



**Soil and Water Testing
Guidelines for Home and
Community Gardens**

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INTRODUCTION



Gardening is a great way to get fresh, nutritious vegetables and fruit, while saving on food costs, helping the environment, and connecting with neighbors, family, and friends. However, some potential planting locations may not be suitable for gardening depending on available soil and water. Water may have disease-causing bacteria, and soil may contain unsafe levels of lead, arsenic, chromium, mercury, or other contaminants that could potentially harm your health. For example, lead exposure among children can lead to a wide range of health problems, from headaches and stomach pain to behavioral problems and anemia (not enough healthy red blood cells). Making sure that your soil and water are safe to use is the first step in creating a garden that produces healthy food and is a safe space to spend time.

The Los Angeles County Department of Public Health encourages you to test your soil and water (if not done by your local water provider) prior to starting your garden. This guide will help you assess the *urgency* for testing your soil and water, and will make recommendations for doing so. **Whether or not you decide to test your soil and water after reading this guide, we recommend reviewing the “Best Practices Management” section that begins on page 24.**

Why testing might be needed

Growing food in an urban area requires gardeners to address different challenges that may not be present in agricultural settings. As shown in the graphic below, these challenges might include

- (A) pollutants from factories and industrial uses (both past and present);
- (B) pollutants from cars that can then contaminate soil;
- (C) contaminated water;
- (D) lead-paint chips from old buildings;
- (E) soil contaminated by prior land uses;
- (F) lack of access to water;
- (G) potentially contaminated harvested rainwater;
- (H) reduced sunlight because of tall buildings,
- (I) increased heat from nearby machinery, like air conditioners; and
- (J) increased heat from hot asphalt pavement.



Credit: This illustration is from "Environmental Challenges Threatening the Growth of Urban Agriculture in the United States" by Sam Wortman and Sarah Taylor Lowell, Journal of Environmental Quality, Vol. 42 No.5, p.1283-1294, June 25, 2014. (<http://modernfarmer.com/2014/07/lead-urban-gardens/>)

While these challenges are real, there are many places in urban areas where you can grow food safely and successfully.

Who should use this guide?

This guide is for people who want to grow food in community gardens or on their own property in Los Angeles County for personal use. This guide addresses health and safety concerns related to soil and water, and recommends practices to minimize health risks after harvest (see “Best Practices Management” section on page 24).

Ultimately, it is important to your health that all of the food you grow is safe to eat based on standards set by organizations such as the Food and Agriculture Organization (FAO) and the World Health Organization (WHO).¹ **If you intend to sell or distribute the food you grow,** contact the Los Angeles County Department of Public Health to learn how to become a Community Food Producer at (626) 430-5421 or http://ph.lacounty.gov/eh/SSE/FoodMilk/foodmilk_SpecFoodServProg.htm

¹ FAO/WHO Working Document for Information and Use in Discussion Related to Contaminants and Toxins in the GSCTFF (March 2012). ftp://ftp.fao.org/codex/meetings/cccf/cccf6/cf06_INF6.pdf (Accessed August 2015)

WATER

Every garden needs water to flourish. However, depending on your water source, it may be important to test your water to make sure it is safe. Underground rocks and soil may contain metals like cadmium and lead, as well as bacteria, parasites, and viruses, which can make water unsafe to drink and for use in the garden. In addition, chemicals used in large-scale farming and industry (e.g., herbicides, pesticides) can contaminate water. To learn more about how water might be contaminated, please read the California Water Board guide at http://www.waterboards.ca.gov/water_issues/programs/gama/docs/wellowner_guide.pdf

Does your site have water?

If you are not sure if your site has water available, you can try the following steps:

1. **Look for clues.**

If there is a water meter box on or near the property, there is a good chance your site may already have access to municipal water.

2. **Ask owners of neighboring properties.**

Ask your neighbors about their water provider. Chances are that if your neighbor is getting water, you can too.

3. **Contact your local jurisdiction.**

The Los Angeles County Department of Public Works website (<http://dpw.lacounty.gov/general/servicelocator/>) can help you determine the utilities for a given address. The website lists information for nearly all parts of Los Angeles County.

Do you need to test your water?

Water can come from a variety of sources which can make the water more or less risky to use. The table below lists potential water sources, whether you need to test your water, and whether there are extra precautions and considerations you should take before using the water (regardless of whether you test).

Water source	Do you need to test the water?	Extra precautions or considerations before using?
Municipal water	No	No
Small water system	No	No
Water well	Yes (periodically)	No
Graywater	No	Yes
Rainwater	Maybe	Yes
Recycled water	No	Yes

Municipal water

Most urban areas have access to water through a public water system. This type of water is often called “potable” or “drinking” water.

All water from public water systems should be safe to use unless other advisories are in effect. If you are certain you are using municipal water, the water should be safe and you do not need to do any further water testing. If you have concerns about the safety of your municipal water (e.g. due to odor or color), contact the California Environmental Protection Agency – State Water Resources Control Board – Division of Drinking Water at:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/publicwatersystems.shtml

Small water system

People that live in areas without access to municipal water may receive water through a small water system. A small water system is one that serves fewer than 3,300 persons.² Small water systems are regulated by the Los Angeles County Department of Public Health. This water should be safe and you do not need to do any further water testing. If you have concerns about the safety of the water from your small water system (e.g. due to odor or color), contact the Los Angeles County Department of Public Health at (626) 430-5420 or http://www.publichealth.lacounty.gov/eh/ep/dw/dw_main.htm

Water well on your property

If your water comes from a well on your property, you may need to test. **Private well water is not regulated and should be tested periodically to make sure it continues to be safe to use and drink.** Please review the “How to test your water” section below.

Your well should be permitted

Wells that are installed illegally (unpermitted) may be too close to potential sources of contaminants or not built to proper specifications. If your well is unpermitted, your water may be higher risk. If you cannot find out whether your well was permitted or not, you should consider testing your water more frequently than recommended by the California State Water Resources Control Board’s “A Guide for Private and Domestic Well Owners.”

