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CSR OMNIBUS UPDATE: Proposed Amendments to Schedule 9

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Summary of Proposed Updates for 2015/2016 Stage 10 amendment to CSR

1. The ministry proposes to convert the Sediment Quality Criteria into Sediment Quality Standards.

2. The ministry proposes no change to the existing Schedule 9 Sediment Quality Criteria to protect aquatic life is proposed.

3. The ministry proposes that no effort be expended on attempting to develop sediment quality standards to protect human health for the Stage 10 amendment to the CSR.

Introduction

Schedule 9 of the Contaminated Sites Regulation (CSR) provides sediment quality criteria (SQC) for the protection of aquatic life. The schedule does not provide any sediment quality criteria for the protection of human health.

In schedule 9, SQC are presented for two distinct sediment types (i.e. sensitive and typical) reflective of two distinct aquatic life environments (i.e. freshwater and marine/estuarine):

1. SQC for sensitive sediment (SQCss) for freshwater and for marine/estuarine sediment and,

2. SQC for typical sediment (SQC_{TS}) for Freshwater and for marine/estuarine sediment.

The Schedule 9 criteria were developed in under contract to the ministry by MacDonald Environmental Sciences Ltd. [1]. The SQC were derived, for the substances prescribed in Schedule 9, by multiplying the CCME, 1999 [2] Probable Effect Level (PEL) for individual Contaminants of Potential Concern by a defined probability of observing a 20% effect (EC_{20}) in selected toxicity tests. The toxicity tests included 28-42 day toxicity tests for the freshwater amphipod, *Hyalella azteca*, and 10 day toxicity tests with the marine amphipods: *Ampelisca abdita* and *Rhepoxynius abronius*. The probability was dependant on sediment use, resulting in the following use specific criteria:

1. Sediment Quality Criteria for sensitive sediment **SQC_{SS}** : a 20% probability of observing an EC_{20} (P20) (equal to 0.62 for freshwater, none derived for marine) and,

2. Sediment Quality Criteria for typical sediment **SQC_{TS}**: a 50% probability of observing an EC20 (P50) (equal to 1.2 for freshwater and marine).

For further technical details related to the criteria see Ministry of Water, Land and Air Protection, 2003 [3].

Schedule 9 was brought into effect as a component of the 2004 Stage 4 amendment to the CSR. The Schedule 9 criteria have not been amended since their implementation in 2004.

While the Schedule 9 SQC have, and continue to provide, effective assessment of sediment quality for the purposes of the CSR, the ministry is aware of a number of issues related to the derivation of the Schedule 9 which could be improved. These include:

1. Need to enhance the current protocol for derivation of SQC to:
    (a) improve overall transparency of process (i.e. substance-specific example derivations, etc.).
    (b) make the database of toxicity results used in the derivation of the SQC either publically available or at least available to the ministry, so that:
        i. ministry staff can directly derive new SQC for additional substances and develop a site specific standards protocol for the SQC and,
        ii. once the site specific standards protocol foe SQC has been implemented, allow environmental consultants to calculate site specific sediment standards for site specific circumstances applicable to their sites.
    (c) allow consideration of adjusting the level of conservatism for SQG, by:
        i. developing a new protocol for the derivation of SQC or,
        ii. adopting/adjusting new sediment quality standards from other jurisdictions.

2. Consider whether sediment standards for the protection of human health are needed for the purposes of the Contaminated Sites Regulation.

Jurisdictional Legislative Review Summary (Environmental Health)

The ministry has reviewed the most recent sediment quality standards and protocols for the derivation of sediment quality standards available from other jurisdictions. The summary findings of the review are provided in Appendix A of this proposal paper.

The review for environmental health concluded that:

1. Many jurisdictions in North America have adopted sediment quality standards identical, or substantively similar to, those in Schedule 9. Many of these other jurisdiction's sediment standards were developed by MacDonald et al. or, were derived using methods equivalent to that used by MacDonald to derive the Schedule 9 SQC. As a result, there would be little or no benefit in using these other jurisdiction's sediment quality standards to update Schedule 9.

