Protocol for Determining Background Levels of Heavy Metals in Soil of Mining Communities

AUA Center for Responsible Mining

I. Objectives

This document provides methodology on how to determine and evaluate the data for the background level of heavy metals (contaminants) in the soil of mining communities. It sets the requirement for choosing the location and sampling principles for the sampling soil to determine background and site related heavy metal's concentration. The Guidance based on the EPA 540-R-01-003 Standard.

Definition of the Background level refers to an appropriate metal's concentration that is not influenced by the releases from a site and is usually described as naturally occurring. Due to a natural feature of the sampling site, in some cases, background levels for certain metals differ from its appropriate norms, established by the Government.

Determination of the background levels of heavy metals in the soil is not mandatory. If the sample quantity, location, and quality of existing data can be used to characterize background chemical concentrations and compare them to site data, then additional samples may not be needed. In the case, when the existing data is inadequate to characterize background, such as an insufficient number of samples to perform the desired statistical analysis, an inappropriate background sample locations, when those affected by another pollution source; an unknown or suspect data quality and the gaps in the available data, the determination of background level of metal is required.

II. Selection of Background Reference Site

The locations to select for background soil sampling should have the same physical, chemical, geological, and biological characteristics of the site being studied, but has not been affected by human activities on the site. A background reference site also should not include contaminants (heavy metals) from other sites or discharges, such as a dust with a high concentration of the reviewed contaminant that brought by the wind from the other pollution source. In urban areas, background soil sampling locations may include areas where widespread, ubiquitous pollution is present that cannot be traced to a specific source for such substances as lead, mercury, cadmium and other contaminants.

The background reference site should closely match (i.e. be substantially similar to) the site being studied, as follows:

- geographical characteristics (e.g. location, topography, size/area, etc.),
- soil physical/chemical characteristics,
- hydrology,
- soil sampling depth.

In an ideal case, the background reference site would consist of the same concentrations of the reviewed contaminants as would be expected if the site had never been impacted by human activities. Usually, there is hardly possible to find such kind of area. If necessary, more than one reference area may be selected if the site exhibits a range of physical, chemical, geological, or biological variability.

Background reference site is normally selected from off-site areas, far away from pollution sources, but are not limited to natural areas undisturbed by human activities.

In some cases, a non-impacted onsite area may be suitable as a background reference area, especially for mining communities. In such situation, the background reference site should not have the following characteristics:

- Areas of added or imported soil fill,
- Road terraces or boulevards,
- Locations near buildings, especially where paint chips may be present,
- Locations where industrial or other contaminant generating activities are known to have taken place, including open garbage burning areas, vehicle parking and storage and material storage areas, or
- Locations near known air deposition sources, like foundries, building materials production or stone treated plants and other air pollution sources that may have deposited metals or other contaminants on the soil in the area.

III. Sampling and analyses of the reference soil sample

The sampling method for background soil samples should be the same as the method used for the characterization of the area being studied. The background soil sampling should be based on a horizontal or distance sampling principles. The distance sampling used in the case that the off-site background reference area is found and selected. Otherwise, when the onsite area as a background reference site is selected, the horizontal sampling is conducted.

If an off-site background reference area is used and distance sampling is performed, the background levels must be established for each community of study or for the several communities that are located in the same geographical and geological position. Therefore, the one background soil sample and one control sample would be enough.

In a case, that an onsite background reference area is used and horizontal sampling is performed, the background levels must be established for each community, individually. It is recommended to take the number of background samples not more than 4 samples for each subject community, depended on the size of community and purposes of the study. The horizontal sampling should be performed at depth 10cm or 20cm.

The analysis method for background soil samples should be the same as the method used for the area being studied, however, adjustments in the methods may be necessary. For example, the laboratory may use low concentration calibration standards to accommodate the low concentrations of the background soil samples and use calibration standards of higher concentration to accommodate the site characterization samples, especially if the site pollution levels are orders of magnitude higher than the background.

IV. Calculation of the Background level

The average of the background soil samples' test results should be consider as a background level for each heavy metal, accordingly. Generally, it's expected that samples taken at an acceptable background reference site should show similar results across all soil samples. In a case that difference among the results of horizontal sampling would be high (more than 10-30%), the background level may be

considered to be the highest concentration of the heavy metal. The result with more than 30% difference among others should be excluded from further calculation.

If the results for background soil sample and appropriate control sample in the distance sampling are differed more than 10%, the location of the background reference area should be revised.

Reference

US EPA 540-R-01-003; OSWER 9285.7-41 --Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites
https://dec.alaska.gov/spar/csp/guidance_forms/docs/background.pdf

PUB-RR-721 --Guidance for Determining Soil Contaminant Background Levels at Remediation Sites. Wisconsin Department of Natural Resources
http://dnr.wi.gov/files/pdf/pubs/rr/rr721.pdf

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