



The **Hazard Evaluation and Emergency Response (HEER) Office** is part of the Hawai'i Department of Health's Environmental Health Administration whose mission is to protect human health and the environment. The HEER Office provides leadership, support, and partnership in preventing, planning for, responding to, and enforcing environmental laws relating to releases or threats of releases of hazardous substances.

What You Need to Know About Lead, Arsenic, and Organochlorine Pesticides in Soils at Hawai'i Schools

This fact sheet provides schools with an overview of lead, arsenic, and organochlorine pesticides (OCPs) in soils at schools in Hawai'i. Additionally, this fact sheet discusses methods for reducing exposure to these contaminants, potential human health concerns, and resources for further information.

Why are lead, arsenic, and OCPs a potential concern for Hawai'i schools?

The Hawai'i Department of Education (HDOE) conducted soil sampling in certain areas at 23 schools on the eastern side of Hawai'i Island. Analytical results showed that approximately 60% of the schools had areas with elevated soil lead levels, 20% had areas with elevated soil arsenic levels, and 20% had areas with elevated soil OCP levels. These chemicals were predominantly found within a narrow strip of 3 to 4 feet along older building foundations. Only rarely were elevated concentrations of these contaminants found in the soil samples collected from other areas of the schools. Lead around the building perimeters is likely associated with the past use of lead-based paint on building exteriors prior to 1978. Arsenic was commonly used for weed control in the 1910s through 1940s, which included use along building perimeters. OCPs were used for termite control at building foundations from the mid-1940s to the 1980s. Restricting access to areas immediately adjacent to building perimeters and foundations through simple methods described in this fact sheet can greatly reduce the potential for exposure to these contaminants.



Children are at risk of lead, arsenic, and OCP exposure from unintentional ingestion of soil through normal play activities, including outdoor recess or gardening in areas where soil may be contaminated.

The potential occurrence of lead, arsenic, and/or OCPs in (pre-1990) building perimeter soils is not unique to schools. The HEER Office and other published studies have documented similar concerns for older homes and businesses. The recommendations provided in this fact sheet can also be used to reduce potential soil exposure to these contaminants around your home or business. Soil testing is the only way to know for certain if levels of soil contaminants are high enough to pose a potential health risk.



What are lead and arsenic, and how did they get in the soil near some school buildings?

Lead and arsenic are naturally occurring elements that are present at low levels in all soils, including soils in Hawai'i. However, elevated levels of both these contaminants in soils are most likely related to past human activities. Current human activities can affect exposure to these contaminants if the soils or building materials are disturbed.

There are two main human-caused sources of **lead** in soils: the past use of lead-based paint, and the past use of leaded gasoline. The use of lead in house paint was banned by 1978 but it still exists in the interior and/or exterior paint of many older buildings in Hawai'i. Soil around the perimeter of buildings can become contaminated with lead as paint chips off of exterior walls and falls to the ground. In addition, some types of older roofing nails can contain lead. Similar to the paint chips, lead can be leached from the nails that have fallen to the ground and contaminate the soil. Elevated levels of lead in soil can also be related to the past use of lead in gasoline. Although lead in gasoline was phased out starting in the 1970s and completely banned in 1995, decades of leaded gasoline use often contaminated soils adjacent to highways and roads with lead. Lead does not degrade in soils but can be dispersed through natural or human soil disturbances over time or could be transported by erosion to adjacent areas.

The main source of the elevated levels of **arsenic** predominantly found along building foundations was likely the use of arsenic-based herbicides, insecticides, and/or rodenticides in the 1920s through 1940s. These chemicals may have also been used along fence lines or property lines for weed control during that same time period. Generally, the HDOE sampling at East Hawai'i schools did not identify levels of arsenic above human health risk levels in open areas and playfields at schools. However only surface soils (the top 4 to 6 inches of soil) were tested. Therefore, it is unknown whether deeper soils may be contaminated without further testing. Since inorganic arsenic is stable in the environment, it can remain in soil for many years.

