address into our online map, Dirt Alert, to see if soil is potentially affected: apps.ecology.wa.gov/dirtalert/

Counties that may have polluted soil include:

- Chelan
- Douglas
- King
- Kitsap
- Okanogan
- Pierce
- Snohomish
- Spokane
- Stevens
- Thurston
- Yakima

Other sources of arsenic and lead that can locally pollute soil include arsenic-treated wood, lead paint, and air emissions from the combustion of leaded gasoline in high-traffic areas. This guide doesn't target these types of pollution. The U.S. Environmental Protection Agency website has information about sources of lead around the home and what you can do: www.epa.gov/lead/protect-your-family-exposures-lead

What is in this guide?

1. Step-by-step instructions for sampling soil:
 - Where and how to collect soil samples
 - Which laboratories are appropriate for soil sample analysis and how to find one
 - The directions you should provide to the lab when submitting soil samples
2. Information about potential health effects of arsenic and lead exposure
3. Simple actions you and your family can take to decrease contact with arsenic, lead, or other harmful chemicals that may be in dirt

NOTE: This guide doesn't meet sampling requirements for state hazardous waste cleanups (Model Toxics Control Act Chapter 70A.305 Revised Code of Washington) or real estate transactions. It provides general soil pollution information but does not characterize it for cleanup. If you are cleaning up a property in the Tacoma Smelter Plume, please use the [Model Remedies Guidance](#)¹ (Publication 19-09-101).

How will soil sampling help me?

Sampling is the only reliable way to learn about arsenic and lead soil pollution around your home or property.

Once you know the average amounts of arsenic and lead that may be polluting soil in areas where children play or where you are generally concerned, you can make informed decisions and take the healthy actions on page 10 to protect yourself and your family.

How do I sample soil on my property?

Soil sampling is a three-step process:

1. Plan the sampling – decide where and how to collect soil samples on your property
2. Collect soil samples – individual samples provide more specific information about an area, but

composite samples (see page 7) can reduce costs and will provide an average of the area

3. Analyze the soil samples – select a lab to analyze soil samples and provide instructions (see page 8)

Follow these steps to estimate arsenic and lead levels in your soil and decide whether they are a health concern. The soil analysis results will help you manage potential human exposures on your property.

There are many approaches to sampling surface soil. This guide provides a simplified, economical approach that strikes a balance between accuracy, precision, and cost.

Step 1. Plan the sampling: Where do I collect samples?

Arsenic and lead levels in soil can vary greatly, even on one property. Therefore, sampling in more than one area is important. To decide where to collect soil samples, consider:

- Where children play directly in the dirt or where people come into contact with soil
- Where exposure to dirt is possible
- Anywhere else you're interested in knowing contamination levels

Patios with hard surfaces or areas covered with wood chips or gravel can help limit contact with polluted soil. You may want to plan on sampling soil at these locations only if the ground surface cover is less than 4 inches deep, has been disturbed or removed, is suspected to have come from a contaminated source, or may be removed in the future.

Divide your property into high-use and low-use areas

Once you have identified the different areas on your property, divide these areas into two categories: high-use areas (where children play or where people come into contact with soil) and low-use areas. You will collect more samples from high-use areas than from low-use areas.

