Urban Agriculture in Michigan:

Things to consider about soil and water

Introduction

The production of food in urban areas offers many opportunities and responsibilities. Plain soil can be turned into beautiful, healthy, and productive fields of fruits, vegetables, and flowers for all to enjoy. Urban and industrial properties, however, often have more chemical contamination, or pollution, than rural areas. If any contamination is present, the responsibilities for the farmer include ensuring that people are safe from it, both when they produce the crops and when they eat the crops. This document contains information about how to do that.

First Step: Consider Your Soil

Soil contamination is common in urban areas. Soil contamination is a concern both for direct contact between people and soil and also for movement of chemicals into plants that are grown in the soil.

Children are especially prone to be affected by soil contamination because of the following:

- Children are smaller and breathe in air that is close to the ground. Sometimes the ground is covered with contaminated soil and dust.
- Children often put their hands or objects like toys in their mouths. If their hands or toys have contaminated soil on them the soil can then be swallowed by the child.
- Children grow at a fast pace, which puts them at more health risk from the chemicals.

Urban farm workers can also have an increased health risk:

- They spend more time on the soil and breathe in more soil and dust.
- They may have contaminated soil on their hands that can be swallowed when hands are not washed before eating.
- They may have contaminated soil on their shoes and clothing that can be tracked into their cars and homes.

It helps to know the property's history. It helps to know the history of the land you are planning to cultivate in order to identify any potential soil contaminants. Even residential properties may be contaminated if they housed buildings that were constructed before 1978, because many of these buildings were painted with paint that contained lead. Lead in paint flakes can last a long time and is especially harmful to children.

Other land uses also have chemicals commonly associated with them that can persist in the soil for many years. Some of these land uses and their associated chemicals are listed here.

Common Sources of Chemicals in Soil

Land Use	Common Chemicals
Agriculture, green space	Nitrate, pesticides/herbicides
Car wash, parking lots, road and maintenance depot, vehicle services	Metals, PAHs (polycyclic aromatic compounds) , petroleum products, sodium, solvents, surfactants
Dry cleaning	Solvents
Existing commercial or industrial building structures	Asbestos, petroleum products, lead paint, PCB (polychlorinated biphenyl) caulks , solvents
Junkyards	Metals, petroleum products, solvents, sulfate
Machine shops and metal works	Metals, petroleum products, solvents, surfactants
Residential areas, buildings with lead-based paint, where coal, oil, gas or garbage was burned	Metals, including lead, PAHs, petroleum products, creosote
Stormwater drains and retention basins	Metals, pathogens, pesticides/herbicides, petroleum products, sodium, solvents
Underground and aboveground storage tanks	Pesticides/herbicides, petroleum products, solvents
Wood preserving	Metals, petroleum products, phenols, solvents, sulfate
Chemical manufacture, clandestine dumping, hazardous material storage and transfer, industrial lagoons and pits, railroad tracks and yards, research labs	Fluoride, metals, nitrate, pathogens, petroleum products, phenols, radioactivity, sodium, solvents, sulfate

If you are considering cultivating land that was used as non-residential property it may be wise to consult with an environmental specialist/consultant for advice.

It helps to know your soil. If you suspect your soil is contaminated you have several choices: a) place clean soil on top to create raised beds; b) remove suspect soil and replace with clean soil (with or without clean compost); and/or, c) have your soil tested.

If you create raised beds it is best if you place a barrier, such as a landscape fabric, on the bottom. Then, fill the raised bed with clean soil, deep enough for the roots of your crops. Avoid using treated wood for the structure. Railroad ties, telephone poles, pressure-treated wood and some painted wood contain chemicals that can get into soil.

If you remove suspect soil you will need to dispose of it in a responsible manner. This may include calling a waste management company or landfill, explaining to them the type and amount of soil you want them to take, and then following their instructions. Remember to wear a dust mask, goggles, gloves, and other clothing that will prevent the soil from coming in contact with your skin and eyes. Also, don't forget to call ahead of time to have utilities marked before digging anywhere on your property. Call 8-1-1 or 1-800-482-7171 for Michigan, or visit www.call811.com.