² <http://water.epa.gov/type/drink/pws/smallsystems/basicinformation.cfm>

Graywater

“Graywater” is water left over after every day washing and cleaning activities such as hand washing dishes, showers, and clothes washing (using biodegradable soaps). It does not contain wastewater from toilets. The use of *untreated* graywater is becoming more common and it is generally safe to use it for watering a garden. **However, the Los Angeles County Department of Public Health recommends limiting *untreated* graywater use to flowers and other plants that you do not plan to eat.** *Treated* graywater³ is another type of water that can be used on any type of plant (edible or not).

If you plan to use graywater, it is important to use the water at the base of the plant or below mulch, rather than spraying the water on top of your plants. This helps reduce the chance of harmful particles ending up in the air. To learn more about graywater, visit:

<http://greywateraction.org/greywater-faq/>

Installing a system to capture and use graywater may help save on water costs and reduce your overall water usage. If you plan to install a piped graywater system, you should check with your local jurisdiction for additional permit or building requirements. If you would like more information about graywater systems, please contact the Los Angeles County Department of Public Health at (626) 430-5290 or

http://www.lapublichealth.org/eh/EP/cross_con/cross_con_main.htm

Rainwater

Rainwater can be used in your garden, but the water must be carefully collected and stored. For example, water collected from roofs may become contaminated from particles on the roof itself, like asbestos and lead. **You may want to consider testing water if it has already been collected and stored on site or if you are collecting the water off of a structure.**

It is important to store collected water in a mosquito-proof tank and avoid direct contact with the water (e.g., do not touch, ingest, or spray the water). Like graywater, it is important to use the water at the base of the plant or below mulch, rather than spraying the water on top of your plants.

The basic requirements when using rain barrels in a gravity flow system are:

- Must have a screened inflow opening, spigot, and hose bib
- Labeled “non-potable”
- Do not spray water
- Do not hook up to potable (drinking) water systems

³ Treated graywater is defined in the California Plumbing Code, Chapter 16, Section 1604.1.

- Install according to the manufacturer's instructions

To learn more about recycled water, visit: <https://www.watereuse.org/>

The Los Angeles County Department of Public Health has guidelines based on the type of on-site collection of rainwater. For more detail, please review the County's guidelines: http://publichealth.lacounty.gov/eh/docs/ep_cross_con_RainwaterMatrix.pdf

If you are planning to install a larger system to collect water, please contact the Los Angeles County Department of Public Health at (626) 430-5290 and review requirements at http://publichealth.lacounty.gov/eh/docs/ep_cross_con_cistern.pdf

Recycled Water

Recycled water is non-potable (not for drinking) water that has been treated⁴ enough for specific uses. Recycled water that is used for watering landscaping is carried in light purple pipes and is typically accompanied by a sign that says "Recycled Water - Do Not Drink."

The Los Angeles County Department of Public Health recommends limiting recycled water use to flowers and other plants that you do not plan to eat. If your recycled water has been treated enough to become potable (drinkable), which means it meets federal standards, you can use it on edible plants. However, most "purple pipe" recycled water does not meet these standards. **If you would like to use the recycled water on edible plants, we recommend looking further into the type of recycled water you have.**

Disinfected tertiary recycled water can be used on edible crops, but many other types (that have been treated at different levels) cannot be used on edible plants. This visual provided by the San Diego County Water Authority may help you to decide:

<http://www.sdcwa.org/sites/default/files/files/water-management/recycled/uses-of-recycled-water-new.pdf>

The Los Angeles County Department of Public Health has specific requirements and guidance for installing recycled water systems, available at:

http://publichealth.lacounty.gov/eh/docs/ep_cross_con_recycle.pdf

If you would like more information about recycled water, please contact the Los Angeles County Department of Public Health at (626) 430-5290 or

http://www.publichealth.lacounty.gov/eh/EP/cross_con/cross_con_recycle.htm

⁴ Recycled water is treated to the standards outlined in the California Health and Safety Code (Title 22 of the California Code of Regulations). More information is available here:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml

How to test your water

1. **Contact the Los Angeles County Department of Public Health**

Before testing, consider discussing your water testing needs with the Los Angeles County Department of Public Health. Staff may be able to assist you in further deciding whether testing is needed. Water quality testing kits are often available at hardware stores and may be used to help narrow concerns. However, a laboratory test will be much more accurate.

Contact the Los Angeles County Department of Public Health at (626) 430-5420 or http://www.publichealth.lacounty.gov/eh/ep/dw/dw_main.htm

2. **Select a lab to test**

The California Environmental Protection Agency State Water Resources Control Board provides a list of labs that can test your water, available at:

http://www.waterboards.ca.gov/drinking_water/certlic/labs/documents/elap_cert_drinking_water_lab.pdf

3. **Questions to ask the lab**

Let the lab know your intended use with the water and ask for a written estimate of the cost. Table 1 below lists the typical chemicals and biologicals that should be tested for drinking water.

4. **Interpret the results**

When you get the results back from the lab, the levels should be below the maximum levels listed in Table 1 (below). The maximum contaminant level is the highest level that is safe for human consumption—any higher and the water is not safe to drink. It may not be necessary to meet all of the levels for drinking water to irrigate edible plants. If your results are borderline, please contact the Los Angeles County Department of Public Health to discuss at 213-738-3220, tox@ph.lacounty.gov, or http://publichealth.lacounty.gov/eh/TEA/ToxicEpi/index_ToxicsEpi.htm

Table 1: Maximum Levels of Inorganic Chemicals and Biologicals in Drinking Water⁵

Chemical	Maximum Contaminant Level, mg/L
Aluminum	1
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL*
Barium	1
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.15
Fluoride	2.0
Mercury	0.002
Nickel	0.1
Nitrate (as NO ₃)	45
Nitrate + Nitrite (sum as nitrogen)	10
Nitrite (as nitrogen)	1
Perchlorate	0.006
Selenium	0.05
Thallium	0.002
Microbiological	Maximum Contaminant Level, mg/L
Total Coliforms	Zero
Cryptosporidium	Zero
Giardia lamblia	Zero

For more information about labs that test water, visit the California Environmental Protection Agency - State Water Resources Control Board website:

http://www.waterboards.ca.gov/gama/domestic_wells_testing.shtml

⁵ Reference: Maximum Contaminant Levels of Inorganic Chemicals Taken from California Code of Regulations (CCR) Title 22, Safe Drinking Water Standards

What should you do if your water is contaminated?

