

From the Ground Up

guide for soil testing in urban gardens





sources

To develop this guide, Toronto Public Health used information from literature reviews, experiences in other jurisdictions, consultations with gardeners and experts, information on soils in the City of Toronto, and a pilot study of five proposed gardens. The full report, entitled *Assessing Urban Impacted Soil for Urban Gardening: Decision Support Tool Technical Report and Rationale*, is available at: toronto.ca/health/lead/soil_gardening.htm

disclaimer

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contact us

For City of Toronto information about your site and to provide feedback on these guidelines, please contact 311 or 416-392-2489 (phone outside of city limits).

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summary

guide for soil testing in urban gardens

Cities are great places to grow food, but they can also have issues with soil contamination. This guide is for people who want to start an urban garden and want to get more information about the safety of their soil.

Follow these three steps to check your soil quality and to take actions to reduce your risks:

Step 1

Establish the level
of concern



Step 2

Test the soil



Step 3

Take actions to
reduce risks





step 1

establish a level of concern

The initial step is to assess whether the soil may be contaminated by past activities on the land. This is done by inspecting the site and researching the history of the garden site.

Doing a site visit and searching the site history will help you determine if your site is:

- Low
- Medium or
- High Level of Concern

The Level of Concern gives you the next steps for your site: **actions to reduce risks** from exposure to soil contaminants, and in some cases, soil testing.



Photo credit: Everdale



what to look for when determining a level of concern

You are looking to find out if your site, or a site close by, is or once was (going back to the earliest records):

- low concern** 
- residential
 - parkland
 - farmland
 - childcare centre or school
-
- medium concern** 
- risk managed park
 - orchard
 - infill area
 - hydro corridor
 - commercial land uses (excluding gas station, dry cleaner, printing or autobody shop)
 - located within: a former landfill; former lead reduction zone; or 30 m from a rail line or major arterial road
 - industrial land that has been remediated
-
- high concern** 
- gas station
 - drycleaner
 - printing shop
 - autobody shop
 - industrial land
 - rail line or railyard industrial land
 - site reveal signs of dumping or burning, smells or staining of the soil

For definitions and instruction on how to find out if your site is or once was any of these land uses, please see Page 6.

conduct site visit



Purpose: Inspect the site to help you determine the Level of Concern.

A site visit involves walking through the area and inspecting the site thoroughly. Use the following checklist to find the information you need.

Site visit checklist

Materials needed



Work Boots



Work Gloves



Shovel



Notebook & Pencils



1. Make a Site Diagram

- Sketch a quick diagram of the site, showing its size, location and surroundings.
- Look around, and note on your diagram:
 - Land use of site (residential, commercial, industrial, school, park, etc.)
 - Neighbouring land uses (immediately next to the garden site)
 - Estimated distances to a major arterial road¹ or railway lines.

¹ Roadways with traffic frequencies greater than 20,000 vehicles per day, speed limits of 50 to 60 km/h, no stop signs (traffic lights control intersections), and frequent use by city buses. Find your street on the City of Toronto Road Classification System, available at: toronto.ca/transportation/road_class/index.htm.



Site visit checklist



2. Walk the site

- Walk each section and note on your diagram any signs of:
 - Stained soil
 - Unusual odours
 - Trash or debris (household garbage, litter (in unusual quantities), old tanks and pipes, construction/demolition debris²)
 - Burned patches
 - Old equipment, pipes or tanks
 - Dead or dying plants
- Pick a few random spots and dig into the soil. Look out for all of the signs identified in the list above.



3. Talk to the neighbours

- Ask what the site was used for in the past
- Ask about any dumping or burning on the site that they have noticed
- Make notes of your conversations, marking the activities and locations on your diagram

² Potentially asbestos-containing materials (e.g., drywall joint compound, mechanical insulation, roofing materials, floor and ceiling tiles, fire doors). Potentially lead-containing material (paint chips, plumbing solder, old pipes). Potentially PCB-containing material (old electrical equipment such as transformers, fluorescent lamp ballasts, capacitors).

conduct site history



Purpose: Learn about your site to help you determine the Level of Concern.

A site history involves:

- searching the City archives
- calling 311 to search additional City records to find out if your site was once a risk managed park, infill area, former landfill or lead reduction zone

Use the following checklist to find the information you need.

