OSPAR COMMISSION

*Protecting and conserving the North-East Atlantic and its resources*

# 2019 updated Audit trail of OSPAR EACs and other assessment criteria used to distinguish above and below thresholds

Hazardous Substances and Eutrophication Series

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# 2019 updated Audit trail of OSPAR EACs and other assessment criteria used to distinguish above and below thresholds

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties contractantes sont l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne.

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# Contents

## Executive Summary

The Audit Trail is a list of all references to assessment criteria currently and many previously used in the OSPAR assessments performed by MIME. It lists both OSPAR defined EACs and BAC, but also other international assessment criteria such as EU EQS, Canadian FEQS, US ERL. The references are safely kept at the OSPAR secretariat to ensure changes in websites or revision of values are recorded over time. The assessment criteria used in each assessment are also included in the OSPAR Contaminants App[1] help files, but the audit trail carries the full reference to the papers, legal documents or workshop reports. There is a spreadsheet also included with a shortlist of references and values, and some further identification of the background for the individual assessment criteria.

## Récapitulatif

La piste d'audit est une liste de toutes les références aux critères d'évaluation utilisés actuellement et dans le passé dans les évaluations OSPAR effectuées par le Groupe de travail MIME d'OSPAR. Elle énumère non seulement les EAC (critères d'évaluation environnementale) et les BAC (concentrations d'évaluation de fond) définis par OSPAR, mais également d'autres critères d'évaluation, tels que les EQS (normes de qualité environnementale) de l'UE, les FEQS (Recommandations fédérales pour la qualité de l'environnement) du Canada, et les ERL (Fourchette d'effets – faible) des Etats-Unis. Les références sont conservées en toute sécurité au secrétariat d'OSPAR pour s'assurer que les modifications des sites web ou les révisions des valeurs sont enregistrées au fil du temps. Les critères d'évaluation utilisés pour chaque évaluation sont également inclus dans les fichiers d'aide pour l'App OSPAR sur les contaminants, mais la piste d'audit comporte la référence complète aux documents, aux documents juridiques ou aux rapports d'atelier. Un tableur est également inclus avec une liste de références et de valeurs, ainsi qu'une identification plus précise du contexte des critères d'évaluation individuels.

[1] https://www.ices.dk/data/assessment-tools/Pages/ospar-cat-app.aspx

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## Introduction

Table 1 lists the EACs used in the MIME rollover assessment, where they were formally adopted, any documentation describing their derivation, and some comments on their applicability. The Table also lists the assessment criteria used to distinguish between good and moderate status when EACs are not available and any corresponding EQS values (EC 2011b).

Most EACs were conceived in a series of OSPAR workshops finalised in 1996 and a follow up ICES/OSPAR workshop in 2004 (OSPAR, 1998 and OSPAR, 2004), further updated in 2008 (SIME 2008 document 0505, OSPAR 2009 Henceforth referred to as MAS 461) in preparation for the QSR 2010, taking into account the EU guidelines for EQS development (EC 2011).

The derivation of the EACs is summarised below. For CBs, some rounding and conversion errors were discovered and revised EACs are presented. MIME recommends that HASEC adopts these revised EACs.

In 2017, MIME made a trial run of Canadian FEQS for brominated flame-retardants. These have been included in the tables as reported in the web-based assessment tool http://dome.ices.dk/OSPARMIME2018/main.html.

All values and derivation links for the 2018 MIME assessment have been extracted from the web-based assessment tool in the accompanying EAC_audit_trail_2018 excel spreadsheet, for easy browsing. Note that the list can be filtered in line 1, to show only the relevant substances or matrix or any of the headlines in the spreadsheet. BACs have been included in the spreadsheet for completeness.

## EACs for CBs

(see Table 2)

SIME 08/5/5-Add.2-E proposed EACs for CBs in water and hence derived

- EACs for CBs in sediment with 1% TOC using direct effect measurements in water and the partitioning coefficient for octanol-water ($K_{oc}$)
- EACs for CBs in fish and mussel using bio-concentration factors (BCFs)

The EACs for CBs in sediment were later modified to apply to sediment with 2.5% TOC and adopted by OSPAR (MAS 461).

The EACs for CBs in fish and mussel derived using BCFs were rejected by ICES MCWG and not adopted by OSPAR.

Alternative EACs for CBs in biota were derived using partitioning theory (MAS 461). The EAC for sediment with 1% TOC was multiplied by 100 to give an EAC for sediment with 100% TOC and this was equated to an EAC for lipid. This assumed that CBs transfer totally to the lipid (or organic carbon) from the (pore)water phase due to high lipophilicity and has been shown to work for silicone rubber in sediment. The EAC for fish was retained on a lipid weight basis and was adopted by OSPAR (MAS 461). The EAC for mussels and oysters was converted to a dry weight basis assuming a lipid content of 1% and a dry weight content of 20% and adopted by OSPAR (MAS 461).

