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<b>Document title</b>	GES boundary proposals for hazardous substances
<b>Code</b>	4J-6
<b>Category</b>	DEC
<b>Agenda Item</b>	4J – HELCOM indicators and assessment
<b>Submission date</b>	18.3.2016
<b>Submitted by</b>	EN-Hazardous Substances

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## Background

HOD 48-2015 agreed on GES boundaries for the core indicators on ‘Hexabromocyclododecane (HBCDD)’, ‘Metals’, ‘Polybrominated biphenyl ethers (PBDE)’ and ‘Perfluorooctane sulphonate (PFOS)’,. (Outcome of HOD 48-2015, Annex 4). A general German study reservation remains on the indicators.

GES boundaries for core indicators on ‘Polychlorinated biphenyls (PCB) and dioxins and furans’, ‘Polyaromatic hydrocarbons (PAH) and their metabolites’ and ‘TBT and imposex’ were not agreed by HOD 48-2015, however State and Conservation 2-2015 agreed on principles for defining GES for these indicators and outlined how the GES boundaries could be formulated (para 4J.12).

This document presents proposals for a revision of the GES boundary for the core indicator ‘Metals’ when assessed in HELCOM offshore assessment units and new proposals for GES boundaries for the core indicators ‘Polychlorinated biphenyls (PCB) and dioxin and furan’, ‘Polyaromatic hydrocarbons (PAH) and their metabolites’ and ‘TBT and imposex’. The proposals are summarized in the table and the rationale behind choice of GES boundaries is presented in the document.

The proposals were discussed at the [‘HELCOM BalticBOOST workshop on HOLAS II hazardous substance assessment’](#) which also was the first physical meeting of the HELCOM Expert Network on Hazardous Substances (EN-HZ). The workshop identified some issues that needed further clarification in the proposals which were clarified at consecutive on-line meetings among the Lead- and Co-Lead Country representatives (8.3.) and (11.3.). The final proposal was circulated among the EN-HZ. The proposals have been developed based on previous guidance by State and Conservation 2-2015 (para 4J.7) especially regarding the application of EQS<sub>biota human health</sub> values for indicators to be used for a status assessment from an environmental point of view (cf. Descriptor 8 in EU MSFD), and further taking into consideration the indicator specific initial guidance provided for Metals (para 4J.12 point 14), PAH (para 4J.12 point 17), Dioxins and PCBs (para 4J.12 point 18) and TBT and imposex (para 4J-11 point 5).

*Summary table. Proposals for GES boundaries. Information in shaded cells are included for information only, no changes are proposed.*

Core indicator		GES boundary	Source	Endorsement type
<b>Metals</b>				
Cd	Offshore assessment units	50 µg/kg ww fish muscle 1000 µg/kg ww mussels	EC 1881/2006	Revision
	Coastal assessment units	0.2 µg/l	EQS water (AA)	No change
		<i>Secondary GES boundary: 2.3 mg/kg dw sediment</i>	QS	No change

		960 µg/kg dw blue mussel	BAC	
Pb	Offshore assessment units	300 µg/kg ww fish muscle 1500 µg/kg ww mussels	EC 1881/2006	Revision
	Coastal assessment units	1.3 µg/l	EQS water (AA)	No change
		<i>Secondary GES boundary:</i> 120 mg/kg dw sediment 1300 µg/kg dw blue mussel 26 µg/kg dw fish	QS BAC BAC	No change
Hg		20 µg/kg ww	EQS <small>biota secondary poisoning</small>	No change
<b>Polychlorinated biphenyls (PCB) and dioxin and furan</b>				
Dioxin and dioxin-like compounds		0.0065 TEQ/kg ww fish, crustaceans or molluscs	EQS <small>biota human health</small>	New GES proposal
		<i>Secondary GES boundary:</i> CB-118 24 µg/kg lw fish liver or muscle:	EAC	New secondary GES proposal
Non-dioxin like PCBs;		sum of congeners (28, 52, 101, 138, 153, 180) 75 µg/kg ww fish muscle	EC 1881/2006	New GES proposal
<b>Polyaromatichydrocarbons (PAH) and their metabolites</b>				
benzo(a)pyrene		5 µg/kg ww crustaceans and molluscs	EQS <small>biota human health</small>	New GES proposal
Metabolite: 1-hydroxypyrene		483 ng/g fish bile	Davies and Vethaak, 2012	New GES proposal
<i>Secodary: Fluoranthene;</i>		<i>Secondary GES boundary:</i> 30 µg/kg ww crustaceans and molluscs, 2000 ug/kg dw sediment	EQS <small>biota human health</small> QS	New secondary GES proposal
<i>Secondary: Anthracene</i>		<i>Secondary GES boundary</i> 24 ug/kg dw sediment	QS	New secondary GES proposal
<b>TBT and imposex</b>				
TBT		1.6 µg /kg dw sediment (5% TOC)	QS	New GES proposal
		<i>Secondary GES boundary:</i> 0.2 ng/l water 12 µg/kg dw mussel	EQS water (AA) EAC	New secondary GES proposal
Imposex		<i>Peringia ulvae:</i> 0.1 VDSI Other species: OSPAR EcoQO class 2 as defined in Table 1 of this document.	Gercken & Sordyl 2009; Magnusson et al 2016 EAC	New GES proposal

