2013 A Rapid Bioassay for Predicting Toxicity of PHC-Contaminated Soil, Phase 3

A rapid (2-h), Microtox®-based bioassay intended for soils contaminated with petroleum hydrocarbons (PHC) above Tier 1 remediation criteria, but potentially sufficiently weathered to be candidates for Tier 2 site-specific assessment, was developed and refined during the first two phases of this project. This assay was not intended to replace any of Environment Canada's battery of Tier 2 tests, but rather to identify soils with toxic levels of bioavailable PHC prior to initiating testing. It was hoped that screening these soils prior to testing would avoid the unnecessary time and expense associated with conducting the full battery of ecotoxicity tests necessary to achieve regulatory closure.

Phase 3 of this project was an expansion of efforts conducted during the first two phases to correlate results of the rapid bioassay with results obtained from the earthworm survival and reproduction bioassay required as part of the full Tier 2 testing battery. While tentative agreement between the rapid bioassay and the earthworm survival endpoint was observed in

Phase 2, no correlation was observed for the other two test endpoints (juvenile production and weight). Phase 2 trials using peat-amended soils showed that soil texture/porosity may exacerbate or otherwise interact with PHC levels to influence observed toxicity.

The rapid bioassay and earthworm survival and reproduction test, as well as physicochemical characterization, were conducted on nine donated soils. Six of eight additional soils donated by Stantec, for which earthworm and/or soil chemistry data were already available, were also subjected to rapid bioassay testing. Two of the eight Stantec soils were unable to undergo the rapid bioassay due to their high moisture content. HydroQual Laboratories Ltd. (HydroQual) and ALS Laboratory Group (ALS) performed duplicate rapid bioassay testing on a subset of samples to ensure reliability of results. Similarly, HydroQual and Stantec performed duplicate testing on one of the donated soils to ensure reliability of chronic earthworm test results.

Results for both the rapid bioassay and earthworm 35-day survival endpoints agreed for all but one of the soils tested. In the case where the tests disagreed, the rapid bioassay identified the soil as toxic while the earthworm test did not (i.e., a false positive result). Agreement for 63-day juvenile reproduction was achieved less than half the time (5 of thirteen tests), with false negative results (i.e., the rapid bioassay did not identify the soil as toxic when in

fact it was) forming the majority of disagreements. Results for 63-day juvenile weight were generally positive, with agreement in the majority of cases (10 of thirteen tests). Disagreements were comprised of two false negatives and one false positive result.

While the rapid bioassay results as a whole were generally predictive of those obtained during the earthworm testing, the lack of correlation with juvenile reproduction data and the presence of both false positive and false negative results preclude the rapid bioassay as a blanket indicator of soil toxicity as outlined in the Tier 2 criteria. Given an understanding of these limitations, however, it may be possible to use the rapid bioassay in conjunction with other information to help determine whether contaminated soils are likely to pass the earthworm survival and reproduction component of the Tier 2 test battery.

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2014 HydroQual_Bioassay Presentation