Some errors were found when checking the data and conversions and the EACs for CBs for biota have been recalculated. They are now presented on a lipid basis and apply to all fish and shellfish (Table 3). To convert to a wet weight basis, they need to be multiplied by a species-specific lipid conversion factor. For fish, these are tabulated in MIME 2011 Annex 4. For shellfish, conversion factors were derived from all the data in the ICES data base (Table 4) and should be used.

EQS values have not been developed for CBs in the water phase, due to the high hydrophobicity. A PCB draft dossier (2010) suggests AA-EQS of 0.003 µg/kg for biota, with corresponding AA-EQS of 4.3 $10^{-9}$ µg/l in freshwater and MAC-EQS of 3.2 $10^{-4}$ µg/l with marine waters a factor of 10 lower. These values are based on freshwater toxicity. Water quality criteria/objectives sited at 0.074–0.175 ng/l USA or IKSR/ICPR (Rhine). These values are not sensible compared to BAC and known concentrations in biota.

MIME 2013 recommends that HASEC adopts the EACs presented in Table 3.

***Table 2**: Various proposals for EACs for CBs in water, sediment and biota*

| | **water**[2] | **sediment**[3] | **sediment**[4] | **fish**[5] | **fish**[6] | **fish**[7] | **mussel**[8] | **mussels, oysters**[9] | **shellfish**[10] |
|---|---|---|---|---|---|---|---|---|---|
| | | 1% TOC | 2.5% TOC | | | | | | |
| | ng $l^{-1}$ | µg $kg^{-1}$dw | µg $kg^{-1}$dw | µg $kg^{-1}$ww | µg $kg^{-1}$lw | µg $kg^{-1}$lw | µg $kg^{-1}$ww | µg $kg^{-1}$dw | µg $kg^{-1}$lw |
| CB28 | 0.7 | 0.67 | 1.7 | 8.35 | 64 | 67 | 6.0 | 3.2 | 67 |
| CB52 | 0.86 | 1.08 | 2.7 | 163 | 108 | 108 | 16.2 | 5.4 | 108 |
| CB101 | 0.2 | 1.21 | 3.0 | 32 | 120 | 121 | 10.2 | 6.0 | 121 |
| CB118 | 0.026 | 0.25 | 0.6 | 6.5 | 24 | 25 | 1.95 | 1.2 | 25 |
| CB138 | 0.2 | 3.17 | 7.9 | 79.6 | 316 | 317 | 19.9 | 15.8 | 317 |
| CB153 | 1.0 | 15.85 | 40 | 3200 | 1600 | 1585 | 358 | 80 | 1585 |
| CB180 | 0.2 | 4.69 | 12 | 126 | 480 | 469 | 6.5 | 24 | 469 |

***Table 3**: Proposed EACs for CBs in biota (µg $kg^{-1}$lw)*

| | EAC |
|---|---|
| CB28 | 67 |
| CB52 | 108 |

[2] Values proposed in SIME 08/5/5-Add.2-E

[3] Values proposed in SIME 08/5/5-Add.2-E calculated by adjusting proposed EACs for water using Koc estimates

[4] Adopted EACs (ref) calculated by multiplying the proposed EACs for sediment by 2.5

[5] Values proposed in SIME 08/5/5-Add.2-E based on adjusting proposed EACs for water using BCF estimates

[6] Adopted EACs (ref) calculated by dividing the adopted EACs for sediment by 0.025 – this assumes that the concentration in sediment with 100% TOC is equivalent to the concentration in the lipid of fish. To convert to a wet weight basis, these concentrations are multiplied by the typical species specific lipid content; e.g. 0.16 for dab, 0.45 for cod (MIME 2011 Summary Record (MIME 11/9/1), Annex 4). There was a transcription error in calculating the value for CB28.

[7] The values that should have been adopted if there hadn't been any rounding errors

[8] Values proposed in SIME 08/5/5-Add.2-E based on adjusting proposed EACs for water using BCF estimates

[9] Adopted EACs (ref) calculated by multiplying the adopted EACs for fish by 0.05 – this assumes the lipid content is 1% and the dry weight content is 20%. To convert to a wet weight basis, these concentrations are divided by the typical species specific dry weight content; e.g. 0.19 for blue mussel, 0.19 for Pacific oyster (MIME 2011 Summary Record (MIME 11/9/1), Annex 4).

[10] The values that should have been adopted. To convert to wet weight, need to multiply by the typical species specific lipid content; e.g. 0.013 for blue mussel, 0.018 for Pacific oyster.

