# Soil Contamination in the City: Approaches to Remediation and Reducing Exposure

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# Common urban soil contaminants

| General source | Examples of previous site uses | Specific contaminants |
|---|---|---|
| Paint (before 1978) | old residential buildings; mining; leather tanning; landfill operations; aircraft component manufacturing | lead |
| High-traffic areas or near roadways | next to trafficked roadways or highways; near roadways built before leaded fuel was phased out | lead, zinc, polycyclic aromatic hydrocarbons (PAHs) |
| Treated lumber | lumber treatment facilities; structures built with treated lumber | arsenic, chromium, copper, creosote |
| Burning wastes | landfill operations | PAHs, dioxins |
| Contaminated manure | copper, zinc salts added to animal feed | copper, zinc |
| Coal ash | coal-fired power plants; landfills; homes with coal furnaces | arsenic, selenium, cadmium, sulfur |
| Biosolids | wastewater treatment plants; agriculture | cadmium, copper, zinc, lead, persistent bioaccumulative toxins (PBTs) |
| Petroleum spills | gas stations; residential/commercial/industrial uses (anywhere an aboveground or underground storage tank is or has been located) | PAHs, benzene, toluene, xylene, ethyl benzene |
| Pesticides | widespread pesticide use, such as in orchards; pesticide formulation, packaging, and shipping | lead, arsenic, mercury, dichlorodiphenyltrichloroethane (DDT), chlordane, and other chlorinated pesticides |
| Commercial or industrial site use | | PAHs, petroleum products, solvents, lead, and other heavy metals (such as cadmium, arsenic, chromium, lead, mercury, and zinc) |
| Dry cleaners | | stoddard solvent and tetrachloroethene |