¹<https://apps.ecology.wa.gov/publications/SummaryPages/1909101.html>



Draw a property diagram

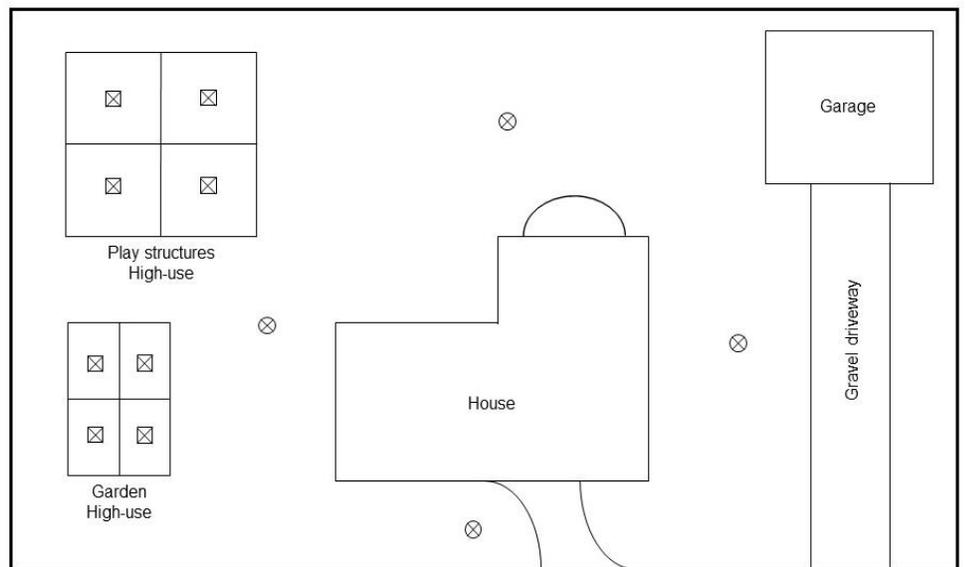
Prepare a diagram identifying the different areas on your property. A diagram will help ensure that you consider all areas of your property and record the areas where you collect soil samples.

Where you choose to sample depends on what you want to know. You may only be concerned about kids' play areas, your garden, horseshoe pits or other recreational areas, or a variety of these types of high-use area examples.

Figure 1 is an example diagram with high-use and low-use areas and sampling locations identified around a house.

Figure 1: Example soil sampling plan for around a house.

- ⊗ Sampling locations in low-use areas for composite analysis.
- ⊠ Sampling locations in high-use areas for individual or composite analysis.



Figures 2 and 3 show examples for rural, multi-acre properties with agricultural or forested areas.

Figure 2: Example soil sampling plan for a multi-use property.

- ⊗ Sampling locations in low-use areas for composite analysis.
- ⊠ Sampling locations in high-use areas (home, camp, etc.) for individual or composite analysis.

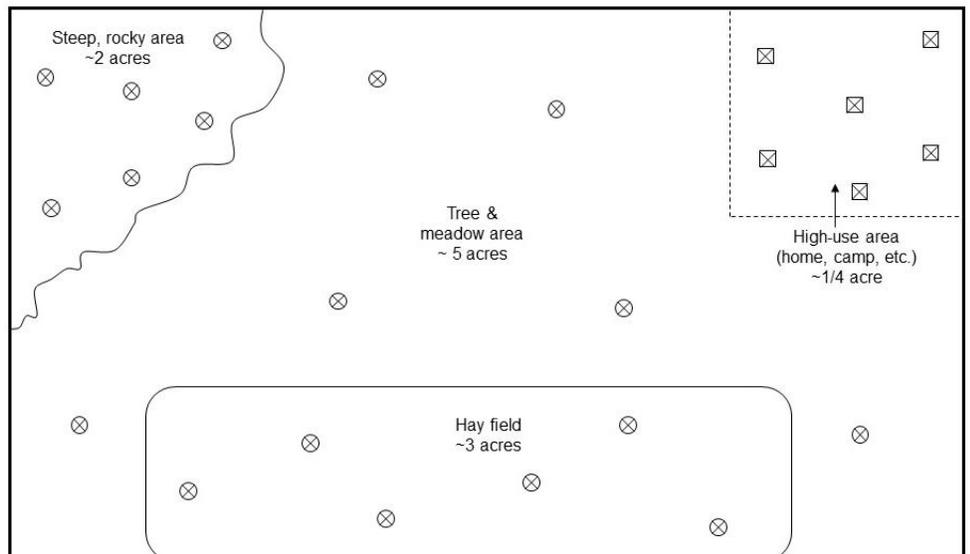
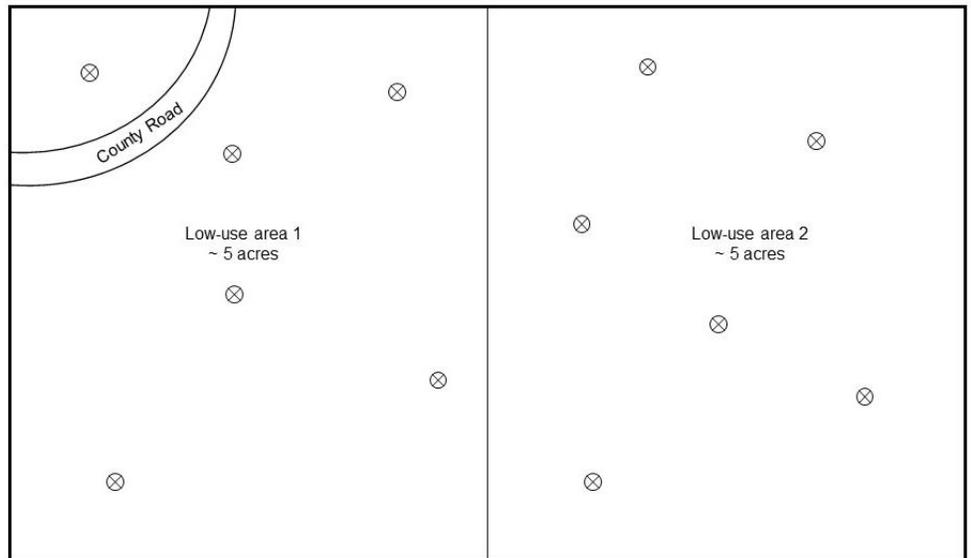