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| | |
|---|---|
| CB101 | 121 |
| CB118 | 25 |
| CB138 | 317 |
| CB153 | 1585 |
| CB180 | 469 |

***Table 4**: Lipid weight conversions for bivalves based on data in the ICES database. The conversions are the median value reported. For lipid conversions, data are submitted for extractable lipid, fat weight and lipid weight, and the median across all three groups is reported.*

| | | Median soft body lipidwt (%) | Number of observations |
|---|---|---|---|
| Pacific oyster | CRAS GIG | 1.8 | 237 |
| softshell clam | MYA ARE | 0.6 | 62 |
| blue mussel | MYTI EDU | 1.3 | 6976 |
| Mediterranean mussel | MYTI GAL | 2.0 | 45 |
| native oyster | OSTR EDU | 1.8 | 33 |

## PAH EACs

The PAH EACs was derived as the PCB's but the use of BCF was accepted, so no recalculation using $EAC^{passive}$.

## Alkylated PAH ERLs

The alkylated PAH ERLs was not part of the original work by Long et al, but is nevertheless presented with reference to Long by Barakat et al, 2011. The values presented in Barakat et al are in agreement with the OSPAR targets used, but it does not give any indication from where the values originate.

## Metal ERLs

The metal in biota EACs was rejected, and as a last resort, EU food criteria were used directly.

For sediments, it was decided to use the US-EPA ERL system (NOAA, 1999; Buchman 2008) as a precautionary limit. The Effect Range Low is set on the basis of ecotoxicological criteria for sediment living organisms (Long *et al*, 1995), and based set as the lower 10% effect level. As such, it is possible, but unlikely that effects can occur at concentrations lower than the ERL. A concentration above the ERL is on the other hand not a sign that effects will be expected (O'Conner, 2004), but only that it cannot be excluded that an effect can occur. As the dataset used is from before 1995, an update should yield at least some new data.

## TBT EAC and Swedish EQS sediment.

The TBT EAC was set in the 2004 BRC/EAC workshop of The Hague. The EAC for biota was accepted, but the EAC for sediment was not included.

*Short description of the datasets used for ERL derivation*

ERL for methods are based on ppm dry weight (mg/kg DW), and organics on ppb dry weight (µg/kg DW).

Long et al (1995), Donald et al (1996) and NOAA (1999) contains metals (also Ag at 1 mg/kg DW) and PAHs – inclusive sums of PAHs, 2-methyl-naphthalene, ppDDE, total DDTs and total PCBs. There is also a Quick reference table (NOAA 2008), which includes a slightly higher number of substances, but as an official NOAA list can be taken as accepted and Quality assured publication for use by US authorities.

The Swedish EPA set an EQS for TBT (Sahlin& Ågerstrand, 2018) which was presented at MIME 2019, the background to the derivation of the standard and proposed a way forward for use in QSR2023 (MIME 19/3/6). The limit was found at 1.6 µg/kg at 5% TOC, i.e. 3.2 µg/kg at the OSPAR normalisation level of 2.5% TOC.

## EU EQS values for biota

The revision of the EU EQS directive in 2013 added several new substances to the biota EQS list, compared to the original three (Hg, Hexachloro- benzene and Hexachloro- butadiene). The background documents for many of these can be found in the corresponding EQS data sheets (EC 2006) and revisions as EQS dossiers (EC 2011b). There is a clear statement that the EQS biota values are set for fish, apart from dioxins, which could and PAHs and fluoranthene which should be measured in crustaceans and molluscs. It is possible to use other biota taxa, as long as they provide the same level of protection though. As PAH's are only given as Benz(a)pyrene toxicity, it is suggested to only measure this PAH, but another way to go is to use toxicity factors for the other PAH's using e.g. (Fisher et al, 2011; Nisbet LaGoy, 1992 given first) or the pragmatic way by the ratio of EAC for the individual PAH to benz(a)pyrene (given below under OSPAR comments).

It should also be noted, that in the guideline for using $EQS_{biota}$ (EU, 2014) a discussion on the use of fish data from fillet or liver vs. whole fish, and comparison of QS's based on human health vs. secondary poisoning for most of the contaminants (except Hg, dicofol and HBCDD) are generally higher for secondary poisoning (a factor of 2 to 5000). The conclusion is that for organochlorines, a lipid corrected concentrations would be preferable, whereas Hg and PFOS probably should be corrected to dry weight. Another topic of discussion is the trophic level, where freshwater is assumed to be protective around 4.5 whereas marine top predators typically is at 5.5, interpreted like the level to analyse from to secure adequate protection in freshwater systems is trophic level 3.5, versus 4.5 in the marine environment. The guide suggests an adjusted (equally protective) $EQS_{biota,\ x}$ can be calculated from the trophic level magnification factor (TMF) for the taxon x at trophic level TL(x), also considering a factor for the expected difference in lipid content (not included in the formula):

$$EQS_{biota,x} = EQS_{biota}/TMF^{(4-TL(x))}$$

Alternatively, the measured concentration can be adjusted to fit the EQS (including correction for lipid/dry weight):

$$Conc_{\ TL\text{-}adj,\ norm} = conc_{meas} * TMF^{(4-TL(x))} * 0{,}05/Lipid\ content_x$$ [or for Hg, PFOS: * 0.26/dry weight $_x$]