What are OCPs and how did they get in the soil near some school buildings?

OCPs are a group of pesticides that were primarily used in and around wooden buildings from the mid-1940s to the late 1980s for termite control. They were also used in agricultural fields to control insects. The OCP most commonly used in Hawai'i in the past was chlordane; however, other OCPs used included aldrin, dieldrin, heptachlor, and dichlorodiphenyltrichloroethane (DDT). In the 1970s and 1980s, the U.S. Environmental Protection Agency (EPA) banned all uses of these OCPs except for heptachlor, which can only be used today to control fire ants in underground power transformers.

OCPs were commonly applied to soil beneath buildings or beneath slab foundations, and around foundation perimeters. The highest concentrations of OCPs in soil are typically found in the top 1 to 2 feet of soil and up to 1 to 3 feet away from the building perimeter. OCPs



Soil contaminants from historic practices (e.g. use of lead paint or pesticides) can be suspect in building perimeter areas. Playing in bare soils or gardening activities in these areas could expose children to soil contaminants.



break down very slowly in the environment and are not detectable by smell or sight. Additionally, application rates were relatively high, and the applications may have been repeated over time. As a result, these OCPs may still be found in treated soils at levels of concern to human health.

How are people exposed to lead, arsenic and OCPs in the soil?

Unintentional ingestion of contaminated soil is the primary source of exposure to lead, arsenic, and OCPs in soil. Dirt on hands from normal play activities, working in a school garden, or from residual dirt on produce grown in the school gardens can result in accidental ingestion of contaminated soil. Children frequently put their hands or other objects in their mouths, and these can often have small amounts of soil and dust on them that the child then swallows. Small soil particles can be also carried into schools on hands, shoes and clothing, or as airborne dust. Once inside the school, the contaminated soil can be deposited on floors, furniture, or other objects that children come in contact with. Neither lead nor arsenic is absorbed through bare skin in significant amounts. Although OCPs can be absorbed through the skin during and immediately after they are applied, the main means of exposure long after application is primarily through ingestion of contaminated soil or contaminated residues.



Produce grown in soil with elevated arsenic and lead levels is generally considered safe to eat as long as it has been thoroughly washed to remove contaminated soil and dust. Arsenic and lead are not generally absorbed by edible plants. Thorough washing with clean, running water is especially important for root crops such as taro, carrots, and sweet potatoes, as well as for leafy vegetables, like fern heads, kale, and lettuce because of the tendency for soil and dust to stick to the surface of the produce. However, OCPs can be absorbed into plants grown in contaminated soil. Therefore, it is very important to grow produce in clean soil free from contamination.

Prevent accidental exposure to contaminated soil by washing hands thoroughly after playing outside or working in the school garden.

What are the human health concerns of exposure to lead, arsenic, and OCPs?

Exposure to **lead** can be particularly harmful to young children. According to the U.S. Centers for Disease Control and Prevention (CDC), lead poisoning is the most common and serious “environmental” disease affecting children. Children’s bodies absorb more lead than adults and their brains and nervous systems are more sensitive to the damaging effects of lead.

Lead can affect most every organ and system in the human body. Children repeatedly exposed to even low levels of lead have been shown to develop behavior and learning problems, lower IQ, hyperactivity, slowed growth, hearing problems, insomnia, and anemia. Once absorbed by the human body, lead is difficult to remove. Consequently, limiting exposure to lead wherever possible is recommended.



Long-term exposure to high levels of **arsenic** is associated with increased cancer risk, heart and blood vessel damage, inflammation of the liver, and dermatological issues. These health effects have not been documented for soil arsenic exposure in Hawai'i. These symptoms are more commonly identified in other countries where drinking water is highly contaminated with arsenic. This is not the case in Hawai'i. The Hawai'i Department of Health (HDOH) has a water quality testing program for all public water systems in the state, including testing for arsenic. Arsenic does not build up in the body, so arsenic levels will start to decrease in the body once exposure stops. In addition, only a certain amount of the arsenic ingested will dissolve in the digestive system and potentially contribute to health risks. This amount that can be absorbed by the body is called the "bioaccessible" arsenic level. The bioaccessibility of arsenic in Hawai'i soils has been demonstrated to be very low.