2. For jurisdictions which have sediment quality standards that were derived using methodology different from that of MacDonald et al.:
    (a) Some of the jurisdictions' standards do not reflect the Province's objectives for sediment standards. For example, the sediment quality standards (i.e. guidelines) are too conservative (i.e. background as opposed to toxicity based), or they are intended for use in prioritizing action at contaminated sites rather than for use as remediation goals or targets.
    (b) Some of the jurisdictions' standards are not considered appropriate for adoption under the CSR because of major differences in sediment characteristics (sediment types, climate, etc.) from those used in British Columbia.

3. None of the other jurisdictions has a complete set of standards for all the prescribed substances of the existing Schedule 9 or for all the additional new substances that might reasonably be anticipated to be needed to update Schedule 9. Therefore, if the ministry were to adopt sediment standards from other jurisdictions, standards would have to be adopted from multiple sources with differing and inconsistent derivation protocols.

4. The methodology for the development of sediment quality standards using protocols significantly different from that used by MacDonald et al. is rapidly evolving at this time. Consequently it seems unlikely that regulatory agencies will be able to agree on a new consistent protocol in the immediate future.

Jurisdictional Legislative Review Summary (Human Health)

Currently there are no sediment quality criteria for human health under the CSR or in use by other Canadian jurisdictions. Under the Province's contaminated site regulatory regime, the CSR soil quality standards are often used as a preliminary screen to determine potential human health concerns related to exposure to contaminated sediment. However in most jurisdictions, including British Columbia, definitive assessment of

human health risks associated with exposure to contaminated sediment is typically achieved through the performance of detailed quantitative risk assessment.

Human health risk assessment of sediment involves the use of general approaches and assumptions similar to those used to assess risks associated with exposure to contaminated soil. However, it is recognized that significant differences between soil and sediment exist in regard to exposure and toxicity. For example, in considering dermal exposure to sediment versus soil, typically wet/damp sediment adheres to skin much more readily than does dry soil, leading to enhanced dermal exposure for sediment compared to soil. On the other hand, the duration of contact with sediment is usually much shorter than the duration of contact with soil, which acts to decrease dermal exposure to sediment compared to soil.

In recognition of these differences related to risk assessment exposure and toxicity assumptions between sediment and soil, Intrinsic Environmental Sciences, Inc., 2012 [4] presented at the 2012 Federal Contaminated Sites National Workshop (FCSNW) discussion draft sediment quality standards to protect human health that were developed under contract to Health Canada. More recently, Health Canada [5] provided a status update on their work towards developing a Technical Advisory Bulletin for Human Exposure to Sediments via Direct Contact for use in human health risk assessment at the 2014 FCSNW. Health Canada's work is still preliminary in nature and it remains uncertain at this point, as to if, and when, Health Canada may promulgate numerical sediment quality guidelines for the protection of human health.

Proposed Updates – Stage 10 Amendment

Protection of Ecological Health

1. Once instigated as a component of the 2004 Stage 4 amendment to the Contaminated Sites Regulation, the Schedule 9 SQC have been universally utilized as appropriate sediment remedial targets at every contaminated sediment site remediated using the numerical standard approach within the Province. The ministry proposes therefore to officially recognize the longstanding use of the Schedule 9 SQC as *de facto* sediment quality standards in the forthcoming Stage 10 amendment to the CSR.

2. Due to time and resource constraints, it is not feasible for the Stage 10 amendment to the CSR to update existing sediment quality standards or to develop *de novo* sediment quality standards. Further as indicated by our legislative review, if new sediment standards were to be adopted from other jurisdictions, such standards would have to be obtained from multiple jurisdictions with inconsistent derivation protocols, often using different sediment assumptions and targeting different remedial goals or levels of risk. It seems unlikely that such a disparate collection of new sediment standards of incongruent and varied origin would benefit the Province's contaminated site

regulatory regime to a greater extent than the CSR sediment standards currently in place. It is proposed that the existing Schedule 9 SQC to protect aquatic life remain in effect.