If tests show that your water is contaminated, it may be best to find another location to garden or another source of water. In the case of rainwater and graywater, it may be possible to filter or disinfect for any biological contaminants. Costs to treat water vary, and can be expensive. If you are interested in treating contaminated water, please contact the Los Angeles County Department of Public Health at (626) 430-5420 or http://www.publichealth.lacounty.gov/eh/ep/dw/dw_main.htm

In addition, consider reviewing the California State Water Resources Control Board's "A Guide for Private and Domestic Well Owners" for additional information on water quality tests, and possible ways to treat the water at http://www.waterboards.ca.gov/water_issues/programs/gama/docs/wellowner_guide.pdf (pages 8-10).

SOIL

A safe garden must have safe soil.

Soil may contain high levels of lead or other metals and these could end up in or on the food grown in your garden. There are two ways you could come into contact with contaminants:

- 1. By directly ingesting (swallowing or inhaling) contaminated soil.**

Ingesting soil with elevated levels of heavy metals is **the most risky and likely exposure**. Children are more at risk because they may swallow soil by putting soiled fingers in their mouths or inhaling soil particles left behind on carpet from dirty shoes. Other vulnerable populations such as seniors or people with weak immune systems may also be at risk.



- 2. By eating produce grown in such soil.**

Plants grown in contaminated soil can also absorb the contaminants, exposing you to risk when you eat the plant. **However, in most cases, this risk is low.** By following the guidelines in the Best Practices Management section on page 24, you can protect yourself and your family from contaminants that could be present in or on your food.

Read on to find out whether you need to test your soil, how to test your soil, and how to amend (do something to improve) your soil depending on test results. For a more detailed guide on soil testing, please see: “Soils in Urban Agriculture: Testing, Remediation, and Best Management Practices for California Community Gardens, School Gardens, and Urban Farms,” by Rachel Surls, Valerie Borel, and Andre Biscaro at <http://ucanr.edu/sites/UrbanAg/files/197207.pdf>

Do you need to test your soil?

Depending on the location of your garden and what's around it, your soil may be at a higher or lower risk. This section will help you determine how critical it is to test your soil.

1. **Look around your site and properties nearby.**

Does the site contain or is it near:

- Trash or abandoned construction material (paint cans, lumber, electronics, wood)?
- Homes or buildings built before 1978 with old or peeling paint?
- A freeway or heavily traveled road (within 500 feet)?
- Dead spots on site where nothing is growing?
- Discolored soil?
- Strong or foul smells?
- Waste water discharge, pits, or ponds?
- Evidence of buried pipes or tanks?

The State of California's Department of Toxic Substances Control (DTSC) has a public website that provides information on permitted hazardous waste facilities. You can enter your proposed site's address into the EnviroStor Data Management System at <http://www.envirostor.dtsc.ca.gov/public/> to see whether your site is close to a hazardous waste site.

If your site appears to have *any* of the above, it is recommended that you test your soil. If none of the above applies to you, continue reading further to assess your site.

2. **Figure out how your site has been used in the past.**

Your site is not a blank canvas! Most places in a city have been used in at least 3 to 4 different ways over the years. Understanding these prior uses will help you decide how important it is to test the soil. For example,

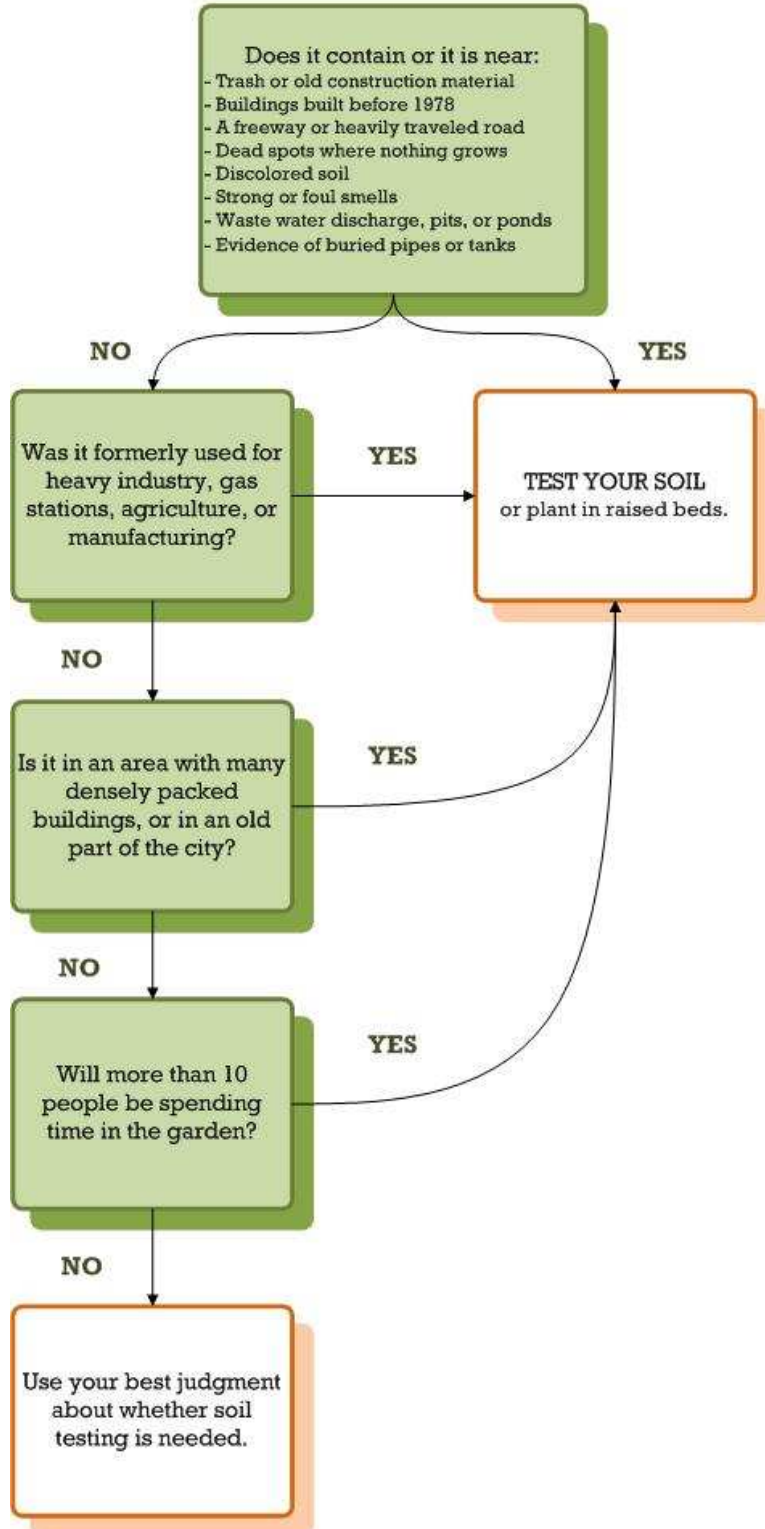
- Was the site previously used for heavy industry, gas stations, agriculture, or manufacturing? If so, it is very likely that the soil has high levels of heavy metals.
- Is the site in an old part of the city with densely packed buildings? If so, it may also have higher concentrations of lead and metals in the soil. In either of these cases, it is important to test the soil.