OCPs are a group of pesticides so their health effects vary by chemical. Repeated exposure to high levels of chlordane, the OCP most commonly used to treat termites in Hawai'i, can cause problems with the nervous system, such as tremors and irritability, and may impair liver function. Chlordane is not known to pose a significant cancer risk.



How do I know if the school's soil is contaminated?

Soil testing is the only way to know for certain if levels of lead, arsenic and OCPs in the soil are high enough to pose a potential health risk. School buildings built before 1978 are more likely to have elevated lead in the soil surrounding the foundations due to the past use of lead-based paint on the structures. In addition, schools located near busy roadways may have elevated lead in the soil from the past use of lead-containing gasoline. Schools constructed on former agricultural land, including sugar cane plantations, could have elevated levels of arsenic in the soil due to the past use of arsenic-based herbicides to control weeds. In addition, soil around and beneath wooden school buildings constructed prior to 1990 may contain high levels of OCPs, such as chlordane.

What can I do if I think a school's soil is contaminated?

Prevent exposure to contaminated soil near building foundations by covering bare soil with thick grass, geotextile and mulch, or geotextile and crushed stone/cinders.

If you suspect your school may have elevated lead, arsenic, or OCP levels in the soil, the soil should be tested, especially if your school is considering or has a garden or has exposed bare soil that children may regularly contact. Check with your school officials and district administrators regarding

assistance with testing of school garden soils or bare soils at the school. The HDOH HEER Office can also provide advice and resources.

The HEER Office has established Environmental Action Levels (EALs) for lead, arsenic and OCPs in the soil. Concentrations of lead, arsenic, or OCPs in the soil below the EALs do not pose a health risk. If tests indicate lead, arsenic or OCPs levels are above EALs, further evaluation or cleanup actions may be necessary to minimize exposure to the soil. Contact the HEER Office if testing indicates soil levels are above the applicable EALs, and for specific advice on control or removal measures that should be taken.



What actions have been taken by schools to prevent exposure to contaminated soil?

HDOE and HDOH have been working with individual East Hawai'i schools to manage areas of soil contamination found during soil testing. HDOE has been implementing short term measures to minimize potential exposure. These included covering the contaminated soil with ground cover and making these areas inaccessible to students and staff. School specific Environmental Hazard Management Plans (EHMPs) have been issued for various schools. These EHMPs will guide schools' management of soils to minimize the possibility of exposure to soil contaminants and provide alternatives for long-term management. Additional soil testing at schools in some other locations is also planned by HDOE.

What can I do to prevent exposure to contaminated soil?

Accidentally swallowing small amounts of soil is the main way students, teachers, and staff would be exposed to lead, arsenic or OCPs in soil. This type of exposure can occur at schools with contaminated soils, and also at people's homes or businesses if contaminants are present. If testing reveals elevated levels of these or other contaminants on your property, or if you suspect your school may have elevated soil contaminant levels, the potential for exposure can be minimized through the following actions:

- Wash hands thoroughly after playing outside, after working in the school garden, and prior to eating.
- Avoid tracking soil into the school and clean up right away if soil is tracked in. Use door mats and boot scrapers. Leave shoes outside whenever possible.
- Maintain dense landscaping, gravel, or permanent cover, such as asphalt or concrete, close to building foundations, roads, and driveways to prevent children from playing in soil where higher contaminant levels can be found.
- Keep children from playing in bare dirt.
- If the school garden area has not been tested for lead, arsenic, and OCPs to determine the soil is OK for use, consider using planter boxes or raised garden beds filled with soil known to be free of contamination. If the soil for the garden beds is from the school property it should be sampled and tested to make sure it is clean. If the soil is brought in from an outside area, ask the person providing the soil to have the soil tested or otherwise provide evidence that it is unlikely to be contaminated. Refer to the HEER Office's "Clean Fill Guidance" for additional information on testing of imported soil (see Further Information, below).
- Plant gardens at least 10 feet away from building foundations, roads, and driveways.
- Bring in clean sand for sandboxes.
- Wash all fruits and vegetables from the garden with clean, running water before bringing them into the school. Wash again carefully with a 1% vinegar solution or soapy water to remove any remaining soil particles. Discard outer leaves before eating leafy vegetables. Peel and remove the outer skin of root and tuber vegetables before eating. Do not compost the produce peelings and unused plant parts for use back in the school garden.