Examples of TL and model lipid contents can be found in the Hg-EQS document [reference to Brendans document]. It was not generally accepted by the contracting parties to adjust the concentrations for Trophic levels, as it was considered to introduce very high degree of uncertainty in the end results. It was also noted that a 5% fat normalisation could be used according to (EU, 2014), for Hg it was noticed that this would amount to the same correction factor as for trophic levels, and this would again lead to higher uncertainty in the final values.

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| No | Name of substance | EQS biota[12] µg/kg wet weight | OSPAR Comments |
|---|---|---|---|
| 5 | Brominated diphenylethers[5] | 0,0085 | Fish ∑28, 47, 99, 100, 153 and 154 |
| 15 | Fluoranthene | 30 | Crustaceans and molluscs<br>OSPAR 110 µg/kg DW! |
| 16 | Hexachloro- benzene | 10 | Fish |
| 17 | Hexachloro- butadiene | 55 | Fish |
| 21 | Mercury and its compounds | 20 | Fish |
| 28 | PAHs | | Crustaceans and molluscs |
| | Benzo(a)pyrene | 5 | OSPAR 600 µg/kg DW! |
| | Benzo(b)fluoranthene | Footnote 11 *(Nisbet: 0,5)* | TEF(B(a)P)* 10,4; n.a. |
| | Benzo(k)fluoranthene | Footnote 11 *(Nisbet: 2)* | TEF(B(a)P)* 2,7; 600/260= 2,3 |
| | Benzo(g,h,i)perylene | Footnote 11 *(Nisbet: 1)* | TEF(B(a)P)* 0,1; 600/110= 5,5 |
| | Indeno(1,2,3- cd)pyrene | Footnote 11 *(Nisbet: 1,7)* | TEF(B(a)P)* 3; n.a. |
| 34 | Dicofol | 33 | Fish |
| 35 | Perfluorooctane sulfonic acid and its derivatives (PFOS) | 9,1 | Fish |
| 37 | Dioxins and dioxin-like compounds | Sum of PCDD+PCDF+ PCB-DL 0,0065 µg.kg –1 TEQ[14] | Fish, crustaceans and molluscs |
| 43 | Hexabromocyclododecane (HBCDD) | 167 | Fish |
| 44 | Heptachlor and heptachlor epoxide | 6,7X10-3 | Fish |

(1) CAS: Chemical Abstracts Service.

(2) This parameter is the EQS expressed as an annual average value (AA-EQS). Unless otherwise specified, it applies to the total concentration of all isomers.

(5) For the group of priority substances covered by brominated diphenylethers (No 5), the EQS refers to the sum of the concentrations of congener numbers 28, 47, 99, 100, 153 and 154.

(11 ) For the group of priority substances of polyaromatic hydrocarbons (PAH) (No 28), the biota EQS and corresponding AA-EQS in water refer to the concentration of benzo(a)pyrene, on the toxicity of which they are based. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA- EQS in water.

(12) Unless otherwise indicated, the biota EQS relate to fish. An alternative biota taxon, or another matrix, may be monitored instead, as long as the EQS applied provides an equivalent level of protection. For substances numbered 15 (Fluoranthene) and 28 (PAHs), the biota EQS refers to crustaceans and molluscs. For the purpose of assessing chemical status, monitoring of Fluoranthene and PAHs in fish is not appropriate. For substance number 37 (Dioxins and dioxin-like compounds), the biota EQS relates to fish, crustaceans and molluscs, in line with section 5.3 of the Annex to Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and non-dioxin-like PCBs in foodstuffs (OJ L 320, 3.12.2011, p. 18).

(13) These EQS refer to bioavailable concentrations of the substances.

(14) PCDD: polychlorinated dibenzo-p-dioxins; PCDF: polychlorinated dibenzofurans; PCB-DL: dioxin-like polychlorinated biphenyls; TEQ: toxic equivalents according to the World Health Organisation 2005 Toxic Equivalence Factors.'