Figure 3: Example soil sampling plan for a forested property.

⊗ Sampling locations in low-use areas for composite analysis.



How many samples should I collect?

Ecology recommends collecting a minimum of four samples per high-use area. Collect more samples if a high-use area is greater than 40 feet by 100 feet, or about 1/10 acre. The concentrations of arsenic and lead can vary significantly. Collecting several samples in each high-use area will provide more specific information about arsenic and lead in soil in an area.

Group low-use areas together by land use type, and take a minimum of four to six soil samples from the grouped area.

How do I decide where to collect samples within an area?

Collect samples throughout each area. Separate each area into roughly equal blocks and collect a sample from the center of each block. Try to collect samples in open areas and near play structures. Sample exposed soil located near buildings if children play in these areas.



If you sample near older buildings, wooden play structures, or roads, your results could be higher due to lead-based paint, arsenic-treated wood, or road-related sources.

How should I prepare samples?

If you choose to have the laboratory analyze each sample individually, you may obtain a better overall estimate of soil pollutant levels, but this process is also more costly.

You can reduce costs by mixing individual samples from different locations from each area into a single sample. Mixing creates a *composite sample*.



A composite result is an average of the soil from different locations equally mixed into one sample. For example, by collecting and mixing samples from six different locations in a single-use area into one sample, you can get a



reasonable estimate of the average metals concentration for that area. The composite sampling process is explained further in Step 2.

How deep should I sample?

Most children play and dig in the top layer of soil. Therefore, collect your samples from the surface to a depth of 6 inches.

Samples from the top 6 inches of soil will not necessarily provide a good estimate of deeper soil conditions, but arsenic and lead contamination from smelter stacks and lead-arsenate pesticides tends to be greatest near the ground surface, often even in the top 3 inches.

If you believe people might be exposed to soil deeper than 6 inches, you may want to collect separate samples from these deeper areas. Sample soil in which crops are or will be planted to the depth it's normally tilled. We also suggest you contact Ecology for assistance with plans to sample soil deeper than 6 inches.

Step 2. Collect the soil samples.

With a clear plan in place, the samples are relatively easy to collect. To help you collect your samples, the steps below are repeated on the checklist on page 11.

Gather your sampling equipment.



- ✓ Clean shovel, trowel, or bulb planter
- ✓ Clean stainless-steel or plastic spoon
- ✓ Permanent marking pen
- ✓ Small, zipper-closure plastic bags or 4-ounce glass sampling containers. Clean glass containers can be obtained from the analytical lab that you choose for your soil analysis (see Step 3).
- ✓ Paper towels or wash bucket and scrub brush
- ✓ A large stainless-steel, plastic, or glass bowl (if you are going to mix individual soil samples into a composite sample)
- ✓ The checklist on page 11

Protect your health while sampling.

- Wear gloves.
- Limit dust by dampening soil before you sample, or wear a dust mask.
- Wash hands and face after sampling.
- Wash clothing separately from other laundry, if it gets dirty.

