CSST POLICY DECISION SUMMARY

PART I : **Record of CSST Policy/Decision Issues Relating to the Derivation of Matrix Standards Based on Canadian Council of Ministers of the Environment Protocol and Site-Specific Objectives Documents**

and

PART II : **Record of CSST Policy/Decision Issues Relating to the Derivation of Matrix Soil Standards Based on Novel CSST Procedures**

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Reflects Decisions to : December 4, 1995

Risk Assessment Unit
Environmental Protection Department
BC Environment

CSST POLICY DECISION SUMMARY

Executive Summary

The Contaminated Sites Soil Taskgroup (CSST) was charged with the development of "transparent and scientifically defensible" soil standards for use in the Contaminated Sites Regulation required under the Waste Management Amendment Act, 1993. CSST was a multi-disciplinary group with representation from the B.C. Ministry of Environment, Lands and Parks, the B.C. Ministry of Health, the Medical Health Officers Council of British Columbia and B.C. Environmental Health Officers. CSST carried out its work between November, 1994 and November, 1995.

This summary contains key science policy issues and decisions reached by CSST in the development of its soil standards. The summary is presented in two parts. Part I deals with policy issues related to the development of soil quality criteria based on procedures as proposed by CCME and considered by CSST. Part II documents policy issues and decisions related to the development of soil quality standards based on "novel" procedures unique to CSST.

To assist readers with the numerous acronyms used in this document, Appendix I presents a "CSST Acronym List". Details of the CSST equations, procedures and models used to calculate the matrix standards of schedule 5 of draft 3.0 of the Contaminated Sites Regulation may be found in "Overview of CSST Procedures for the Derivation of Soil Quality Standards for Contaminated Sites" (CSST, 1996).

Table of Contents

PART I : Record of CSST Policy/Decision Issues Relating to the Derivation of Matrix Standards Based on Canadian Council of Ministers of the Environment Protocol and Site-Specific Objectives Documents

IA. Introduction

CSST began its task of developing transparent and scientifically defensible soil standards and related regulatory procedures for use in the Contaminated Sites Regulation by considering science policy issues and decisions inherent in two key Canadian Council of Ministers of the Environment (CCME) documents ; "A Protocol for the Derivation of Ecological Effects-based and Human Health-based Soil Quality Criteria for Contaminated Sites" - Final Draft Report, (CCME, 1994a)[1] and "Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada" - Final Report, (CCME, 1994b). These documents known as the "protocol" and "SSOs" respectively were drafted by the Subcommittee for Environmental Quality Criteria for Contaminated Sites (SCEQCCS), an *ad hoc* subcommittee of the CCME Environmental Protection Committee - Contaminated Sites Advisory Group (EPC-CSAG) as a component of the work undertaken for the National Contaminated Sites Remediation Program (NCSRP). The SCEQCCS was charged with the task of generating a set of "common scientific tools" to guide the assessment and remediation of NCSRP sites in Canada.

CSST reviewed the above mentioned two CCME documents in great detail and even considered the possibility of outright adoption of the CCME criteria derivation procedures for use in developing soil quality standards for the Contaminated Sites Regulation. However, as detailed below, CSST chose not to recommend simple adoption of the CCME criteria derivation process in its entirety, but rather decided to recommend modified soil quality standard derivation procedures for the protection of human and environmental health at contaminated sites in British Columbia. As a result, CSST has adopted, modified and/or rejected various components of the science policy recommended by CCME.

[1] This document has since been finalized (CCME, 1995).

IB. CSST Record of Decision Relating to the CCME Protocol and Site-Specific Objectives Documents

The following represents a section by section record of CSST's decisions regarding the CCME science policy issues contained in the CCME "protocol" and "SSOs" documents. Unless otherwise indicated, each CSST record of decision relates to the identified section of the CCME protocol or site-specific objectives document.

IB1. CSST Decisions Related to CCME Protocol Part A - Framework

Section 1.3.3 - National Guidance

Issue: In order to develop "scientifically defensible" criteria SCEQCCS has elected to derive criteria based on policy decisions relating to toxicological and environmental fate/transport considerations.

No modification of criteria in consideration of:

1. technological feasibility to achieve
2. economic costs to achieve
3. public consultation

SCEQCCS believes all the above issues should be addressed as part of a risk management exercise and should therefore be considered as components of selecting appropriate remedial solutions for specific sites.

Should BC Environment support criteria derivation based on toxicological and environmental fate/transport considerations?

CSST Decision: *Yes, criteria derivation should be based on toxicological and environmental fate/transport considerations. It is not possible to consider factors identified in 1-3 above in a meaningful manner when setting generic criteria. These factors are better addressed within the context of site specific risk management.*

Additional Question

Section 1.3.3(a) - Toxicological Derivation

Issue: Health members of CSST noted that based on "real world" experience, some of the toxicologically modeled human health soil ingestion standards might not be reflective of actual health risks. Thus, for some contaminants CSST believes numbers based on models may not accurately reflect the actual risks posed. In

consequence, as described in more detail below in Part IIC1 of this summary, CSST recommended that a "real world health experience review" be conducted to account for more practical and realistic experience which may be available for such contaminants as lead, arsenic, cadmium, chromium and benzene. CSST believed that for these substances sufficient information may exist to allow an alternative derivation procedure to be developed which can predict likely human health outcomes from exposure to contaminant concentrations in soil.

CSST therefore proposed that empirical study results could provide a better scientific base for criteria development in some cases.

Should empirical or real world correlative data be used to adjust or correct soil standards derived from the toxicology based equations?

CSST Decision: *Yes. Such adjustment is not thought to be necessarily excluded under the section 1.3.3 of the CCME protocol. See also, Part IIC1 of this summary document.*

Additional Question

Section 1.3.3(b) - Need for Documentation for "real world" matrix standards

Issue: In order to be consistent with CSST's principle of scientific "transparency" of process, CSST proposed that rationales for "real world" adjustment of standards based on models be fully documented.

Should documentation be required to support "real world" based matrix standards?

CSST Decision: *Yes.*

Section 2.2 - Protocol issues

Issue: The protocol ignores issues relating to;

1) Toxic mixtures (ie. possibility of toxic interactions). CCME assessment/remediation criteria are based on single contaminant analysis),

2) Depth of soil contamination on site (no advice on "how deep is safe"), and

3) Some possible defined exposure scenarios for both human health (e.g. pregnant woman, nursing mother, aged asthmatic scenarios) and ecological effects (e.g. ecological secession scenario).

Should BC Environment accept above limitations?

CSST Decision: *Yes, these issues have to be ignored in setting "generic" criteria. Generic criteria will be set using exposure assumptions that represent high exposure to receptors (e.g. children). This, along with policy decisions that specify a high "default" level of protection provide the best means of addressing these concerns in a practical manner.*

Section 2.3 - Ecological Guiding Principles

Issue: The stated goal of the SCEQCCS process is to develop ecological effects (EE) based criteria that would allow a "functioning soil ecosystem" to be sustained on site for current and likely future land uses.

Functional Soil Ecosystem = PLANTS, BACTERIA, FUNGI, PROTOZOAN, INVERTEBRATE and VERTEBRATE animals.

Should BC Environment support the stated goal of maintenance of a "functioning soil ecosystem" in EE criteria derivation? If yes, for which land uses?

CSST Decision: *In principle CSST supports the concept of maintenance of a "functioning soil ecosystem" irrespective of land use.*

However, CSST also believes it is unreasonable to confer equivalent protection to all species in all circumstances. Rather, it is necessary to consider "appropriate levels of protection" to ecological receptors in the context of land use and site specific objectives.

Section 2.3.1 - Human Health Guiding Principles

Issue: The stated goal of the SCEQCCS process is to develop human health (HH) criteria that confer "no appreciable health risk". Health Canada has stated that to achieve "no appreciable risk" one must take into account multi-media exposure to contamination such that no exceedance of the "Residual Tolerable Daily Intake" (RTDI) occurs.

i.e. RTDI = TDI - EDI

where TDI : "tolerable daily intake"
EDI : sum of five universal environmental media normal background "estimated daily intake".

