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OFFICE OF WASTE MANAGEMENT

Policy Memo 00-01

GUIDANCE FOR ARSENIC IN SOIL

1.0 PURPOSE

This policy establishes an approach for determining soil remedial objectives for arsenic at sites regulated under the Rhode Island Departmental of Environmental Management (the Department) Office of Waste Management. The policy is being adopted to alleviate difficulties encountered at sites at which the concentrations of arsenic exceed existing Method 1 Residential or Industrial/Commercial Direct Exposure Criteria, and to facilitate acceptable and timely advancement of contaminated sites through the site remediation process. This policy is developed under the authority of Rhode Island General Laws, Chapters (as applicable) and shall be construed to be consistent with the *Rules and Regulations for the Investigation and Remediation of Hazardous Materials Releases* (March 1993, amended August 1996) (short title, "Remediation Regulations").

2.0 BACKGROUND

Arsenic is a naturally-occurring element; the 20th most abundant element in the earth's crust. Arsenic is usually found in the environment combined with other elements, such as oxygen, chlorine and sulfur, or in organic form. Inorganic arsenic occurs naturally in many kinds of rock, especially ores that contain copper, lead, iron, nickel, and other metals. Studies of background levels of metals in Rhode Island soils have identified that the mean arsenic soil concentrations in Rhode Island appeared lower than the national average, as discussed in Section 3.0. Further, RI's concentration of arsenic is lower than certain other New England States due to the fact the State of RI is not part of the Connecticut River Valley geological formation. The Connecticut River Valley geological formation has elevated levels of arsenic. The State of RI is part of the New England Coastal geological formation, which has lower levels of arsenic.

In additional to its natural occurrence in soils, arsenic has also historically been used in a variety of commercial applications. The principal (74%) use of arsenic is as a component of a wood preservative. Most of the remaining use (19%) is in the production of agricultural chemicals, such as insecticides, herbicides, algaecides, and growth stimulants. Smaller amounts have been used in the production of glass, nonferrous alloys, in the electronics industry and in medicine.

The U.S. Environmental Protection Agency (US EPA), the International Agency for Research on Cancer (IARC), and the National Toxicology Program (NTP) classify arsenic as a human carcinogen. Epidemiological studies have shown that inhalation exposure to inorganic arsenic

increases the risk of a variety of forms of lung cancer. Most of these studies involved worker exposure to arsenic trioxide dust at copper smelters or arsenate at chemical plants. Epidemiological studies have also shown that ingestion of inorganic arsenic increases the risk of developing skin cancer, most commonly squamous and basal cell carcinomas. In addition, evidence exists that ingestion of arsenic may also increase the risk of certain internal cancers, including tumors of the bladder, kidney, and liver.

For these reasons, the US EPA regulates arsenic as a carcinogen and has developed a variety of toxicity values for use in setting remedial objectives for arsenic. While the US EPA has not established a national regulation regarding arsenic in soil, its generic soil screening level (SSL) for arsenic in soil is 0.4 mg/kg, corresponding to a cancer risk level of one-in-one-million (denoted $1x10^{-6}$) for exposure through soil ingestion (US EPA, 1996).

3.0 THE REMEDIATION REGULATION'S ARSENIC STANDARDS

Methods for establishing remedial objectives for hazardous substances in the State of Rhode Island are specified in the Remediation Regulations. According to Rule 8.01 of the Remediation Regulations, five regulatory requirements must be met when establishing remedial objectives for a hazardous substance. These requirements are as follows:

- The remedial objective for a carcinogenic substance does not exceed a $1x10^{-6}$ excess lifetime cancer risk and the cumulative excess cancer risk posed by the contaminated-site does not exceed $1x10^{-5}$;
- The remedial objective for each non-carcinogenic substance does not exceed a hazard index of 1, and the cumulative hazard index posed by the contaminated-site does not exceed 1 for any target organ;
- The remedial objective will not significantly contribute to adverse effects to any environmentally sensitive areas at or in the vicinity of the contaminated-site;
- The remedial objective will be protective of the natural resources of the State, including but not limited to groundwater; and
- The remedial objective shall address the requirements of Rule 8.07 (Upper Concentration Limits)

Rule 8.01 also states that "Concentration-based soil and groundwater objectives may consider background conditions".