Talk to the property owner or neighbors about past uses. If your site is vacant, find out for how long and what was happening on the property before. For example, ask what structures were on the site, how they were used, and the year those structures were built. Your local jurisdiction's planning department and library may be able to help you understand the site's prior uses, and may have old photographs or maps.

3. Decide next steps.

Use the flow chart below to help you make your final decision.

Should you test your soil?



A. If you answered no to all of the questions in numbers 1 and 2 above, you probably do not need to be concerned about unsafe soil. However, if a large number of people will be spending time in the garden (e.g., a community garden), the Los Angeles County Department of Public Health recommends testing. Review the next section for details.

B. If you answered yes to any of the questions in numbers 1 and 2 above, the Los Angeles County Department of Public Health recommends testing. Review the next section for details.

C. If you answered yes to any of the questions above in numbers 1 and 2 above, **but you cannot or choose not to test your soil**, the Los Angeles County Department of Public Health recommends planting in raised beds, and importing clean, healthy soil to grow your plants. Review the “Soil Treatments after Testing” and “Best Practices Management” sections for details.

How to test your soil

1. Determine your contaminants of concern.

Using Table 2, figure out the contaminants that will most impact your site. For example, if your site was previously a park, you may want to test for asbestos and lead.

Table 2: Contaminants of Concern based on Previous/Current/Proximate Uses

Previous Use	Contaminants of Concern
Residential – including parks, vacant lots	Asbestos, Lead
Commercial – agriculture, gas stations, dry cleaners, retail establishments, auto-body shops	Pesticides, metals, petroleum products, solvents
Heavily Industrial – metal plating, manufacturing	Polycyclic aromatic hydrocarbons, benzene, toluene, xylene, ethyl benzene, Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , metals, petroleum products and constituents, PCBs, Dioxins

2. Select a lab to test your soil.

Soil test kits sold at garden stores are not recommended for this kind of testing because they cannot test for many contaminants or heavy metals. Instead, use a lab to test your soil. Select your lab before collecting soil samples because each lab will have specific testing guidelines. The cost of testing will depend upon the size of your garden, the number of soil samples needed, and the type of analysis conducted by the lab. For a basic soil test which includes nutrients, pH, and lead, a soil test can cost as little as \$10. While a single soil test may be enough for a small backyard vegetable garden, more samples, and possibly more analysis, will be needed for larger spaces. Soil testing for small and medium-sized community gardens, where the site has no unusual features and no past uses of concern, should cost approximately \$200 to \$500. If there are many issues of concern, there is a chance the cost of your soil test will increase, so be sure to discuss this with the lab. See Table 3 for a list of labs, and Table 4 for list of questions to ask the lab. You will rely on the lab to help interpret the results of the test, so it is important to ask whether they will assist you.

Table 3: List of Soil-testing Labs

The following list is for reference; Los Angeles County does not endorse any particular laboratory.

<p>Wallace Laboratories (Agriculture, Soil, Water, Plants) 365 Coral Circle, El Segundo, CA 90245 310-615-0116 http://www.bettersoils.com info@wllabs.com</p> <p>Timberleaf Soil Testing (Crops, Soil) 39648 Old Spring Rd., Murrieta, CA 92563 951-677-7510 http://www.timberleafsoiltesting.com/ tmbrlfsoiltest@verizon.net</p> <p>XRF Research, Inc. (Elemental Analysis) 9921 Carmel Mountain Rd. #326, San Diego, CA 92129 800-613-6064 http://www.xrfresearch.com info@xrfresearch.com</p> <p>MACS Lab, Inc. (Materials Analysis) 431 Crown Point Circle, Ste. 120, Grass Valley, CA 95945 800-622-7522 http://www.macslab.com/ info@macslab.com</p> <p>CLS Labs (Soil, Water, Environmental) 3249 Fitzgerald Road, Rancho Cordova, CA 95742 800-638-7301 http://www.californialab.com/ info@californialab.com</p> <p>Soil & Plant Laboratory (Soil, Plants, Crops, Horticulture) 1101 S. Winchester Blvd., Ste. G-173, San Jose, CA 95128 408-727-0330 http://www.soilandplantlaboratory.com soilab@soilandplantlaboratory.com</p> <p>Calscience 7440 Lincoln Way, Garden Grove, CA 92841 714-895-5494</p>	<p>Soil & Plant Laboratory (Soil, Plants, Crops, Horticulture) 4714 E. Hunter Ave., Anaheim, CA 92807 714-282-8777 http://www.soilandplantlaboratory.com soilab@soilandplantlaboratory.com Umass Soil & Plant Testing – soil fertility 682 North Pleasant Street, Amherst, MA 413-545-2311 http://soiltest.umass.edu/ soiltest@umass.edu</p> <p>Cornell Nutrient Analysis Laboratory (Environmental, Biologicals, Soil) 804 Bradfield Hall, Cornell University, Ithaca, NY 14853 607-255-4540 http://cna1.cals.cornell.edu soiltest@cornell.edu</p> <p>Agricultural Analytical Services Laboratory (Soil Fertility, Environmental) Penn State University, University Park, PA 16802 814-863-0841 http://www.aasl.psu.edu/Default.htm aaslab@psu.edu</p> <p>CDFA Center for Analytical Chemistry 169 East Liberty Ave, Anaheim, CA 92801 714-680-7901</p> <p>Weck Laboratories, Inc. 14859 East Clark Ave, Industry, CA 91745 626-336-2139</p> <p>Los Angeles County Agricultural Commissioner/Weights and Measures (primarily works with other government agencies) Environmental Toxicology Laboratory 11012 South Garfield Ave, South Gate CA 90280 562-622-0437 http://acwm.lacounty.gov/wps/portal/acwm/main/home/business/environmentaltoxology toxlab@acwm.lacounty.gov</p>
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Table 4: Questions to ask Soil-testing Labs⁶