If you decide to test your soil you will need to collect samples and send them to a testing laboratory. Basic soil testing can be performed by the following laboratories:

a. The Greening of Detroit has a program to assist with soil testing at a low cost. For more information call 1-313-237-8733.
b. Michigan State University Extension, Wayne County will test your soil for pH, phosphorus, potassium, calcium and magnesium. Liming and/or fertilizer recommendations are provided and are based on the crop(s) to be grown and soil test results. The cost of the soil test kit is $25. You are responsible for mailing the sample in. You can get a test kit by calling 1-734-721-6576.
c. Michigan State University Diagnostic Center for Population and Animal Health (DCPAH) will test your soil for the following chemicals: aluminum, antimony, arsenic, barium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, phosphorus, potassium, selenium, sodium, sulfur, thallium and zinc. The cost is $50. For more information call 1-517-353-1683.
d. University Laboratories, Inc., in Novi, MI, provides food safety testing to detect chemicals. Call 1-248-615-8000 for more information.
e. Other commercial testing laboratories may be found in the yellow pages of your local telephone directory.

How to obtain a good soil sample for testing. The most challenging part of testing your soil may be getting a soil sample that is most like the entire area you will be using for gardening or farming. Here's how to get a good sample (remember to wear gloves and other clothing that will prevent the soil coming in contact with your skin and eyes):

1. Use a shovel or trowel and a clean plastic pail. Do not use a metal pail.
2. Plan on collecting 5-15 soil samples for each area of the property you want to test.

3. Remove dead plants, mulch or turf thatch from the ground before putting your shovel or trowel into the ground.
4. Dig to the depth you expect the plant roots to be, about 6-8 inches deep for flowers and vegetables, and 8-12 inches deep for trees.
5. Remove the same amount of soil from each area of the property. Dig a separate set of soil samples from the front and back yards if they have had different uses or have different types of soil. Sample light soil, dark soil, limed and un-limed areas separately.
6. Mix the samples together in the plastic pail. Break up any lumps and remove all stones, debris, etc.
7. When the soil is dry, mix and crush it so all the soil is the size of rice or smaller.
8. Do not mail wet soil. Air dry the soil if necessary. Do not use artificial heat (such as radiators or ovens) to force-dry the sample.
9. Check with the laboratory you have chosen for instructions on the amount of soil required to be sent to the laboratory for analysis. The laboratory will either provide you with a shipping container or give you further instructions for the type of container to send to them.

Additional soil testing. If you suspect your soil may be contaminated with fuels or industrial chemicals (such as gasoline, diesel, heating oil, organic solvents, paints, plating chemicals, etc.) more specialized sample collection and analyses may be needed. In these cases, you should contact the Michigan Department of Agriculture and Rural Development (MDARD) Toxicologist (800-292-3939) or your local Michigan Department of Environmental Quality office for further guidance on how to have this testing performed.

Comparing your soil test results with the soil chemicals list. If the test levels of the chemicals are the same or less than those listed in Table 1, the soil is considered to be acceptable for residential (unrestricted) land use in Michigan.

Keep in mind that these levels may not be ideal for the growth of some plants. Your local agricultural extension office is a good source for this type of information. Some information about the levels of some common urban contaminants for plant growth can found at www.epa.gov/oswer/riskassessment/ecorisk/ecossl.htm.

Second Step: Consider Your Crops

Given the many health benefits of eating fresh fruits and vegetables, every attempt should be made to use the guidance in this document to create healthy conditions to grow your crops. However, eating fruits and vegetables grown in contaminated soils may have both benefits and

risks. Some plants take up contaminants in the soil more easily than others. Likewise, some plants are not as easy to remove soil from as others. The vegetables on the **Not as good for growing in urban areas** list should be grown in areas where contamination is not a concern or where clean soil and composts have been used. Because compost can contain bacteria, fungus, or parasites, it is important to know the source of both the clean soil and the composting materials. Note that building raised beds with clean materials will help create healthy gardens in many situations, but may not eliminate contaminants carried in the air or dust and splash back from soils.

Use the following lists:

Best for growing in urban areas:

Vegetable Fruits and Seeds: tomatoes, eggplant, peppers, okra (seed pods only), squash (summer and winter), corn, cucumber, melons, peas and beans (shelled), onion (bulb only).