Should BC Environment support a multi-media approach to HH soil quality standard derivation and by inference support Health Canada's "no appreciable risk" concept?

CSST Decision: *CSST recommends HH soil quality standards be derived based on the simplified direct TDI apportionment equations as developed in the decision for section 5.1 below. If an official Health Canada EDI is available for a substance, a HH "number" should also be calculated based on an equation which incorporates the EDI (ie. as described in the CCME SCEQCCS protocol).*

The final HH soil ingestion standard should be based on the more "reasonable" of the two preliminary numbers derived by these two equations as determined by CSST.

Section 2.4 - Land Uses

Section 2.4(a) - Differential Land Uses

Issue: SCEQCCS recommended that criteria should be derived for 4 primary land uses (ie. Agriculture, Residential/Parkland, Commercial and Industrial).

Should BC Environment support the four main land use concept?

CSST Decision: *Yes. Note that for BC Environment's regulatory purposes the Residential/Parkland group will be separated in a matrix table of standards giving 5 discrete land use categories.*

Section 2.4(b) - Differential Protection tied to Land Use

Issue: SCEQCCS suggests that "contaminant sensitivity" (ie. potential to produce adverse effects) increases as one moves from Industrial to Agricultural land.

i.e. Above assumption justifies:

1. Variable level of protection re: EE with changing land use, and

2. Variable receptors of concern re: HH with changing land use.

Should BC Environment support:

1. **The concept of differential levels of EE protection accorded to different land uses?**

2. **The concept of a variable level of EE protection with change in land uses?**

3. **The concept of a variable critical HH receptor of concern with change in land use?**

CSST Decision: *Yes, all three concepts should be supported.*

Section 2.4.1 - Land Use Definitions

Issue: CCME provides four main land use definitions, page 14 of protocol:

1.	Agricultural	- (Ag)
2.	Residential/Parkland	- (R/P)
3.	Commercial	- (C)
4.	Industrial	- (I)

Are land use definitions appropriate to BC Environment?

CSST Decision: *Definitions in CCME protocol are appropriate.*

IB2. CSST Decisions Related to CCME Protocol Part B - Eco Health

Part B Eco Health

Section 2.4(a) - Measurement versus Assessment Endpoints

Issue: The protocol bases Ecological Effect (EE) soil quality criteria (SQC) derivation procedures on "measurement" end points (e.g. LD_{50} values) rather than "assessment" endpoints (ie. population studies).

Should BC Environment support use of measurement endpoints in EE SQC derivation?

CSST Decision: *Yes - this is the only practical method in view of the lack of data relative to "ecological assessment" endpoints.*

Section 2.4(b) - Preferred Measurement Endpoints

Issue: The protocol states only mortality, reproduction and growth endpoints should be used in EE based SQC derivation.

Should BC Environment support use of mortality, reproductive and growth endpoints in EE SQC derivation?

CSST Decision: *Yes, the use of these endpoints is supported but will not preclude use of additional endpoints if appropriate. Enzyme induction and behavioral endpoints will not be considered.*

Section 2.4.2 - Short/Long-term tests

Issue: The protocol states that long term toxicity test data is preferred for EE based SQC derivation. However, since there is not much true chronic (long-term) EE data available, it is acceptable to use short term (acute) EE data. This short term data is adjusted (ie. via safety factors (SF) application to NOAEL/LOAEL data) to estimate chronic dose effects for use in EE based SQC derivation.

Should BC Environment support application of SF to NOAEL/LOAEL data to estimate "chronic toxicity" in EE SQC derivation or alternately just use acute toxicity estimates (e.g. EC_{50} and/or LD_{50} data) to derive EE based SQC (ie. soil matrix standards)?

NB There are data limitations to use of either of these methods

CSST Decision: *No. CSST simply recommends that all relevant ecological data (i.e. short or long term) be used to derive EE SQC (soil matrix standards). In view of the inherent uncertainty associated with most ecological bioassay studies, CSST sees little need to try to adjust NOAEL/LOAEL estimates through the application of SFs.*

Section 4.1 - Ecological Receptors

Issue: The protocol has proposed critical receptors (predictive sentinel species) believed relevant to Ecological function at Agricultural, Residential/Parkland, Commercial and Industrial sites. See Table 1 of Protocol .

Should BC Environment support critical receptors identified in Table 1 of the CCME draft Protocol document as suitable predictive sentinel species to encompass the prescribed "scope" of Ecological function present at identified land use sites?

CSST Decision: *Yes, support use of critical receptors identified in Table 1 of the CCME protocol.*

Section 4.2 - Ecological Exposure Pathways

Issue: SCEQCCS defined 3 probable ecological exposure paths:

1. Direct Soil Contact (microbes/inverts/plants) for all 4 land uses,

2. Food Ingestion (herbivores eating contaminated plants) for Agriculture land use only, and

3. Soil Ingestion (herbivores eating soil or fodder) for Agriculture land use only.

Should BC Environment support the above 3 exposure paths proposed in the protocol or simplify to only a single pathway (i.e. direct soil contact)?

CSST Decision: *In all cases the primary ecological matrix standard should be based on the single direct soil contact pathway only (i.e. the "soil invertebrate and plants" matrix standard). On agricultural lands, food and soil ingestion pathways may also be considered through derivation, where possible, of a livestock protection standard.*

Section 5.1 - Agricultural (Ag) Scenario

Issue: Figure 5 of the protocol identifies the following primary ecological activities to be protected at Agricultural sites:

- growth of crops
- raising of livestock

Therefore require consideration of:

1. A direct soil contact procedure to protect microbial nutrient cycling essential for the health of soil invertebrates and plant growth (crops),

2. A livestock food ingestion procedure (i.e. to ensure that no indirect phytotoxicity related toxicity occurs in livestock), and

3. A.livestock soil ingestion procedure (i.e. to ensure that no direct soil ingestion related toxicity occurs in livestock).

Should BC Environment support SCEQCS Ag scenario?

CSST Decision: *Yes - CSST recommends that the growth of crops, microbial function and livestock be protected at Agricultural sites.*

Section 5.2 - Residential/Parkland (R/P) Scenario

Issue: Figure 6 of the protocol identifies the primary ecological activity to be protected at Residential/Parkland sites as:

- growth of ornamental/native flora

Therefore require consideration of a direct soil contact procedure to ensure that soil microbes, soil invertebrates and plants are protected.

Should BC Environment support Residential/Parkland scenario?

CSST Decision: *Yes - support scenario described in principle.*

Section 5.3 - Commercial (C) Scenario

Issue: Figure 7 of the protocol identifies the primary ecological activity to be protected at commercial sites as:

- managed areas for plant growth (ie. flowerbeds and lawns)

Therefore, SCEQCCS recommends use of the same ecological receptors/scenario as that used at Residential/Parkland sites but also recommends provision of a lower level of ecological protection than that provided at either Ag or R/P sites (i.e. use soil contact procedure to protect microbes, invertebrates, and plants).

Should BC Environment support Commercial scenario?

NB It could be argued that since the primary activity to be protected relates to "managed areas", no need exists to provide soil standards capable of supporting the non-supplemented growth of microbes/invertebrates/plants at all.

CSST Decision: *Yes - support scenario described.*

Section 5.4 - Industrial (I) Scenario

Issue: Figure 8 of the protocol recommends that identical primary ecological activities be protected at industrial and commercial sites

- ie. maintenance of "managed areas" like flowerbeds/lawns.

Therefore SCEQCCS says at Industrial sites use the same receptors/scenario as used at commercial sites (ie. soil contact procedure microbes/invertebrates/ plants).

NB SCEQCCS says can't "write off" industrial lands *"a priori"* - such land should at least be able to grow unsupplemented grass.

Should BC Environment support Industrial scenario?

CSST Decision: *Yes - support scenario described*

Section 7.2 - Ecological Effects Data Quality

Issue: CCME says soil based bioassay data should meet minimum data acceptability parameters similar to those used for CCME Water Quality Guidelines.