Good communication is the key to getting the soils tests you want. Let the lab know:

- Address and location of the site.
- If you know, the historic use of the site (agricultural, industrial, residential, commercial)
- What you plan to do at the site – grow food for consumption, flowers, community garden, etc.
- At a minimum, you would like the soil tested for heavy metals and other contaminants.
 - *The United States' Environmental Protection Agency recommends that for urban areas, at a minimum, the soil test should include pH, percent organic matter, nutrients, micronutrients, and metals, including lead.*

You should understand the basic services the soils lab will perform. Ask them:

- What tests do you recommend for my planned use?
- Based on the prior uses, are there any other tests you recommend?
- Do you perform tests for elevated levels of heavy metals and other contaminants – in particular, those listed in the California Code of Regulations Title 22: Inorganic Persistent and Bioaccumulative Toxic Substances?
- Do you participate in the North American Proficiency Testing Program?
 - *This program assures that soil test analyses are being performed using validated testing methods.*

Each lab may operate differently. You should determine the specific services the soils lab will perform. Ask them:

- How much will it cost?
- What is the recommended procedure for taking soil samples?
- Will you provide containers to collect the soil?
 - If not, what type of containers do you prefer for collection?
- What size should the sample be? For example, is two (2) cups of soil okay?
- Is it okay for people to call the lab for advice and information?
- Is a description provided with the soil test results?
- Do you provide remediation and/or amendment recommendations with the soil tests?
- What is your turnaround time?

The lab may offer other services beyond testing for contaminants that can help you understand your soil health. You may wish to ask them:

- What are the costs and procedures to add a test for soil fertility? herbicide test?

⁶ Reference: University of California Agriculture and Natural Resources, Cooperative Extension. "Soils in Urban Agriculture: Testing, Remediation and Best Management Practices for California Community Gardens, School Gardens, and Urban Farms." 2014

3. Map the sampling area.

Many sites will have several distinct areas that need sampling. For example, there may be “dead” places where plants are not growing, discolored soil, or areas covered with trash or peeling paint. Take separate soil samples for each of these areas. Making a map of your site and noting areas with different characteristics will help you decide how many samples to collect. Table 5 includes distinct areas to look out for and how to sample soil when near these areas.

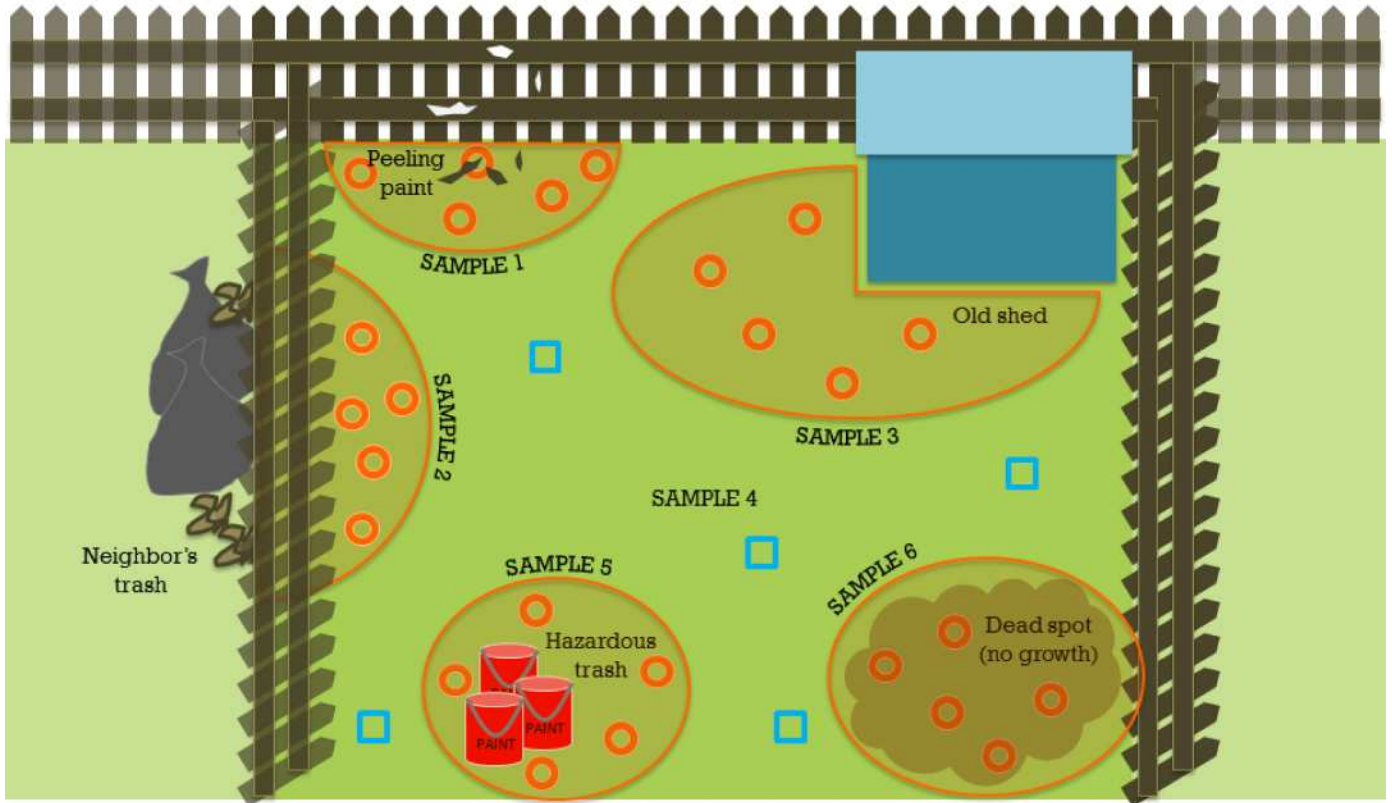
Table 5: Areas to Sample, Avoid, or Remediate Prior to Planting

