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To: Interested Parties

From: Lynn Bailey, Brownfields VCP Specialist
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Subject: Introduction to the *Hawaiian Islands Soil Metal Background Evaluation Report*

This technical memorandum presents a brief overview of how Hawaii-specific background metals concentration ranges were derived and how the data may be used when making site decisions. The *Hawaiian Islands Soil Metal Background Evaluation Report* evaluated naturally occurring, background concentrations of metals and related elements in the volcanic soils of Hawaiʻi. The database used in the study was compiled from literature review of previous research projects, soil data requested from the Natural Resources Conservation Service database, and soil data collected by the Hawaiʻi Department of Health (HDOH). A total of 180 samples representing surface soil concentrations of 29 chemicals throughout the seven main Hawaiian islands (Kauaʻi, Oʻahu, Molokaʻi, Lanaʻi, Maui, Kahoʻolawe, and Hawaiʻi Island) were included for the background analysis. Samples with probable anthropogenic sources were excluded from the study; therefore, the study results represent the concentration ranges expected to be associated with background conditions and not site-related contamination.

Estimated background ranges of metals and related elements were primarily generated from evaluation of cumulative probability plots and spatial and soil type distribution univariate plots (i.e., the combined plots analysis). The plots were evaluated to determine if the dataset for the target element may represent more than one distinct concentration population. If a single population was identified for the target element, then the data were evaluated to confirm that

they most likely represent background conditions. If two or more populations were identified for the target element, detailed spatial analysis, elemental association, geochemical analysis and professional judgment were used to distinguish between concentrations representing background conditions and elevated concentrations that may represent contamination. Estimates made using the combined plots analysis were validated by performing correlation coefficient and geochemical regression studies to analyze the geochemical association of metals that show strong correlation with reference metals (e.g., Al, Fe) in natural soils.

The following parameters for each target element were determined by evaluating the combined cumulative probability and univariate plots:

- **Upper bound concentration (UBC):** The upper limit of a relatively continuous distribution of assumed natural background concentrations of a metal in soil, excluding outliers. The UBC is estimated based on inflection points and/or gaps in the data distribution from the combined cumulative probability and univariate plots.
- **Background threshold value (BTV):** The maximum concentration that can be attributed to background conditions based on the data reviewed during this study, which may or may not include natural outliers.
- **Outlier:** Data points with concentrations that are much higher or lower than the rest of the dataset and do not fit a continuous distribution. Outliers can be attributed to natural enrichment processes, anthropogenic contribution or site contamination.

Detailed guidance that will assist the environmental community in evaluating the use of background concentrations when making site decisions is pending. The results of this study were incorporated into the Fall 2011 edition of the HDOH Environmental Hazard Evaluation Guidance and associated environmental action levels (EAL). Purely risk-based action levels were selected as the final EAL for a metal if the risk-based concentration is higher than the UBC for that metal. If the reported concentration of a metal in soil exceeds the estimated background concentration but does not exceed risk-based action levels then no further evaluation is necessary.

The UBC was selected as the final EAL for a metal if estimated background concentrations are higher than risk-based action levels developed for that metal. For example, background levels of analytes such as antimony, arsenic, cobalt, thallium, and vanadium in volcanic soils can exceed risk-based action levels in volcanic soils under certain geologic conditions. For these analytes, and for elements where EALs do not exist:

1) Concentrations below the UBC can reasonably be considered background in the absence of

known releases of the metal at the site.

2) Concentrations exceeding the BTV should be considered highly suspect. In the absence of additional data to support a natural origin, the need for remedial actions should be evaluated.

3) In many cases, concentrations between the UBC and BTV can be assumed to be background provided that no anthropogenic sources of releases are known. In some instances, a more detailed research of the geochemistry of soils in the area may be required to determine whether the identified metal is anthropogenic or natural background.

HDOH welcomes environmental professionals to submit background data for metals in soil across Hawai‘i for inclusion in the Hawai‘i Background Metals Study. Data should be for soil samples from known locations in Hawai’i that are not suspected to be impacted by releases or other anthropogenic activities. Include a description of soil texture, color and composition, as well as geographic coordinates with datum or a map of the approximate location where the sample was collected. Also include a brief a brief summary of the sample collection methodology used (e.g., decision unit size, collection depth, discrete or multi-incremental, etc.). All or some portion of the elements summarized in Table 6 of the current HDOH document should be included. Note the laboratory extraction and analytical methods used. If possible, laboratory extraction methods, analytical methods, and practical quantitation limits (reporting limits) should be comparable to those in the posted HDOH report. Data validated via EPA’s PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity) are preferred but this is not a requirement.

For more information or to volunteer data for the study, contact Dr. Roger Brewer or Lynn Bailey in the Honolulu Office at 586-4249 or John Peard in Hilo at 808-933-9921.

Reference

HDOH, 2012, *Hawaiian Islands Soil Metal Background Evaluation Report*: Hawai‘I Department of Health, Hazard Evaluation and Emergency Response (May 2012).