Tree Fruits: apples, pears.

Not as good for growing in urban areas:

Green Leafy Vegetables: lettuce, spinach, Swiss chard, beet leaves, cabbage, kale, collards.

Other Vegetables: broccoli, cauliflower, green beans, snow peas.

Root Crops: carrots, potatoes, radish.

Third Step: Consider Your Water

Water that is safe for people to drink is safe for watering crops. If you want to use water from a source that has not been approved for human use you may want to have the water tested. Many laboratories that test soil for contaminants can also test water. Your local health department is also a source of information for water testing. Instructions for getting water samples may vary depending on the contaminants and the laboratory. Ask the testing laboratory for instructions.

Compare your water test results for chemicals to Table 2. If the test levels are the same or less than those listed in Table 2, the water is considered to be acceptable for residential (unrestricted) land use in Michigan. Keep in mind that these levels may not be ideal for the

growth of some plants and/or fish. Your local agricultural extension office is a good source for this type of information.

Along with chemicals the amount of bacteria present in the water you use for your crops may need to be measured. This is especially important if you will be using any surface water, like water from a river, lake or pond, to irrigate your crops. The amount of bacteria in irrigation water (and processing water, like that used to remove soil after harvesting) is more of a concern for produce that may be eaten raw, for example carrots, leafy greens, tomatoes and strawberries.

It is preferred that water used for agriculture have no bacteria present, however in some circumstances some amount of bacteria may be safe. Currently the Food and Drug Administration (FDA) is taking comments on its Proposed Agricultural Water Standards – Proposed Rule for Produce Safety, which is part of the FDA Food Safety Modernization Act. This Proposed Rule includes guidelines and some specific numerical standards for bacteria. A summary sheet is available at: https://www.fda.gov/files/food/published/FSMA-Final-Rule-for-Produce-Safety--How-Did-FDA-Establish-Requirements-for-Water-Quality-and-Testing-of-Irrigation-Water--PDF.pdf.

Many laboratories that test water for chemicals can also measure bacteria. Ask the testing laboratory for instructions for taking a water sample to be tested for bacteria.

Fourth Step: Consider Other Activities

Here are additional ideas to keep people safe when they produce or eat crops grown in urban soils.

For Gardening:

- Wash fruits, vegetables and flowers to remove bacteria and other contaminants. This is especially important for any parts that will be eaten. Remove the outer leaves of crops like head lettuce and cabbage since these leaves are most likely to have been in contact with the soil. Also consider throwing away part or all of the bottom leaves of leafy vegetables.
- Peel root vegetables such as carrots, potatoes, and beets. This will help remove any soil that is on them. The peelings should not be added back to the soil or any compost.
- While gardening, do not drink, smoke, or engage in other activities that may introduce soil into the mouth. Consider wearing a face mask in dusty conditions.
- Keep soil moist while gardening to control dust.
- Make sure children do not eat soil or put dirty toys or other objects in their mouths.

- Keep children away from the soil by covering the soil with landscape fabric or another barrier. Then put clean play materials such as sand or wood chips on top of the barrier. Check the area often to be sure underlying soil isn't mixing with play materials.
- Cover the soil in your garden and on the walking paths with a thick layer (about 4 inches) of mulch, clean compost, or straw. This will help to reduce soil splashing onto your plants, gardening equipment, and people.
- It is a good idea to leave the soil outside of your home. Wash the soil from your garden tools and harvested vegetables while outside. Designate certain clothing, including footwear and tight-fitting disposable gloves for gardening use only. Brush any soil off your clothes and change your shoes before going indoors. Remove gardening footwear before entering the car and store all used gardening equipment and clothing outdoors.
- Wash your hands and clean under your nails after working in the soil. Have children who play or work in the soil wash up too.
- Wash all exposed body surfaces, preferably by showering, as soon as possible after gardening.
- Don't let pets in areas where the soil might be contaminated. If pets do come into contact with contaminated soil, give them a bath before they come into the house or car.
- Test the pH level in your soil. Some contaminants move into the plants more easily when the pH level is too low. Keep the pH level near neutral, 6.5 – 7, by following your soil test's recommendations. You can raise pH by adding a product containing lime or lower pH by adding a product containing sulfur. Always follow the package instructions.
- Add compost made of clean organic matter, such as grass clippings, to your soil. Some chemicals stick to organic matter, making them less likely to move into your plants.