Site history search checklist

1. Get your site searched in the City of Toronto databases

Call 311 and ask to have your site searched by Toronto Public Health in the following:

- Historical Land Use database
- Risk Managed Park
- Lead reduction zones
- Infill zones
- Landfill database
- Toronto Public Health records of environmental site assessments

Please note: it could take up to several days for this research to be completed.

2. Visit the City of Toronto Archives

255 Spadina Road (short walk from Dupont Subway Station)

416-397-5000 ▪ toronto.ca/archives ▪ 9:00 a.m. to 4:30 p.m. ▪ Monday to Friday

The Archives are open some Saturdays, but certain materials may not be available on the weekend. Admission to the Archives is free. You will need to register as a researcher to get access to the Archives materials. This is a simple step that requires you to provide identification that includes your address and agree to comply with Archives rules.

It will probably take two to three hours for you to research a single site at the Archives. If you identify any indicators of High Concern, you can stop searching.



Site history search checklist



What to do at the Archives

- Register and sign in
- Check the Street Names Binder

Check the Street Names binder for your municipality. Look up the street name for your site to determine if and when the street name has changed. You will need this information when you check the City Directories and Fire Insurance Plans.



- Use the maps

Use the Building Construction Dates map to look up the date the neighbourhood around your site was developed.



- Check the databases

Use the following resources to look up the historical uses of your site and of immediately surrounding sites. Start with the editions produced soon after the neighbourhood was developed, and proceed forward in time.

- City Directories (this resource will tell you the types of businesses that were around the site in question)
- Fire Insurance Plans (these will show the lot sizes and the type of structures that were present on or around the site)



- If needed, check additional databases

If the resources above do not provide enough information, use the following resources to look up the historical land uses of your site and immediately surrounding sites:

- Assessment rolls
- Aerial photographs (these will help you see if it was a residential area or industrial area, etc.)



putting it all together

Now you have got all the information you need to determine the Level of Concern for your site and the next steps.

Table 1: Putting it all together - Establishing a Level of Concern and Next Steps for your site

level of concern	definition	next steps
low concern	<ul style="list-style-type: none">• Garden site has always been residential, parkland, farmland, child care centre or school	Take Action Level 1 (see Page 20)
medium concern	<ul style="list-style-type: none">• Garden site is or has once been a risk managed park, orchard, hydro corridor, infill area, commercial land uses (excluding gas station, dry cleaner, printing and auto body shop)• Garden site is located within: a former landfill; former lead reduction zone; or 30 m from a rail line or a major arterial road• Industrial land that has been remediated	Test the soil (see step 2)
high concern	<ul style="list-style-type: none">• Garden site is or has once been a gas station, dry cleaner, print shop, auto body shop, rail line or rail yard• Is or has once been industrial land• Garden site reveals indications of dumping or burning, smells or staining in the soil	Take Action Level 3 (see Page 20)

things to consider for *all* sites



Soil quality is an important consideration for anyone growing food in the city. The only way to know for sure about the safety of your soil is to test your soil. Alternatively, you can use raised bed or container gardens with clean soil.

Interior and exterior house paint contained significant amounts of lead until the early 1990s. The soil surrounding buildings painted with lead-based paint may be contaminated with lead. Using raised bed or container gardens is the best way to avoid exposure to lead contaminated soil. Add clean soil and compost every year. Plant non-edibles directly beside buildings.

If you are planting a garden on public land (e.g., park or hydro corridor) or you are a developer using part of your commercial or industrial land for a garden, there may be regulatory requirements for soil sampling. Call 311 or refer to the full report for more information at: toronto.ca/health/lead/soil_gardening.



Photo credit: Everdale



step 2

test the soil

Toronto Public Health recommends testing the soil if the planned garden is on a Medium Concern site AND if the garden is larger than 16 m² (170 ft²) or 4 X 4 m (13 X 13 ft). Testing the soil consists of taking a soil sample, having it analyzed, and interpreting the results. It is not cost-effective to conduct soil testing for small gardens. This is based on estimates of the cost of soil testing versus building a raised bed garden. If you have a small garden in the Medium Concern category go to Action Level 3 (see Page 20).

Toronto Public Health developed Urban Gardening Soil Screening Values (SSVs) to ensure that gardeners are not exposed to unsafe levels of soil contaminants through contact with garden soil and consumption of garden produce (see Table 2, Page 17). In deriving the SSVs, we considered public health, children's exposure, background levels of soil contaminants, and other sources of exposure to contaminants.

soil sampling

Purpose: Collect a representative soil sample of the site. A composite soil sample is made up of two or more combined sub-samples to represent an area of the garden.

