Health Consultation

North Galloway Road
Yakima, Yakima County, Washington

April 4, 2002

Prepared by

The Washington State Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

DOH 334-242 April 2002

Foreword

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond quickly to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health.

For additional information or questions regarding DOH, ATSDR or the contents of this Health Consultation, please call the health advisor who prepared this document:

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Glossary

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than 2 weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one which lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or living organisms that is not normally found there.
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption or inhalation. It is calculated per kilogram of body weight per day.

Epidemiology	The study of the occurrence and causes of health effects in human populations. An epidemiological study often compares two groups of people who are alike except for one factor, such as exposure to a chemical or the presence of a health effect. The investigators try to determine if any factor (i.e., age, sex, occupation, economic status) is associated with the health effect.
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure may be short-term (acute) or long-term (chronic).
Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Indeterminate public health hazard	Sites for which no conclusions about public health hazard can be made because data are lacking.
Ingestion rate	The amount of an environmental medium which could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.

Maximum Contaminant Level (MCL)	A drinking water regulation established by the federal Safe Drinking Water Act. It is the maximum permissible concentration of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal Risk Level (MRL)	An amount of chemical that gets into the body (i.e., dose) below which health effects are not expected. MRLs are derived by ATSDR for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
Oral Reference Dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides which are not easily dissolved in water.
Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Route of exposure	The way in which a person my contact a chemical substance that includes ingestion, skin contact and breathing.

U.S. Environmental Protection Agency (EPA)	Established in 1970 to bring together parts of various government agencies involved with the control of pollution.

Background and Statement of Issues

This health consultation was prepared at the request of a resident to evaluate the potential health hazard posed by lead and arsenic contamination resulting from past use of lead arsenate pesticide on property located in Yakima, Yakima County, Washington. DOH prepares health consultations under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

Acid lead arsenate ($PbHAsO_4$) was the primary insecticide used to control the codling moth in Washington fruit orchards between 1905 and 1947.[1, 2] Lead arsenate solution was sprayed directly onto the trees using hand sprayers, and any excess spray dripped from the trees contaminating soils beneath or near them. Use of lead arsenate dropped drastically in 1948 when DDT became widely available.[3] High levels of arsenic in soil resulting from lead arsenate use rendered much of the land in central Washington unproductive for agriculture due to arsenic's toxicity to vegetation.[1] Potential concern for human health arose when old orchard lands began to be converted to other land use purposes such as schools or residential areas. Lead and arsenic, the primary constituents of lead arsenate pesticide, are highly toxic to humans.

A resident became concerned about chemical contamination in the area when two relatively young members of her family developed cancer (one with pancreatic cancer and the other with stomach cancer). One of the cancer victims also complained that he had difficulty growing plants in the garden. Several other people from across the highway also suffered from cancer (one brain cancer, others general cancer). In addition, an oncologist that treated one of them made a comment that there seemed to be a lot of cancers from that part of the state. He suggested testing the drinking water for arsenic and other metals, and the soil for lead and arsenic

The petitioner sampled the soil from the home of one of the cancer victims. Soil samples were analyzed for lead and arsenic. Both lead and arsenic levels in soil were above background levels. The owner of the drinking water system that supplied the residence had the drinking water analyzed for several inorganic contaminants. No contaminants were present at levels of concern. Table 1 summarizes the analytical results for lead and arsenic in soil and water.

Table 1. Soil and Water sampling results from a residence on N. Galloway Rd, Yakima County, Washington

Sample	Location	Contaminant	Concentration (ppm)	Comparison [a] Value (ppm)
Soil 1	garden	arsenic	29	20
		lead	340	250
Soil 2	back yard	arsenic	28	20
		lead	140	250
Soil 3	front yard	arsenic	44	20
		lead	160	250
Soil 4	back yard (patio)	arsenic	41	20
		lead	210	250
Soil 5	garden	arsenic	42	20
		lead	450	250
Soil 6	front yard (front door)	arsenic	56	20
		lead	160	250
Water 1	community well	arsenic	ND	10 mg/l
		lead	ND	15 mg/l

a - Comparison values for soil are MTCA cleanup levels. Drinking water values are EPA's Maximum Contaminant Levels (MCLs)
ND = Not Detected

Discussion

Lead and arsenic are both toxic to humans. The presence of lead and arsenic at elevated levels in soil, however, does not necessarily indicate that adverse health effects are expected to occur to people living on or near the site. In order for chemical contaminants to cause harm, they must first enter the body through ingestion, inhalation or dermal absorption. Metals do not pass easily through the skin and inhalation of resuspended soil is not thought to be a significant contributor to exposure, therefore, the most likely route of exposure to lead and arsenic at the N. Galloway Rd. residence is inadvertent ingestion of contaminated soil through direct contact.[4, 5] Consumption of produce grown in contaminated garden soil is another potential pathway, and will also be addressed. The following discussion will address the potential health hazards associated with exposure to lead and arsenic found in soil on the property. The issue of cancer will also be discussed in general terms.

