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LETTER REGARDING RISKS FROM CONTAMINATED SOILS NTC ORLANDO FL
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January 10, 1999

BUREAU OF WASTE CLEANUP
JAN 12 1999
TECHNICAL REVIEW SECTION

Ligia Mora-Applegate
Bureau of Waste Cleanup
Florida Department of Environmental Protection
Room 471A, Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Dear Ms. Mora-Applegate:

Occasionally, there is some confusion regarding the use of average soil concentrations in risk assessment, both for estimating risks from a site and in determining whether existing soil concentrations are consistent with risk-based soil cleanup goals. I would like to take this opportunity to clarify, if I can, some of these issues.

In most cases, risks from contaminated soils are evaluated based on chronic exposure. Under these circumstances, an individual will be exposed to contaminated soils over an area rather than at one specific location. If the individual's contact with the contaminated area is random, the best representation of the concentration to which he/she is exposed is the average contaminant concentration over that area. The ability to accurately generate an average concentration over a given area is dependent upon a number of things, including the location of the sampling and the number of samples. Because there may be some uncertainty as to whether the average of a given set of samples in fact represents the true average over the area of interest, the USEPA recommends use of a 95% upper confidence limit estimate (95% UCL) of the mean generated from the data. [Note: See the attached sheet for the formula used to calculate the 95% UCL] This is considered to be conservative in that there is, in effect, 95% certainty that the true average is less than the value used for risk calculations or comparisons.

Because it provides the best indication of exposure concentration over time, the 95% UCL of the mean concentration is generally the most appropriate basis for comparing site contaminant concentrations with soil cleanup target levels (SCTLs). There are a few exceptions to this, when the maximum concentration rather than the 95% UCL should be compared with the SCTL. These are:

1. When the 95% UCL value exceeds the maximum concentration observed concentration. If the site contaminant concentrations are quite variable, the 95% UCL can exceed the highest concentration observed on site. In this situation, the USEPA recommends using the maximum detected concentration, rather than the 95% UCL, for risk assessment purposes.

2. When there are insufficient data to support calculation of a 95% UCL. USEPA guidance recommends that a 95% UCL value should not be calculated (and the maximum concentration used instead) if there are fewer than 10 samples (*Supplemental Guidance to RAGS: Calculating the Concentration Term*, OSWER, 1992).

3. When SCTLs are based on acute toxicity in children. Small children occasionally ingest relatively large quantities of soil while playing. Typical residential SCTLs based on chronic, low-level exposure to soils are probably also protective under circumstances of a large, acute soil dose for most chemicals, but there are some important exceptions (Calabrese et al., Environ. Health Perspect. 105:1354-1358, 1997). During development of residential SCTLs for the Brownfields program, eight chemicals were identified as having potentially unacceptable risks associated with an acute, large soil ingestion episode in children (e.g., 5 to 10 g. of soil on a single occasion). For each of these chemicals — barium, cadmium, copper, cyanide, fluoride, nickel, phenol, and vanadium — residential SCTLs were derived based on acute toxicity in children. Since these SCTLs are based on protection during a one-time soil exposure incident, it is important that they not be exceeded at any point on-site where children might be exposed. In situations involving current or potential residential land use and the presence of these specific chemicals, the residential SCTLs for these chemicals should be compared with maximum detected soil concentrations rather than 95% UCL values. That is, these specific SCTLs should be used as "not-to-exceed" values.

In evaluating whether contaminant concentrations on site are consistent with the SCTLs, it should not be automatically assumed that a site-wide average should be used. The general idea is to average concentrations over an area based on reasonable activity patterns for the most-exposed potential receptor. Observations of human activity associated with the site can be used to assist in a determination of the appropriate size of areas for averaging when evaluating risks posed by current site conditions. It is often more difficult to decide what constitutes reasonable averaging for future land use where human activity patterns are unknown. It has been suggested that when future residential exposure scenarios are involved, concentrations should be averaged over no more than 0.5-acre sections, corresponding to an average residential lot, for comparison with residential SCTLs.

Areas of localized, high contaminant concentrations ("hot spots") may be of concern, even in situations where the 95% UCL of the mean concentration for the chemical is within acceptable limits. The need to consider hot spots arises from concern

that toxicity may result, under some circumstances, from relatively brief exposure to very high contaminant concentrations. Data with which to evaluate toxicity from such acute exposures are often not readily available, and a conservative, expedient approach is to set an upper limit for hot spot concentrations based on some multiple of the SCTL. As a general rule, an upper limit for contaminant concentrations in hot spots of 3-times the SCTL should be health protective [with the notable exception of residential SCTLs based on acute toxicity in children, as discussed above].

I hope that this information is useful. Should you have any questions regarding this information, please do not hesitate to contact me.

Sincerely,

Stephen M. Roberts, Ph.D.

Equation for the Calculation of the 95% UCL of the Arithmetic Mean for a Lognormal Distribution:

$$95\%UCL = e^{(\overline{x}+0.5s^2+sH/\sqrt{n-1})}$$

Where:

e = constant (base of the natural log, equal to 2.718)
$\overline{x}$ = mean of the log transformed data
s = standard deviation of the log transformed data
H = H-statistic
N = number of samples

Equation for the Calculation of the 95% UCL of the Arithmetic Mean for a Normal Distribution:

$$95\%UCL = \overline{x} + t(s/\sqrt{n})$$

Where:

$\overline{x}$ = mean of the untransformed data
s = standard deviation of the untransformed data
t = Student-t statistic
n = number of samples