The Remediation Regulations establish default or Method 1 remedial objectives in soil and groundwater for a select group of substances. Soil remedial objectives are developed for Direct Exposure, Leachability, and Upper Concentration Limits. The Method 1 soil remedial objectives established for arsenic in the Remediation Regulations are shown below:

Land Use	Direct Exposure Criterion (mg/kg)	Upper Concentration Limit (mg/kg)
Residential	1.7	10,000
Industrial/Commercial	3.8	10,000

The Remediation Regulations have not established Groundwater Objectives or Leachability Criteria for arsenic.

The Method 1 Residential Direct Exposure Criterion for arsenic of 1.7 mg/kg is not a risk-based value, but was adopted from a state-wide study of background arsenic concentrations summarized in a document entitled *Background Levels of Priority Pollutant Metals in Rhode Island Soils* (RIDEM, undated). Background, as defined in Rule 3.05 of the Remediation Regulations, shall mean the ambient concentration of hazardous substances present in the environment that have not been influenced by human activities, or the ambient concentrations of hazardous substances consistently present in the environment in the vicinity of the site which are the result of human activities unrelated to releases at the contaminated site.

In the background study, a statewide geometric mean arsenic concentration of 1.67 mg/kg was calculated from 105 samples collected throughout the State. A risk-based soil objective for arsenic, based on its potential carcinogenic effects and default residential exposure assumptions specified in the Remediation Regulations, is 0.4 mg/kg. Because the risk-based value is below the State geometric mean background concentration, the mean background concentration (rounded to 1.7 mg/kg) was promulgated as the Method 1 Residential Direct Exposure Criterion. The lifetime incremental cancer risk value associated with this criterion is four-in-one-million ($4x10^{-6}$).

4.0 STATEMENT OF PROBLEM

Since implementation of the Remediation Regulations, arsenic in soil has been detected at investigated sites at concentrations above the Method 1 Residential and Industrial/Commercial Direct Exposure Criteria. At these sites, the Department would require site-specific background determinations to be performed to determine that there has been no release of arsenic. In the past, these comprehensive background investigations have been required without consideration either to the magnitude of exceedences of the criteria or to site specific factors. As a result, at many sites it has been both cost- and time-prohibitive to determine that the arsenic present at the site is consistent with background levels and not the result of a release of arsenic.

5.0 SOLUTION METHODOLOGY

The Department has evaluated two background arsenic studies for soil samples collected within the boundaries of the State. The results of the first study, which was based upon 105 samples,

indicated that the mean background concentration of arsenic in the State was 1.67 ppm. This arsenic concentration is based on data points extracted from Department site files that constitute the full inventory of sites. A second study (pending publication) conducted after the finalization of the Remediation Regulations evaluated 338 samples and confirmed the findings of the first study.

The Department recognizes that background concentrations may be above the Statewide average at any particular site. In addition, the distribution of data used to determine the statewide average overlaps the distribution associated with contaminated sites. Therefore, the Department will require a tiered approach to determine if the concentrations observed at a site are background; this will determine, in part, the need for remedial action.

The tiered approached is based upon a statistical evaluation of the statewide background data. Accordingly, the Department will continue to require reporting at the current Direct Exposure Criteria of 1.7 ppm. Above this value, an evaluation will be required in order to determine whether the observed concentrations at a particular site reflect either a release or a background condition. The requirements for this evaluation, which are outlined below, reflect the statistical distribution observed in the statewide background studies. In this tiered system the level of documentation and investigation will be lower for sites whose concentration are near the mean and more for sites which are further away from the mean. Previously the same level of documentation and investigation was required at all sites independent of the observed concentration.