Protection of Human Health

3. In view of the nascent state of development of sediment quality standards to protect human health, the ministry does not propose that any effort be expended on developing such standards at this time. Rather the ministry recommends that the Schedule 5 Intake of contaminated soil (i.e. incidental soil ingestion) standards continue to be used to screen substances as Potential Contaminants of Concern (PCOCs) in detailed human health risk assessments of contaminated sediment sites, and in the case that a substance is screened in, that the sediment be remediated based on the risk assessment.

Other Issues – Next Cycle Revisions

For the longer term, the following aspects related to the revision/updating of the sediment quality standards should be considered:

4. Continue to use the current ministry approved 2003 [1] derivation methodology (i.e. the protocol originally developed for the ministry by MacDonald et. al., 2003) or follow an identical narrative intent until agreement on improved standardized methodology is reached by jurisdictions.

5. As future time and resources allow, consider to update sediment standards where new data has become available and develop new sediment standards for emerging toxicants using the current ministry approved 2003 [1] derivation or follow an identical narrative intent.

6. As future time and resources allow, consider changes to existing CSR sediment standards where issues have previously been identified, including:
    a. Adjusting the DDE standard so that it is more stringent than the standard for DDT, reflective of its greater toxicity.
    b. Recalculating the TCDD-TEQ based PCDDs and PCDFs standard using updated World Health Organization, 2005 TCDD-TEFs.
    c. Determining if PCBs standards should be recalculated in view of the availability of World Health Organization, 2005 TCDD-TEFs for some PCBs.
    d. Determining if a sediment standard for methylated naphthalenes (as defined under BC WQG) is needed in addition to the existing sediment standard for 2-methylnaphthalene.

e. If alkylated PAHs are included in the proposed new CSR Schedule X soil quality standards, determine if the Total PAHs sediment standard should be updated to include alkylated PAHs.

7. Repeal of the use of "*sediment quality quotients"* for PCOC mixtures.

8. Monitor the development of new sediment standard derivation protocols amongst the various regulatory agencies, including the recent work underway by Health Canada related to the possible future derivation of human health protective sediment quality standards.

References

[1] MacDonald, D.D. et al., 2003. *Development and Applications of Sediment Quality Criteria for Managing Contaminated Sediment in British Columbia.* MacDonald Environmental Sciences Ltd., Nanaimo, B.C. November, 2003.

[2] CCME, 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment. Winnipeg, Manitoba. 1999.

[3] Ministry of Water, Land and Air Protection, 2003.. *Criteria for Managing Contaminated Sediment in British Columbia: Technical Appendix.* Contaminated Sites Program, Environmental Management Branch, Environmental Protection Division. Victoria, B.C. 2003.

[4] Segal et. al., 2012. *Interim Guidance for Evaluating Human Health Risks Associated with Direct Exposure to Contaminated Sediments at Federal Contaminated Sites in Canada.* A presentation by Intrinsic Environmental Sciences, Inc. at the Federal Contaminated Sites National Workshop. Real Property Institute of Cnada. Airstream Centre, Toronto, Ontario. Ap30 – May 3, 2012.

[5] Roushorne, M. et. al., 2014. *Development of Health Canada Guidance on Assessing Human Health Risks Associated with Contaminated Sediments.* A presentation by Health Canada, Safe Environments Program at the Federal Contaminated Sites National Workshop. Real Property Institute of Canada. Westin Ottawa Hotel., Ottawa, Ontario. April 14 – 16, 2014.