### Action requested

The Meeting is invited to:

- consider and endorse the proposed GES boundaries with a view of adoption by HOD 50-2016,
- consider the proposal from the expert network on hazardous substances to also include other substances in HOLAS II.

## GES boundary proposals for hazardous substances

### Metals

GES-boundaries for metals were agreed at HOD 48-2015. The expert network on hazardous substances proposes to adjust GES boundary for cadmium (Cd) and lead (Pb) when used in offshore assessment units.

Water matrices for cadmium (Cd) and lead (Pb) are not considered to be applicable for the offshore assessment units as the measured concentrations vary significantly and additionally monitoring in the water phase is generally very demanding, and proposes to review the GES boundary for these areas to designate biota as primary GES boundary and sediment as secondary GES boundary.

**The proposal for cadmium (Cd) and lead (Pb) is to use the foodstuff threshold values fish muscle Cd: 50 µg/kg ww, Pb: 300 µg/kg ww and mussels Cd: 1000 µg/kg ww, Pb: 1500 µg/kg ww for assessment in offshore assessment units (EC 1881/2006).**

If fish liver values are available then conversion factors are to be applied to calculate muscle concentrations. However conversion factors are not yet fully developed, and some experts have expressed concern regarding the confounding effect of using conversion factors instead of direct measurements. Data for calculation of preliminary conversion factors are available for perch and to some extent for herring and flatfish.

The approach is in line with the approach used in OSPAR to set the target values for cadmium and lead. Foodstuff targets as described in Regulation (EC) No 1881/2006 are the currently best available protective threshold value, future studies considered needed to conclude if the foodstuff value is suitable for environmental protection goals.

The secondary GES boundary and associated matrices (sediment and mussel) agreed at HOD 48-2015 for cadmium (Cd) and lead (Pb) are not proposed to be changed and no changes are proposed to mercury (Hg).

### Polychlorinated biphenyls (PCB) and dioxin and furan

The State and Conservation 2-2015 meeting agreed to use the EQS biota human health value as the GES boundary for dioxin and tentatively to use the food safety value as GES boundary for non-dioxin-like PCBs (para 4J.12 point 18), however, this proposal had not been translated into specific GES boundary proposals.

**Based on this guidance the HELCOM expert network on hazardous substances discussed the final wording of the target and propose the GES boundary for;**

- **Dioxin and dioxin-like compounds; EQS<sub>biota human health</sub> 0.0065 TEQ/kg wet weight measured in fish, crustaceans or molluscs**
- **Non-dioxin like PCBs; foodstuff threshold based on the sum of six congeners (28, 52, 101, 138, 153, 180) 75 µg/kg wet weight fish muscle (EC 1881/2006)**

#### *Secondary GES boundary*

- *Dioxin like-PCBs: EAC for PCB118 24 µg/kg lipid weight measured in fish liver or muscle*

The GES boundary value for non-dioxin like PCBs is proposed to be based on food safety thresholds as described in Regulation (EC) No 1881/2006. The sum of OSPAR EACs for the same congeners (PCB-congeners; 28, 52, 101, 138, 153, 180) was considered, however when the sum is normalized to 5% fat the value would be less protective (133 µg/kg ww) than the food safety threshold (75 µg/kg ww) and thus not

considered to be suitable as the general approach of applying the GES boundary value that protects the most sensitive species group. As the value for human consumption is stricter compared to the environmental values (EACs) it is proposed to be used. Assessing environmental status using a food safety value is not considered to be without difficulties in the interpretation by the experts, as exposure needs to be taken into consideration. The experts further noted that most of the available environmental monitoring data will be used to assess the food safety based GES boundary and the secondary GES boundary.

### Polyaromatic hydrocarbons (PAH) and their metabolites

The State and Conservation 2-2015 meeting agreed to use thresholds from the EQS Directive and considered any other PAH than benzo(a)pyrene to be supporting parameters (para 4J.12 point 17).