NB These data acceptability requirements are not overly onerous.

Should BC Environment support Data Acceptability requirements for bioassays used in EE derivation?

CSST Decision: *No - CSST recommends that all available relevant data listed in respective CCME substance assessment documents should be at least initially considered in Soil Quality Criteria Ecological Effects (SQC_{EE}) derivation.*

Section 7.5.2 - SQC_{SC} Derivation

Section 7.5.2(a) - Agricultural/Residential/Parkland TEC Estimation

Issue: SCEQCCS' preferred order for Threshold Effects Concentration (TEC) estimation for Soil Quality Criteria - soil contact (SQC_{SC}) is:

1. Weight of evidence method,
2. LOEC extrapolation method, and
3. Median effects extrapolation method

Should BC Environment support preferred order for SQC_{SC} - TEC derivation?

CSST Decision: *No. CSST proposes an alternative SQC_{SC} derivation procedure be used (see sections 7.5.2 and 7.5.3 below). This alternative procedure is "weight of evidence" based.*

Section 7.5.2(b) - Agricultural/Residential/Parkland "NPER" protection

Issue: SCEQCCS advises that the appropriate level of protection to be afforded by SQC_{SC} on Agricultural and Residential/Parkland sites lies within the "NPER" level (ie. the "No to Potential Effects Range") for EE (see Figure 11 of protocol).

Should BC Environment support a "no to potential effects" level of protection for ecological receptors on Ag and R/P sites?

CSST Decision: *No - a more significant level of effects is acceptable.*

CSST recommends for each substance, plotting Ecological data as percent response versus concentration for both lethal and non-lethal effects. Then calculate and fit "lines of best fit" and estimate concentrations corresponding to the EC50-NL and LC20.

For agricultural/residential/parkland set SQC_{SC} at the less stringent (i.e. the lessor) of the EC50-NL or the LC20 estimates.

Section 7.5.3 SQC_{SC} - Derivation

Section 7.5.3(a) - Commercial/Industrial (C/I) Level of Protection

Issue: The protocol states that a "lower effect" of protection is to be accorded to ecological receptors on Commercial and Industrial (C/I) lands.

This is achieved by setting SQC_{SC} equal to the Effects Concentration Low (ECL) for the "effects" distribution used to calculate the TEC for Ag, and R/P lands.

Thus, ECL equals the Effects Range Low (ERL) or 25th percentile of the EE data. (see Figure 13 of Protocol).

Should BC Environment support an "Effects range low" level of protection for ecological receptors on Commercial and Industrial lands?

CSST Decision: *No - see CSST recommendation for section 7.5.2 above.*

For commercial/industrial land establish SQC_{SC} at the more stringent (i.e. the greater) of the EC50-NL or the LC20 estimates.

Section 7.6 - SQC_{SI} Derivation

Issue: Protocol, pages 53-60 and Appendix 7, provides for a complicated "check" procedure to accord protection to "grazing herbivores" (ie. the Soil Quality Criteria - soil ingestion , SQC_{SI}) which might ingest contaminated soil along with fodder at Ag sites.

Should BC Environment support calculation of SQC_{SI} for use on Ag lands to protect grazing herbivores?

Initial options considered by CSST:

1. Try and calculate this and re-visit the policy question based on the experience and practicability of the process, or

2. Leave this issue either to site specific RA or address through site-specific bioassays.

CSST Decision: *No - procedure is considered too complex and too dependent on default assumptions of questionable scientific veracity.*

CSST proposed an alternative derivation procedure for a livestock protective number which encompasses both contaminated soil and food ingestion. Estimates of chronic daily intake of contaminants via soil and food are compared to a toxicity reference value (TRV) typically derived from the veterinary literature. A soil contaminant concentration representing unity (i.e. 1.0) for the ratio of expected exposure to the TRV is set as the livestock protective soil quality standard.

Section 7.7 - SQC_{FI} Derivation

Issue: The protocol provides for a complicated "check" procedure to accord protection to "grazing herbivores" (ie. Soil Quality Criteria - food ingestion, SQC_{FI}) which may consume plants in which contaminants have bioaccumulated at Ag sites. (See pages 60-65 of protocol).

Should BC Environment support calculation of SQC_{FI} for use on Ag lands to protect grazing herbivores from consuming contaminated plants?

CSST Decision: *No - Procedure is considered too complex and too dependent on default assumptions of questionable scientific veracity. CSST recommends an alternative derivation procedure (see CSST decision for section 7.6 above).*

Section 8 - Final SQC_{EE} for Various Land Uses

Issue: SCEQCCS recommends the following procedures be used in establishing SQC_{EE}:

1. At Agricultural land set SQC_{EE} equal to the lowest of:

- SQC_{SC} - Ag, or
- SQC_{SI}, or
- SQC_{FI}

2. At Residential/Urban parkland land set SQC_{EE} equal to SQC_{SC} - R/P

3. At Commercial or Industrial land set SQC_{EE} equal to SQC_{SC} - C/I

Should BC Environment support final SQC_{EE} derived for the various land uses?

CSST Decision: *For Agricultural land CSST recommends SQC_{EE} be based on the lower of SQC_{SC} - Ag or SQC_{S+FI} (see Part IIB1c below).*

CSST supports protocol recommendations for R/P and C/I land.

Section 8(a) - Microbe Check

Issue: The protocol, page 42, calls for the performance of a "microbial function" check of calculated SQC_{SC} values.

Essentially the CCME microbe check calculates a microbe SQC_{SC} in an identical manner as that used to calculate the usual SQC_{SC}, except that in calculating the microbe SQC_{SC}, the invertebrate and plant data is excluded from the "effects" distribution (ie. distribution is solely microbe based).

Then the microbe SQC_{SC} is compared to normal SQC_{SC}. If the microbe SQC_{SC} is less than the originally calculated SQC_{SC} then the SQC_{SC} is set to equal the geometric mean of both the microbe SQC_{SC} and the original SQC_{SC}.
If the microbe SQC_{SC} is greater than the original SQC_{SC} then the original SQC_{SC} stands.

Should BC Environment support the requirement for the microbe check for <u>all</u> land uses?

CSST Decision: *No - CSST recommends use of the microbe check <u>only</u> for Agricultural land use. Furthermore, CSST recommends only the simple adoption as a matrix standard, of the microbe check soil quality criteria, derived by Environment Canada under CCME methodology, when and if such criteria become publicly available).*

Additional Question

Section 8(b) - Additional Ecological Soil-Groundwater Protective Standards

Issue: The SSO procedure allows for use of appropriate water quality criteria in the groundwater (GW) check to ensure that soil criteria are calculated which can adequately protect GW used for:

- aquatic life,
- livestock watering, and
- direct phytotoxicity (i.e. irrigation watering)

Should BC Environment support the above SSO procedure and use the SSO procedure to calculate environmental soil quality standards which would be protective of groundwater used for:

- **aquatic life,**
- **livestock watering, and**
- **irrigation watering.**

CSST Decision: *Yes, to develop discrete soil - groundwater protective standards. (See also Part IIB1a and IIB1b below).*

IB3. CSST Decisions Related to CCME Protocol Part C - Human Health

Section 1 - Introduction/Principles

Issue: The protocol primarily bases it's defined HH exposure scenario derived criterion on "direct soil ingestion" (ie. derivation of soil ingestion Preliminary Soil Quality Criteria - Human Health, $PSQC_{HH}$) not on other possible HH exposure routes (ie. dermal or inhalation).

Should BC Environment support HH derivation based primarily on "direct soil ingestion"?

CSST Decision: *Yes - This is generally believed to be the quantitatively most important pathway of direct exposure to soil. Where data are available, indirect exposure to soil may also be considered.*

Section 1 (a) - Role of Checks

Issue: The protocol allows for subsequent manipulation of $PSQC_{HH}$ via four additional "check" mechanisms designed to ensure soil criteria are not developed which might result in cross-media contamination of air and water ;

- a "ground water used as drinking water" check (GW),
- a "volatiles in indoor air" check,
- a "vegetable/milk/meat" produce check, and
- an "off-site dust" check.