Further Information

For questions related to lead, arsenic and OCPs in soils at schools, contact:

Hawai'i Department of Health
Hazard Evaluation and Emergency Response Office
2385 Waimano Home Road
Pearl City, Hawai'i 96782

Telephone: (808) 586-4249
Website: <http://hawaii.gov/doh/heer>

If you have questions about having your child tested for lead contact:

Hawai'i Childhood Lead Poisoning Prevention Program (HI-CLPPP)
741 Sunset Avenue
Honolulu, Hawai'i 96816

Telephone: 808-586-4345
Website: <http://health.hawaii.gov/cshcn/leadpp/>

Hawai'i Department of Health's Children with Special Health Needs Branch manages the Hawai'i Childhood Lead Poisoning Prevention Program (HI-CLPPP). HI-CLPPP is a joint program with the Centers for Disease Control and Prevention (CDC) aimed at preventing childhood lead poisoning. HI-CLPPP monitors all elevated blood lead levels and supports families and health care providers to prevent or minimize the health effects from lead exposure: <http://health.hawaii.gov/cshcn/home/leadpp/>

Hawai'i Department of Health's Indoor and Radiological Health Branch's lead program helps: (1) prevent exposure to lead and lead-based paint, and (2) maintains the State of Hawai'i lead abatement accreditation, certification, and registration systems for lead abatement entities and individuals: <http://health.hawaii.gov/irhb/lead/>

Hawai'i Department of Health's Solid and Hazardous Waste Branch provides guidance on disposal of lead-based paint waste: <http://health.hawaii.gov/shwb/files/2013/06/lbpwaste.pdf>

Removing Lead from School Buildings:

U.S. Environmental Protection Agency's (EPA) Lead Renovation, Repair and Painting Certification requires that companies performing projects that disturb lead-based paint in homes, child care facilities and pre-schools built before 1978 have their company certified by EPA or the State of Hawai'i, use certified renovators who are trained by EPA-approved training providers and follow lead-safe work practices: <http://www2.epa.gov/lead/renovation-repair-and-painting-program>

Other Resources for Exposure to Lead, Arsenic and OCPs:

Hawai'i Department of Health's HEER Office: A Guide to Soil Testing for Organochlorine Termiticides at Residential Sites in Hawai'i, September 2011. <http://eha-web.doh.hawaii.gov/eha-cma/documents/c1578f33-2d86-43f1-8655-64862c45f642>

Hawai'i Department of Health's HEER Office: Past Use of Chlordane, Dieldrin, and other Organochlorine Pesticides for Termite Control in Hawai'i: Safe Management Practices Around Treated Foundations or during Building Demolition, September 2011. <http://eha-web.doh.hawaii.gov/eha-cma/documents/573a9d28-3b52-4e39-ae33-87d77632cf82>

Hawai'i Department of Health's HEER Office: "Clean Fill Guidance", Guidance for Soil Stockpile Characterization and Evaluation of Imported and Exported Fill Material, October 2017. <http://eha-web.doh.hawaii.gov/eha-cma/documents/ee9cfe45-347c-4258-863f-2eebbaadc75f>

Agency for Toxic Substances and Disease Registry's ToxFAQs website is a federal government website providing information and recommendations regarding lead, arsenic and OCPs. <http://www.atsdr.cdc.gov/toxfaqs/index.asp>

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