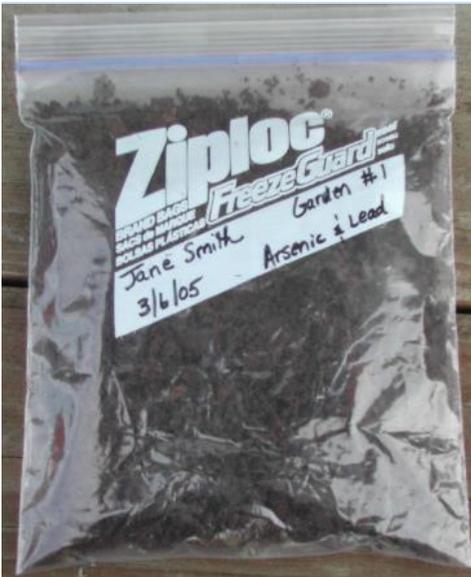


Figure 4 on page 7 illustrates composite sampling steps.

Collect the soil samples.

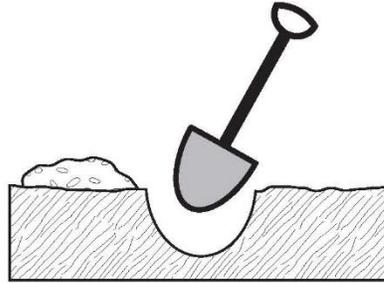
1. Protect your health while sampling (see steps on page 5).
2. Using the permanent marker, label a plastic bag or glass container with the following information:
 - The number or name of the sampling location from your property diagram
 - Your name
 - Date
 - What you want to analyze (arsenic and lead)
3. Clear away any grass, tree needles, leaves, gravel, wood chips, or other foreign materials from the soil surface.
4. Dig a hole to desired depth with your shovel, trowel, or bulb planter.
5. Scrape soil evenly along the sides of the top to the bottom of the hole with the spoon, and fill up a plastic bag or a jar. Avoid or discard pebbles, rocks, leaves, roots, and stems. You only need about 1 cup of soil per hole. Mix soil thoroughly before placing in the plastic bag or jar.
6. Either discard the spoon, or clean it using a paper towel or wash bucket and scrub brush. If you are reusing the spoon to collect the next sample, it should be free from any visible dirt.
7. Seal the sample jar or plastic bag securely.

Mix a composite sample for each area (optional, less costly method for analysis).

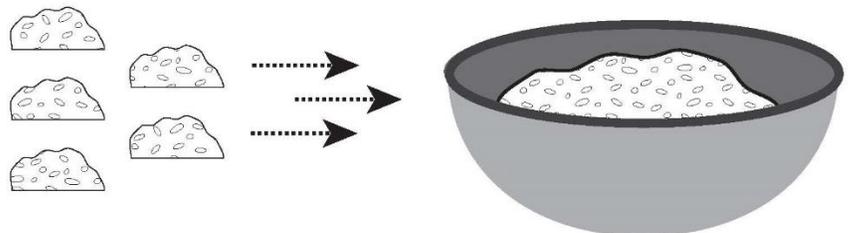
1. Collect four or more samples (as described above) from a low-use or high-use area.
2. Put equal amounts of soil—for example, ½ cup—from each sample into a large bowl.
3. Mix the soil thoroughly.
4. Use a clean spoon to fill up a plastic bag or jar with a portion of the mixed soil.
5. Discard the remaining soil back into the holes.

Figure 4: Composite sampling steps.

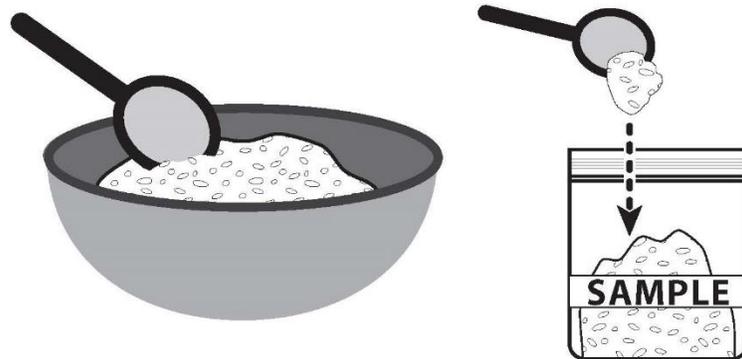
1 | Gather soil from each sampling location



2 | Soil from each location is combined and mixed



3 | Soil sample is taken from mixture and prepared for lab analysis



Record all soil samples on the Sample Inventory Sheet on page 13.