Should BC Environment support subsequent application of checks on $PQSC_{HH}$?

CSST Decision: *Yes but for the GW check only. CSST believes data is insufficient at this time, to develop scientifically meaningful checks for volatiles in indoor air, vegetables/milk/meat produce or off-site dust.*

Additional Question

Section 1(b) - Possible inclusion of "Soil-Outdoor Air" and "Soil-Indoor Air" Standards

Issue: On initial review of proposed CSST HH soil quality standards, stakeholders noted that no standards to protect against "Soil-Outdoor Air" or "Soil-Indoor Air" contaminant exposure had been proposed for common volatile petrochemical contaminants (i.e. BTXE - benzene, toluene, xylene and ethylbenzene). Several toxicological "risk-based" models were proposed by which such soil quality standards might be developed.. CSST noted that these soil-air models had not yet been verified or validated by empirical studies and that the derivation of risk-based soil-air standards might be construed as establishing "acceptable" air contaminant concentrations, an activity which lies outside of CSST's terms of reference. As this issue was deemed to be primarily a human health issue, CSST referred it to the B.C. Ministry of Health (MOH) for advice. The advice received suggested that the issue could be more properly addressed through risk management activities performed on a site specific basis rather than through the provision of soil-air protective standards.

Should toxicologically based "Soil-Outdoor Air" and "Soil-Indoor Air" HH protective standards be developed by CSST?

CSST Decision: *Based on the MOH's advice on this issue, CSST decided that "Soil-Outdoor Air" and "Soil-Indoor Air" standards should not be developed at*

this time, for any substance listed in schedule 5 of draft 3.0 of the Contaminated Sites Regulation.

Section 1(c) - Multimedia Approach

Issue: The protocol uses a multimedia approach to SQC_{HH} development (ie. assumes RTDI = TDI-EDI).

where RTDI : Residual Tolerable Daily Intake,
TDI : Tolerable Daily Intake,
EDI : Estimated Daily Intake.

Should BC Environment support use of a multimedia approach in HH soil quality standard derivation?

CSST Decision: *CSST supports the concept use of a multimedia RTDI approach in principle. However for purposes of deriving soil quality standards for use in the Contaminated Sites Regulation, CSST decided that this was best done through setting target soil intake to 20% of the TDI.*

Section 1(d) - RTDI Apportionment

Issue: The protocol then allows only a 20% apportionment of the RTDI to soil for purposes of SQC_{HH} derivation.

Should BC Environment support a 20% apportionment of the TDI for HH criteria derivation?

CSST Decision: *Support 20% apportionment of TDI per se, rather than 20% of the RTDI.*

Section 1(e) - TDI Apportionment

Issue: The protocol develops soil HH criteria based on "defined exposure scenarios" tied to four land uses.

One of the principles of these defined exposure scenarios is that the most highly exposed human receptor should be used (ie. child vs. adult).

Should BC Environment support use of generic defined exposure scenarios tied to four land categories in soil HH criteria derivation?

CSST Decision: *Yes. Again for BC Environment's regulatory purposes, the CCME Residential/Parkland land use grouping will be separated in schedule 5 of*

draft 3.0 of the Contaminated Sites Regulation to give a total of five distinct land use categories.

Section 2 - Toxicology

Issue: The protocol differentiates between non-threshold and threshold substances in conferring levels of protection and deriving criteria.

Should BC Environment support concept of differential standard derivation for threshold and non-threshold agents?

CSST Decision: *Yes.*

Section 2(a) - Risk levels

Issue: For non-threshold agents (see page 71 of the protocol). The SCEQCCS has specified that for non-threshold substances, risks should at least be remediated to levels within the range of 10^{-4} to 10^{-6}.

Should BC Environment support SCEQCCS' stated opinion regarding the "acceptable risk" range for carcinogenic substances?

CSST Decision: *CSST recommended using an acceptable risk of 1×10^{-5} for purposes of calculating non-threshold substance soil quality standards. CSST also recommended use of 1×10^{-5} as a default level for site specific risk assessment. In addition, CSST was of the opinion that proponents should be able to request that the Local Medical Health Officer (LMHO) lead a community review process to recommend on a site- specific basis a level of acceptable risk. It was also felt that the final decision as to an appropriate level of acceptable human health risk for a site subjected to such a LMHO-community process should lie with the BC Environment Regional Manager.*

Section 2.1.1 Classification of Carcinogenic Status

Issue: The protocol has deferred classification decisions regarding substance carcinogenicity to Health Canada.

Should BC Environment support deferring carcinogenic classification to Health Canada?

CSST Decision: *CSST recommends supporting Health Canada carcinogenic classification only to the extent stated in CSST's "Hierarchy of acceptable toxicity reference value sources" paper (Fox, 1995).*

Additional Question

Section 2.1.1(a) - Need for "Hierarchy of Toxicity Reference Values"

Issue: In order to achieve consistency in the development of toxicologically based soil quality standards to protect the health of human and non-human biota, a hierarchy of acceptable toxicity reference values was required by CSST. In consequence, a paper "Hierarchy of Preferred Sources of Toxicity Reference Values for use in Calculation of CSST Numbers for use in the Contaminated Sites Regulation" (Fox, 1995) was prepared for CSST's review and approval.

Should CSST's "Hierarchy of Acceptable Toxicity Reference Value Sources" paper be used in calculation of soil quality standards?

CSST Decision: *CSST approved the above mentioned paper for use in calculating soil standards under the Contaminated Sites Regulation.*

Section 2.2 - Threshold Substances TDI/RfD Approach

Issue: The protocol uses a RfD approach for threshold substances (ie. uses TDIs obtained from Health Canada).

$$\text{i.e. } TDI = \frac{\text{NOAEL or LOAEL}}{UF}$$

where NOAEL : No observed adverse effect level
LOAEL : Lowest observed adverse effect level
UF : Uncertainty factor

Should BC Environment support derivation of soil HH criteria based on TDI for non-carcinogenic substances?

CSST Decision: *Yes - This is a commonly accepted method in limit setting.*

Section 2.2(a) - Threshold Substances TDI Sources

Issue: Page 74 of the protocol states "Health Canada has accepted responsibility for determining the TDI for each contaminant being addressed by the NCSRP".

To date, no official TDI's have be provided by Health Canada other than those published

under the Canadian Environmental Protection Act (CEPA).

If Health Canada will not provide requisite TDIs should BC Environment use RfDs from other agencies (ie. USEPA or WHO) in deriving SQC_{HH} standards?

CSST Decision: *Yes - As stated in CSST's "Hierarchy of Acceptable Toxicity Reference Value Sources" paper.*

Section 3 - Mixtures

Issue: The protocol derives criteria for individual substances only, (i.e. NOT FOR MIXTURES), or in the case where Toxicity Equivalency Factors (TEFs) are available, for chemical classes of substances (ie. PCDD and PAHs).

Should BC Environment support single substance criteria derivation and exclude consideration of toxic interactions/mixtures?

CSST Decision: *Yes - Current status of toxicological science precludes widespread generic criteria derivation based on toxic mixtures other than Dioxin - TEQs (Toxic Equivalency Quotients) or PAH BaP-TEQs.*

Issues of toxicity for interactive contaminant mixtures should be dealt with via site-specific risk assessment.

Section 3.2 - Determination of EDI

Issue: The CCME protocol recommends use of the EDI in the equation for $PSQC_{HH}$. EDIs are to be developed by Health Canada. To date, no official EDI estimates (other than those published under CEPA) have been forthcoming from Health Canada.

As few EDI's are forthcoming from Health Canada should CSST develop it's own simplified $PSQC_{HH}$ derivation formula to exclude consideration of background EDI exposure?

CSST Decision: *Yes. Note CSST has recommended an alternative $PSQC_{HH}$ derivation process (see section 5.1 below). Furthermore, it is not clear that EDIs based on the average Canadian population are meaningful for use in setting soil standards.*

Section 4 - Human Health Exposure Scenarios

Issue: The CCME protocol assumes a lifetime period of exposure in HH scenarios.