Use the following checklist to walk you through taking a soil sample.



Photo credit: Don Nichols

Soil sampling checklist



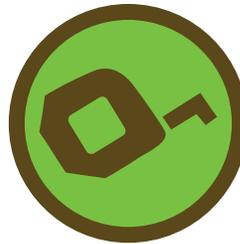
Materials Needed



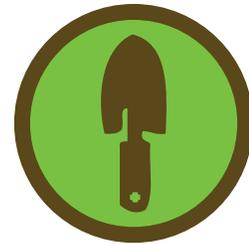
Work Boots



Work Gloves



Measuring Tape



Trowel



Shovel



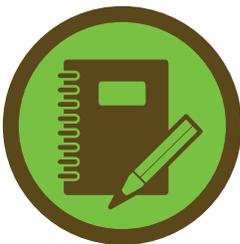
2 Clean Plastic Buckets (9L each)



Resealable Bags (3.7L)



Cooler & Ice Packs



Notebook & Pencils



Large Black Permanent Marker



Tape, Pylons or Rope (Something to mark boundary of proposed garden site)

Soil sampling checklist

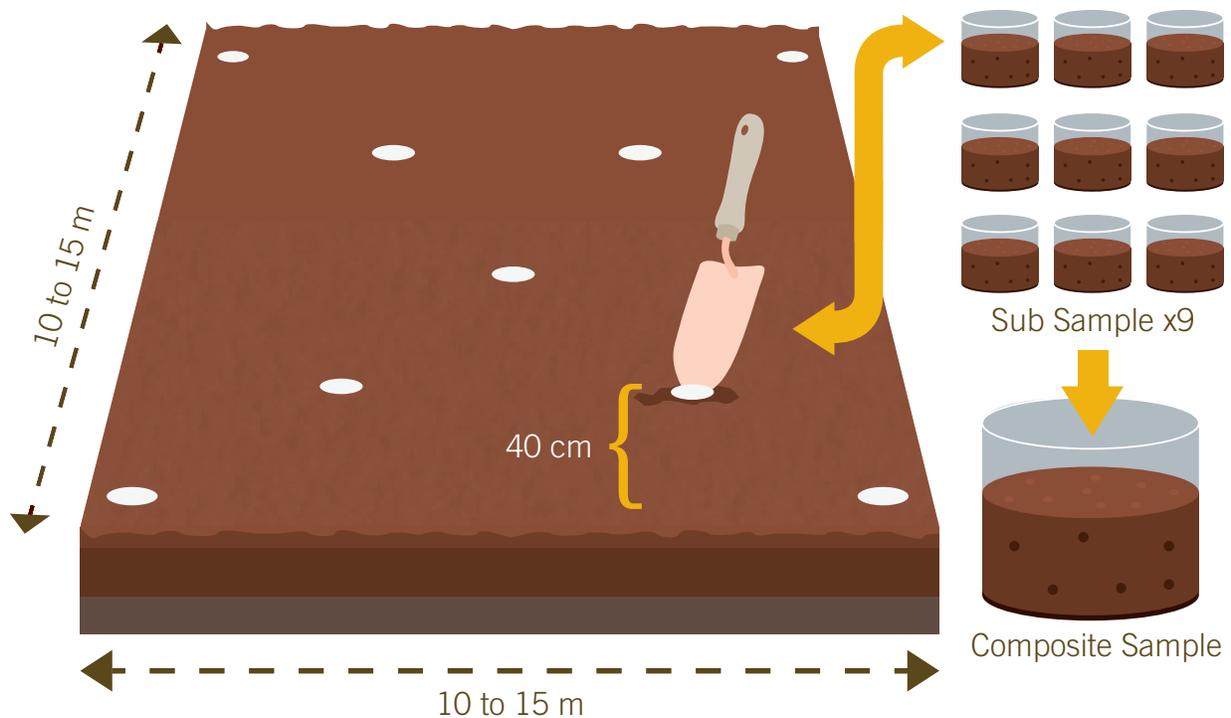


Create a diagram and plan where you are going to take your soil samples:



- Make note of the name and address of the property
- Draw a line around your garden using pylons, tape or rope. The soil sample should be taken from the area that the gardeners use. A typical community garden will need only one or two soil samples. We recommend that a composite soil sample is taken every 10 x 10 to 15 x 15 m area (approximately 50 x 50 ft). Starting at one corner of the composite soil sampling area, walk diagonally to the far corner and repeat, making an "X" pattern. Mark the location of a sub-sample approximately every 2.5 m (8 ft) using a pylon or some other marker. This is where you will take your sub-samples of soil that will make a sample. For gardens larger than half an acre, call 311 for help
- Note the location of the sub-samples on your diagram

Figure 1: Soil Sampling Area





Soil sampling checklist



Sample the soil



- Strip off turf or other vegetation from the sub-sample spot
- Take shovel and dig into soil down to 40 cm (16 in)
Place sub-sample soil into Bucket 1
- Break up and mix the sub-sample soil in Bucket 1
- Remove stones and visible debris
- Note the presence and type(s) of debris, smells, and staining in your field notes
- Transfer a trowel full of the mixed soil from Bucket 1 to Bucket 2
- Refill the hole with the remainder of the soil in Bucket 1, and replace the turf
- Repeat until nine sub-samples have been collected separately in Bucket 1 and transferred to Bucket 2



Create composite soil sample



- Mix the combined sub-samples in Bucket 2 to make the composite.
- Label sample bag with:
 - name of site
 - sample number
 - sampling date
 - name(s) of person(s) doing the sampling
- Transfer the mixed soil from Bucket 2 to the labeled sample bag
- Seal the sample bag and place it in a cooler with ice packs

Note: If you are creating more than one composite sample, all equipment should be washed with soap and water between the composite samples. There is no need to wash the equipment when taking sub-samples.

The laboratory will tell you how much soil you need. Typically, each composite soil sample is approximately 2 cups (2 small trowels of soil). Each laboratory is different and prices change over time. You should expect to pay between \$150 to \$300 for each composite soil sample.

soil analysis



Purpose: Select a laboratory for the soil analysis and tell the lab staff what analyses you would like them to do.

Toronto Public Health has identified a list of the most likely contaminants present in Medium Concern sites (see Table 2, Page 17). We recommend you also test for pesticide residues in hydro corridors. Use the following checklist to walk you through getting your samples analyzed.



Soil Analysis Checklist

1. Select a laboratory able to do the analysis

- Find qualified labs in your area through:
 - Standards Council of Canada (SCC) or the Canadian Association for Laboratory Accreditation (CALA). You can find the contact information for these organizations through an internet search
 - Yellow Pages (heading: Laboratories – Analytical & Testing)
 - Internet search (keywords: environmental analytical laboratory Toronto)
 - Ask the lab if they are accredited by the SCC or CALA, and if they meet the MOE Reg. 153 method detection limit for the metals and PAHs



Photo credit: Lauren Baker

Soil analysis checklist



2. Contact the Laboratory

- Get in contact with your chosen lab several days before you take the samples to:
 - Confirm price and turnaround time
 - Obtain a chain of custody form. The chain of custody form provides information on you (the client), the samples, and the analyses that you want
 - Tell the lab when you expect to deliver the samples
 - Obtain instructions for handling the samples and delivering them to the lab



3. Fill out a Chain of Custody Form

- Fill out the chain of custody form and keep the required copies with the samples
 - Every lab's form differs, but you will have to indicate that you want the soil tested for pH values, metals and PAHs. Write out the full name of each one listed in Table 2 on Page 17
- Contact the lab for advice if you have any difficulty with the form
- Soil interpretation
 - Ask the lab to interpret the soil samples according to the contaminants and the Soil Screening Values for urban gardening listed in Table 2 on page 17



4. Deliver Samples to the Lab

- The laboratory will provide instructions
- Deliver or ship samples to lab within one day of sampling. Some laboratories will pick up the soil sample
- Keep samples refrigerated or in a cooler between the time you take them and the time you deliver or send them to the lab

interpreting the results



**Purpose: Compare the soil test results to the two sets of Urban Gardening Soil Screening Values (SSVs) shown on Page 17 to determine which Level of Concern and Action Level applies to the garden site.
If you have difficulty interpreting the results, call 311.**

Interpret the soil tests, confirm the Level of Concern and take appropriate action.

Compare the concentration of each contaminant identified in the soil test results with the Urban Gardening Soil Screening Values (SSVs) shown in Table 2 on Page 17.