1. Indicate which samples are composites.
2. Until you deliver your samples to the lab, store them together in a large, zipper-closure plastic bag, box, cooler, or similar container with a copy of the inventory sheet for reference. Keep samples refrigerated or on ice if possible.

Step 3. Analyzing the soil samples

A laboratory must analyze your soil samples to identify the arsenic and lead levels. The lab can also provide a general estimate of the cost to analyze your samples. They also may offer sample jars.

Transport the samples to the lab as soon as it is convenient. In the meantime, store them in a cool, dark place until they can be delivered to the lab, preferably in a refrigerator or cooler on ice. You can deliver the samples to the lab or ship them using a parcel service.

Once the lab receives the samples, they should be able to perform the analysis and report the results to you within three to four weeks.

How do I find a lab that can complete these tests?

Analytical labs can be found online or in the yellow pages. You do not necessarily need to use a lab near your home because many labs can work with you through the mail.

Not all labs can analyze metals in soil. Ecology maintains a list of labs that are accredited by the state to perform arsenic and lead soil analyses. [Ecology's Lab Search Database](#)² can help you locate an appropriate lab to analyze your samples. If you have questions or would like Ecology to send you a current list of labs, please contact us (see page 1).

Ask lab staff the following questions:

- Can they analyze arsenic and lead in soil by SW 846 Methods 6010D, 6020B?
- Can they screen the sample to 2 millimeters (mm) if necessary?
- Can you mail samples to them?
- How much will it cost?
- How long will it take?

If the answer to the first two questions is yes, the lab should be able to accurately analyze your soil samples.

Should I have the lab analyze for both arsenic and lead?

Generally, soil samples are analyzed for both arsenic and lead to get the best understanding of metal pollution of greatest concern for people, especially young children.

What instructions should I give the lab?

Ask the lab to:

- Analyze the samples for arsenic and lead by SW 846 Methods 6010D or 6020B.
- Thoroughly mix each sample before analysis.
- Screen the samples to remove all soil and debris greater than 2 mm. The soil grain size in the sample should be less than 2 mm, or about a tenth of an inch (for example, very coarse sand and finer). If necessary, screening may add to your cost, but it is important.
- Report the sample concentrations in units of milligrams per kilogram (mg/kg) relative to the dry weight of the soil.
- Use reporting limits no greater than 5 mg/kg arsenic and 10 mg/kg lead. The samples have to be analyzed so that very low concentrations can be determined accurately.

What should I do with the lab results?

The state cleanup level is 20 parts per million (ppm) for arsenic and 250 ppm for lead when we clean up wide-spread smelter or pesticide contamination. The lab will most likely report your arsenic and lead levels in mg/kg, which is the same as ppm. If your lab results are above these levels, please take the healthy actions described on page 10 to prevent or reduce contact with soil around your home or property as soon as possible.

We encourage you to contact Ecology or your local health department for assistance and to discuss options if your results are above the state cleanup levels.

² <https://apps.ecology.wa.gov/laboratorysearch/Default.aspx>

Help is available

Ecology or your local health department or district can help as you plan each sampling step. We want you to succeed in protecting people from harmful arsenic and lead in soil.

Ecology contacts and our Dirt Alert website are listed on page 1.

You can be exposed to arsenic and lead in soil by breathing dust or swallowing small amounts of soil and dust. They are not absorbed through the skin.

See page 10 for healthy actions you can take to protect yourself and your family.

Can arsenic and lead cause health problems?

Arsenic and lead in soil does not pose an immediate health risk. However, long-term exposure increases the risk of certain health problems.

Arsenic can cause a variety of health problems, including heart disease, diabetes, and cancer of the bladder, lung, skin, kidney, liver, and prostate.

In children, lead can cause behavioral problems such as hyperactivity, permanent learning difficulties, and reduced physical growth. In adults, lead can increase blood pressure, affect memory, and contribute to other health problems.

How can I be exposed?

Arsenic and lead soil pollution from metal smelter or orchard pesticide sources tends to be found in the upper 3 to 18 inches of soil.

Arsenic and lead are not absorbed through the skin. You can be exposed by breathing dust or swallowing small amounts of soil and dust.

People at greatest risk are those exposed to soil on a regular basis, such as children, gardeners, construction workers, and landscapers.