The core indicator is proposed to have a GES boundary for concentration of benzo(a)pyrene and a parallel boundary for the main metabolite of PAH (1-hydroxypyrene) in fish bile. Either boundary can be used for an assessment depending on availability of suitable monitoring data.

#### The proposal for the GES boundary:

- **Concentration of benzo(a)pyrene: EQS biota human health 5 µg/kg ww measured in crustaceans and molluscs**
- **Concentration of the metabolite 1-hydroxypyrene; 483 ng/g measured in fish bile of (HPLC/GC-MS-method) (derived for cod).**

#### Secondary GES boundary:

- *Fluoranthene; EQS human health 30 µg/kg ww (crustaceans and molluscs) or QS sediment 2000 ug/kg dw,*
- *Anthracene; QS sediment 24 µg/kg dw.*

The proposed GES boundary concentration of the main PAH metabolite 1-hydroxypyrene in fish bile corresponds to a PAH concentration of crude oil in water causing unacceptable effects for adults and larvae of cod (Davies and Vethaak, 2012). The GES value has been derived based on studies of cod, however it is also applicable for measurements in other species monitored in the Baltic Sea such as flounder, eelpout, herring and perch.

The QS sediment values proposed as secondary GES boundaries are derived from ecotoxicity studies with sediment dwelling organisms in accordance with WFD CIS guidance and are thus considered an eligible alternative to the EQS.

#### References:

Davies, I.M., Vethaak, A.D., 2012. Integrated marine environmental monitoring and their effects. ICES Cooperative Research report No. 315. 270 pp.

### TBT and imposex

The core indicator for TBT and imposex has been agreed to apply an 'umbrella approach' where the assessment is done based on measurements of either TBT concentration, imposex or both, however it is not a requirement to measure both. The proposal for the GES boundary for the two approaches is:

- a. **TBT: primary GES boundary: QS sediment 1.6 µg /kg dw (5% TOC) (developed by Sweden based on toxicity (EU WFD EQS 0.02 µg/kg dw), and secondary GES boundary: EQS water: 0.2 ng/l, EAC mussel 12 µg/kg dw**
- b. **Imposex: primary GES boundary: 0.1 VDSI for *Peringia ulvae* (previously *Hydrobia ulvae*), for other species OSPAR EcoQO class 2 as defined in Table 1.**

*Table 1. Imposex assessment classes related to GES for gastropod snail species. (VDSI - Vas Deferens Sequence Index, ISI - intersex stage index)*

Assessment class	Species Parameter	<i>Nucella lapillus</i>	<i>Neptunea antiqua</i>	<i>Hinia reticulata</i>	<i>Buccinum undatum</i>	<i>Peringia ulvae</i>	<i>Littorina littorea</i>
		VDSI	VDSI	VDSI	VDSI	VDSI	ISI
1	GES	<0.3	<0.3				
2		0.3 – <2	0.3 – <2	<0.3	<0.3	<0.1*	
3	sub-GES	2 – 4	2 – <4	0.3 – <2	0.3 – <2	0.1* – <1	<0.3
4		4 – 6	4	2 – 4	2 – 4	1 – 3	0.3 – 1.2
5						>3	1.2 – 4

\*The lower value for *Peringia ulvae* in the Baltic Sea compared to the value 0.3 used in the North Sea is based on data from less polluted reference areas in the Baltic Sea in Sweden and Germany (Gercken & Sordyl 2009; Magnusson et al 2016).

Regarding the secondary GES boundary for concentration of TBT in biota (mussels), it is considered important to include this value as most of the long-term trend information is available for biota. Sediment data will allow for spatial GES assessments, although analytical detection limits for TBT in sediment can be higher than GES, especially after normalisation to 5% TOC. For the northern sub-basins in the Baltic Sea, mussels might not be available as a suitable matrix, and thus it might be needed to develop a threshold value for fish. In this case a fish-threshold value could be calculated from the food safety target (15.2 µg/kg seafood ww), however it should be noted that most of the fish measurements are from liver and would require conversion to muscle in order to be evaluated against the food safety target. It should further be noted that the protection level for EAC mussel is higher compared to the food safety value, so further work on deriving a suitable fish matrix target would be needed. In addition, concentrations of triphenyltin, which is another toxic organotin compound often found in fish, can be added with TBT concentrations if it is considered relevant.

