

Wisconsin Statewide Soil-Arsenic Background Threshold Value

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RR-940

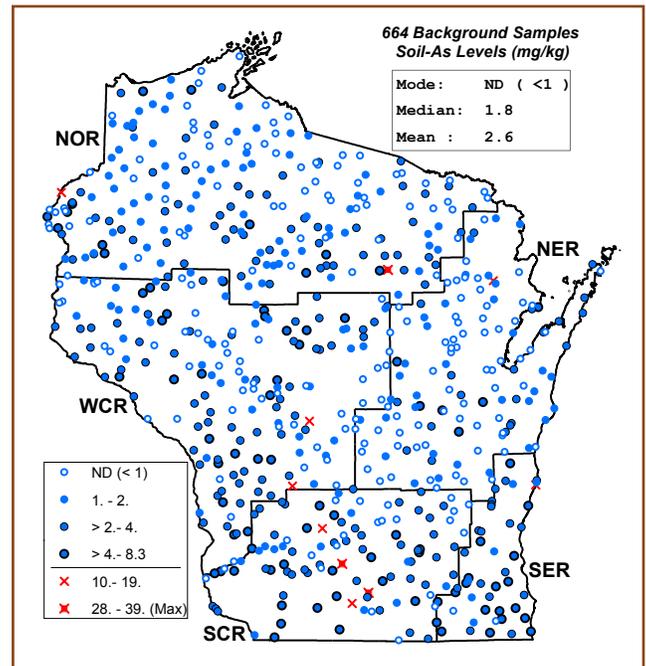
The United States Geological Survey (USGS) has released “Scientific Investigations Report 2011-5202” (pubs.usgs.gov/sir/2011/5202) on naturally occurring arsenic (As) concentrations in surface soils in Wisconsin. See page two for a summary of the report, including data statistics.

DNR’s Remediation and Redevelopment (RR) Program has reviewed the report prepared by USGS and concluded that the data set is of sufficient scope and quality to establish a statewide soil-As background threshold value (BTV). The BTV is a level that can be categorically accepted as “not exceeding background.” When sufficient soil data have been collected at a site and none exceeds the BTV, then it can be concluded that the observed soil-As levels do not exceed background.

The sampling results and the statistical analysis of the data indicate the highest value obtained that is not considered a statistical outlier is 8 mg/kg (=8ppm) in the USGS report.

Based on discussions and feedback from the Wisconsin Department of Health Services and Department of Agriculture, Trade and Consumer Protection, the RR Program intends to use **8 ppm as the statewide soil-As BTV**. It is then reasonable to conclude that any value above 8 ppm could be the result of a hazardous substance discharge.

In situations where soil-As levels exceed 8ppm, the results should be discussed with an RR Project Manager before any additional sampling is conducted as it may be possible that DNR has information that the elevated arsenic levels are consistent with locally high background. If DNR determines that sufficient information on soil-As background concentrations does not exist, Responsible Parties (RP) and their consultants could gather additional soil data for the purpose of establishing a site specific soil-As background level that exceeds 8 ppm. This process is subject to site specific review and approval by an RR Project Manager.



If a site specific background value is being considered, the RR Program recommends the following:

- 1 A combination of US EPA SW-846 Methods 3050B and 6020A (ICP-MS) to get an MDL of 1 mg/kg or less. The ICP-MS (Inductively Coupled Plasma-Mass Spectrometry) method is a more sensitive test and has less interferences, especially from aluminum, than the ICP-AES procedure that was used in the USGS study.
- 2 U.S. EPA’s statistical ProUCL program which is the same software used in the USGS study. It is useful in evaluating site specific data distribution (normal or non-normal) and in identifying potential outliers. ProUCL is available at: www.epa.gov/osp/hstl/tsc/software.htm.



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Summary of the USGS report on surface soil-As concentrations in Wisconsin

In 2006 and 2007, soil scientists from the U.S. Department of Agriculture's Natural Resources Conservation Service collected six-inch deep soil samples at 664 locations across the state. The locations and number of samples were selected to proportionally represent the varied geographic regions covered by the major soil types in the state. Samples were collected from undisturbed areas away from roads, fence lines, disposal sites and construction areas to avoid obvious anthropogenic influences. The University of Wisconsin State Laboratory of Hygiene (SLoH) analyzed the metal content of the samples. A representative sample aliquot was digested in a mixture of hydrochloric and nitric acids and the resulting solution was analyzed by the Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) method. The SLoH ICP-AES procedure resulted in a method detection limit (MDL) for soil-As of 1 mg/kg (1 ppm).

Key findings from the statistical evaluation of the 664 soil-As results:

- 1 The most frequently observed sampling result (mode) was non-detectable (*i.e.* less than method detection limit (MDL) of 1 ppm). This occurred for nearly one-third (211 out of 664) of the samples. The median value was **1.8 ppm** and the 95th percentile was **6 ppm**.
- 2 Using all 664 sample results (and assigning a value of 1 ppm for the non-detectable results), the mean was estimated at **2.6 ppm**. The data histogram showed a non-normal data distribution (*i.e.*, no bell curve) precluding the use of typical computational methods to estimate the confidence limits for the mean. Instead, the nonparametric Kaplan-Meier estimation was used to estimate the 95% upper confidence limit (UCL) for the mean (95% UCL). The 95% UCL was estimated at **2.8 ppm**.
- 3 Rosner's outlier test was applied to the data set to determine if any of the sampling results were statistical outliers. That analysis indicated that the 10 highest results (values ranging from 10 ppm to 39 ppm) were statistical outliers. The USGS report has summary tables with data statistics after these outliers were dropped. Without the outliers, the mean was estimated at **2.3 ppm**, and the 95% UCL was **2.4 ppm**. The 95th percentile remained the same at **6 ppm**. Without outliers, the maximum soil-As concentration was **8 ppm**.

Summary table of key findings

Statistic	All data - 664 samples	Without outliers - 654 samples
Mode (<i>most frequently observed result</i>)	< 1 ppm	< 1 ppm
Median	1.8 ppm	1.8 ppm
95% upper confidence limit for the mean	2.8 ppm	2.4 ppm
95th percentile (to 1 significant figure)	6 ppm	6 ppm
Maximum	39 ppm	8 ppm

Questions?

For questions or further information contact
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This document contains information about certain state statutes and administrative rules but does not necessarily include all of the details found in the statutes and rules. Readers should consult the actual language of the statutes and rules to answer specific questions.

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