Appendix A

Results of Jurisdictional Review of Sediment Quality Standards

Jurisdiction	Standard/guideline	Pros	Cons	Consider in Adoption for BC?
Canadian Council of Ministers of the Environment (CCME) (1999)	The CCME protocol calculates sediment quality guidelines (SQGs) from a threshold effect level (TEL) based on the geometric mean of the lower of the 15th percentile of the effect data set and the 50th percentile of the no effect data set. The TEL represents a value at which adverse effects are never or almost never observed. If the uncertainty is high, a safety factor may be applied. Alternatively, a guideline may be derived spiked sediment toxicity (chronic LOEL multiplied by a safety factor or a lower acute LC50/EC50 multiplied by a safety factor) or adopted from another jurisdiction (lowest available guideline).	- Both freshwater and marine guidelines available - Widely accepted approach	- Data set not available - Intended as guidelines, not standards - Highly conservative approach may not lead to concentrations that are practical for use at contaminated sites	Yes, would harmonize BC approach with other Canadian jurisdictions but by adopting guidelines as standards would become more conservative.
Environment Canada (1995-ongoing)	The Minister is required under CEPA section 54 (1999) to issue environmental quality guidelines. These commitments are met by the CCME by developing Canadian Environmental Quality Guidelines. However, under the Chemicals Management Plan, there is an additional need to develop Federal Environmental Quality Guidelines to support federal environmental quality monitoring and risk assessment and risk management activities on substances for which CCME guidelines do not yet exist. Approaches are consistent with CCME: For substances for which there is an abundance of data available, a distributional approach is used. Where there is less data available, the approach uses a critical toxicity value plus an application of (safety) factors to account for the greater uncertainty. The following standards have recently been derived: - Cobalt - Hydrazine - PBDEs - Alcohol ethoxylates The following guidelines will be released this fall: - vanadium - BPA			Yes, guidelines would address some of the emerging substances but would need careful consideration of provincial background for PBDEs before adoption.

	- hexabromocyclododecane, - chlorinated alkanes (aka chlorinated paraffins) - (another BPA-related one) - PFOS (delayed)			
Ontario(1993, 2010, 2011)	Under the 2002 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem, the Ontario Ministry of Environment and Environment Canada developed a harmonized framework for assessing contaminated sediments in the Great Lakes (COA, 2008). While developed specifically for use in the Great Lakes, the Ministry recognized that the COA sediment framework can be applied to assess contaminated sediments province-wide, and replaced the previous Ministry sediment guidance documents with this integrated document. However, no changes were made to the Provincial Sediment Quality Guidelines (PSQGs) developed in 1993 or to the process used to develop them. The PSQGs recognize three levels of effect: - The No Effect Level: The No Effect Level (NEL) indicates a concentration of a chemical in the sediment that does not affect fish or sediment-dwelling organisms. At this level negligible transfer of chemicals through the food chain and no effect on water quality is expected. Sediment meeting the NEL are considered clean. - The Lowest Effect Level: The Lowest Effect Level (LEL) indicates a level of contamination that can be tolerated by the majority of sediment-dwelling organisms. Sediments meeting the LEL are considered clean to marginally polluted. - The Severe Effect Level: The Severe Effect Level (SEL) indicates a level of contamination that is expected to be detrimental to the majority of sediment-dwelling organisms. Sediments exceeding the SEL are considered heavily contaminated. The LEL was adopted into the *Environmental Management Act* Part XV.1 as site condition standards. LELs are based	- Very recent - Developed for similar use (prescribed substances under the Ontario *Environmental Management Act*) - Large number of substances have standards	- One standard, no distinction between sediment uses - LEL approach/ concentrations too conservative for commercial/industrial water lots and harbours, would need to adopt both LEL and SEL - Not associated with an effect level/protection goal - Many confounding factors that may affect benthic invertebrate presence other than contamination - No marine standards	No, no benefits over SQC approach currently in use for BC

