CSR OMNIBUS UPDATE: Protocol Summary - Amendments to Schedule 5 Human and Environmental Health Protection, Soil to Water Pathway Matrix Soil Standards

Author: George Szefer **Date:** February 2016

Protocol Summary

1. Update the CSST 1996 [1] Groundwater Protection Model (GPM), used to derive soil to water pathway matrix numerical soil standards, to:
    a. incorporate advances related to the science of modelling contaminant transport in soil and water; and,
    b. ensure consistency in the use of the model, or model elements, between the various CSR Protocols and Technical Guidance.
2. Use the updated Groundwater Protection Model to derive new human and environmental health protection, soil to water pathway matrix soil standards for existing CSR Schedule 5 and new prescribed substances for use in Schedule X, Part 1 Matrix Soil Standards.
3. Derive as a component of step 2 above new human and environmental health protection, soil to water pathway matrix standards for all land uses specified in Schedule X Part 1 Matric Soil Standards.
4. As identified by others, [2] repeal CSR Schedule 5 and replace with the new schedule of matrix numerical soil standards (i.e. Schedule X Part 1 Matrix Soil Standards).

Associated Omnibus Updating Documents

Details related to the proposed changes to CSR Schedule 5 Human and Environmental Health Protection, Soil to Water Pathway matrix standards are available in the ministry's 2015 Draft Discussion Document entitled "CSR OMNIBUS UPDATING: Proposed Amendments to Schedule 5 Soil to Water Pathway Standards". [3]

Details related to the Ministry`s response/decisions on stakeholder comment received on the proposed omnibus updating changes to the CSR Schedule 5 Human and Environmental Health Protection, soil to water pathway matrix standards are available in 2015 Omnibus Updating of CSR Standards Draft Discussion Documents – Land Remediation Response to Stakeholder Comment. [4]

Protocol Details Related to Human and Environmental Health Protection, Soil to Water Pathway Matrix Soil Standards for the CSR Stage 10 Amendment

CSR Soil to Water matrix soil standards were derived using the CSST 1996 protocol [1] and the omnibus updated Groundwater Protection Model (GPM). Modifications to the Groundwater Protection Model, used for the CSR Stage 10 Amendment, made in consideration of stakeholder comments and other ministry considerations, are summarized as follows.

Changes to the Model to Incorporate New Science or Harmonization with other Protocols

1. The model was revised to:
    a. include an upgraded graphical user interface;
    b. provide greater transparency in parameter selection/input and substance properties; and,
    c. include updated model documentation and help file information (in progress).

2. The existing soil type used in the model was revised to:
    a. be more broadly representative of coarse-grained soil conditions in BC; and
    b. provide general agreement with the coarse-grained soil type, and corresponding average linear groundwater velocity, as provided in the CCME 2006 [5] soil protocol.

3. The US EPA SSG [6] distribution coefficient isotherms (soil pH-K_d relationships) for inorganic substances were adopted for existing and new matrix substances, where available, with the exception of the following:
    a. existing distribution coefficients were retained for barium, chloride, copper, mercury and sodium;
    b. a literature-based isotherm was adopted for lead based on mean values provided in Sauvé et al, 2000 [7] and,
    c. as distribution coefficients were not available in US EPA SSG [6], distribution coefficients for cobalt, manganese, molybdenum and uranium were adopted from the US DOE RAIS database. [8]

4. The mixing equation was modified to the peer reviewed US EPA SSG [6] mixing model.

5. The saturated zone transport equation was modified to the Domenico (1987) [9] two-dimensional steady-state solution for harmonization with Protocol 13. [10]

6. The biodegradation rates for organic substances were modified to the rates provided in Axiom Environmental Inc., 2011. [11] Concurrently, the biodegradation rates for tetrachloroethylene and trichloroethylene were removed consistent with the Axiom [11] and Science Advisory Board for Contaminated Sites in BC [12] recommendations and for harmonization with Protocol 13. [10]

7. The US DOE RAIS database [8] was used for the selection of the following substance properties: solubility; soil organic carbon-water partitioning coefficient (K_{oc}); and, dimensionless Henry's Law constant (H').

8. A new pH-dependent K_{oc} isotherm for pentachlorophenol was adopted from US EPA SSG. [6]

9. A solubility constraint (50% of pure-phase solubility) was adopted for organic substances.

10. The background adjustment was revised to report either the background concentration or the calculated standard, whichever is greater.

11. The Hazardous Waste Regulation [13] leachate quality standards were removed as hazardous waste soil quality is assessed separately under the Contaminated Sites Regulation. [14]

12. The model was revised to include updated water use standards and calculation of soil to water protective AW standards for both freshwater and estuarine/marine AW water use standards.

13. The model defaults and input parameters for source dimensions, fraction of organic carbon, and bulk density were harmonized with the CCME, 2006 [5] model.

Consequential Changes to CSR Protocols

1. Update CSR Protocols 2 [15] and 13 [10] to improve the overall usability of the protocols. Also, as part of the update, ensure consistency with the new CSST model [1] based on the model changes identified above.