Lead

Past uses of lead in paint, gasoline, plumbing, pesticides and canning have contributed to wide spread dispersion of lead and subsequent human exposure. Elimination of lead in gasoline and solder used in canning has greatly reduced exposure to lead through inhalation and ingestion pathways. As a result, the number of one to 5-year-old children in the U.S. with elevated blood lead levels has dropped from 88.2% in the late 1970s, to 4.4% in the early 1990s.[6] Currently, the main pathways of lead exposure in children are ingestion of paint chips, contaminated soil and house dust, and drinking water in homes with old plumbing.

Natural background levels of lead in Yakima basin soil range from 2-17 ppm.[7] All samples from the N. Galloway Rd. property exceed background levels. Only one sample, however, exceeds a level that the EPA considers to be a potential hazard (400 ppm in bare soil of areas where children play).

Lead causes a wide array of health effects in different systems of the body, but the primary target Is the nervous system. Children less than seven years old are more susceptible to lead exposure and more sensitive to its toxicity than adults. Health effects include decreased IQ, decreased attention span, and irritability.[8]

The EPA has classified lead and lead compounds as a probable human carcinogen based on sufficient evidence from animal studies, but inadequate evidence from human studies. Animals exposed to very high doses of lead compounds in drinking water developed renal tumors.[6] The carcinogenicity of lead has not been documented in humans.

The levels of lead found in soil on the N. Galloway Rd. property do not appear to be of concern to adults. Children, on the other hand, are likely to ingest larger amounts of soil, and they are more susceptible to lead's toxicity. Therefore, lead in soil at the property represents a potential concern. A recent blood lead survey conducted by the Washington State Department of Health in the fall of 1999 found very low incidence of elevated blood lead in children living in agricultural areas of central Washington despite past widespread use of lead arsenate in the region.[9] Cases of elevated blood lead levels in these children were often traced to eating paint chips, Mexican folk remedies, or Mexican candies that contained high levels of lead, and could not be attributed to past use of lead arsenate pesticide.

Arsenic

Sources of arsenic contamination in the U.S. are primarily from pesticide use or industrial emissions (i.e., smelters). Background levels for arsenic in central Washington soils are normally less than 6 ppm.[5] Arsenic levels detected in all soil samples collected from the N. Galloway Rd. property were above natural background levels. Furthermore, arsenic levels in all soil samples were above MTCA cleanup levels.

The majority of information concerning the health effects of arsenic exposure in humans comes from studies of populations that were chronically exposed to arsenic in their drinking water and occupational studies in which workers were exposed to arsenic trioxide dust in the workplace.

Several studies have indicated that workers exposed to arsenic trioxide (As_2O_3) dust in air at smelters have an increased risk of lung cancer.[10, 11] Furthermore, a positive dose response between cumulative exposure to arsenic and lung cancer risk was observed. In other words, the more arsenic workers were exposed to, the more likely they were to develop lung cancer. Chronic exposure to arsenic in drinking water has occurred in large populations in Taiwan, Chile, Mexico, Argentina, and Bangladesh.[12, 13] In Bangladesh, where the water concentrations were frequently greater than 0.5 mg/l and as high as 3.8 mg/l, symptoms included dermatological effects (hyperpigmentation, hypopigmentation, keratosis, cracking skin, lesions, and skin cancers), bladder cancer, and black foot disease that ultimately leads to gangrene. Studies in U.S. populations exposed to arsenic in drinking water have not shown increased cancer incidences, but arsenic concentrations in water were generally less than those reported in Taiwan and Bangladesh. The effects of chronic exposure to arsenic in soil have not been studied.

Arsenic ingested with soil is not thought to be readily absorbed in the gastrointestinal tract compared to that ingested in water. Studies in rabbits, monkeys, and swine that ingested arsenic contaminated soils revealed that only about 25% or less of the arsenic was absorbed in the animals' gut. Arsenic in water, by comparison, is thought to be 70-80% absorbed in the human gut.

Arsenic levels found at the N. Galloway Rd property, though elevated, do not appear to be at levels that would adversely effect adults. The levels, however, are a potential health concern for children because they are more likely to contact contaminated soil through playing, and inadvertently ingest it through frequent hand to mouth contact. Soil arsenic levels surrounding active and inactive copper and lead smelters are often much higher than levels found on old orchards. Children living near former smelters have had elevated urinary arsenic levels compared to a background population. No adverse health effects have been attributed to exposure to arsenic in soil in any studies.

