UNIVERSITY OF SASKATCHEWAN

College of Agriculture and Bioresources

Department of Soil Science

51 Campus Drive
Saskatoon SK S7N 5A8 Canada
Telephone: (306) 966-6823
Facsimile: (306) 966-6881

Risk Assessment of top soil application from Iqaluit land farm to Iqaluit road surfaces

The following risk assessment pertains to applying soil from Iqaluit land farm cell #3 to cap gravel roads. The concern for the soil from cell #3 is in regards to petroleum hydrocarbon (PHC) contamination. PHC is a general term used to describe the complex mixture of organic compounds found in fossil fuels and PHCs are regulated into four distinct fractions (F1-F4), each with their own level of toxicity. Furthermore, benzene, toluene, ethylbenzene and xylenes (BTEX) are organic contaminants commonly associated with PHC contamination and are routinely measured in addition to PHC concentration due to their increased toxicity.

To determine if the soils present risk to either human health or to the environment a total of four soil samples from cell #3 have been sent to Paracel Laboratories LTD to measure the concentration of the four petroleum hydrocarbon (PHC) fractions as well as benzene, toluene, ethylbenzene and xylenes.

Results

From the soil concentration data provided by Paracel Laboratories LTD there is no human health or environmental risk from benzene, toluene, ethylbenzene and xylenes. The laboratory reports that the concentration in soil for all of these chemicals is below the instrumental detection limits of 0.002 mg/kg soil. For comparison, the Canadian Council of Ministers of the Environment (CCME) has set a Canada wide standard of 0.03 mg/kg soil for benzene.

The soil concentration data for the F1, F2, F3 and F4 fractions for petroleum hydrocarbons indicate that there is no human health or environmental risk provided that the soil from Cell #3 is not used in a residential zone. The potential risk to the residential zones comes from the F2 and F3 fractions; whereas there is no apparent risk associated with the F1 or F4 fractions for either residential or commercial zones. Two of the four samples from cell #3 exceed the F2 guideline for a residential zone and three of four samples from cell #3 exceed the F3 guideline for a residential zone. A comparison of cell #3 soil concentration and CCME Canada wide guidelines is provided in Table 1.

The F2 fraction from Cell #3 exceeds two separate guidelines for a residential zone, vapour inhalation and soil-eco contact. Vapour inhalation refers to the vapour intrusion/penetration through the concrete foundation of basements or slab-on-grade cement. In Iqaluit, residential homes do not have basements and are not built directly on the ground. Therefore this pathway is unlikely to be a concern; however it should be noted for future city planning. Soil-eco contact refers to the health of soil invertebrates and vegetation and for residential zones it is important to have a healthy ecosystem.

The F3 fraction from Cell #3 exceeds the guideline for soil-eco contact. Considering that both the F2 and F3 fractions exceed the soil-eco contact guideline there is an increased potential that the soil invertebrates and vegetation will not be as healthy as expected in a residential zone.

The CCME guideline values for the eco-soil contact pathway for F2 and F3 fractions is driven by a more sensitive response to the generic earthworm species used in toxicity testing, *Eisenia andrei*, *Eisenia fetida* or *Lumbricus terretris,* all from the Lumbricidae family. However, in northern Canada the dominant earthworm species is likely from the Enchytraeidae family, of which there is minimal PHC toxicity data (3). Furthermore, PHC toxicity is known to be reduced due to the aging and weathering of PHCs in soil longer than four weeks (3). The toxic concentration of total petroleum hydrocarbons to most plant species is generally >10,000 mg/kg soil (3).

Table 1. Comparison of Iqaluit land farm cell #3 PHC fractions and CCME (2) Canada wide Tier 1 guidelines.

PHC Fraction	Cell #3 (mg/kg-soil) July 2012 Front	Cell #3 (mg/kg-soil) July 2012 Back	Cell #3 (mg/kg-soil) Oct, 2012 South	Cell #3 (mg/kg-soil) Oct, 2012 North	CCME Tier 1 Guidelines (mg/kg-soil) Commercial	CCME Tier 1 Guidelines (mg/kg-soil) Residential
F1	<7	<7	<7	<7	320	30
F2	153*	196*	32	149	260	150
F3	433**	404**	177	777**	1700	300
F4	75	81	101	205	3300	2800

* - exceeds CCME guideline for F2 fraction for a residential zone but does not exceed guideline for commercial zone

** - exceeds CCME guideline for F3 fraction for a residential zone but does not exceed guideline for commercial zone

Summary

There is no human health risk from the application of the top soil on the roads in Iqaluit because the soil vapour intrusion pathway into residences does not exist in the Iqaluit housing stock. There may be a slight ecological risk based on analysis of soil invertebrate species that do not live in or near Iqaluit. However, because the toxicological data quality for the target soil species is of very poor quality we estimate that there will be no appreciable ecological harm from applying the Cell #3 topsoil to roads in Iqaluit.

This risk assessment has been carried out by:

Kyle James, MSc Toxicology
University of Saskatchewan
Kyle.james@usask.ca

Steven D Siciliano, BSc, PhD Toxicology
Professor of Soil Toxicology
University of Saskatchewan
Steven.siciliano@usask.ca

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