Harms et al. 2014

# How they impact health
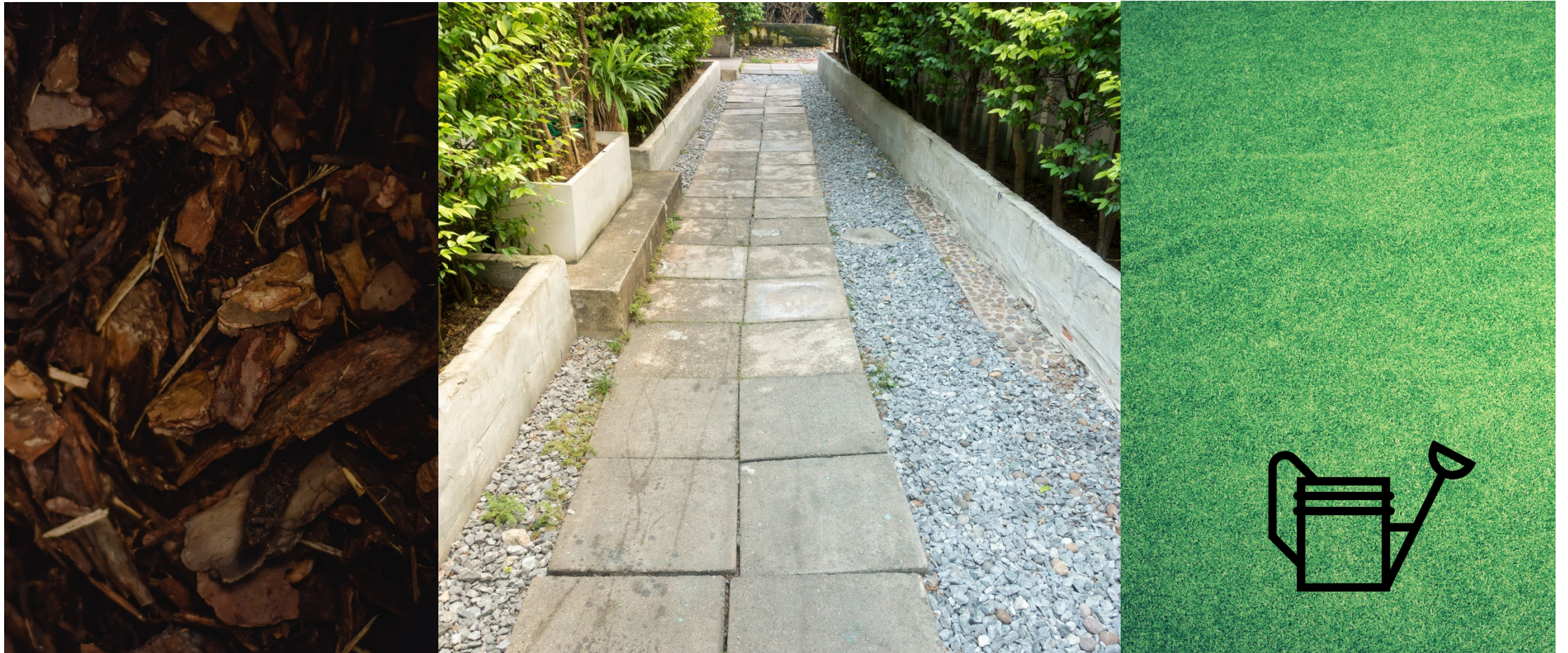


Li et al. 2018
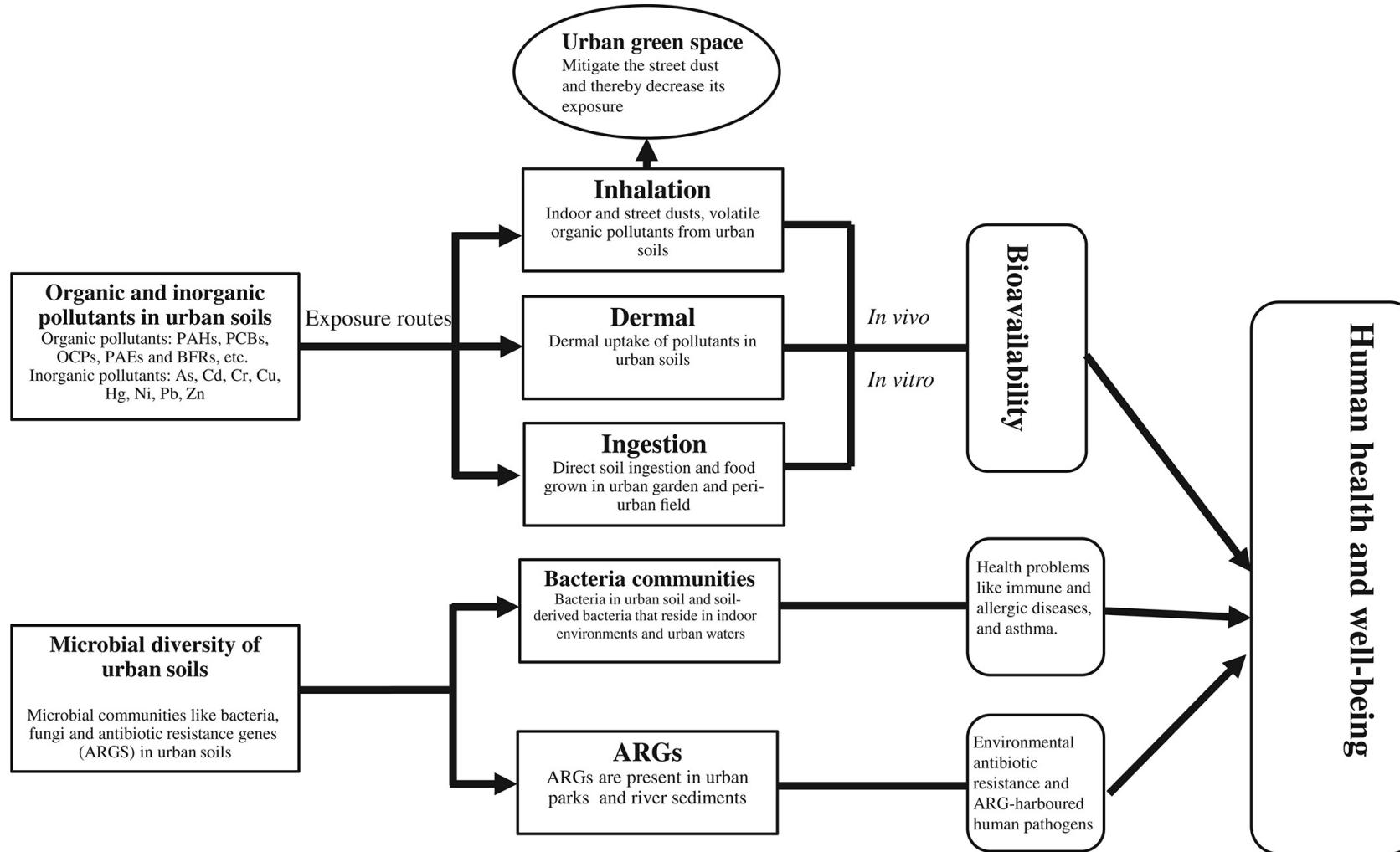
# Lead as an example