For Farming:

- Follow the same advice outlined in the gardening section.
- Utilize minimum tillage and dust reduction practices in any production cycle.
- Because of individual and unique livestock production practices, and the different potential for exposure to contaminants, anyone raising livestock is urged to contact the MDARD Toxicologist at 1-800-292-3939.

If You Want to Sell Your Produce, Here Is Some Advice

Deciding on a marketing strategy that works for you depends on your personal preferences and business strengths, the amount and type of product you produce, the financial risk you are willing to accept, and the amount of customer contact you are willing to have. Depending on the market type you choose and the products you will sell, there are different licensing and regulatory requirements, and food preparation needs. MDARD has a Marketing Guide for growers interested in bringing their crops to market, "Growing Michigan's Future: A Guide to Marketing Your Michigan Food and Agriculture Products," found at: http://www.michigan.gov/mdardmarketingguide. There are rules and regulations involved in protecting the consumer and producers.

Proof of using Good Agricultural Practices (GAP) is often sought out by restaurants and grocery stores. GAP certification is one method businesses use to approve produce suppliers. It is a stamp of approval that the grower is aware of the importance of good practices to keep food safe and healthy. For information on GAP certification please visit www.mifarmfoodsafety.org/.

New regulations under the Food Safety Modernization Act will place specific requirements on many food businesses, from farm to consumer (or customer), to ensure a safe and wholesome food supply and to minimize the risk of foodborne illness. The new regulations will include specific requirements for growing and harvesting produce for human consumption. For more information on the new regulations, please visit www.fda.gov/fsma.

Other valuable resources for selling produce in Michigan include:

Michigan State University Product Center Food-Ag-Bio provides assistance in developing and commercializing high value, consumer-responsive products and businesses in the agriculture and natural resource sectors. For more information, call 1-517-432-4608 or 1-517-432-8750, or visit www.productcenter.msu.edu.

Michigan Food and Farming Systems – MIFFS is a statewide, non-profit organization whose purpose is to improve Michigan's economy, environment and the social well-being of communities by promoting family farms, local food and sustainable agriculture. For more information, call 1-517-432-0712, or visit www.miffs.org.

Michigan Small Business and Technology Development Center enhances Michigan's economic well-being by providing counseling, training, research and advocacy for new ventures, existing small businesses and innovative technology companies. For more information visit www.misbtdc.org.

Michigan Economic Development Corporation is a public-private partnership serving as the state's marketing arm and lead agency for business, talent and jobs, tourism, film and digital incentives, arts and cultural grants, and overall economic growth. For more information, call 1-888-522-0103, or visit www.michiganadvantage.org.

Summary

Producing food in urban areas can provide many benefits to the urban population, such as improved nutrition and a better quality of life. Urban areas tend to have more environmental contamination than rural areas. Contamination on the property needs to be recognized and managed to ensure crop production practices will be safe for everyone. This document aims to provide the crop producer with information that will help them safely produce crops that are safe to eat.

Attachments

Table 1. Acceptable Levels of Common Urban Chemicals in Soil*

Chemical	Chemical Abstract Service Number	Michigan Unrestricted Residential Use Acceptable Concentration (milligrams per Kilogram soil = parts per million)
Acenaphthene**	83329	8.7
Acenaphthylene**	208968	5.9
Aluminum	7429905	6,900
Anthracene**	120127	41
Antimony	7440360	1.2
Arsenic	7440382	5.8
Asbestos	1332214	68
Barium	7440393	150
Benzene**	71432	0.10
Beryllium	7440417	5.2
Benzo(a)anthracene	56553	20
Benzo(b)fluoranthene**	205992	20
Benzo(k)fluoranthene	207089	200
Benzo(g,h,i)perylene	191242	2,500
Benzo(a)pyrene	50328	2.0
Boron	7440428	10
Cadmium	7440439	160
Chromium (III)	16065831	330,000
Chromium (VI) (or Total Chromium)	18540299	3.3
Chrysene**	218019	2,000
Cobalt	7440484	0.80
Copper	7440508	32
Dibenzo(a,h)anthracene	53703	2.0
Dioxin	(several)	0.00009
Ethylbenzene**	100414	0.36
Fluoranthene**	206440	5.5
Fluorene**	86737	5.3
Fluorine (soluble fluoride)	7782414	40
Indeno(1,2,3-cd)pyrene	193395	20
Iron	7439896	6.0
Lead	7439921	400
Manganese	7439965	440
Mercury (Total)**	Varies	0.0012
Methylphenols	1319773	0.60
Molybdenum	7439987	1.5
Nickel	7440020	30
Phenanthrene**	85018	2.1
Phenol	108952	9.0
Phosphorus (Total)	7723140	1,300
Polychlorinated biphenyls (PCBs)**	1336363	4.0