Should BC Environment support HH criteria derivation based on lifetime exposure as a first principle?

CSST Decision: *Yes - Ensures no limitations on land use and will not over-estimate exposure.*

Section 4.1.1 - "Soil Allocation Factor" (Apportionment)

Issue: The SCEQCCS has elected to apportion the RTDI equally among five "universal" environmental media (ie. air, soil, water, food and consumer products).

This results in only 20% of the RTDI being available for soil HH criteria derivation.

Should BC Environment support the use of the 20% Soil Allocation Factor?

CSST Decision: *Yes - but normally only as 20% of total TDI.*

Section 4.1.1 - $PSQC_{HH}$ Derivation Procedure if EDI Exceeds RTDI

Issue: The protocol states that if the EDI already exceeds the TDI (RTDI = 0) for a substance, no $PSQC_{HH}$ is to be calculated. Rather the soil HH criterion is simply established at the background (ie. EDI) level attributable to soil.

Should BC Environment support establishment of $PSQC_{HH}$ at "background" (i.e. soil EDI) level as an appropriate SQC_{HH} soil quality standard if the EDI exceeds the TDI?

CSST Decision: *If "generic" provincial or local background can be shown to exceed the value for $PSQC_{HH}$ calculated by CSST method, then BC Environment should only require site clean-up to background level.*

Section 4.1.2 - Non-threshold EDI Exceedance of TDI

Issue: The protocol (page 80) specifies that for a carcinogenic substance the SQCHH will be established at a default level of risk = $1x10^{-6}$.

Should BC Environment support establishment of HH soil quality standards at a $1x10^{-6}$ level of risk?

CSST Decision: *No, CSST has decided to use $1x10^{-5}$ to calculate HH soil quality standards based on the lower limit of the acceptable risk range recently recommended by the BC Associated Boards of Health. See also, Section 2 - Risk Levels, above.*

Section 4.2 - Absorption

Issue: The protocol allows for consideration of a substance's "absorption" or bioavailability (Absorption Faction - AF) potential via ingestion, dermal or inhalation routes in SQC_{HH} derivation.

Should BC Environment support use of an Absorption Factor - Soil (AF_S) in $PSQC_{HH}$ derivation?

CSST Decision: *Yes if the AF_S for a substance is available and has been subjected to scientific peer review.*

Section 4.3.2 - Agricultural Land defined HH exposure scenario

Issue: Figure 19 of the protocol provides the SCEQCCS's defined exposure scenario for Ag land.

Should BC Environment support CCME's defined HH exposure scenario for Ag land?

CSST Decision: *Yes for assumed appropriate sensitive receptor, exposure period and direct exposure pathway to be used to calculate HH soil-ingestion standards.*

Section 4.3.3 - Residential/Parkland defined HH exposure scenario

Issue: Figure 20 of the protocol presents SCEQCCS's defined exposure scenario for R/P lands.

Should BC Environment support CCME's defined HH exposure scenario for R/P lands?

CSST Decision: *Yes for assumed appropriate sensitive receptor, exposure period and direct exposure pathway to be used to calculate HH soil-ingestion standards.*

Section 4.3.4 - Commercial land defined HH exposure scenario

Issue: Figure 21 of the protocol presents SCEQCCS's defined exposure scenario for commercial land.

Should BC Environment support CCME's defined HH exposure scenario for Commercial land?

CSST Decision: *Yes for assumed appropriate sensitive receptor, exposure period and direct exposure pathway to be used to calculate HH soil-ingestion standards.*

Section 4.3.5 - Industrial Land defined HH exposure scenario

Issue: Figure 22 of the protocol presents SCEQCCS's defined exposure scenario for industrial land.

Should BC Environment support CCME's defined HH exposure scenario for Industrial land?

CSST Decision: *No. CSST has recommended that issues relating to the derivation of soil quality standards to protect HH at industrial sites should be referred to the Workers Compensation Board (see decision relating to additional question below).*

Additional Question

Section 4.3.5(a) - Role of Worker's Compensation Board in Industrial Site Management

Issue: The Worker's Compensation Board (WCB) is mandated to protect worker's health and safety from exposure to industrial chemicals. Thus if soil quality standards for the protection of human health from contaminants at industrial sites were to be derived by BC Environment using CSST derivation procedures, such standards might conflict with WCB standards.

Should BC Environment specify human health protective soil-ingestion standards for industrial sites or leave the issue of the development of such standards at these sites to the WCB?

CSST Decision: *Based on WCB statutory primacy in this area, CSST recommends that human health soil-ingestion standards not be specified for the industrial land use category in the Contaminated Sites Regulation. Rather the issue of worker safety as it relates to the possible ingestion of contaminants in soil should be regarded as the sole responsibility of the*

WCB.

Consequently, in regard to protection of human health, only soil quality standards protective of groundwater used for drinking water, will be derived for industrial lands.

Section 5.1 - $PSQC_{HH}$ derivation formula for threshold substances

Issue: Page 89 of the protocol uses the following formula for $PSQC_{HH}$:

$$PSQC_{HH} = \frac{(TDI - EDI) \times SF \times BW}{[(AF_I \times IR) + (AF_D \times DR) + (AF_S \times SR)] \times ET} + BSC$$

NB The above "CCME protocol" $PSQC_{HH}$ formula effectively uses the RTDI, where RTDI = (TDI - EDI)

Should BC Environment support the "CCME protocol" $PSQC_{HH}$ formula proposed by SCEQCCS for non-carcinogenic substances?

CSST Decision: *See sections 1d and 2.3.1 above - CSST recommends that the "CCME protocol" $PSQC_{HH}$ formula for non-carcinogenic substances should be used, where published data for EDI and BSC (Background Soil Concentration) are available, to calculate a new $PSQC_{HH(EDI)}$ value. This new $PSQC_{HH(EDI)}$ value should then be compared to the value calculated for $PSQC_{HH}$ using CSST's preferred simplified "TDI apportionment-based" formula (see below). CSST recommends adoption as the appropriate soil quality standard, of the "more reasonable" of the CCME protocol-based $PSQC_{HH(EDI)}$ or the TDI apportionment-based $PSQC_{HH}$.*

Section 5.1 - $PSQC_{HH}$ derivation formula for threshold substances

Issue: CSST has recommended that a preferred simplified "TDI apportionment-based" $PSQC_{HH}$ value based on a 20% apportionment of the TDI, always be calculated.

See CSST decisions relating to: Part A - Section 2.3.1. , and
Part C - Section 1 and Section 4.1.1.

In view of CSST's decisions, the following "TDI apportionment-based" $PSQC_{HH}$ derivation formula was proposed:

$$PSQC_{HH} = \frac{[SAF \times TDI] \times BW}{[(AF_I \times IR) + (AF_D \times DR) + (AF_S \times SR)] \times ET}$$

where SAF = 0.2

Should BC Environment support CSST's above simplified "TDI apportionment-based" $PSQC_{HH}$ derivation formula?

CSST Decision: *Yes for threshold substances. Use SAF = 0.2 as standard default apportionment factor for TDI.*

Section 5.2 - $PSQC_{HH}$ derivation formula for non-threshold substances

Issue: For non-threshold substances, page 90 of the protocol uses the following formula to derive a CCME recommended $PSQC_{HH}$ value:

$$PSQC_{HH} = \frac{RsD \times BW}{[(AF_I \times IR) + (AF_D + DR) + (AF_S \times SR)] \times ET}$$

NB formula assumes adult is critical receptor

Should BCE support CCME's above recommended $PSQC_{HH}$ derivation formula for carcinogenic substances?

CSST Decision: *Yes, use formula but RsD should be based on 1×10^{-5} acceptable risk. Note that ET (Exposure Time) should be based on a 70 year lifetime for agricultural, residential, urban park and commercial land use scenarios.*

Section 5.3.2 - Need for Groundwater Check

Issue: The protocol presents a GW leachate model which can calculate for nonionic organic contaminants only, a soil concentration which will not result in GW exceeding the Drinking Water (DW) guideline

Should BCE support the need to protect GW used as DW from soil contaminants?