Protect yourself from arsenic and lead in soil

Wash your hands with soap.

After working or playing in the dirt, always wash your hands, especially before eating. Use plenty of soap and water — not hand sanitizer. Hand sanitizers don't remove dirt.



Take off your shoes at the door.

Use a wipe-off mat to reduce the amount of dirt and dust coming into your home. Provide a shoe rack or area for shoes at your door. Ask guests to remove their shoes, too.



Mop and vacuum once a week.

Dust with a damp cloth to reduce dust inhalation. Don't sweep with a broom — it can stir up dust. Use a vacuum with a HEPA filter or a damp mop. Keep young children out of rooms for an hour after vacuuming to let dust settle.



Wash children's toys, bedding, and pacifiers frequently.

This applies to indoor and outdoor items.

Cover or replace bare patches of soil in your yard to keep toys out of the dirt and reduce human contact.

Provide a sand box for children to dig in.



Wear shoes and gloves when gardening and working outdoors.

Grow your produce in raised beds or pots made with untreated materials. Use a scrub brush to clean dirt from under your fingernails. Dust yourself off outside and wash dirt-covered clothes separately.



Wash all fruits and vegetables before eating.

Use a scrub brush to wash all fruits and vegetables. Peel root vegetables. Eat a diet rich in iron, calcium, and vitamin C to decrease the amount of lead your body absorbs.



Wipe your pets' paws before they enter your home and brush and bathe them regularly.

Cover up bare soil so pets don't dig and track dirt into the house. Give pets their own beds.

Soil Sampling Checklist

STEP 1: Plan the sampling

- Divide your property into high-use and low-use areas according to where children play.
- Identify where to collect a minimum of four samples from each use area.
- Flag or stake your sampling locations.
- Prepare a diagram that shows sample locations, number of samples, and depths (6 inches deep for most samples).
- Select a lab to analyze the samples.

STEP 2: Collect the soil samples

Gather your soil sampling equipment.

- Clean shovel, trowel, or bulb planter.
- Clean stainless-steel or plastic spoon.
- Permanent marking pen.
- Small zipper-closure plastic bags or 4-ounce glass sampling containers.
- Paper towels or wash bucket and scrub brush.
- A large stainless-steel, plastic, or glass bowl (if you are going to mix individual soil samples together).

Collect the soil samples.

- Using the permanent marker, label a plastic bag or glass container with the following information: the number or name of the sampling location, your name, date, and what you want to analyze (arsenic and lead).
- Clear away any grass, tree needles, leaves, gravel, wood chips, or other foreign materials from the soil surface.
- Dig hole to desired depth with your shovel, trowel, or bulb planter (6 inches deep for most samples).
- Using the spoon, evenly scrape soil from the top to the bottom of the sides of the hole into a plastic bag or jar. Avoid or discard pebbles, rocks, leaves, roots, and stems. Only about 1 cup is needed from each hole.
- Clean the spoon using a paper towel or wash bucket and scrub brush. If the spoon is to be used for another sample, it should be free from any visible dirt.
- Seal the sample jar or plastic bag securely.

Create a composite sample (optional):

- Collect all individual samples from an area. Put equal amounts of soil from each sample into a large bowl.
- Mix the soil thoroughly.
- Using a clean spoon, fill up a plastic bag or jar with the mixed soil.
- Discard the remaining soil back into the holes.

- List all of your soil samples on the Sample Inventory Sheet on page 13.
- Indicate which samples are composites.
- Until your samples are delivered to the lab, store them together in a large plastic bag, box, cooler or similar container with a copy of the inventory sheet for reference. Keep samples refrigerated or on ice if possible.

STEP 3: Analyze the soil samples

Tell the lab to:

- Screen samples to 2 mm (1/10 inch) if necessary.
- Report on dry-weight basis.
- Report in units of mg/kg.
- Use SW 846 Methods 6010D or 6020B for arsenic and lead.
- Analyze with reporting limits no greater than 10 mg/kg (lead) or 5 mg/kg (arsenic).

Protect your health

- Wear gloves.
- Limit dust by dampening soil before you sample or wear a dust mask.
- Wash hands and face after sampling.
- Wash clothing separately from other laundry if it gets dirty.

Sketch your property diagram