Chemical	Chemical Abstract Service Number	Michigan Unrestricted Residential Use Acceptable Concentration (milligrams per Kilogram soil = parts per million)
Pyrene**	129000	480
Selenium	7782492	0.41
Tetrachloroethylene**	127184	0.10
Thallium	7440280	1.4
Toluene**	108883	5.4
Trichloroethylene**	79016	0.10
Vinyl chloride**	75014	0.020
Xylenes**	1330207	0.80
Zinc	7440666	65
*If soil sampling is representative of more than one-half acre, additional evaluation may be needed.		
**Chemical is volatile. Additional evaluation may be needed.		
For more information please contact the MDARD Toxicologist at 1-800-292-3939.		

Table 2. Acceptable Levels of Common Urban Chemicals in Water

Chemical	Chemical Abstract Service Number	Michigan Unrestricted Residential Use Acceptable Concentration (micrograms per Liter = parts per billion)
Acenaphthene	83329	38
Acenaphthylene	208968	52
Aluminum	7429905	50
Anthracene	120127	43
Antimony	7440360	6.0
Arsenic	7440382	10
Asbestos	1332214	7,000,000 (fibers/Liter)
Barium	7440393	210
Benzene	71432	5.0
Benzo(a)anthracene	56553	2.1
Benzo(b)fluoranthene	205992	1.5
Benzo(k)fluoranthene	207089	0.80
Benzo(g,h,i)perylene	191242	0.26
Benzo(a)pyrene	50328	1.6
Boron	7440428	500
Beryllium	7440417	0.41
Cadmium	7440439	1.3
Chromium (III)	16065831	42
Chromium (VI)	18540299	11
Chrysene	218019	1.6
Cobalt	7440484	40
Copper	7440508	5.0
Dibenzo(a,h)anthracene	53703	0.21
Dioxin	(several)	0.0000000031
Ethylbenzene	100414	18
Fluoranthene	206440	1.6
Fluorene	86737	12
Fluorine (soluble fluoride)	7782414	2,000
Indeno(1,2,3-cd)pyrene	193395	0.022
Iron	7439896	300
Lead	7439921	4.0
Magnesium	7439954	400,000
Manganese	7439965	50
Mercury (Total)	Varies	0.0013
Molybdenum	7439987	73
Nickel	7440020	29
Nitrate	14797558	10,000
pH	NA	6.5 to 8.5 (pH units)
Phenanthrene	85018	1.4
Phenol	108952	450

Chemical	Chemical Abstract Service Number	Michigan Unrestricted Residential Use Acceptable Concentration (micrograms per Liter = parts per billion)
Phosphorus (Total)	7723140	1,000
Polychlorinated biphenyls (PCBs)	1336363	0.000026
Pyrene	129000	140
Selenium	7782492	5.0
Sodium	17341252	230,000
Sulfate	14808798	250,000
Tetrachloroethylene	127184	5.0
Thallium	7440280	2.0
Toluene	108883	270
Trichloroethylene	79016	5.0
Vinyl chloride	75014	2.0
Xylenes	1330207	41
Zinc	7440666	66
For more information please contact the MDARD Toxicologist at 1-800-292-3939.		

Resources and References

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This document was prepared by the Michigan Department of Agriculture and Rural Development, with assistance from the Michigan Department of Environmental Quality and the Michigan Department of Community Health.

March 2014