CSST Decision: *Yes. See also IIB1a below.*

Section 5.3.2(a) - GW Check Preferred Model

Issue: CSST noted that SCEQCCS recommended a relatively unsophisticated model be used to calculate soil-groundwater protective standards.

Should BCE support the specific leachate model presented in the protocol to back-calculate soil contaminant concentrations which would not result in GW contamination in excess of appropriate DW guidelines?

CSST Decision: *No. CSST has recommended use of alternative soil to GW contaminant fate and transport models which are believed to offer a level of protection which is more consistent with CSST principles. See also IIB1b below.*

Section 5.3.2(b) - GW Check Mandatory Use

Issue: The protocol views the GW check as a mandatory actionable check (i.e. if the GW check produces a soil criterion more stringent than the CCME recommended $PSQC_{HH}$, then the GW based criterion must be used in place of the $PSQC_{HH}$).

Should BCE support use of the GW check as a mandatory actionable check mechanism for $PSQC_{HH}$?

CSST Decision: *CSST recommends that the GW as DW "check" should be incorporated as a specific discrete soil quality standard for all land uses. See IIB1a below.*

Section 5.3.3 - Produce/Milk/Meat (Vegetable check)

Issue: The protocol presents a complex and elaborate check procedure to ensure that the derived $PSQC_{HH}$ do not inadvertently result in unacceptable contributions to the total daily intake of contaminants via home-grown produce, meat and milk. This procedure not only estimates the contaminant transfer to produce/milk/meat based on questionable bio-concentration factor (BCF) values, but it also e estimates the type and amounts of foods grown on-site and the amounts of such foods actually consumed on-site.

The protocol proposes that this "vegetable" check be a mandatory actionable check mechanism on Agricultural lands and "recommends" that it also be so used on residential sites for backyard garden produce.

Should BCE support the produce/meat/milk check as a mandatory actionable check mechanism for $PSQC_{HH}$ on Ag, and R/P lands?

CSST Decision: *No, see section 4.3.2 above.*

Section 5.3.4 - Indoor Air Volatilization Check

Issue: The protocol presents in Appendix 9, a check mechanism designed to ensure that volatile organic contaminants do not migrate into the basements of buildings

and thus pose a potential HH indoor air contamination risk.

The SCEQCCS recommends that this check be considered a mandatory actionable check to be applied to the CCME recommended $PSQC_{HH}$ for all four land categories.

The CCME model is based on a residential home (parameter value estimates were subjected to stochastic analysis). There is some question then as to how relevant the modeled conditions (i.e. residential building parameters) might be if applied to a generic industrial site (i.e. large factory building parameters).

The CCME model calculates $PSQC_{HH}$ soil criteria for volatile substances which result in indoor air concentrations which would not be expected to exceed 20% of the inhalation reference dose for non-carcinogenic substances or a carcinogenic risk level in excess of 1×10^{-6} .

Should BCE support use of the indoor air volatilization check as a mandatory actionable check mechanism for $PSQC_{HH}$ across all land uses?

CSST Decision: *No. CSST believes the "state of science" regarding air infiltration modeling is not sufficiently developed at this time, to allow meaningful generic indoor air volatilization checks to be calculated.*

However, CSST has also encouraged BC Environment to initiate Indoor Air Infiltration model validation studies and has recommended that the above decision should be revisited in light of the results of such studies in the future. See also CSST decision relating to section 1 above.

Section 5.3.5 - Off-site Dust Check

Issue: Appendix 6 of the protocol recommends that an "off-site dust" check incorporating an erosion model be applied to the CCME recommended $PSQC_{HH}$ value calculated for industrial land. The purpose of this check is to ensure that the transfer of eroded soil contaminants from industrial sites remediated in compliance with the CCME recommended $PSQC_{HH}$ value will not result in soil contamination on neighboring R/P properties in excess of the $PSQC_{HH}$ - R/P.

The CCME model first estimates, wind erosive transfer of soil from industrial lands to neighboring R/P properties. The model then estimates the degree of mixing of eroded and native soil on the R/P site. Finally the model back-calculates a contaminant concentration in the soil of the industrial site which would not be expected to result in contamination of the neighboring R/P site in

excess of the R/P criterion.

The protocol states in Appendix 6, that "if the $PSQC_{HH}$ for the industrial site exceeds Ci (i.e. the concentration in eroded soil), then the SQC_{HH} should be set to equal Ci." A further recommendation is made to "cap" all $PSQC_{HH}$ calculated for Industrial lands at 15x the SQC_{HH} for residential sites to protect against possible off-site contamination.

Should BC Environment support the use of the off-site dust check as a mandatory actionable check for $PSQC_{HH}$ on industrial lands?

CSST Decision: *No. CSST believes such potential off-site pollution of neighboring properties can be better controlled through the application of existing BC Environment legislative and regulatory controls.*

Section 6 - Derivation of Final SQC_{HH} for Various Land Uses

Issue: The protocol establishes the following final SQC_{HH} for various land uses:

1. Agricultural lands

final SQC_{HH} = most stringent of;	1.	Agricultural $PSQC_{HH}$
	2.	GW Check
	3.	Volatile Indoor Air Check
	4.	Vegetable Produce Check

2. Residential/Parkland

final SQC_{HH} = most stringent of;	1.	Residential/Parkland $PSQC_{HH}$
	2.	GW Check
	3.	Volatile Indoor Air Check
it is also recommended that;	1.	Vegetable Produce Check be viewed as an additional Major Adjustment Factor (MAF) to be considered in determining final SQC_{HH}

3. Commercial Lands

final SQC_{HH} = most stringent of;	1.	Commercial $PSQC_{HH}$
	2.	GW Check

3. Volatile Indoor Air Check

4. Industrial Lands

final SQC_{HH} = most stringent of;
1. Industrial $PSQC_{HH}$
2. GW Check
3. Volatile Indoor Air Check

it is also recommended that;
1. Off-site Dust Check be viewed as an additional Major Adjustment Factor (MAF) to be considered in determining final SQC_{HH}

Should BC Environment support use of the above CCME procedures in derivation of final SQC_{HH} for various land uses?

CSST Decision: *CSST supports only the use of the following procedures to calculate SQC_{HH} values for use as HH matrix standards, for the various land uses:*

1. Agricultural Lands

calculate discrete SQC_{HH} values for;
1. *Agricultural $PSQC_{HH}$*
2. *GW Check*

2. Residential/Urban Parkland

calculate discrete SQC_{HH} values for;
1. *Residential/Urban Parkland $PSQC_{HH}$*
2. *GW Check*

3. Commercial Lands

calculate discrete SQC_{HH} values for;
1. *Commercial $PSQC_{HH}$*
2. *GW Check*

4. Industrial Lands

calculate discrete SQC_{HH} values for;
1. *GW Check*

IB4. CSST Decisions Related to CCME Protocol Part D - Final SQC

Part D. Derivation of Final SQC

Section 1.1 - Final criteria derivation

Issue: The protocol sets a single final soil quality criterion (SQC_F) for each substance for each land use category, as the most stringent of the final SQC_{EE} and the final SQC_{HH}.

Should BCE support final derivation of a single final SQC?

CSST Decision: *No, CSST recommends calculation of discrete SQC_{EE} and SQC_{HH} values for use in establishing discrete site-specific factor associated soil quality standards. See also additional question below.*

Additional Question

Section 1.1(a) - Need to Identify "Mandatory" Soil Quality Standards

Issue: The standards of the Contaminated Sites Regulation act both to qualify a site as a contaminated site, and may also be used to determine when a contaminated sites has been satisfactorily remediated, under the Contaminated Sites Regulation. As a result, one or more of the soil quality matrix standards listed in schedule 5 of draft 3.0 of the Contaminated Sites Regulation must act as a "mandatory" standard against which the determination as a contaminated site under the regulation can be made. CSST agreed with CCME policy that equal weight should be accorded to the protection of human and non-human biota from toxic insult at remediated contaminated sites, and extended this policy to include the consideration of the aesthetic concerns detailed in the "other protection" section of schedule 5 matrices.

