

**Title:** Lead Migration From Contaminated Sites - Door County, Wisconsin (Study No. 14)

**Investigators:** Principal Investigator

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**Period of Contract:** August 7, 1986 through September 30, 1988

**Objectives:** To determine the migration, distribution and concentrations of lead, arsenate and copper pesticide residues.

**Background/Need:** Lead arsenate, copper sulfate, lime-sulfur and related inorganic compounds were used on cherry and apple crops in Door County from the late 1880s until 1960. Lead and arsenic have been detected in soil at a hazardous level at a number of sites throughout Door County. Contaminated wells appear to be geographically correlated to the contaminated sites. Past investigation identified the heavily contaminated site chosen for this study.

**Methods:** Soil samples were collected on two separate occasions to determine the vertical distribution of metals in the soils. Samples were analyzed for lead, arsenic, and copper content. Studies were also conducted to determine levels of lead associated with various soil particle sizes, relative mobility of lead and the sorptive capacity of the dolomitic aquifer materials for lead. Three groundwater monitoring wells were constructed and sampled on 21 different dates, mostly during the spring and fall. Analysis of groundwater samples included lead, chloride, nitrate, pH and specific conductivity.

**Results:** The soils on site are quite alkaline, with a pH ranging from 7.6 to 8.1. The lead content of surface soils collected ranged from 45 milligrams per kilogram (mg/kg) to 10,800 mg/kg, while average concentrations normally ranged between 15 and 25 mg/kg. The most contaminated area is located adjacent to an old foundation and floor slab from a building likely used for pesticide storage. A plume of higher lead content has spread east into the edge of an agricultural field. Arsenic levels ranged from 7 to 2040 mg/kg and copper between 35 and 5,600 mg/kg, both with a similar distribution to lead. Little downward migration of lead and arsenic occurred over at least two to three decades that the materials have been out in the open environment. A significant amount of contamination was found in the fine-grained soil particles. Desorption/sorption studies found that lead can move from the soil medium to the aqueous medium with relative ease under conditions of vigorous stirring. Sorptive capacities of dolomitic aquifer materials show that fresh dolomite surfaces are capable of reducing lead levels in contaminated water relatively quickly and to levels below 10 micrograms per liter (ug/l) for concentrations as high as 4500 ug/l. Lead levels are expected to decrease as the contact area per volume ratio for water moving through both the zone of aeration and saturated zone

increases, and with the presence of iron hydroxides and clays.

Groundwater samples revealed lead levels well below the drinking standard of 50 ug/l, and no pattern for detection of lead was discernible over time. Measurements of the relative water table position over time indicate that the groundwater is in a continual state of flux, with increased rapid infiltration during periods of rainfall and snow melt.

**Conclusions:**

Investigators concluded that removal of the upper 20 to 25 centimeters of soil in the contaminated area would eliminate heavy metal soil contamination on the site. Lead is soluble to levels that would greatly exceed the current drinking water standard. Depth to water table, temperature, specific conductance, chloride and nitrate confirmed the dynamic flow of groundwater at the site. The shallow and deep aquifer both respond quickly to surface infiltration events.

**Recommendations/  
Implications:**

The highly contaminated zone should be managed to prevent erosion.

**Availability of Report:**

This report is available for viewing and loan at:

The Water Resources Center  
1975 Willow Drive  
Madison, WI 53706  
(608) 262-3069  
Publication 050846

**Key Words:**

Arsenic, copper, Door County, lead, pesticide

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