*: TEF by Nisbet adn LaGoy (1992); then OSPAR EAC ratio

## Federal Environmental Quality Guidelines (FEQGs) from Canada

Canada (2018) have also set up a system for deriving environmental quality guidelines. In the MIME 2017 meeting, the lack of PBDE EQS and EACs was tried to be filled with the Canadian FEQS, based on the Environment Canada (2013) derived values. The FEQS are derived based on ecotoxicological values, and the basis for derivation was the lowest toxicity endpoint with an application factor of 100 (10 to account for the extrapolation from laboratory to field conditions and inter- and intra- species variations in sensitivities, and 10 because PBDEs are persistent and bioaccumulative). The only accepted data was for invertebrates, as fish data was found to be of unacceptable quality. Data used for the assessment was *Acartia tonsa* for the congeners 28,47,99 and 100 and Daphnia magna for 153 and heptaBDE and octaBDE's, combined with mouse, mink and American Kestrel data for wildlife diet (mammalian). Lipid weight normalisation was used for BMF. For sediments, data was normalised to 1% organic carbon, and the most sensitive species was found to be the oligochaete (*Lumbriculus variegatus*) over amphiphods. The sediment values were corrected to 2.5% TOC for us in the OSPAR trial assessment.

For biota, the FEQGs would be multiplied by 20 in trial assessment 2020, so that they were on a lipid weight basis (assuming the fish used in the toxicity trials had 5% lipid). The fish assessment would then be conducted on a lipid weight basis. However, the shellfish assessment would continue to be conducted on a wet weight basis (since too few samples have supporting lipid weight measurements), with the FEQGs adjusted to take into account the lower lipid content of shellfish by multiplying the original FEQGs by the ratio $lipid_{shellfish}$ / 5 (where $lipid_{shellfish}$ is the typical % lipid content of the shellfish species being assessed).

***Table 5**. Federal Environmental Quality Guidelines for Polybrominated Diphenyl Ethers (PBDEs) (from Environment Canada, 2013) NOTE: Fish tissue converted to lipid by a factor of 20.*

| Homologue* | Congener | Water (ng/L) | Fish Tissue (ng/g lipid) | Sediment ** (ng/g dw) | Wildlife Diet† (ng/g ww food source) | Bird Eggs (ng/g ww) |
|---|---|---|---|---|---|---|
| triBDE | total | 46 | 2400 | 44 | – | – |
| tetraBDE | total | 24 | 1760 | 39 | 44 | – |
| pentaBDE | total | 0.2 | 20 | 0.4 | 3 (mammal) 13 (birds) | 29‡ |
| pentaBDE | BDE-99 | 4 | 20 | 0.4 | 3 | – |
| pentaBDE | BDE-100 | 0.2 | 20 | 0.4 | – | – |
| hexaBDE | total | 120 | 8400 | 440 | 4 | – |
| heptaBDE | total | 17‖ | – | – | 64 | – |
| octaBDE | total | 17‖§ | – | 5600§ | 63§ | – |
| nonaBDE | total | – | – | – | 78 | – |
| decaBDE | total | – | – | 19§# | 9 | – |

*****FEQG for triBDE (tribromodiphenyl ether), tetraBDE (tetrabromodiphenyl ether), hexaBDE (hexabromodiphenyl ether), heptaBDE (heptabromodiphenyl ether), nonaBDE (nonabromodiphenyl ether) and decaBDE (decabromodiphenyl ether) are based on data for the congeners: BDE-28, BDE-47, BDE-153, BDE-183, BDE-206, and BDE-209, respectively unless otherwise noted.

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**Values normalised to 1% organic carbon.

†Applies to mammalian wildlife unless otherwise noted.

‡ Value based on the commercial PentaBDE formulation, DE-71, which contains mostly pentaBDE and some tetraBDE.

||Values based on commercial OctaBDE mixture DE-79, which is composed mainly of heptaBDE and octaBDE (octabromodiphenyl ether).

§Values adopted from Ecological Screening Assessment Report (Environment Canada 2006). Sediment guidelines for octaBDE and decaBDE were adapted from the SAR by being corrected for the sediment organic carbon in the actual https://circabc.europa.eu/.../PAH%20EQS%20dossier%202011.pdf.

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*0505a2_NL sime EAC for PCB*.