2. Adopt leachate test methods in Protocol 2 [15] to allow for use of leaching tests for site-specific numerical soil standards calculation. Harmonize leaching tests between CSR Protocols 2 [15] and 13. [10]

3. Revise the maximum transport distance allowed in CSR Protocol 2 [15] to 500 m for harmonization with Protocol 21. [16]

4. Under CSR Protocol 2, [15] retain the maximum allowed average linear groundwater velocity of 100 m/year and revise the minimum allowable velocity to 5 m/year.

Next Cycle Revisions

1. Evaluate other groundwater model related SABCS recommended changes [17] to the CSST Protocol, which although supported by the ministry, were deferred to future review due to time and resource constraints.

2. Evaluate the potential for web-hosting of the GPM.

3. Evaluate existing and potential new constraints/limits to ensure appropriate conservatism of the GPM.

4. Evaluate the consistency achieved by, and feasibility of, incorporating changes to the GPM to address dilution due to infiltration occurring downgradient from the contaminant source zone.

5. Evaluate incorporation of the Aquatic Life (AW) protective pathway transport assessment used in CCME, 2015 [18] for use in deriving matrix soil to groundwater standards for the protection of aquatic life (i.e. consider modification of the ten times AW dilution factor used in the GPM).

6. Evaluate incorporation of the CCME, 2015 [18] AW pathway transport assessment for use in setting the aquatic life protection water quality standards under the CSR.

7. For chlorinated solvents, undertake an evaluation of alternate approaches that may more effectively address concerns related to determination of whether biodegradation may occur and the concomitant potential for formation of toxic daughter products in groundwater.

8. For ionizing organic substances, consider incorporation of variable soil pH ranges where sufficient soil pH-K_{oc} relationship data are available.

9. Evaluate the practicability of, and need to, develop soil standards based on porewater to protect soil invertebrates.

10. Evaluate the practicability of, and need to, develop soil to groundwater standards to protect phreatophyte and non-phreatophyte plants.

11. Evaluate the practicability of, and need to, develop soil standards based on groundwater contaminant transport to surface water for the purposes of protecting wildlife surface water ingestion (i.e. wildlife drinking watering pathway).

12. Undertake an updated literature review of models/approaches used in other jurisdictions for protection of water uses through setting/calculation of soil standards.

13. Review assumptions for the Dilution Attenuation Factor (DAF) value used in the model.

References

[1] British Columbia. (1996). *Overview of Contaminated Sites Soil Task Group (CSST) Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites.* Ministry of Environment. Victoria, British Columbia. January 31, 1996.

[2] British Columbia. (2016). *CSR OMNIBUS UPDATE: Protocol Summary - Amendments to Schedule 4 and 5 Human Health Protection Soil Standards.* Ministry of Environment. February, 2016.

[3] British Columbia. (2015). *CSR Omnibus Updating: Proposed Amendments to Schedule 5 Soil to Water Pathway Standards*. Ministry of Environment. July, 2015.

[4] British Columbia. (2015). *Omnibus Updating of CSR Standards Draft Discussion Documents – Land Remediation Response to Stakeholder Comment*. Ministry of Environment. November, 2015.

[5] Canadian Council of Ministers of the Environment. (2006). *A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines.* CCME. 2006.

[6] United States Environmental Protection Agency. (1996). *Soil Screening Guidance: User's Guide, 2nd Edition. EPA/540R-96/018*. July 1996.

[7] Sauvé, S., Hendershot, W., Allen, H. (2000). *Solid-Solution Partitioning of Metals in Contaminated Soils: Dependence on pH, Total Metal Burden, and Organic Matter.* Environmental Science & Technology, 34. 2000.

[8] United States Department of Energy. (2015). *Risk Assessment Information System*. 2015.

[9] Domenico, P.A. (1987). *An Analytical Model for Multidimensional Transport of a Decaying Contaminant Species*. Journal of Hydrology, 91. 1987.

[10] British Columbia. (2008). *Protocol 13 for Contaminated Sites. Screening Level Risk Assessment*. Ministry of Environment. August 1, 2008.

[11] Axiom Environmental Inc. (2011). *Proposed Values of Biodegradation Rate for Organic Chemicals for Use in the British Columbia CSST Model (draft).* March 2011.

[12] Science Advisory Board for Contaminated Sites in British Columbia. (2005). *Screening Level Risk Assessment, SLRA Level 1 and SLRA Level 2*. August 2005.

[13] British Columbia. (2009). *Hazardous Waste Regulation. B.C. Reg. 63/88*. A regulation under the *Environmental Management Act*.

[14] British Columbia. (2014). *Contaminated Sites Regulation. B.C. Reg. 375/96*. A regulation under the *Environmental Management Act*.

[15] British Columbia. (1998). *Protocol 2 for Contaminated Sites. Site-Specific Numerical Soil Standards*. Ministry of Environment. February 11, 1998.

[16] British Columbia. (2015). *Protocol 21 for Contaminated Sites. Water Use Determination. Version 1.0, Draft 15*. Ministry of Environment. 2015.

[17] Science Advisory Board for Contaminated Sites in British Columbia. (2005). *Scientific Review of British Columbia CSST Soil Standards Derivation Protocol*. July 2005.

[18] Canadian Council of Ministers of the Environment. (2015). *A Protocol for the Derivation of Groundwater Quality Guidelines for Use at Contaminated Sites*. CCME. 2015.