	on benthic invertebrate presence and not directly associated with an effect level. Exceedance of a LEL would trigger a risk assessment and further investigation; if evidence from benthic community assessment, toxicity testing and/or potential for biomagnification would be collected sediment remediation would be required. Many of the LEL standards are similar or lower in concentration than CCME's NOEL based guidelines and in range of current SQC_{SS}.			
Quebec(2007)	The Quebec sediment quality criteria have been derived using the CCME toxicological database. They recognize five levels of intervention for management: - CCME TEL and PEL - Newly derived REL, OEL, FEL	- Very recent - Large number of substances have standards		No, no benefits of adopting QC criteria over CCME unless deciding to provide SQC for multiple sediment uses
Alberta (2014)	The Alberta Sediment Quality Guidelines were compiled from a number of sources with the majority being obtained from CCME, with additional guidelines obtained from Environment Canada, Ontario, and British Columbia (including those for emerging substances such as PBDEs). Jurisdictions outside North America were not considered applicable to Alberta biota and water use.			No
Atlantic provinces	The Atlantic Provinces have adopted CCME sediment guidelines. More recently, Atlantic PIRI (2015) developed additional petroleum hydrocarbon standards using the PETROTOX model. The PETROTOX-based sediment standards were developed for "typical" (habitat for sensitive components) and "other" sediments. The effect level is a HC5 and HC50.	- Recent - Largest PHC database currently available - No other existing toxicity-based hydrocarbon standards available in Canada (with the exception of PAHs) - Using a database of chronic LC50/ NOELs for multiple species can be considered a conservative approach to	- Derived for hydrocarbon products rather than fractions	Yes, PETROTOX standards should be considered for adoption (either as adopted by Atlantic provinces or derived from database)

		standards development - Assumes additivity of hydrocarbons - HC5 protection level already considered acceptable under risk assessment and site-specific risk-based standards		
Yukon, NWT, and Nunavut	The NWT and Nunavut have adopted CCME sediment guidelines. The Yukon is considering adopting sediment standards into their CSR, but has difficulty determining standards appropriate for dealing with the mineralized nature of many parts of the territory.			No
United States	Between 1990 and 1995, NOAA developed sediment quality guidelines for marine waters for the National Status & Trends program intended for the use of ranking sites that warranted further study of the occurrence of adverse effects and ranking contaminants of concern (see NOAA, 1999). The guidelines are not intended as regulatory standards or remediation targets. Data was collected from studies performed throughout North America including both chemical measures and biological effects, to identify: - 10^{th} percentile (Effects Range Low; ERL) - concentrations below which effects rarely occur; - 50^{th} percentile (Effects Range Medium; ERM) – concentrations above which effects frequently occur USGS developed consensus-based sediment quality guidelines for freshwater based on probable effect concentrations (USGS 2000).	- ERL/ERM approach would translate well for sensitive and typical sediment use in CSR	- Not recent - Only available for 9 metals, 13 PAHs, 3 PAH classes (LPAH, HPAH, Total PAH), 3 chlorinated organic hydrocarbons (DDE, Total DDT, Total PCB) - Differences in amounts and quality of data among guidelines - Effect for ERL 10% for metals, but closer to 25% for organics - Interpretation for risk management will be difficult because predictive abilities are not equivalent to	No, set of standards available too limited and not consistently derived (freshwater standards derived similar to current CSR standards).

