

DEPARTMENT OF ECOLOGY

November 30, 2012

TO: Craig Rankine, Site Manager, SWRO, TCP

FROM: Arthur Buchan, Toxicologist, HQ, TCP

SUBJECT: Use of Composite Samples for Ecological Risk Assessment

The purpose of this memorandum is to document an interpretation from the Department of Ecology regarding the use of vertical composite samples that would be included with surface sampling locations for confirmational sampling purposes, specifically as it pertains to Ecological Risk Assessment and the Terrestrial Ecological Evaluation (WAC 173-340-7490 through 7494). This memorandum only pertains to the technique of homogenizing an entire core sample and then analyzing the result. See attached figure 5.8 (Subsampling and Sampling across Depth), entire core is mixed (ECY, 1995).

Question 9 of the Draft *Technical Document: Terrestrial Ecological Evaluations under the Model Toxics Control Act* [ECY Draft, date] states:

Question 9: Where are the most appropriate locations/depths to sample for confirmational sampling (evaluation that the cleanup action is protective of ecological receptors)?

Answer: Confirmational sampling should be done on a site specific basis. Under WAC 173-340-740(7) (b), it states that "Sampling and analytical procedures shall be defined in a compliance monitoring plan prepared under WAC 173-340-410. The sample design shall provide data that are representative of the area where exposure to hazardous substances may occur." There is potential for ecological receptors of concern to be exposed to hazardous substances at a variety of depths and locations. For example, soil biota (earthworm) feeds and inhabits a variety of depths. An avian predator (robin) feeds on soil biota, but is restricted to soil surface levels. Therefore, consultation with Ecology is recommended prior to submitting a compliance monitoring plan, so that it can be verified and/or agreed upon that the confirmation locations and depths are representative to where exposure to hazardous substances might occur.

Literature Sources Supporting Vertical Composite Sampling Derived from a Continuous Core:

ECY Documents:

Statistical Guidance for Site Managers (ECY, 1992) has a section dedicated to composite sampling. It describes a method of composite sampling where the entire sampling core is retained, homogenized, and then sampled. It also states that this technique should only be applied when the statistical parameter of interest is the mean concentration, and should not be used for volatile organics (due to possible compound loss through volatilization).

Guidance on Sampling and Analysis Methods (ECY, 1995) also has a section dedicated to composite sampling. It describes the approach that calls for retaining the entire core, homogenizing all of the material, then subsampling. This approach is preferred from a statistical point of view because the subsampling variance will be lower (see also Figure 5.8 of this document).

EPA Documents:

In the *Frequently Asked Questions* section of EPA's Ecological Risk Assessments (Mid-Atlantic Risk Assessment, 2012), Question 3 asks: "How is composite sampling applied spatially? How is it applied temporally?" The answer states that vertical compositing is limited to layers in which exposure potential is uniform. For example, sediment dwelling receptors spend disproportionate amounts of time in the surface sediment layers. Therefore, composite sampling should combine discrete samples from within, but not between 0-6 inch, 6-12 inch, and 12-24 inch sediment layers.

Other Documents:

As noted in *Bulk Sampling: Problems and Lines of Attack* (Duncan, 1962), "Blending of increments of bulk material is an economical method of attaining an average that will represent the lot from which the composite sample is derived. The problem in blending is to prevent the physical average from being a biased one."

In summary, the goal of composite sampling is to obtain the true mean concentration from select soil media intervals in which exposure potential is uniform for the biota in question. Based on the documents cited above, it appears that vertical composite sampling (specifically, homogenizing a core sample then analyzing the result) would be an appropriate sampling technique to include with surface locations for confirmational sampling purposes. This would be on a site specific basis for Ecological Risk Assessment and only if the following conditions (verification) have been met:

1. The sample design must provide data that are representative of the depth where receptor exposure to hazardous substances may occur.
2. The contaminant of interest is an inorganic substance or a persistent (nonvolatile) organic compound.
3. The statistical parameter of interest is the mean concentration over the depth of interest, not a maximum or peak concentration or surface concentration.
4. The receptor of interest does not spend a disproportionate amount of time at any one depth.
5. A continuous coring device (such as a vibra-corer) is used to obtain samples with depth.
6. Thorough mixing of the core is verified to prevent an unbiased mean.

Other things to consider when determining the appropriate use of composite sampling include the following:

- An uncertainty analysis should be included with the Terrestrial Ecological Evaluation explaining the sampling procedures and reasoning behind substitute composite sampling. In addition, if composite samples are used as substitutions to specific surface samples, the results of those surface samples should also be included.
- Method of contaminant deposition and exposure pathways play a role in whether or not composite sampling may be appropriate. For example, in the case of atmospheric deposition of

a contaminant, discrete surface samples are needed to evaluate exposure to children playing in a yard, but composite sampling may be more appropriate for understanding risk to invertebrates inhabiting the soil column. A site where contamination has penetrated throughout the soil column may use different logic for determining situations where composite sampling may be appropriate.

- PQL should be considered. If cleanup level is set at or near the PQL, composite sampling may not be appropriate due to the risk of dilution associated with compositing.

Please note, this memorandum only covers WAC 173-340-7490 through 7494. All other applicable rules and regulations still apply. Please note: Sampling procedures can be found at the ECY document *Guidance on Sampling and Data Analysis Methods* (pub. No. 94-49, 1995), statistical procedures can be found at the ECY document *Statistical Guidance for Site Managers* (Pub. No. 92-54, 1992).

Should you have any questions, please contact me at (360) 407-7146 or Arthur.Buchan@ecy.wa.gov.

REFERENCES CITED:

Duncan, A.J. (1962). Bulk Sampling: Problems and Lines of Attack. *Technometrics* (4) (2):319-344

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Washington State Department of Ecology. (1992). *Statistical Guidance for Ecology Site Managers*. Publication No. 10-09-057.

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Washington State Department of Ecology. (2012). Draft: Technical Document: Terrestrial Ecological Evaluations under the Model Toxics Control Act. Internal Review: No Publication No.

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CHAPTER 5: FIELD SAMPLING PROCEDURES

Figure 5.8 Subsampling and Sampling Across Depth

