

FINAL

**CRITERION EVALUATION FOR URANIUM IN SOIL IN
PORT HOPE**

Prepared for:

Port Hope Area Initiative Management Office

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EXECUTIVE SUMMARY

The Port Hope Area Initiative Management Office (PHAI MO) is responsible for cleaning up historic low-level radioactive contamination at residential properties, major sites, parklands and municipal properties as well as the clean-up of the existing federally owned Welcome and Port Granby Waste Management Facilities. Through the Port Hope Project, an estimated 1.2 million cubic metres of remaining historic low level radioactive waste (LLRW) currently located in Port Hope on residential, parkland, landfill, roadway, commercial, industrial, waste management/consolidation and harbour sites will be removed and consolidated in a new engineered above ground long-term waste management facility. Similarly, some 450,000 cubic metres of LLRW at the Port Granby Waste Management Facility will be relocated to a new engineered above ground long-term waste management facility as part of the Port Granby Project.

Based upon the large volumes of contaminated soil to be addressed by the Port Hope and Port Granby Projects, project-specific soil clean-up criteria were developed during the planning phase following protocols and regulatory guidance in use at that time (EcoMetrix 2005). Project-specific clean-up criteria were developed for radium-226, antimony, arsenic, lead and uranium. At that time, it was determined that the project-specific criteria for antimony, arsenic and lead would be utilized if it was considered to be more appropriate and agreed to by the key stakeholders. For uranium, a project-specific criterion of 35 mg/kg was developed for residential/parkland land use.

The PHAI criteria were reviewed by a number of regulatory agencies including Health Canada, the Canadian Nuclear Safety Commission (CNSC) and the Ontario Ministry of the Environment (MOE) as well as by subject matter experts retained by the Municipalities of Port Hope and Clarington.

Since the development of the PHAI uranium in soil criterion, the MOE and Canadian Council of Ministers of the Environment (CCME) have published generic clean-up criterion of 23 mg/kg for residential land use. In addition, in 2011 the CNSC conducted bioaccessibility tests on Port Hope soils and determined an upper bound gastric and intestinal bioaccessibility of 83%. The introduction of a generic criterion and updated bioaccessibility studies using Port Hope soils have resulted in a re-examination of the PHAI uranium in soil criterion.

An evaluation of the current PHAI uranium in soil criterion of 35 mg/kg for current and foreseeable unrestricted use was undertaken for a toddler (the most important receptor) using standard risk assessment principles following methods and default assumptions provided by the MOE in their risk assessment documentation under O.Reg. 153/04. The evaluation was based upon a multi-media approach which considered exposure pathways including direct contact with

soil, consumption of backyard produce, as well as ingestion of drinking water, inhalation of air, and consumption of supermarket foods. In addition, the evaluation assumed that the uranium in Port Hope soils was 100% bioaccessible, even though historical and recent tests conducted by the CNSC indicate that the bioaccessibility is less than 100%.

In general, many risk assessments evaluate single or few sources of contamination and a limited number of exposure pathways. To address this issue, the MOE under O.Reg. 153/04 recommends apportioning 20% of the total exposure to any one pathway; thus a Hazard Quotient (HQ) value under 0.2 represents a situation in which no adverse health effects are likely to be associated with the estimated level of exposure for a single pathway. However, in multi-media assessments, the estimation of exposures are associated with all major exposure sources (*e.g.*, air, drinking water, soil and supermarket foods) such that the total exposure of each receptor is being adequately accounted for and therefore the use of an HQ value of 1.0 is considered to be appropriate to represent an “acceptable level” of exposure.

In addition to the MOE risk model, a regulatory risk model from Health Canada was applied as an additional line of evidence to support the results of the evaluation. This risk model also provided a Hazard Quotient for comparison against a value of 1. Figure ES-1 summarizes the results.

The evaluation demonstrated that:

- The Hazard Quotient (HQ) value for toddlers exposed to uranium in soil at a concentration of 35 mg/kg using the multi-media approach considering all major exposure pathways (air, drinking water, soil, backyard produce and supermarket food) and 100% bioaccessibility was below 1 (*i.e.* 0.78) indicating that it is not anticipated that adverse effects to human health would occur at these levels.
- The inclusion of bioaccessibility levels at values less than 100% in the calculations further reduced the HQ values to 0.69 for 81% bioaccessibility (CNSC recommended value) and 0.57 for 61% bioaccessibility (PHAI MO recommended value), providing additional support to the conclusion that adverse effects on human health are unlikely at a uranium in soil concentration of 35 mg/kg.
- The use of the different regulatory approach (Health Canada) also resulted in an HQ value below 1 at 0.46, thereby providing further support that adverse effects on human health are unlikely at an uranium in soil concentration of 35 mg/kg.
- A separate analysis accounting for consumption of uranium in domestic well water at a concentration of 2.8 µg/L was conducted which also resulted in an HQ value below 1 at 0.91, providing further support that there is not anticipated to be an unacceptable level of risk with an uranium in soil concentration of 35 mg/kg.

- Although there is a data gap with respect to indoor dust, an assessment of the potential exposure through this pathway showed that it is not expected that this data gap would affect the conclusions of the assessment.

The multiple lines of evidence presented in this evaluation using MOE and Health Canada risk models demonstrate that 35 mg/kg is protective of the most exposed residential receptor (the toddler) and, thus, remains a scientifically sound criterion that can be applied to the PHAI remediation activities for current and foreseeable unrestricted use.

Figure ES-1 Summary of Results for Toddler Considering Various Risk Approaches

