



The Development of New York State Soil Cleanup Objectives for Arsenic

New York State developed soil cleanup objectives (SCOs) for environmental contaminants in soil including arsenic. This fact sheet describes why and how the health-based SCOs for arsenic were developed.

Why the Concern - Arsenic Toxicity

Exposure to arsenic can cause several cancer and non-cancer health effects. Arsenic is classified as a known human carcinogen by the United States Environmental Protection Agency (US EPA) and several other health agencies based on studies that show increased risks for lung, skin and bladder cancer in people who were exposed to high levels of arsenic in drinking water for long periods of time. Long-term oral exposure to arsenic can also cause noncancer health effects such as darkening and thickening of the skin on the hands and feet, nerve and liver damage, high blood pressure and damage to blood vessels. Since arsenic can cause adverse health effects in humans after high levels of exposure, lower levels of arsenic exposure in environmental media such as soil or water over long periods of time may pose an increased risk for arsenic-related health effects.

Arsenic Contamination in Soil - Soil Clean-up Objectives

In 2006, the New York State Department of Environmental Conservation (DEC) and the New York State Department of Health (DOH) developed legislatively-mandated soil cleanup objectives (SCOs) for priority chemicals at contaminated sites. SCOs are contaminant-specific soil concentrations that are cleanup goals based on current, intended or reasonably anticipated future land use. This factsheet provides information on the derivation of the New York State health-based SCOs for arsenic for different land use categories. In developing the SCOs, the DEC and DOH considered many factors. These included noncancer and cancer health effects, soil background concentrations (i.e., levels of chemicals typically found in soils), short- and long-term exposures via incidental soil ingestion, dermal contact, inhalation, homegrown vegetable consumption, and consumption of home-produced foods (e.g., animal products).

Toxicity Values

Health-based SCOs are calculated from toxicity values for chemicals. Toxicity values are derived by "authoritative bodies" (state, national, or international regulatory or advisory public health organizations), and represent long-term chemical exposures at which health effects are unlikely. They can be based on the noncancer or cancer health effects of the chemical. The DOH reviewed the

available toxicity values for arsenic from authoritative bodies and chose those that were developed in a way that is most consistent with current practices for deriving toxicity values.¹

Deriving Health-Based SCOs for Arsenic

The health-based SCOs for arsenic are calculated from the toxicity values using information about how people might be exposed to chemicals in soil. This information includes body weights, the amount of soil that people might incidentally swallow (ingest), how often soil is ingested and how long, whether or not vegetables are grown in contaminated soil, and other factors. Arsenic exposures from sources other than soil are also taken into account.

The noncancer and cancer SCOs represent concentrations of arsenic in soil that are unlikely to cause noncancer and cancer health effects, respectively, based on the exposure assumptions for a particular land use. Health-based noncancer and cancer SCOs for arsenic were calculated for three types of land use where people live on the property. The land uses are called unrestricted, residential and restricted residential (SCOs also were developed for commercial and industrial land uses). All three land uses for properties where people live assume that exposure to arsenic occurs through ingestion of contaminated soil and indoor dust and inhalation of soil particles in air. The residential category also assumes exposure through consumption of homegrown produce, and the unrestricted category adds in both exposure through consumption of homegrown produce and other home-produced foods (e.g., animal products such as beef or milk). The health-based arsenic SCOs calculated by the DOH for the unrestricted, residential and restricted residential land uses are summarized in the following table.

**Health-Based SCOs for Arsenic
(all values in parts per million (ppm))**

Land use	Noncancer SCO	Cancer SCO
unrestricted	1.1	0.11
residential	2.2	0.22
restricted residential	11	1.1

For each land use category, the lowest of the calculated health-based SCOs was chosen as the final health-based SCO. For arsenic, the final health-based SCOs are those based on cancer: 0.11 ppm, 0.22 ppm and 1.1 ppm for unrestricted, residential and restricted residential land use, respectively. These values are consistent with the arsenic residential risk screening value for soil derived by the US EPA (0.4 ppm).² The cancer SCOs were set at a level that corresponds to an increased cancer risk of one-in-one million. The DOH and the US EPA have historically used the one-in-one million risk level to manage exposures and risks at contaminated waste sites. The approach is consistent with the US EPA's preference for managing risks at this level (as stated in its National Contingency Plan for hazardous waste sites),³ as well as the New York State legislation that required establishment of the SCOs.⁴

Considering Background Levels and Determining Final Arsenic SCOs

As specified in the legislation that required the SCOs, when the risk-based SCO for a chemical (e.g., calculated using the methods described above) is lower than its rural soil background concentration, the final SCO may be set at the rural soil background concentration. As part of developing the SCOs, the DEC and DOH conducted an extensive survey that evaluated concentrations of selected chemicals, including arsenic, in rural New York State soils. The DOH used information from this survey to identify rural soil background concentrations of 13 ppm for unrestricted land use (based on protection of ecological resources) and 16 ppm for residential and restricted residential land use (based on protection of human health). Based on this rural soil background information, the final SCOs for arsenic are those shown in the following table.

**Final SCOs for Arsenic
(all values in ppm)**

Land use	Final SCO
unrestricted	13
residential	16
restricted residential	16

For More Information on the SCOs

The SCOs are included in a DEC regulation (Title 6, New York Codes Rules and Regulations, Part 375) for the remediation of contaminated sites. The regulation is available on DEC's web site at <http://www.dec.ny.gov/chemical/34189.html>. To see a list of the SCOs, click on the link (on the right hand side of the page) entitled "Subpart 375-6: Remedial Program Soil Cleanup Objectives." The SCOs are in two tables at the end of the document. To see the definitions of the different land use categories, click on the link (also on the right hand side of the page) entitled "Subpart 375-1: General Remedial Program Requirements." The land use category definitions are given in Sections 375-1.8(g)(1) and 375-1.8(g)(2). If you would like more detail on the methods that DEC and DOH used to derive the SCOs, click on the links for the Technical Support Document.

This fact sheet was prepared by the Bureau of Toxic Substance Assessment, New York State Department of Health, September, 2011. For questions about this document, contact the New York State Department of Health at 518-402-7800.

¹The toxicity values used to derive the health-based SCOs were developed by the United States Environmental Protection Agency. The cancer toxicity value, or cancer potency factor, is 1.5 per milligram/kilogram/day based on skin cancer in humans resulting from long term exposure to arsenic in drinking water. The exposure dose corresponding to an increased cancer risk of one-in-one million calculated from this cancer potency factor is 0.00067 micrograms/kilogram/day. The noncancer toxicity value, or reference dose, is 0.3 micrograms/kilogram/day based on skin effects and effects on the blood vessels in humans resulting from long term exposure to arsenic in drinking water. Available toxicity values developed by a total of four authoritative bodies were evaluated.

²United States Environmental Protection Agency (US EPA). 1996. Soil Screening Guidance: Technical Background Document. EPA Document Number EPA/540/R-95/128. July 1996. Available on-line at <http://www.epa.gov/superfund/health/conmedia/soil/introtbd.htm>.

³United States Environmental Protection Agency (US EPA). 2001. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments). Final. Publication 9285.7-47. Available on-line at <http://www.epa.gov/oswer/riskassessment/ragsd/index.htm>.

⁴New York State Environmental Conservation Law. Article 27, Title 14, Section 27-1415.1.