Potential Source	Contaminants of Concern	Sample Distance from Source
Painted structures (pre-1978) or current industrial sites	Lead	Sample within twenty (20) feet of source
Freeways and heavily-trafficked roads	Lead, Metals, Petroleum, PAHs, VOCs, SVOCs	Sample within one-hundred feet (100) feet of source
Residential burn barrels	Polycyclic Aromatic Hydrocarbons (PAHs), Dioxins, Metals	Sample immediately downwind
Fences and other treated wood structures	Arsenic, Chromium, Copper, Dioxins, PAHs, Pentachlorophenol, VOCs, SVOCs	Sample within five (5) feet of the fence line
Fossil fuel burning power plants, concrete plants, smelters, industrial incinerators, refineries	Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , PAHs, Metals, Petroleum products and constituents, PCBs, Dioxins	Sample or avoid areas within one (1) mile of these facilities or plan to mitigate potential exposure
Orchards and pesticide sites	Arsenic, Lead, and many varieties of chlorinated and organophosphate pesticides	Sample area of potential application and immediately downwind
Other sites such as petroleum, dry cleaning, wood treatment, above or underground storage tanks, or old transformers	Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , PAHs, Metals, Petroleum products and constituents, PCBs	Sample or avoid visibly stained areas, suspect areas with no vegetation, and areas of known operation and/or spills

4. Develop a sampling plan.

For each distinct area, you will need to combine several *subsamples* to form one *sample*. Use your map to record how and where the subsamples are collected, the depth at which subsamples are taken (usually 4-6 inches), and the number of subsamples for each distinct area. See Figure 1 for a sampling plan map with subsample locations and sample areas noted.

Figure 1: Sampling Plan Map



Neighbor

Potential Garden Site

Neighbor

-  Distinct sample area
-  Subsample
-  Subsample from uniform area (area has no obvious concerns)

Combine subsamples **within** each area to form **one sample per** area. In this example, you have 30 subsamples and 6 samples.

5. Collect and prepare your samples.

Follow these steps when collecting your samples:

A. Preparation

- Gather supplies: suitable clean gloves, a clean collection container (often provided by the lab), and a shovel or trowel.
- Put on gloves.
- Make sure nothing is covering the soil (e.g. leaves, grass, etc.).
 - If the soil is covered, remove this top layer to expose the soil.

B. Collecting samples:

- Refer to your sampling plan map. Go to a distinct area of your site.
- Collect 5 to 7 subsamples (approximately one (1) cup of soil each) from different parts *within* the distinct area. Take samples from the top 4 to 6 inches of soil.
- Put the samples into a clean collection container.
- Mark your site and your map indicating where you collected each subsample.
- Mix the subsamples together to form one sample for that distinct area. At this point, the sample for each distinct area may be 5 to 7 cups worth of soil.
- Take approximately two cups from the sample, and bag it according to the lab's instructions.
 - If your soil sample is not completely dry, spread the soil out on clean wax or butcher paper and allow it to dry at room temperature before bagging it.
 - When bagging, try to remove as much air from the bag as possible.
- Repeat this process for each distinct area. Make sure your collection container is clean before collecting samples from each distinct area. You will have **one sample per distinct area**. **DO NOT mix subsamples or samples from separate distinct areas together.**
- Store samples in a cool, dry place at room temperature.
- Wash your hands thoroughly after collecting soil.

6. Deliver samples to the lab.

The lab will likely give you containers and instructions to send in samples for testing. In general, transfer each dry sample into a separate, clean, re-sealable plastic bag to mail to the lab.

7. Interpret the results.

Most guidelines on acceptable levels of contaminants are meant for exposure through ingestion or skin contact rather than gardening. However, these reputable guides still can help you understand what ranges of certain chemicals may be acceptable.

The range of acceptable levels depends on the source of the information. The table below provides the range of maximum levels acceptable based on three separate sources: the California Human Health Screening Level (HHSL), the United States Environmental Protection Agency's (EPA) Soil Screening Levels (SSL), and the EPA's Technical Review Workgroup.

Table 6: Maximum Levels to Guide Interpretation of Soil Test Results⁷

Chemical	Range of maximum levels of chemicals in parts per million (ppm)
Arsenic	.07 to .4
Cadmium and compounds	1.7 to 70
Chromium III	100,000 to 120,000
Chromium VI	17 to 230
Lead and led compounds	80 to 100 (low risk) >100 to 400 (potential risk) 400 – 1200 (potential risk for children) > 1200 (high risk)
Nickel and compounds	1,600
Zinc	23,000

These levels are advisory only; the lab may be able to help you interpret your results or at least indicate what should concern you. If you have vulnerable populations using your garden, we recommend using the smaller number as the maximum allowable concentration. If you have any questions regarding your results that the lab does not answer, please contact the Los Angeles County Department of Public Health at 213-738-3220, tox@ph.lacounty.gov, or http://publichealth.lacounty.gov/eh/TEA/ToxicEpi/index_ToxicsEpi.htm

8. Monitor your soil.

Depending on where you are gardening, and how you amend your soil prior to planting, your soil may become contaminated in the future. It is important to monitor the health of your soil regularly. Consider retesting the soil every two to five years. If you originally found contaminants of concern and are trying to lessen the problem, more frequent testing may be needed to track your progress towards improving the soil.