Regarding the modifications of the *Peringia ulvae* imposex GES boundary compared to the OSPAR EcoQO for the species, it can be noted that the species is not as sensitive to TBT as other gastropod species (e.g. *Nucella lapillus*). In Swedish monitoring stations it has been noted that a fairly high percentage of the females (27%) have been affected at the OSPAR EcoQO VDSI boundary of 0.3. Based on data from less polluted reference areas in the Baltic Sea, a lower GES boundary value (VDSI=0.1) for *Peringia ulvae* is proposed for the core indicator (see Table 1). The sub-GES values 1 and 3 (used to scale the 'distance to target') are based on interspecies comparisons between *Peringia ulvae* and *Littorina littorea* (Schulte-Oehlmann et al., 1998).

#### References:

- Gercken J. and Sordyl H., 2009. Pilotstudien zum biologischen Effektmonitoring in Küsten- und Binnengewässern Mecklenburg-Vorpommerns, Schriftenreihe des Landesamtes für Umwelt, Naturschutz und Geologie Mecklenburg-Vorpommern 2009, Heft 2, 134pp (In German)
- Magnusson, M., Andersson, S., Bergkvist, J., & Granmo, Å., 2016: Biologiska effekter av organiska tennföreningar. Havet 2015 s. XX-XX. Havs och vattenmyndigheten. In press. (In Swedish)
- Schulte-Oehlmann U., Oehlmann J., Bauer B., Fioroni P. and Leffler U.-S., 1998. Toxicokinetic and -dynamic aspects of TBT-induced imposex in *Hydrobia ulvae* compared with intersex in *Littorina littorea* (Gastropoda, Prosobranchia). *Hydrobiologia* 378: 215–225.

## Additional issues regarding hazardous substance indicator based assessment

### Hazardous substances of relevance that are not core indicators

The HELCOM expert network on hazardous substances expressed their concern at the 'HELCOM BalticBOOST workshop on the hazardous substance assessment' that the current set of core indicators does not cover all hazardous substances giving cause for concern. In particular 'classic compounds' for which data, and to some extent targets, are available were raised as potentially relevant to include in HOLAS II in addition to core indicators. The substances are considered to be relevant for the Baltic Sea from a risk assessment point of view as these substances still pose problems.

Additional substances to the core indicators could be taken into HOLAS II, either by agreeing to develop additional indicators or to include supporting time trends of additional substances in the HOLAS II report. Indicators could be developed for DDE (DDTs) and HCB, and time trends could be included for HCH and total oil concentration (measured by spectrofluorometry). DDE is considered to be a particular problem in the Baltic Sea in a European perspective especially as Germany and Poland used the substances longer than e.g. in the North Sea region, and indicator development could make use of extensive research information available on concentrations causing negative impacts on e.g. White-tailed eagles. Recent monitoring of sediment and biota has detected rising concentrations of HCB giving cause for concern and an indicator approach could make use of the available EQS biota secondary poisoning 10 µg/kg ww fish. HCH is considered to be an emerging problematic substance, also from a human health perspective, and some time trends could be of interest. The HELCOM time trend on total oil concentration from the 1970s (concentration of oil measured by spectrofluorometry: Finnish data) would be an interesting time series to include in the HOLAS II assessment as a supporting parameter.

### Automating the indicator assessment protocols

Extracting and pre-processing monitoring data from the COMBINE database has in the past required significant manual work as a first step in the indicator evaluation. OSPAR MIME has developed an R-script that performs these first steps of the indicator assessment and significantly reduces the amount of manual work needed. The 'HELCOM BalticBOOST workshop on hazardous substance assessment' concluded that the statistical methods used are very similar to the ones used in the HELCOM core indicators, and that the method should be applied also on HELCOM core indicators. The workshop recommended that Lead Country representatives, HELCOM Secretariat, ICES Secretariat and OSPAR experts working on the issues, would arrange an on-line meeting to discuss how to proceed with the issue. OSPAR experts have indicated a willingness to share the code and work together with HELCOM experts to develop the code further. HELCOM experts will need to modify the code to HELCOM needs relating e.g. to substances and thresholds used.

### Aligning the HOLAS II hazardous substance assessment with WFD chemical status assessment

Contracting Parties advised at HOLAS II 4-2015 (para 4.10) that the HOLAS II assessment of hazardous substances is to be aligned with the chemical status assessment under the WFD covering the territorial waters.

The HELCOM expert network on hazardous substances discussed the issue at the 'HELCOM BalticBOOST workshop on hazardous substances assessment' and noted that most monitoring stations are located in the coastal area and noted further that not all assessment units on scale 4 for waterbodies or -types contain monitoring stations.