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COPENHAGEN: 6-10 DECEMBER 2004

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***Table 1*** *OSPAR EACs and equivalent green / red transition assessment criteria*

The sum of CBs was removed, as it is not agreed in the EU as an EQS.

| Matrix / Determinand | OSPAR EAC or proxy | value | (MAC-) EQS | Adoption of EAC or proxy by OSPAR | Derivation of EAC or proxy | Comments |
|---|---|---|---|---|---|---|
| **Water** | | | | | | |
| **CBs (ng/l)** | | | | | | |
| CB28 | EAC | 0.7 | - | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB52 | EAC | 0.86 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB101 | EAC | 0.2 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB118 | EAC | 0.026 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB138 | EAC | 0.2 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB153 | EAC | 1.0 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |
| CB180 | EAC | 0.2 | | Not adopted | SIME 08/5/5-Add.2-E | Used to derive biota and sediment EAC |

| **Fish muscle metals (µg/kg)** | | ww | ww | | | |
|---|---|---|---|---|---|---|
| Mercury | EC | 500 | 20<br>22[$] QS | MAS 461 (table 5c)<br>(OSPAR 2009) | | EC food limit (Commission Regulation (EC) No 1881/2006) inappropriate proxy for EAC<br>EQS from 2013/39/EU<br>QS secondary poisoning from 150105 as MeHg |
| **Fish liver metals (µg/kg)** | | ww | | | | |
| Cadmium | EC | 1000 | | MAS 461 (table 5c) | | EC food limit (Commission Regulation (EC) No 1881/2006) used, but inappropriate proxy for EAC |
| Lead | EC | 1500 | | MAS 461 (table 5c) | | EC food limit (Commission Regulation (EC) No 1881/2006) used, but inappropriate proxy for EAC |
| **CBs (µg/kg)** | | lw | | | | |
| CB28 | EAC | 64 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB52 | EAC | 108 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB101 | EAC | 120 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB118 | EAC | 24 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB138 | EAC | 316 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB153 | EAC | 1600 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |
| CB180 | EAC | 480 | | MAS 461 (table 5c) | SIME080505a2, MAS 461 | conversion errors so need to be revised |

| **other (µg/kg)** | | ww | | | | |
|---|---|---|---|---|---|---|
| γ-HCH | EAC fish<br>EAC fish liver<br><br><br>EAC fish | 1.1<br>11<br><br><br>(0.5-5) | | MON 2004<br><br><br><br>(MON 1998 annex 5)<br>(Agreement 97-15e-2) | OSPAR, 2004<br>Derived from 1.1 µg/kg ww whole fish in OSPAR 379 2008<br><br>(OSPAR Commission, 1996 Third Workshop on Ecotoxicological Assessment Criteria) | Derived intersessionally MON 04/02/02 page 17<br>First used in OSPAR 390:2009 CEMP Assessment<br>EAC in liver is EAC in whole fish multiplied by 10, by expert judgement of the MON group.<br>Original EAC range (firm) for fish |
| DDE | EAC | 5-50 | | Agreement 97-15e-2 | OSPAR Commission, 1996 Third Workshop on Ecotoxicological Assessment Criteria | Not assessed in 2004 as DDT/DEE was not part of the OSPAR list of substances anymore, but it is still analysed together with PCBs and show a nice decreasing trend most places. |
| Brominated dipheny- lethers (sum) | | | 0.0085 | | | EQS from 2013/39/EU (sum of the concentrations of [1] congener numbers 28, 47, 99, 100, 153 and 154 ) |
| HCB (Hexachlorobenzene) | | | 10 | | | EQS from 2013/39/EU |
| HCBD (Hexachlorobutadien) | | | 55 | | | EQS from 2013/39/EU |
| PFOS | | | 9.1 | | | EQS from 2013/39/EU Perfluorooctane sulfonic acid and its derivatives, no documentations of if its sum or individual fluorinated compounds |
| HBCDD (Hexabromo-cyclododecane) | | | 167 | | | EQS from 2013/39/EU |

| **Mussel/oyster (µg/kg)** | | | | | | |
|---|---|---|---|---|---|---|
| **metals (µg/kg)** | | ww | ww | | | |
| Mercury | EC | 500 | 20<br>22[$] QS | MAS 461 (table 5b) | | EC food limit (Commission Regulation (EC) No 1881/2006) inappropriate proxy for EAC<br>EQS from 2013/30/EU<br>QS secondary poisoning from 150105 as MeHg |
| Cadmium | EC | 1000 | 160[$] QS | MAS 461 (table 5b) | | EC food limit (Commission Regulation (EC) No 1881/2006) inappropriate proxy for EAC<br>QS secondary poisoning from 310705 |
| Lead | EC | 1500 | 1000[$] QS | MAS 461 (table 5b) | | EC food limit (Commission Regulation (EC) No 1881/2006) inappropriate proxy for EAC<br>QS secondary poisoning from 310705 |
| **CBs (µg/kg)** | | dw | | | | |
| CB28 | EAC | 3.2 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB52 | EAC | 5.4 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB101 | EAC | 6.0 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB118 | EAC | 1.2 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB138 | EAC | 15.8 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB153 | EAC | 80 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| CB180 | EAC | 240 | | MAS 461 (table 5b) | SIME080505a2, MAS 461 | conversion errors so needs to be revised |
| **PBDEs (µg/kg)** | | ww | | | | |
| BDE28 | FEQS | 120 | | Trial 2017 | Environment Canada 2013 | |
| BDE47 | FEQS | 44 | | Trial 2017 | Environment Canada 2013 | |
| BDE99 | FEQS | 1 | | Trial 2017 | Environment Canada 2013 | |
| BD100 | FEQS | 1 | | Trial 2017 | Environment Canada 2013 | |
| BD153 | FEQS | 4 | | Trial 2017 | Environment Canada 2013 | |
| BD154 | FEQS | 4 | | Trial 2017 | Environment Canada 2013 | |