			the intended effects range (No ERL exceeded 68% not toxic to amphipods, 11% highly toxic; ERM exceeded 48% not toxic and only 39% highly toxic)	
EPA Region IV	EPA Region IV adopted sediment criteria from NOAA and from MacDonald (1994) in 2001 to obtain a list of two types of concentrations: Effect Values and Screening Values. Screening values are either identical to the Effect Value, or the Practical Quantification Limit, whichever is greater.	-	- Intended for use at hazardous waste sites -	No, no benefits over SQC approach currently in use for BC
EPA Region VI	EPA Region VI adopted its standards from multiple jurisdictions including Ontario, Washington State, and federally available standards.	-	-	No
EPA Sediment Quality Benchmark	Sediment Quality Benchmarks (reviewed in Di Toro et al. 1991 and US EPA 2003) are based on observations that the response to a contaminant correlates with the concentration in the interstitial pore water rather than the concentration in sediment; and that the effects concentration for a chemical in pore water is essentially equal to that reported for water-only exposures. In other words, the toxicity of a nonionic contaminant to sediment-dwelling organisms is proportional to the concentration of the contaminant that is freely dissolved in the sediment pore water (equilibrium partitioning). The equilibrium partitioning (EqP) methodology derives standards for nonpolar organic contaminants from their corresponding ambient water quality standards and their affinity to adsorb to organic carbon in sediment (sediment chemical concentration that is normalized on a sediment organic carbon basis). When more organic carbon is present in sediment, the concentration of a nonpolar organic contaminant freely dissolved in sediment pore water will be smaller, and therefore, proportionally less toxic to aquatic organisms. The EqP approach is applicable to both fresh and marine/estuarine sediments.	- Includes biological availability - EqP-derived values could include cumulative effects in the case of PAHs	- EPA values would require recalculation since they are based on National Water Quality Criteria	Yes, but would require BC-specific derivation with water quality standards of low uncertainty.

	The EqP approach has been widely accepted.			
Texas	The Texas Commission on Environmental Quality (TCEQ), the lead environmental agency for the state of Texas, was advised by its Surface Water Quality Monitoring Advisory Group on sediment screening benchmarks. The Group had intended to select a set of benchmarks for adoption. However, it concluded that in order to expand the list of substances it was necessary to include multiple sources and databases. These included NOAA, CCME, ON MOE, MacDonald et al (2000), and other US states. Where available, TECs were the preferred value for adoption.	-	- No consistent derivation protocol, effects level, or underlying assumptions	No
California	The State Water Resources Control intends to develop and adopt sediment quality objectives (SQOs) for enclosed bays and estuaries. This process will require approximately four years to complete. Draft Sediment Quality Objectives have been proposed that divide sediments in three categories (Low, Moderate and High Disturbance) based on concentration ranges of 12 substances. This information is intended to be combined with other lines of evidence for decision making.	-	-	No
Washington State	Sediment management standards (SMS) developed by the Washington State Department of Ecology were incorporated into law in 2013 (WA DOE 2013). They are intended to: • Set standards for sediment quality (there are both numeric and narrative standards); • Apply the standards to reduce pollutant discharges; and • Provide a decision process for the cleanup of contaminated sediment sites. Two types of standards are recognized: - Sediment cleanup objectives (SCO; no adverse effect level) - Cleanup screening levels (CSL; minor adverse effect level) The data was obtained from bioassay tests for stations in Washington State and Oregon only and standards derived using the Floating Percentile Model. It is noted that the SCO standards have been criticized among others for: not meeting a no adverse effect level, both the SCO and CSL standards are of high concentrations when compared with standards derived by alternative methods, and the model appears to exhibit a contaminant-specific disconnect between predicted and actual toxicity.	- Recent	- Model used is not transparent - Not conservative - Intended to prioritize clean-up, not determining whether a site is contaminated - Criticized by scientific community	No

