

## Finalization of Research and Preliminary Selenium Soil Quality Guideline Derivation

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Selenium (Se) soil quality guidelines were reassessed based on the most recent toxicity data. Following interpretation of the results from 2015-2017 toxicity studies, the ameliorating effect of sulphate (SO<sub>4</sub>) was further investigated with the higher Se concentration range in coarse and fine soils. The new toxicity data was included in the overall dataset, consisting of six plant species: alfalfa (*Medicago sativa*), barley (*Hordeum vulgare*), carrot (*Daucus carota*), cucumber (*Cucumis sativus*), northern wheatgrass (*Elymus lanceolatus*), red fescue (*Festuca rubra*), and two invertebrate species, earthworms (*Eisenia andrei*) and springtails (*Folsomia candida*). These species were tested in coarse and fine soils under various Se and SO<sub>4</sub> combinations, ranging from <0.3 to 31.2 mg/kg for Se and from 28 to 1,500 mg/kg for SO<sub>4</sub>. Benchmark Dose Software (BMDS) was used to build the dose-response curve and estimate representative toxicological endpoints for plants and invertebrates. Endpoints were plotted to derive a Species Sensitivity Distribution (SSD) as a function of soil texture and SO<sub>4</sub> concentration. The 25th percentile from each SSD was used for ecological guidelines, where Se toxicity depends on SO<sub>4</sub> concentration in soil. The reassessed soil guidelines would improve environmental performance through decreasing greenhouse gas emission (by decreased remediation volumes). In addition, they would improve conservation efforts and reduce instances where remediation would generally be required because of guideline exceedances, although Se may not pose unacceptable risk to the environment or human health. This research was made possible through funding provided by the Petroleum Technology Alliance Canada (PTAC).

### Anthony Knafla

Mr. Knafla is the founder of Equilibrium, a company that provides services in risk assessment, liability management, Phase II investigations, and remediation. He has 27 years of experience in the fields of toxicology, contaminant fate and transport, risk assessment, regulatory hearing support, modelling, analytical techniques, risk management, environmental investigations, and remediation innovation. Mr. Knafla has developed toxicological profiles for Health Canada and provided scientific support to Environment

Canada. He is a Diplomate of the American Board of Toxicology and a professional biologist in Alberta with educational backgrounds in medical science and biochemistry, as well as select courses in engineering. Mr. Knafla has innovated and managed the development of several environmental software tools used in the support of remediation, reclamation, and general decision making

### Viktoria Winter

Ms. Winter is an environmental scientist/toxicologist at Equilibrium Environmental Inc., and a professional biologist in Alberta. She has eleven years of experience in ecotoxicology studies and environmental industry. Her skillset includes toxicology, human health and ecological risk assessment, research in support of environmental toxicology, vegetation and wildlife surveys, and field investigation. She has worked on sites impacted by various industrial operations including upstream oil and gas, pesticide and fertilizers applications. Environmental toxicology experience included developing and validating of a new egg-injection protocol and multi-generational study of PBDE exposure in small songbirds, and plant and invertebrate toxicity testing for petroleum hydrocarbon impacted soils. Ms. Winter worked on the data gap analyses in ecotoxicology, bioavailability and bioaccessibility, phytoremediation and plant tolerance potential studies (TPH, lead, selenium), and assisted with building weight-of-evidence approach to redefine provincial ecological soil selenium guidelines.

### Darlene Lintott

Darlene is a Consulting Scientist at Element's Edmonton facility for the past 20 years. She has over 30 years of experience as an environmental scientist and has a B.Sc. in Chemistry and a Master's in Environmental Toxicology. Her diverse project experience includes assessing contaminant fate in soil and aquatic environments, development of regulatory methods and standards and evaluating the ecotoxicological impact of contaminants. At Element, she conducts applied research projects, method development and helping clients with a wide variety of environmental, technical and regulatory issues.