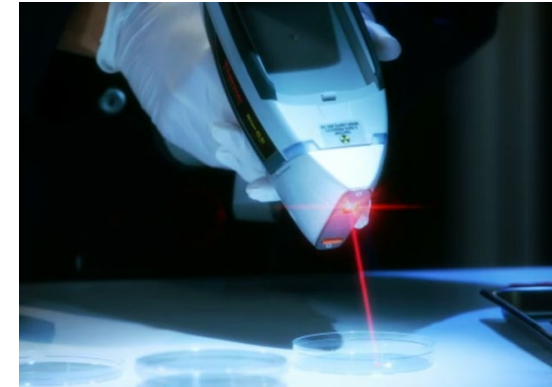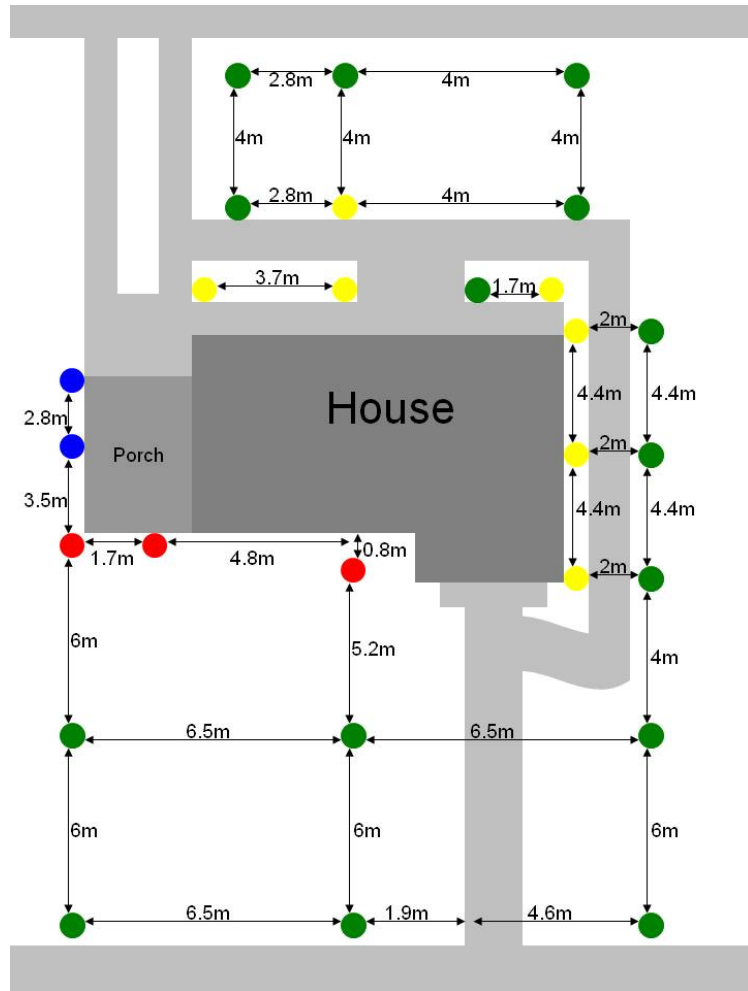
# A framework for soil lead management
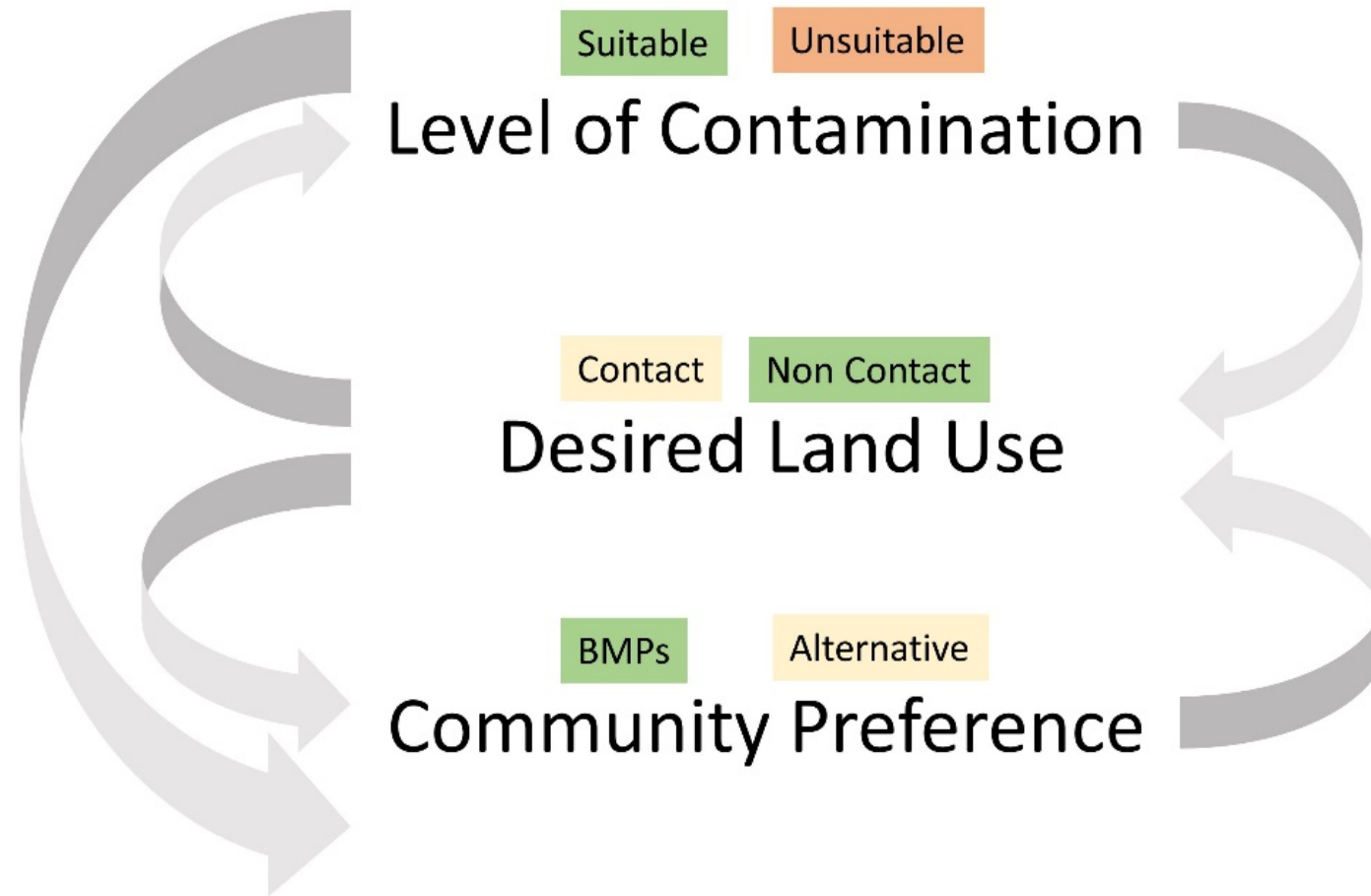
# Reducing contact with soil