⁷ <http://ucanr.edu/sites/UrbanAg/files/197207.pdf>

Soil Treatments after Testing

After you receive your results, talk to the soil lab about next steps. You may also reach out to the Los Angeles County Department of Public Health or University of California Cooperative Extension (<http://celosangeles.ucanr.edu/>) to discuss next steps. If your soil results come back with a concern, there are several potential ways to help solve the problem:

1. **Plant in raised garden beds.**

A raised garden bed is a freestanding garden bed with soil mounded above the ground. The soil is contained using some type of barrier such as wood, rocks, hay bales, etc.

Raised garden beds reduce the risk of coming into contact with contaminants while gardening. In order to minimize contact with the existing soil, line your beds with permeable landscape fabric before adding clean soil. Landscape fabric allows air and water to flow through to the ground, unlike black plastic. We recommend building raised beds that are at least 12" to 18" deep. Use clean soil to fill your raised beds. Look for product certification such as Organic Materials Review Institute (OMRI) for soil and other garden products (compost). For more information on how to build raised beds, visit the University of California Cooperative Extension Urban Agriculture website at: http://ucanr.edu/sites/UrbanAg/Production/Farm_Garden_Design/



What should you use to build your raised beds?

Remember to select clean building materials and avoid repurposed wood with old paint or varnish, creosote or pressure treated lumber, or old tires.

2. **Mulch bare soil and avoid contact.**

Mulch is a protective covering (sawdust, leaves, compost, gravel, or paper) spread or left on the ground that can help reduce water evaporation and keep contaminated dust from uncovered soil from coming in direct contact with gardeners. Using mulch on pathways or other uncovered soil lowers the risk of breathing in or swallowing contaminants.

3. **Amend the existing soil.**

If the site has been residential or green space without a history of industrial use, but the soil test results are close to maximum levels, it still may be possible to grow in the existing soil. Talk to your soil-testing lab about your options. The lab may recommend that you turn your soil deeply and thoroughly, or leave it be, depending on the test results.

Examples of recommendations may include the following:

- **Maintain the soil pH at or close to neutral (6.5 to 7).** Plants are better able to absorb soil nutrients and are also less likely to absorb lead and some other heavy metals at this pH. The pH of your soil should be part of the soil test. Depending on the soil pH, different amendments will be necessary. In Southern California, soil is more likely to be alkaline with a pH higher than 7. For more information about pH and how to change it, see <http://www.clemson.edu/extension/hgic/plants/other/soils/hgic1650.html>
- **Add organic matter, lime, zinc, gypsum, biosolids, or agricultural charcoal** to the soil each planting season depending on the contaminants of concern. This helps to dilute contaminants and hold soil nutrients. For best practices on maintaining soil health, see University of California Cooperative Extension Urban Agriculture website, which includes information on soil quality and fertility at [http://ucanr.edu/sites/UrbanAg/Production/Soils/Soil Quality and Fertility/](http://ucanr.edu/sites/UrbanAg/Production/Soils/Soil%20Quality%20and%20Fertility/)

4. **Find another site.**

Unfortunately, not all places are good for gardening. In some cases, the long-term health and safety concerns outweigh the benefits from gardening and it may be best to find another site.

BEST PRACTICES MANAGEMENT

Before starting a garden, we recommend that all gardeners follow these steps:

1. **Find out about nearby septic systems.**

Your garden should not be located near a septic system. A “septic system” is a small-scale sewage treatment system on your own property often used in areas that are not connected to main sewage pipelines. Septic systems treat waste from your home or building on site. If you live in a rural area, it is likely that you have a septic system. Even if you are in a city, there may be a septic system close to your site because sometimes public sewer lines are not close enough to connect to.

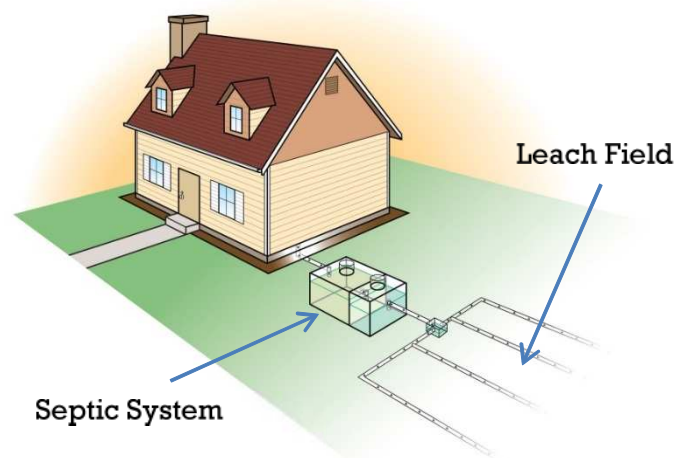
You may have a septic system if...



- You do not see any manholes close to your site. Sewer manholes are located at roadway intersections and along the center of the road. They are labeled “SEWER” or “SS” (sanitary sewer). If there are manholes in the street, the site uses a sewer system. If you do not see any manholes, you are probably using a septic system. The septic system is typically close to the street (for easy emptying) but can be located elsewhere, especially if your site was subdivided or redeveloped.

Plants should be planted **at least 10 feet away from a septic system** and its leach field or seepage pit to avoid bacterial contamination (see picture on right).⁸ Trees should be planted at least 50 feet away to avoid damage to the system.

If you have questions about identifying septic systems or what to do if you are near a septic system, please contact the Los Angeles County Department of Public Health at (626) 430-5380 or



http://publichealth.lacounty.gov/eh/EP/lu/lu_main.htm

⁸ <http://sfp.ucdavis.edu/files/148325.pdf>, <http://www.clemson.edu/extension/hgic/plants/other/landscaping/hgic1726.html>

2. Plant as far as possible from other hazards.

Try to plant as far as possible from areas such as painted structures, fences, freeways and roads, and other potential hazards listed in Table 5 (above).

3. Add organic matter to amend your soil.

Adding high quality compost, worm castings, and other organic matter to your soil on a regular basis will help to improve it over time. Organic matter has many benefits, including those listed below.

- Mixing organic matter into your soil makes contaminants less concentrated.
- Organic matter binds with harmful heavy metals so that plants aren't as likely to absorb them.
- Organic matter holds nutrients for plants, and releases them slowly, helping plants to grow successfully.
- Organic matter helps soil to hold moisture, so that water can reach plant roots.