Minnesota	Developed in 2007, Minnesota recognizes two types of freshwater sediment quality targets (SQTs): - Level I SQTs are intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms (i.e., benthic invertebrates) are unlikely to be observed. - Level II SQTs are intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are likely to be observed. The SQTs are adopted consensus-based threshold effect concentrations (TECs) for Level I, and probable effect concentrations (PECs) for Level II (MacDonald et al, 2000). Other effects-based freshwater SQGs that have been published were adopted for those chemicals for which consensus-based SQGs were not available (CCME 1999; NYSDEC 1999).	- Recent	- Freshwater only	No, no benefits over SQC approach currently in use for BC
New York	Sediment Guidance Values (SGVs) were established from values determined by three methods: - equilibrium partitioning (EqP); - consensus-based sediment quality guidelines for freshwater sediments (MacDonald, et al. 2000); and - ERL/ERMs for marine/estuarine sediments (Long et al. 1995). Values derived with the equilibrium partitioning method were only used to establish SGVs for sediment contaminants when empirically-derived values were not available, and for contaminants which bioaccumulate. SGVs include those for mixtures of PAHs and mixtures of metals. The SGVs were last updated in 2014 (NYSDEC 2014).	- Recent		No
Wisconsin	Wisconsin uses sediment quality guidelines based on MacDonald et al (2000) TEL and PEL concentrations, and a calculated midpoint concentration (MEC), to define a level of concern as follows: - Level 1 < TEL - Level 2 > TEL but less than MEC - Level 3 < PEL but greater than MEC - Level 4 > PEL	-	-	No, no benefits over SQC approach currently in use for BC
Florida	Sediment Quality Assessment Guidelines (SQAG) for 34 priority substances for coastal sediments were developed by MacDonald et al (1994) and consist of two effect levels: - PEL - TEL SQAGs for inland waters were developed using data specific to the	-	-	No, no benefits over SQC approach currently in use for BC

	southeast by MacDonald et al. (2003).			
Sediment Evaluation Framework for the Pacific Northwest	The Sediment Evaluation Framework for the Pacific Northwest developed by Washington State, Oregon and Idaho includes sediment screening levels (SLs) for marine and freshwater as well as tissue target levels (TTLs) for aquatic life, wildlife consumers and human consumers. The SLs were adopted from previously developed standards and guidelines for Puget Sound and Washington State. The framework also includes a list of what must be considered bioaccumulative substances in sediments. The SLs are intended for sediment characterization and disposal (SEF 2009).	-	-	No, different intended use.
Netherlands	The Dutch Ministry of Housing, Spatial Planning and Environment has used soil (Target and Intervention Value; 95 and 50% effect levels derived from a NOEC database) standards for sediment assessments since 1994, but has more recently developed separate standards to guide sediment remediation based on a predicted no effect concentration (PNEC)[1] (Janssen et al 2004). A PNEC is calculated from NOECs for four or more taxonomic groups when available or by using the equilibrium partitioning method, according to the EU framework, and converted to dry weight and modified by a factor for the difference in organic carbon (from the assumed 5%) to obtain a maximal permissible concentration (MPC; equal to a HC5) and a negligible concentration (NC, also called Target Value; MPC divided by 100[2]). A serious risk concentration (SRCeco, also called Intervention Value) is derived that represents a concentration at which sediment functions will be seriously affected or are threatened to be negatively affected. This is assumed to occur when 50% of the species and/or 50% of the microbial and enzymatic processes are possibly affected. SRCs are also calculated for human health, and if lower, adopted as the sediment SRC. Sediment standards are calculated for all substances occurring in water that have a log Kow or log Koc>3. When substances have a log Kow >5, an additional safety factor may be used for sediment	- Recent - Database available - Scientifically defensible	- Cannot be adopted as is, but would need to be re-calculated with the database or with the PNECs to eliminate the estimated background and assumed (Dutch) organic carbon. -	Yes, database is available and method would be scientifically defensible and transparent. Would require derivation of standards from PNECs specific to BC; questionable whether resources are available for the additional work.

[1] PNECs are derived as part of the EU risk assessment process but do not have legal status.
[2] Extrapolation from HC5 to HC0 and a factor 10 to include combination toxicity.

	PNECs. When a sediment PNEC is derived by equilibrium partitioning, a safety factor of 10 is used in the EU to protect benthic organisms against risks due to sediment ingestion (under Dutch methods, no safety factor is used but bioaccumulation studies are required). National estimated background is incorporated in the MPC.			

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