Should CSST recommend "mandatory" matrix standards for use in the Contaminated Sites Regulation?

CSST Decision: *In view of the above, CSST decided that for purposes of defining a site as a contaminated site under the Contaminated Site Regulation the following three soil quality matrix standards should be viewed as mandatory applicable standards;*

- *"Soil ingestion" standard (Human Health protection) at Agricultural, Residential, Urban Park and Commercial sites,*

- *"Soil Invertebrate and plants" standard (Environmental protection), at all sites, and the*

- *"Odour" standard (Other protection) at all sites.*

Additional Question

Section 1.1(c) - Need for new "Other Protection" matrix standards

Issue: CSST recognized that soil contaminants can present "hazards" beyond those directly related to ecological and human health. These include physical/chemical hazards (explosivity, flammability, corrosivity, reactivity, radioactivity, etc.) and issues of aesthetic quality (organoleptic considerations). The CCME protocol does not address any of these non-toxicological hazards.

Should BC Environment derive soil quality numbers to address possible physical/chemical hazards and/or aesthetic issues?

CSST Decision: *Yes, but only for organoleptic and aesthetic concerns. No soil quality numbers should be derived to deal with explosivity, reactivity, corrosivity, flammability or other such physical/chemical hazards which soil contamination may present. According to BC Environment members of CSST, such hazards are adequately addressed by provisions in the Special Waste Regulation. A CSST soil quality standard to address odour considerations will be presented as a discrete matrix standard.*

See also IID1 below.

Section 1.2 - Nutritional Requirement and Background Concentration Verification

Section 1.2(a) - Nutritional Requirement

Issue: The protocol allows further adjustment of the SQC_F to ensure:

Plant nutritional requirements are met by both Agricultural and Residential/Parkland SQC_F

Specifically, the protocol states "If SQC_F concentration can be shown to be less than that concentration required to meet essential nutrient demands of plants then the final SQC_{EE} becomes the plant nutritional requirement concentration."

Should BCE support the CCME plant nutritional verification procedure?

CSST Decision: *No, CSST believes agricultural sites are "managed" sites and therefore the assurance of plant nutritional requirements at such sites is a primary responsibility/decision of site owner.*

Section 1.2(b) - Background Concentration Verification

Issue: The protocol allows further adjustment of the SQC_F to ensure:

Background soil contaminant concentrations are considered by both Agricultural and Residential/Parkland SQC_F

Specifically, the protocol states "If SQC_F is below the acceptable background concentration then SQC_F is replaced by the background concentration as the operative criterion".

Should BCE support Background verification procedure?

CSST Decision: *In principle, CSST agrees with the concept that SQC values should not be established at levels below normal background levels. This belief is reflected in existing BC Environment policy and in draft 3.0 of the Contaminated Sites Regulation which precludes the classification as a contaminated site, and thus the consequent requirement to remediate, any site with contaminant concentrations at or below local natural background concentrations of any substance.*

END OF PART I

PART II : Record of CSST Decisions on Policy/Decision Issues Relating to the Derivation of Matrix Soil Standards Based on Novel CSST Procedures

IIA. Introduction

In addition to considering CCME guidance relating to soil quality standards for contaminated sites, CSST also developed a number of additional new procedures by which to derive matrix soil standards for use in the Contaminated Sites Regulation. As detailed below, these new derivation procedures also required CSST to make decisions relating to science policy and address unique issues and assumptions inherent in these "novel" matrix standards.

IIB. New "Environmental Protection" Matrix Standards

IIB1a. Need for additional soil groundwater protective matrix standards

Issue: CSST noted that as suggested in the CCME SSOs procedures, additional new soil groundwater protective standards to protect the current and future use of groundwater at remediated contaminated sites for use by non-human receptors (i.e. aquatic life, livestock and irrigation) could be developed and added to matrices if desired.

Should new additional soil groundwater protective matrix standard derivation procedures be developed?

CSST Decision: *CSST decided that to the greatest extent possible, additional new soil groundwater standards to protect groundwater used for irrigation, livestock watering and for use by aquatic life should be incorporated into matrices.*

IIB1b. Models to be used for derivation of additional soil to groundwater protective matrix standards

Issue: The model and equations recommended by CCME to derive soil to groundwater criteria to protect groundwater used as drinking water from non-polar organic soil contaminants are inadequate to derive soil groundwater protective standards for either polar organics or heavy metals. Nor is the CCME model believed to be sufficiently sophisticated to allow the derivation of practical soil standards for use at remediated contaminated sites to protect groundwater for current and future use by the non-human receptors noted in IIB1a above.

However, BCE hydro-geologists through the use of progressively more sophisticated models were able to provide for CSST's approval, procedures

which would allow the derivation of both the new soil groundwater standards called for under CSST's decision IIB1a above and for the future protection of groundwater used as drinking water. Details of these new soil-groundwater standard derivation procedures and models appear in the document "Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites" (CSST, 1996).

Should the new soil-groundwater fate and transport models proposed by BC Environment hydro-geologists be used by CSST to derive additional new soil to groundwater matrix standards?

CSST decision: *The new soil to groundwater models proposed by BCE hydro-geologists were reviewed and ultimately approved for use by CSST.*

Consequently, where appropriate, new soil groundwater matrix standards were calculated and added to the environmental protection section (to ensure protection of groundwater used for aquatic life, livestock and irrigation) and to the human health protection section (to ensure protection of groundwater used for drinking water) in schedule 5 of the draft Contaminated Sites Regulation.

IIB1c. Livestock Matrix Standards

Issue: CSST rejected the "herbivore check" proposed by CCME for agricultural and residential land uses. CSST's had several reasons for this decision. For example, CSST believed it was more reasonable to assume that livestock were not raised at (i.e. absent from) most residential sites within the Province, and that the CCME model for the herbivore check employed assumptions which were not scientifically defensible. Consequently, CSST originally proposed that the issue of livestock protection at remediated agricultural sites might be adequately addressed by reference to the "Toxicity to soil invertebrates and plants" matrix standard.

However, when this assumption was tested based on the veterinary literature, it was found that for many substances, the "Toxicity to soil invertebrate and plants" matrix standard was in fact not sufficiently protective of livestock. BCE toxicologists through the use of a more sophisticated model were able to provide for CSST's approval, procedures for selected heavy metals, which would allow the derivation of a new "Livestock ingesting soil and fodder" matrix standard for use at agricultural sites. Details of the new livestock standard derivation procedure and model appear in "Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites" (CSST, 1996).

Should the new livestock soil and fodder ingestion model proposed by BC Environment toxicologists be used by CSST to derive new "Livestock ingesting soil and fodder" matrix standards?

CSST Decision: *The new "Livestock ingesting soil and fodder" standard derivation models proposed by BCE toxicologists were reviewed and ultimately approved for use by CSST.*

Consequently, where appropriate, calculated new livestock protective matrix standards were added to the environmental protection section of schedule 5 of the draft Contaminated Sites Regulation.

IIB1d. Use of Interim CCME Criteria as "Toxicity to soil invertebrate and plant" Matrix Standards in Schedule 5.

Issue: For several substances proposed for inclusion in schedule 5, the available soil invertebrate and plant toxicity data was either insufficient or inadequate to generate appropriate "Toxicity to soil invertebrate and plant" protective standards for use in the environmental protection section of CSST matrices. For these substances however, data was available to allow the derivation of CSST "Intake of contaminated soil" protective standards for use in the human health protection section of matrices.

It was also noted that in circumstances where data was inadequate to generate both human health and environmental protection matrix standards, CSST had decided that no matrix would be constructed for use in schedule 5 of the Contaminated Sites Regulation. Rather, for such substances, CSST had decided that the CCME interim criteria would continue to be used as the appropriate soil standard in schedule 4 of the regulation.