# Covering contaminated soils



Using clean Mississippi River alluvium to cover contaminated soil.

Median surface soil lead, >1,000ppm to 6ppm.

New Orleans, approx. 86,000 homes >400ppm , cost $225.5 and 290.4 million.

Mielke et al. 2006

# Soil removal

At some levels necessary, but there are high costs.

Issues with disposal.

Soil systems take a long time to develop.

Given the extent, widespread implementation not feasible.



Photo Credit: Dennis Oda, *Star Advertiser*

# Phytoremediation



Using plants to remove, degrade, or sequester pollutants.

Often requires mobilizing lead so that it's available for uptake.

While phytoextraction is not a viable option, phytostabilization may be an effective tool.

Blaustein 2017
Egendorf et al. 2020

# Soil amendments

Amendments can make lead less bioavailable, i.e. able to enter tissues of plants or animals.

Phosphate, compost, fertilizers, biosolids, and others.

Adding amendments can also dilute the amount of lead in soil.

Soil properties can change, may require monitoring. Tradeoffs, phosphates can increase the solubility of soil As.

# Gardening as solution?

**Soil management** - many of the same properties that gardeners manage in an effort to maintain soil health and fertility also reduce potential exposure to Pb.





**Social network and community building** Urban gardens are places of social transformation – while vacancy leaves holes and disconnects communities, networks of gardens can grow in and connect.

Schwarz et al. 2016

# Working towards system level solutions

# Community testing models

# NYC clean soil bank & PUREsoil as models



Recycles clean native soil from deep excavations at construction sites to other NYC construction sites, both public and private.

PUREsoil NYC is a new program from the Mayor's Office of Environmental Remediation that makes clean soil available to community-based organizations to improve the quality of degraded soil in NY.

Soils, mixed with compost, had significantly lower contaminant levels and comparable crop yields (Egendorf et al. 2018)



Egendorf et al. 2018

# Avoiding the next lead

A Clean Soil Act?

*The World Food Prize Winner Says Soils Should Have Rights*

*Earth Needs a Clean Soil Act*

Policy that connects across systems.

Accessible testing and remediation resources.

Solutions that don't place the burden of clean-up on individuals.

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# Resources

[Soils in Urban Agriculture: Testing, Remediation, and Best Management Practices](), UCANR

[Our Soil](), building health relationships with soil

[PUREsoil NYC]()

Thank you!