Your soil test will confirm whether your site is Low, Medium or High Concern, depending on what is found in your soil sample. For example, based on Step 1 (site history and visit), you may have concluded that your site is Medium Concern. However, after you have the soil tested, you may find that the levels of contaminants are high and that your site falls into the category of High Concern.



Photo credit: Lauren Baker

**Table 2: Urban Gardening Soil Screening Values (SSVs) (mg/kg)**

metals	ssv 1	ssv 2
Arsenic (As)	11	110
Cadmium (Cd)	1.0	10
Cobalt (Co)	23	170
Chromium, total (Cr)	390	630
Chromium, VI (CrVI)	5.0	5.0
Copper (Cu)	180	660
Mercury (Hg)	2.7	2.7
Molybdenum (Mo)	13	13
Nickel (Ni)	34	340
Lead (Pb)	34	340
Selenium (Se)	10	11
Zinc (Zn)	500	1800
pahs		
Acenaphthene	0.050	0.32
Acenaphthylene	0.093	0.47
Anthracene	0.58	0.58
Benz(a)anthracene	0.23	2.3
Benzo(a)pyrene	2.3	3
Benzo(b)fluoranthene	0.23	2.3
Benzo(g,h,i)perylene	0.10	1.0
Benzo(k)fluoranthene	0.23	2.3
Chrysene	0.099	0.99
Dibenz(a,h)anthracene	0.77	0.77
Fluoranthene	0.14	1.4
Fluorene	0.39	0.39
Indeno(1,2,3-c,d)pyrene	0.23	2.3
Phenanthrene	3.1	3.1
Pyrene	0.11	1.1

NOTE: We recommend you also test for pesticide residues in hydro corridors. The laboratory will interpret these results for you by comparing them to toxicological standards.

NOTE: Some of the SSV1 and SSV2 values are the same. Please refer to the Technical Guide for an explanation. The contaminants in the Table are used as indicators to guide gardeners to take appropriate actions. Units can be expressed as mg/kg, µg/g, ppm or parts per million.



interpreting results

Use the Soil Screening Values (SSVs) to interpret the soil test results, confirm the Level of Concern, and take the appropriate action.

The SSVs are different than the soil standards developed by the provincial government. Toronto Public Health developed Urban Gardening Soil Screening Values specifically for gardening in Toronto.

If the concentrations of all of the contaminants are below the SSV 1, then the site is Low Concern:



action level 1

Recommended

If the concentration of any contaminant is over the SSV 1 level, but lower than the SSV 2, then the site is Medium Concern:



action level 2

Recommended

If the concentration of any contaminant is above the SSV 2, then the site is High Concern:



action level 3

Recommended

See Page 20 for Action Level 1, 2, and 3.



Photo credit: Everdale



step 3

take action to reduce risks

Gardeners can take many simple and inexpensive actions to reduce their exposure to urban soil contaminants.

Depending on the Level of Concern for your site, there are three different levels of recommended actions to reduce your exposure to soil contaminants. Table 3 on Page 20 summarizes the three Action Levels.

There is a higher likelihood that many contaminants are present in the soil of High Concern sites. It is not economically feasible to test for all the possible soil contaminants. Therefore, we recommend that raised bed or container gardens or fruit and nut trees are used at these sites.



Photo credit: Lauren Baker



**Table 3: Levels of Concern and Recommended Actions
to Reduce Gardeners' Exposures to Soil Contaminants**

<p>low concern</p> <p></p> <p>action level 1</p>	<p>Use good gardening practices:</p> <ul style="list-style-type: none">• Wash your hands after gardening and always before eating• Wash produce thoroughly
<p>medium concern</p> <p></p> <p>action level 2</p>	<p>Use good gardening practices AND:</p> <ul style="list-style-type: none">• Lower the concentrations of contaminants by adding clean soil and organic matter (compost and manure) to the existing soil. Adding organic matter will also improve the pH level of the soil• Reduce dust by covering bare soil with ground cover or mulch. Peel root vegetables before you eat or cook them• Avoid growing the types of produce that accumulate soil contaminants (See list on next page)
<p>high concern</p> <p></p> <p>action level 3</p>	<p>Use good gardening practices AND:</p> <ul style="list-style-type: none">• Reduce dust by covering bare soil with ground cover or mulch• Build raised bed gardens (add a minimum of 40 cm/16 in. of clean soil on top of garden fabric), or grow food in containers• Add clean soil and organic matter annually (compost and manure) to the raised bed or containers <p>OR</p> <ul style="list-style-type: none">• Grow only nut and fruit trees (not any other types of produce)



take action to reduce risks

For Medium Concern Sites – avoid certain plants that can accumulate soil contaminants