To date, there has not been any indication of increased cancer incidence in historical orchard land of Washington State; however, there have not been any studies that targeted people living on lead arsenate treated land. A group of studies in the region, however, have focused on a cohort of orchardists from Washington state that worked in lead arsenate treated fields. The initial study began in 1938 and indicated that lead and arsenic were being absorbed by orchardists and, to a lesser degree, their families.[14] Thirty years later, the mortality rate of the orchardist cohort was actually less than that of all of Washington State.[15] Later, between 1968 - 1980, it appeared that orchardists were 30% more likely to die of respiratory cancer, and a study was conducted to determine if past use of lead arsenate was a risk factor. The study, however, was inconclusive.[16]

Thousands of acres in central Washington have been contaminated by past use of lead arsenate. While adverse health effects have not been linked to lead or arsenic exposure on old orchard land, the Washington State Department of Ecology (Ecology) realizes that the contamination may potentially represent a hazard to people over their lifetime. Ecology is currently

investigating strategies with which to address the area-wide contamination of central Washington soil with lead and arsenic.

Gardening on lead and arsenic contaminated soil

Root uptake of lead and arsenic by vegetable plants and subsequent ingestion by humans is another potential source of human exposure. There is limited evidence that root crops such as carrots might absorb more metals than previously thought,[17] but the overwhelming majority of information suggests that lead and arsenic are less of a concern for uptake by plants than other metals such as cadmium.

Washington State University has published a bulletin for gardeners that grow produce in lead and arsenic contaminated soils.[18] The bulletin provides several recommendations with which to reduce exposure to lead and arsenic in/on produce and garden soil. The bulletin can be found on the Internet at http://soils.tfrec.wsu.edu/lead%20papers.htm. A hard copy has been provided to the petitioner with this consultation.

*Cancer Cluster*s

Cancer is a common disease that will affect about 1/3 of people in the U.S. The cause of many types of cancer is unknown; however, numerous factors including diet, lifestyle, environmental exposure, and genetics may be associated with the occurrence of cancer. Additionally, cancer risk increases with age. While cancer is often spoken of in a general sense, as if all forms of cancer were manifestations of the same disease, scientists and health professionals acknowledge that there are many different types of cancer that result from different causal mechanisms. Because it is a common disease, it is not uncommon for people to know one or more people that have been affected by cancer. When several people within close geographic proximity develop cancer, a cancer cluster is often reported. A cluster is the occurrence of a greater than expected number of cases of a particular disease within a group of people, a geographic area, or a period of time. A suspected cancer cluster is more likely to be a true cluster if it involves a large number of cases of one type of cancer, rather than several different types; a rare type of cancer, rather than common types; or a number of a certain type of cancer cases in age groups not usually affected by that type of cancer.[19] Even when a greater than expected number of specific cancer types is identified, it is often determined that the cluster occurred by chance, and is not the result of an identifiable cancer causing mechanism.

It is difficult to assign a single environmental cause to the cancers reported by the resident in Yakima. The types of cancers reported (pancreatic, stomach, and brain) affect different organ systems of the body. Furthermore, none of these cancer types have been found to be associated with long-term exposure to arsenic or lead in epidemiological and toxicological studies. Therefore, it is not likely that exposure to lead- and arsenic-contaminated soil in the area has led to the cancers observed by the petitioner.

Child Health Initiative

ATSDR recognizes that infants and children may be more vulnerable to exposures than adults when faced with contamination of air, water, soil, or food.[20] This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter and their breathing zone is closer to the ground, resulting in a greater likelihood to breathe dust, soil, and heavy vapors.
- Children are smaller and receive higher doses of chemical exposure per body weight.
- Children's developing body systems are more vulnerable to toxic exposures, especially during critical growth stages in which permanent damage may be incurred.

Conclusions

A resident became concerned about chemical contamination from past agricultural practices when several people that she knew developed cancer. Furthermore, a radiation oncologist that treated one of the patients supported this observation. Soil samples from a residence of one of the cancer victims revealed elevated levels of lead and arsenic. A water sample from the well that supplied drinking water to the residence did not contain inorganic contamination of concern. *No public health health hazard* exists for residents exposed to arsenic and lead in soil at the home Galloway Road . The levels of lead and arsenic in soil represent more of a concern for young children, but young children are not present at this residence. Elevated levels of lead in the garden suggest that precautionary measures be taken should children reside here in the future.

Several factors indicate that lead and arsenic in soil at this residence, and other residences in the area, are not responsible for the cancers observed by the petitioner. The varying types of cancer noted by the resident indicate varying causes and are not associated with lead or arsenic exposure. In addition, doses estimated from exposure to arsenic in soil, the primary contaminant of concern with respect to cancer, are relatively low compared to drinking water arsenic exposures that have been associated with cancer.

Recommendations/Action Plan

Reduce exposure to lead- and arsenic-contaminated soil

- Remove shoes before entering home. This will help to limit the amount of soil contaminants that are tracked into the home.
- Limit contact with soil when gardening (see WSU Bulletin "Gardening on lead- and arsenic-contaminated soils).
- Wear protective clothing while gardening or working in the yard. Protective clothing should be removed before entering the house.
- Thoroughly wash produce grown in the garden. Peel carrots and other root crops before consumption.

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Certification

This Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

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