| **PAHs (µg/kg)** | | dw | ww | | | |
|---|---|---|---|---|---|---|
| Naphthalene | EAC | 340 | | MAS 461 (table 5b) | SIME080505a1 | |
| Phenanthrene | EAC | 1700 | | MAS 461 (table 5b) | SIME080505a1 | |
| Anthracene | EAC | 290 | | MAS 461 (table 5b) | SIME080505a1 | |
| Fluoranthene | EAC | 110 | 30 | MAS 461 (table 5b) | SIME080505a1 | EQS from 2013/39/EU crustaceans and molluscs. |
| Pyrene | EAC | 100 | | MAS 461 (table 5b) | SIME080505a1 | |
| Benzo[bj]]fluoranthene | | | * | | | EQS from 2013/39/EU crustaceans and molluscs. |
| Benzo[k]fluoranthene | EAC | 260 | * | MAS 461 (table 5b) | SIME080505a1 | EQS from 2013/39/EU crustaceans and molluscs. |
| Benz[a]anthracene | EAC | 80 | | MAS 461 (table 5b) | SIME080505a1 | |
| Benzo[a]pyrene | EAC | 600 | 5* | MAS 461 (table 5b) | SIME080505a1 | EQS from 2013/39/EU |
| Benzo[ghi]perylene | EAC | 110 | * | MAS 461 (table 5b) | SIME080505a1 | EQS from 2013/39/EU crustaceans and molluscs. |
| Indeno[1,2,3-cd] pyrene | EAC | | * | | | EQS from 2013/30/EU crustaceans and molluscs |
| **other (µg/kg)** | | dw | **ww** | | | |
| γ-HCH | EAC | 1.45 | | Mon 1998, annex 5 | Derived from 0.29 µg/kg ww in OSPAR 379 2008 | used in OSPAR 390:2009 CEMP Assessment, |
| DDE (p,p-) | EAC | 5-50 | | Agreement 1997-15e | OSPAR Commision, 1996 Third Workshop on Ecotoxicological Assessment Criteria | Not assessed in 2004 as DDT/DEE was not part of the OSPAR list of substances anymore, but it is still analysed together with PCBs and show a nice decreasing trend most places. |
| TBT | EAC | 12 | 15.2 Sec.pois. 230 Human Cons | Agreement 2009-2 | Derived from 2.4 µg/kg ww in OSPAR 379 2008 OSPAR Commission, 2004: OSPAR/ICES Workshop on evaluation and update of BRCs and EACs | Sec.Pois=:QS secondary poisoning Human Cons.= QS human consumption QS from Common Implementation Strategy for the Water Framework Directive Substance Data Sheet (30) Tributyltin Final Version of 15.01. 2005, NOT included in 2013/39/EU |
| **Sediment** | | | | | | |
| **metals (mg/kg)** | | 5% Al | | | | |
| Arsenic | ERL | 8.2 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) Not used as ERL < BC |
| Cadmium | ERL | 1.2 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Chromium | ERL | 81 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised). |
| Copper | ERL | 34 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised). |
| Mercury | ERL | 0.15 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Nickel | ERL | 21 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised)<br>Not used as ERL < BC |
| Lead | ERL | 47 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Zinc | ERL | 150 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised). |
| **CBs (µg/kg)** | | 2.5% TOC | | | | |
| CB28 | EAC | 1.7 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB52 | EAC | 2.7 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB101 | EAC | 3.0 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB118 | EAC | 0.6 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB138 | EAC | 7.9 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB153 | EAC | 40 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| CB180 | EAC | 12 | | MAS 461 (table 5a) | SIME080505a1, MAS 461 | |
| **PBDEs (µg/kg)** | | 2.5% TOC | | | | |
| BDE28 | FEQS | 110 | | Trial 2017 | Environment Canada 2013 | |
| BDE47 | FEQS | 97.5 | | Trial 2017 | Environment Canada 2013 | |
| BDE66 | FEQS | 97.5 | | Trial 2017 | Environment Canada 2013 | |
| BDE85 | FEQS | 1 | | Trial 2017 | Environment Canada 2013 | |
| BDE99 | FEQS | 1 | | Trial 2017 | Environment Canada 2013 | |
| BD100 | FEQS | 1 | | Trial 2017 | Environment Canada 2013 | |
| BD153 | FEQS | 1100 | | Trial 2017 | Environment Canada 2013 | |
| BD154 | FEQS | 1100 | | Trial 2017 | Environment Canada 2013 | |
| BD183 | FEQS | 14000 | | Trial 2017 | Environment Canada 2013 | |
| BD209 | FEQS | 47.5 | | Trial 2017 | Environment Canada 2013 | |