Various plants types are different from each other, and so is their uptake of contaminants. Some plants will uptake some soil contaminants, while others do not at all. Some plants will uptake contaminants only in the parts of the plant that we don't eat. We recommend for Medium Concern sites:

- Eat only the fruit, seed or grain (not the leaves, root, or shoot) for the following plants:
 - tomato
 - corn
 - barley
 - oat
 - rice
 - rye
 - sunflower
 - wheat
 - soybean
- Grow these plants in raised bed or container gardens:
 - alfalfa
 - amaranth
 - beets
 - carrots
 - chicory
 - brassicas (broccoli, brussel sprouts, cabbage, cauliflower, kale, kohlrabi, mustard greens, canola, turnip)
 - dandelion
 - endive
 - garden pea
 - lettuce
 - mushrooms
 - radish
 - rice (wild)
 - sorghum
 - sorrel
 - spinach

Action Level 2 measures will reduce the concentration of soil contaminants over time. Therefore, after two years of implementing Action Level 2 measures, consider testing the soil again. If the tests show that the site is now a Low Concern site, you can start growing these plants in the garden soil.



let's work through an example together

Suzanne is a community youth worker in Toronto. She wants to start a community vegetable garden at her local community centre.

step 1

establish a level of concern

Once she got permission to build a garden, she researched her site and discovered that it has previously been agricultural land, with an orchard. Suzanne does a thorough walk through the proposed garden site. She uses a shovel to turn over the soil in various locations and doesn't notice any indication of garbage dumping, soil staining, or strange odours coming from the soil. Suzanne classifies her site as Medium Concern (orchards are Medium Concern sites).



Photo credit: Elena Elisseeva



step 2

test the soil

Suzanne is planning a garden that is 15 by 15 m (50 x 50 ft). This classifies her garden as a large garden so she notes that soil sampling is recommended for her site.

She does an internet search and after a few phone calls, finds a laboratory that will analyze her soil samples for the metals and PAHs (listed in Table 2 on Page 17), for the best price.

For the size of her garden, Suzanne notes that she only needs one sample to send to the laboratory. The laboratory she is working with sends her a container for her composite soil sample with instructions on how much soil is needed.

Suzanne starts her soil sampling by making a detailed map of her garden site. She then draws a line around her garden using pylons. She starts in one corner of her garden and walks in a diagonal line to the far corner and repeats, making an “X” pattern across her garden.

Suzanne takes a soil sample approximately every 2.5 m (8 ft) by digging into the soil down to 40 cm (16 in) and putting that soil sub-sample into a standard sized bucket (Bucket #1).

She makes sure to include soils from just below the grass line down through to 40 cm. She removes the grass and other vegetation from the soil sample. Suzanne mixes the soil around and then takes a sub-sample from Bucket #1 and transfers a scoop of the soil to Bucket #2. She empties the soil from Bucket #1 back into the hole that she just dug. Suzanne then goes on to dig her next sub-sample.



When Suzanne has collected all of her sub-samples (nine will do) in Bucket #2, she mixes all the soil in the bucket, turning over the soil multiple times making sure to mix the soil completely. Suzanne then takes a scoop or two and puts it in the container (either the laboratory will provide it or you can use a sealable plastic bag). Suzanne labels the bag providing all the information that the laboratory needs (e.g., date, contact person, contact information, site name). She stores the soil sample in a cooler with ice packs for shipping or until the laboratory picks up the sample.

In about a week, Suzanne receives the laboratory results. She compares her soil sample to the Urban Gardening Soil Screening Values (SSVs). She is particularly concerned about lead and arsenic levels. The lead level for her soil is 2.4 mg/kg, while the arsenic level is 1.3 mg/kg.

Suzanne compares all of the soil contaminants and determines that they are all below the SSV1. She classifies her garden as a Low Concern site, even though it was originally thought to be Medium Concern.

step 3

take action to reduce risks

Suzanne proceeds with her garden plan, makes sure to let all her gardeners know that they need to take Action Level 1 measures to reduce their exposure to urban soil contaminants: wash their hands after gardening and thoroughly wash all the produce before eating.



416.338.7600 toronto.ca/health

 **TORONTO** Public Health