Should CCME Interim soil quality criteria be used as appropriate "Toxicity to soil invertebrate and plants" matrix standards for substances for which human health matrix standards can be calculated but for which no soil invertebrate and plants standard can be calculated?

CSST Decision: *Rather than "lose" the ability to use legitimately derived matrix standards to protect human health for substances for which environmentally protective matrix standards could not be derived due to data limitations, which would effectively result if no matrices were developed for such substances, CSST decided that since the interim CCME criteria were deemed to be "equally protective of the health of both human and non-human biota", the interim CCME criteria could be used as "Toxicity to soil invertebrate and plants" standards in matrices for substances for*

which ecological data limitations precluded the derivation of environmental protective matrix standards by normal CSST procedures.

IIC. New "Human Health Protection" Matrix Standards

IIC1a. Adjustment of toxicologically derived soil ingestion standards to incorporate "real world" experience in arsenic, cadmium and lead matrices.

Issue: Health members of CSST noted that based on "real world" experience, some of the toxicologically modeled matrix soil ingestion standards might not be reflective of actual health risks. As a result, a contract was arranged with the UBC Department of Health Care and Epidemiology to review empirical studies which correlated health outcomes with exposure to arsenic, cadmium, chromium, lead and benzene in soil. As a result of this review, MOH members were able to provide empirically derived soil ingestion standards for arsenic, cadmium and lead. These "real world" adjusted standards were provided to CSST for approval.

Should toxicological derived "soil intake" matrix standards for arsenic, cadmium, chromium, lead and benzene be adjusted based on the results of the "real world" clinical experience review conducted for these substances?

CSST decision: *CSST approved "real world" adjustment of soil ingestion matrix standards for arsenic, cadmium and lead. CSST also approved the use of "real world" standards for arsenic, cadmium and lead as soil ingestion matrix standards in schedule 5 of the Contaminated Sites Regulation.*

IID. New "Other Protection" Matrix Standards

IID1a. Physical/Chemical Hazard Protective Matrix Standards

Issue: CSST noted that in addition to protection of the health of human and non-human biota from toxic risk and/or hazard, it would be desirable to also ensure that soil contamination concerns relating to physical/chemical hazards (i.e. explosivity, flammability, reactivity, radioactivity, etc.) and objectionable odour were adequately addressed in the matrices.

Should new matrix standard derivation procedures be developed to ensure protection against "other" non-toxicological (i.e. physical/chemical) hazards associated with soil contamination?

CSST Decision: *CSST decided that an additional section of Site-specific Factors (i.e. "Other Protection") would be added to matrices to deal with non-*

Matrix standards to protect against objectionable soil odours arising from on-site volatile contaminants would be derived using the "Simplified Odour Model" approved by CSST.
BC Environment members of CSST were of the opinion that physical/chemical hazards possibly associated with soil contaminants could be adequately controlled under the existing provisions of the Special Waste Regulation. Consequently, CSST decided that no additional matrix standards to protect against physical/chemical hazards or risks of on-site soil contaminants were in fact necessary.

END OF PART II

Documents Cited

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CSST, 1996. **"Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites"**. BC Environment. January, 1996.

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Appendix I. CSST Acronym List

Acronym	Definition
AF	Absorption Factor
AF_D	Absorption Factor - Lung
AF_I	Absorption Factor - Gut
AF_S	Absorption Factor - Dermal
Ag	Agricultural Land Use
BCE	BC Environment
BCF	Bio-Concentration Factor
BW	Body Weight (kg)
BSC	Background Soil Concentration
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
C	Commercial Land Use
CCME	Canadian Council of Ministers of the Environment
Ci	Contaminant Concentration in Eroded Soil
C/I	Commercial/Industrial Land Use
CEPA	Canadian Environmental Protection Act
CSAG	Contaminated Sites Advisory Group
CSST	Contaminated Sites Soil Taskgroup
DR	Soil Inhalation Rate (mg/m^3)
DW	Drinking Water
EC50-NL	Median Effective Concentration - Nonlethal distribution (mg/kg)
ECL	Effects Concentration Low (mg/kg)
EDI	Estimated Daily Intake (mg/d)
EE	Environmental Effects, Ecological Effects
EHO	Environmental Health Officer
EPC	Environmental Protection Committee
EE SQC	Environmental Effects - Soil Quality Criteria
ERA	Environmental Risk Assessment
ERL	Effects Range Low (ecological)
ET	Exposure Period (hr/d/wk/yr)
GW	Groundwater
HH	Human Health
HH SQC	Human Health Soil Quality Criteria
HRA	Human Health Risk Assessment
IR	Soil Ingestion Rate (mg/d)
LC20	Lethal Concentration - 20%
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
LMHO	Local Medical Health Officer

Acronym	Definition
LOAEL	Lowest Observed Adverse Effect Level
LOEL	Lowest Observed Effect Level
MAF	Major Adjustment Factor
MOH	BC Ministry of Health
NCSRP	National Contaminated Sites Remediation Program
NO	No Observable
NOAEL	No Observed Adverse Effect Level
NOEL	No Observed Effect Level
NPER	No to Potential Effects Range
PAH	Polynuclear Aromatic Hydrocarbon, Polycyclic Aromatic Hydrocarbon
PAH BaP-TEQ	PAH Benzo[a]pyrene Toxicity Equivalency Quotient
PCDD	Polychlorinated Dibenzodioxin
$PSQC_{HH}$	Preliminary Soil Quality Criteria - Human Health (TDI based)
$PSQC_{HH(EDI)}$	Preliminary Soil Quality Criteria - Human Health (EDI based)
R	Residential Land Use
RA	Risk Assessment
RfC	Reference Dose - Inhalation (mg/m^3)
RfD	Reference Dose - Oral (mg/kg)
RsD	Risk Specific Dose (mg/kg)
RTDI	Residual Tolerable Daily Intake (mg/d)
SCEQCCS	Subcommittee for Environmental Quality Criteria - Contaminated Sites
SAF	Soil Apportionment Factor (20%)
SF	Safety Factor
SMC 1	Soil Quality Criteria - Microbe Check Group 1
SMC 2	Soil Quality Criteria - Microbe Check Group 2
SQC	Soil Quality Criteria
SQS	Soil Quality Standard
SQC EE, SQC_{EE}	Soil Quality Criteria - Environmental Effects
SQC F, SQC_{F}	Soil Quality Criteria - Final
SQC FI, SQC_{FI}	Soil Quality Criteria - Food Ingestion
SQC HH, SQC_{HH}	Soil Quality Criteria - Human Health
SQC ia, SQC_{ia}	Soil Quality Criteria - Indoor Air
SQC meat	Soil Quality Criteria - Meat
SQC milk	Soil Quality Criteria - Milk
SQC SC, SQC_{SC}	Soil Quality Criteria - Soil Contact
SQC SC1, SQC_{SC1}	Soil Quality Criteria - Soil Contact Group 1
SQC SC2, SQC_{SC2}	Soil Quality Criteria - Soil Contact Group 2

Acronym	Definition
SQC SI, SQC_{SI}	Soil Quality Criteria - Soil Ingestion
SQC_{SI+F}	Soil Quality Criteria - Soil Ingestion + Food
SQC veg	Soil Quality Criteria - Vegetables
SR	Soil Dermal Contact Rate
SS-ERA	Site Specific - Environmental Risk Assessment
SS-HRA	Site Specific - Human Health Risk Assessment
SSO	Site Specific Objective
SSS	Site Specific Standard
TDI	Tolerable Daily Intake (mg/d)
TEC	Threshold Effects Concentration - ecological
TEC	Toxicity Equivalency Factor
TEQ	Toxicity Equivalency Quotient
TRV	Threshold Reference Value
UF	Uncertainty Factor
USEPA	United States Environmental Protection Agency
WCB	Worker's Compensation Board of British Columbia
WHO	United Nations World Health Organization
Ya-aq	Groundwater Coefficient - Aquatic Life
Ya-dw	Groundwater Coefficient - Drinking Water
Ya-ir	Groundwater Coefficient - Irrigation Watering
Ya-lw	Groundwater Coefficient - Livestock Watering

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