| **PAHs (µg/kg)** | | 2.5% TOC | | | | |
|---|---|---|---|---|---|---|
| Naphthalene | ERL | 160 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Phenanthrene | ERL | 240 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Anthracene | ERL | 85 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Dibenzothiophene | ERL | 190 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Fluoranthene | ERL | 600 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Pyrene | ERL | 665 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Benz[a]anthracene | ERL | 261 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Chrysene/Triphenylene | ERL | 384 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised)<br>ERL applies to CHR, but formally adopted for CHRTR – currently assess CHR |
| Benzo[a]pyrene | ERL | 430 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Benzo[ghi]perylene | ERL | 85 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| Indeno[1,2,3-cd] pyrene | ERL | 240 | | MAS 461 (table 5a) | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| 2-methyle-Naphthalene | ERL | 70 | | | NOAA (1999)/Long (1995) | ERL for whole sediment (not-normalised) |
| C1-Naphthalene | ERL | 155 | | | Barakat (2011)[&] | ERL for whole sediment (not-normalised). ERL adopted in principle, but not for this congener specifically |
| C2-Naphthalene | ERL | 150 | | | Barakat (2011)[&] | ERL for whole sediment (not-normalised). ERL adopted in principle, but not for this congener specifically |
| C1-Phenanthrene | ERL | 170 | | | Barakat (2011)[&] | ERL for whole sediment (not-normalised). ERL adopted in principle, but not for this congener specifically |
| C2-Phenanthrene | ERL | 200 | | | Barakat (2011)[&] | ERL for whole sediment (not-normalised). ERL adopted in principle, but not for this congener specifically |
| C1-Dibenzothiophene | ERL | 85 | | | Barakat (2011)[&] | ERL for whole sediment (not-normalised). ERL adopted in principle, but not for this congener specifically |
| γ-HCH | ERL | 3 | 1.1 [QS, µg/kg dw] | OSPAR agreement 2009-2 | USEPA (2005); as BHC | First used in OSPAR 390:2009 CEMP Assessment |
| DDE-p,p' | ERL | 2.2 | | OSPAR agreement 2009-2 | NOAA (1999)/Long (1995) Buchman (2008) | First used in OSPAR 390:2009 CEMP Assessment |
| DDT-p,p' | ERL | 1 | | | MacDonald (1996) | For future use |

| **PAHs (µg/kg)** | | 2.5% TOC | | | | |
|---|---|---|---|---|---|---|
| Sum DDT | ERL | 1.58 | | | NOAA (1999)/Long (1995) NOAA (2008) | For future use, sum of all DDTs |
| HCB | ERL | 20 | | OSPAR agreement 2009-2 | USEPA (2005); Buchman (2008) | First used in OSPAR 390:2009 CEMP Assessment |
| Dieldrin | ERL | 0.02 (Revised according to macDonald) | | OSPAR agreement 2009-2 | MacDonald (1996)/ Buchman (2008) | First used in OSPAR 390:2009 CEMP Assessment Notice error of a factor 100 compared to MacDonald (1996) |

$: EQS datasheet 2005 secondary poisoning of top-predators

§: EQS datasheet 2005 Food uptake by man

*: the biota EQS and corresponding AA-EQS in water refer to the concentration of benzo(a)pyrene, on the toxicity of which they are based. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA- EQS in water.

&: Barakat (2011) reference to Long (1995) for methylated PAHs but these are not found in Long (1995). C1-Naphthalenes as 70+85 for 2-methylnaphthalene and 1-methylnapthalene respectively used in the table above

Notes

- MIME 2011 Annex 4 gives species specific factors for converting fish EACs between lw, ww and dw bases
- MIME 2011 Annex 4 gives species specific factors for converting mussel / oyster EACs between ww and dw bases
- The latest conversion factors can be found on the web-tool http://dome.ices.dk/OSPARMIME2018/main.html under assessment criteria, and species-specific conversion factors

The Aspect
12 Finsbury Square
London EC2A 1AS
United Kingdom

t: +44 (0)20 7430 5200
f: +44 (0)20 7242 3737
e: secretariat@ospar.org
www.ospar.org

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