Buying, or better yet, producing, quality compost is one of the best investments a gardener can make.

Based on testing results and advice from the lab, you may want to consider additional soil amendments that can help your garden flourish. You can learn more about amending your soil at: [http://ucanr.edu/sites/UrbanAg/Production/Soils/Soil Quality and Fertility/](http://ucanr.edu/sites/UrbanAg/Production/Soils/Soil%20Quality%20and%20Fertility/)

4. Conserve water.

Over watering wastes precious natural resources, especially in our current drought. All gardeners should learn about irrigation systems and strategies for conserving water and reducing run-off (<http://ucanr.edu/sites/UrbanAg/Production/Water/>). One avenue is to consider mulching (see #2 in “Soil Treatments after Testing” section) which helps reduce water evaporation. Mulch also helps preserve soil moisture by keeping the soil cool in summer.

Los Angeles County has adopted water conservation regulations prohibiting residents from

- Overwatering in a manner that causes runoff into adjoining streets, parking lots or alleys;
- Watering more than once a day or between the hours of 10:00 a.m. and 5:00 p.m.; or
- Possessing hoses, faucets and sprinkling systems that leak.

Check with your local jurisdiction for additional water restrictions due to the drought. Find out more here: <http://dpw.lacounty.gov/wwd/web/Conservation/Drought.aspx>

5. Wear gloves when you garden, and wash your hands immediately after gardening.

This will help minimize the risk of consuming soil accidentally, or bringing soil into the home.

6. Wash produce thoroughly using running water, remove outer leaves of vegetables, and peel root crops.

Food grown in your garden should always be washed well before eating. Washing vegetables and fruits after a harvest (barring serious contamination) can make a significant difference in promoting health and wellness.⁹ In addition, removing the outer leaves of crops like lettuce and peeling root crops like carrots helps reduce exposure to contaminants, since these crops are in direct contact with the soil.

7. Avoid bringing soil into the home.

In order to minimize the spread of contaminated soil, be sure to clean tools, gloves, and shoes before bringing them indoors; put heavily soiled clothes in a bag before bringing them inside and wash them as soon as possible.

8. Review other best practices garden management tips.

Los Angeles County and the University of California Cooperative Extension provide many resources to help you make your garden successful and healthy for everyone eating food grown there.

For more information, visit:

[http://celosangeles.ucanr.edu/UC Master Gardener Program/Gardening Articles/](http://celosangeles.ucanr.edu/UC_Master_Gardener_Program/Gardening_Articles/)

CONCLUSION

While there are issues that need to be addressed to garden safely in urban areas, gardening nevertheless provides many benefits to both individuals and the community – such as ready availability of fresh fruits and vegetables as well as opportunities for physical activity. By following the guidance in this document, people can garden with confidence and know that they have ensured that their garden is a healthy space. We applaud your efforts!

⁹ <http://modernfarmer.com/2014/07/lead-urban-gardens/>

REFERENCES AND RESOURCES

Los Angeles County and its partners have additional resources that can assist you with best garden management practices, healthy practices, troubleshooting, and other resources to create a successful garden. Consider reviewing the following additional documents:

- **University of California, Division of Agriculture and Natural Resources (UC ANR), Guide to Urban Agriculture.** Available at: <http://ucanr.edu/sites/UrbanAg/>
- **“Reusing potentially contaminated landscapes: growing gardens in urban soils,”** by the U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (EPA/542/F-10/011)
- U.S. Environmental Protection Agency’s **Contaminated Site Clean-Up Information (CLU-IN)** website: www.clu-in.org/ecotools/urbangardens.cfm
- **“Environmental Challenges Threatening the Growth of Urban Agriculture in the United States,”** by Sam E. Wortman and Sarah Taylor Lovella. Available at: <https://www.agronomy.org/publications/jeq/abstracts/42/5/1283>
- Cornell Waste Management Institute’s **“What Gardeners Can Do: 10 Best Practices for Healthy Gardening.”** Available at: <http://cwmi.css.cornell.edu/WhatGardenersCanDoEnglish.pdf> (Spanish version “Lo que los jardineros podemos hacer: 10 Consejos para practicar la jardinería de manera saludable”- available at: <http://cwmi.css.cornell.edu/WhatGardenersCanDoSpanish.pdf>).
- **“Soils in Urban Agriculture: Testing, Remediation, and Best Management Practices for California Community Gardens, School Gardens, and Urban Farms,”** by Rachel Surls, Valerie Borel, and Andre Biscaro. Available at: <http://ucanr.edu/sites/UrbanAg/files/197207.pdf>
- **“Soil Contaminants and Soil Testing,”** by UC ANR. Available at: http://ucanr.edu/sites/UrbanAg/Production/Soils/Soil_Contaminants_and_Soil_Testing/
- **“Urban Gardening: Managing the Risks of Contaminated Soil,”** by Rebecca Kessler. Available at: <http://ehp.niehs.nih.gov/121-a326/>
- **“Heavy Metals in Produce from Urban Farms in the San Francisco Bay Area,”** by Hannah Kohrman and C. Page Chamberlain. Available at: <http://www.inuag.org/sites/default/files/Kohrman%20and%20Chamberlain%20Heavy%20Metals%20SF%20Bay.pdf>
- Cornell Waste Management Institute’s **“Guide to Soil Testing and Interpreting Results,”** by Hannah Shayler, Murray McBride, and Ellen Harrison. Available at: <http://cwmi.css.cornell.edu/guidetosoil.pdf>

- **“Sustainable Water Management for Urban Agriculture,”** by Janett Nolasco.
Available at: http://pacinst.org/wp-content/uploads/2013/02/sustainable_water_management_for_urban_agriculture3.pdf
- **UC ANR Guide to Water Irrigation.** Available at:
<http://ucanr.edu/sites/UrbanAg/Production/Water/Irrigation/>
- **UC ANR Guide to Water Conservation.** Available at:
<http://ucanr.edu/sites/UrbanAg/Production/Water/Conservation/>
- **California’s Regional Water Boards Information.** Available at:
http://www.waterboards.ca.gov/about_us/contact_us/rwqcb_directory.shtml

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