Background determinations for concentrations within Tier 1 and Tier 2 will be the responsibility of an Environmental Professional. An Environmental Professional must submit a certification that the site conditions are background. This certification must document that the concentrations are background. The certification must include a discussion including but not limited to the information listed in each tier below.

Tier 1: Concentrations of arsenic between 1.7 ppm and 4 ppm

Background certifications in this tier must include, at a minimum, the following:

- Submittal of an evaluation of the spatial distribution of analytical data to determine if concentrations of arsenic are unrelated to potential releases throughout the site;

- Submittal of an evaluation of the site's history to determine if arsenic was used onsite and could have contributed to a release; and

- The remediation goal will be the site specific background level determined by the study.

If certified to be background the Department will issue a Non- Jurisdictional Letter based on the certification. The certification that site condition is background is the responsibility of the Environmental Professional. The Department may, however, at any time, audit the certification

and may require additional information and/or sampling at the site. The audit will consist of a review of the submitted notification to determine if the above minimum requirements were met.

If determined by the Environmental Professional to be a release, the notification should include proposed best management practices as a remedy for the site. These best management practices typically include excavation and/or the use of engineered controls such as a soil or asphalt cap with an appropriate Environmental Land Usage Restriction (ELUR).

Tier 2: Concentrations of arsenic between 4 ppm and 7 ppm

Background certifications in this tier must include the, at a minimum, the following:

- Submittal of an evaluation of the spatial distribution of analytical data to determine if concentrations of arsenic are unrelated to potential releases throughout the site;

- Submittal of an evaluation of the site's history to determine if arsenic was used onsite and could have contributed to a release;

- Submittal of an evaluation surrounding sites data via file reviews; and

- The remediation goal will be set at the site specific background level determined by the study.

If certified to be background the Department will issue a Non- Jurisdictional Letter based on the certification. The certification that site condition is background is the responsibility of the Environmental Professional. The Department may, however, at any time, audit the certification and may require additional information and/or sampling at the site. The audit will consist of a review of the submitted notification to determine if the above minimum requirements were met.

If determined by the Environmental Professional to be a release, the notification should include proposed best management practices as a remedy for the site. These best management practices typically include excavation and/or the use of engineered controls such as a soil or asphalt cap with an appropriate Environmental Land Usage Restriction (ELUR).

Tier 3: Concentrations of arsenic above 7 ppm

Arsenic concentrations above 7 ppm will be assumed by the Department as attributable to a release and will automatically require some level of response action as outlined in the Remediation Regulations, consistent with exceedances of any other Method 1 Residential Direct Exposure Criterion including, but not limited to, a full background study.

Department will require a full site-specific background study concentrations above 7ppm. This study will be used to determine the site-specific remedial goal. The background study proposal should at a minimum include, but not be limited to, the proposed sampling locations (including

reasoning and justification for selection), plans for soil type classification to confirm that the proposed soil sampling locations have the same characteristics as the soil at the site, procedures for obtaining access (i.e. permission) to sample any proposed off-site background locations, the proposed statistical method to be used to evaluate the collected data, and the proposed analytical testing method.

Residual levels of arsenic above the site-specific background concentration will not be allowed to remain on-site unless there is an approved engineered control in place with an associated ELUR requiring maintenance of the remedy. This approach is consistent with the Department's regulation of other sites in the program that have residual exceedences of any Method 1 Direct Exposure Criterion. This approach does not preclude performing parties from exercising their options under the Remediation Regulations to conduct Method 3 risk assessments or site-specific background determinations.

It is important to note that the site-specific background concentration may exceed both the risk-derived residential arsenic concentration (0.4 mg/kg) and the risk-derived industrial/commercial arsenic concentration (3.8 mg/kg). Subsequently, compliance with the site-specific background concentration may result in increased risk at the site posed by residual arsenic existing below the level that is considered jurisdictional. Furthermore, since the site specific background concentration will functionally demarcate the transition between a release-driven issue and a health-driven issue, the Department of Health (DOH) may provide additional guidance regarding proper management of residual arsenic concentrations. Finally, all soils must be managed in accordance with the Department's current and future requirements and polices.

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