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Background

Improvement of the data, especially, on airborne input of nitrogen (document 3-3) and transboundary loads for both nitrogen and phosphorus as well as update of the national time serious for the whole period of observation have resulted in the need to update national input ceilings to sub-basins, based on the Maximum Allowable Inputs agreed in the MD2013 which remain unchanged. The first draft illustrating overall approach to update input ceilings was presented at PRESSURE 11-2019. Values presented at that autumn meting were provisional and served for illustration of the proposed approach. Further, the proposed approach was considered and in general supported by HOD 57-2019, which requested to discuss provisional values as well as methodology for their calculation at expert level and approved organizing of the thematic workshop on the proposed nutrient input ceilings on 20 April 2020.

Attachment 1 to this document contains the latest update of nutrient input ceilings based on the best available data n nutrient inputs and transboundary loads in the period 1995-2017. All data were verified by national data reporters and used also for the assessment of the NIC assessment in the PLC-7 project (document 3-4). The attachment also contains description of the methods applied to compute input ceilings and discussion on the difference between new and previously agreed values of input ceilings.

Attachment 2 is the full dataset used for the update of the input ceilings in MS Excel format.

Action requested

The Meeting is invited to discuss proposed values for national input ceilings, clarify remaining issues and agree on the proposed values as targets for the management objective - minimize input of nutrients from human activities - of the updated BSAP.

On revised Nutrient input ceilings (NIC) for the BSAP update

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March 30, 2020

1. Background

The allocation in the HELCOM BSAP Nutrient Reduction Scheme follows the polluter pays principle in its simplest implementation: all nutrient inputs to a sub-basin should be reduced with the same percentage relative to the reference input period (1997-2003). After reductions are achieved, the total input to the basin should equal to MAI for that basin. The country-wise nutrient reduction targets (CART) of the 2013 Ministerial Declaration have been followed up using Nutrient Input Ceilings (NIC) that caps the nutrient inputs from each country-basin combination. NIC is defined as the difference between the inputs in the reference period and CART. Further, the advantage with NIC is that once established one are assured that keeping within NIC result in achieving MAI for the basin in question, independent of evaluating consequences of updated data for the reference period. This has proven extremely valuable since data are continuously updated.

2. Introducing Nutrient Input Ceilings in Baltic Sea Action Plan

NIC has de facto replaced CART in the assessment of progress towards the goals of the HELCOM BSAP Nutrient Reduction Scheme, mainly due to practical/technical advantages. In addition, NIC are more attractive because of its direct link to MAI and also follows concepts developed elsewhere such as, for example, *Total Maximum Daily Load* (TMDL) of the U.S. Clean Water Act, which enhance clarity and communicability of the Nutrient Reduction Scheme.

NIC is so far only implicitly adopted through its relationship to MAI and CART of the 2013 Ministerial Declaration. It would be desirable to have a formal documentation of their values.

3. Objectives of a revision of NIC

A revision of NIC does not include changes to MAI, nor changing any of the principles of allocation used in the 2013 MD. However, the update of the BSAP serves as a good opportunity to revise the NIC to correct a few deficiencies of the CART definitions of the 2007 BSAP and the 2013 MD in order to make the NIC future proof and policy relevant. In addition, new updated data sets call for adjustments in the numerical values.

A number of possible updates has been identified and the ones considered here are:

1. **Take into account expected reductions in atmospheric deposition due to decreased ship emissions in both North Sea and the Baltic Sea due to the NECA**

   NECA negotiations were not complete in 2013 and it was decided that only expected reductions due to decrease emissions of the Baltic Sea international shipping should be taken into account. However, now NECA is agreed and under implementation for both Baltic Sea as well as North Sea ship traffic, and since North Sea shipping is a significant source for atmospheric nitrogen deposition on the Baltic Sea it is natural to include these expected reductions as well.

2. Increase robustness of riverine transboundary parts of NIC

In the NIC currently used for evaluation, and in some of the CART, the net waterborne transboundary contributions are included in the country contribution without an explicit notion. For some countries, e.g., LV and LT, the net transboundary corrections are of large significance. However, still there are major uncertainties in the computation of transboundary inputs, not the least in river retention, and large improvements of these estimates are anticipated in years to come. It is imperative that NIC are constructed and presented in a manner that addresses the potential and probable need of updating the computation of the transboundary part of NIC.

3. Highlight the contributions of the major (transboundary) rivers

The five rivers Vistula, Oder, Neva, Nemunas and Daugava are by far the largest rivers in terms of nutrient inputs. Together they contribute with about 30% of the nitrogen and 46% of the phosphorus inputs to the Baltic Sea. Further, they drain to sub-basins with reduction requirements and in practice it is not possible to reach MAI without significant reductions in these rivers. In addition, they are all transboundary rivers where joint action is needed by several HELCOM and/or non-HELCOM countries.

4. Take into account updated data

The calculation of 2013 NIC (CART) was based on time-series obtained within the PLC 5.5 project. At that time data was available for the period 1994-2010. Since then we increased the length of time-series substantially (at present to 2017) and various updates have increased the data quality. Examples of updated data are:

   a. EMEP have updated atmospheric deposition data using new emissions data sets and improved modeling
   b. EMEP provides new estimates of expected reductions of atmospheric deposition due to implementation of NECA and Gothenburg Protocol within the ENIRED II project.
   c. River retention and border load data are updated for the river transboundary calculations
   d. Latvia have reported corrected total phosphorus inputs for the earlier part of the time-series that significantly improve the data quality of the reference period.
   e. Denmark has reported new data for the whole time-series based on improved modeling.

5. Take into account methodologies developed within PLUS, MAI-CART OPER, PLC-6 and PLC-7 in preparing data and calculating nutrient inputs

   a. Improved quality control and assurance
   b. Flow normalization are now performed on each catchment individually, previously on country-basin aggregated inputs

4. Principles of the NIC calculation

The NIC are calculated based on the exact same principles as decided in the 2013 Ministerial Declaration:

1. Sharing of reductions are based on nutrient inputs in the period 1997-2003, using flow normalized riverine inputs, direct point source inputs, normalized atmospheric nitrogen deposition from EMEP and estimated atmospheric phosphorus inputs.
2. Expected reductions due to emission reductions in non-HELCOM countries from implementation of the Gothenburg Protocol are considered before allocating reductions.
3. Expected reductions due to emission reductions by Baltic Sea and North Sea[1] shipping from implementation of NECA are considered before allocating reductions.
4. Each HELCOM country as well as other countries contributing with waterborne transboundary inputs (i.e., Belarus, Czech Republic and Ukraine) should reduce their inputs in proportion to their contribution to the inputs to the Baltic Sea in the reference period.

The mathematical description of the calculations is provided in Annex 1.

5. Data

Data was gathered for 1995-2017 from the PLC-water data base (retrieved on March 19, 2020) together with the previously performed gap-filling within PLC-7. The river data was flow normalized individually for all sub-catchments. Transboundary rivers, which also include the five largest (in terms of nutrient inputs) rivers, are analyzed separately. The same transboundary rivers as were used in the 2013 MD calculations are analyzed here. Remaining normalized waterborne loads were aggregated according to country and basin. From these time-series, the average 1997-2003 nutrient inputs were derived. Normalized atmospheric deposition per country and basin 1995-2017 was delivered by EMEP on Sept 24, 2019. The reference inputs per country and basin are given in Tables A2.1 and A2.2 in Annex 2, together with some other tables showing reference transboundary and airborne inputs.

An updated assessment of the transboundary contributions has been performed described in Annex 3. Note that retention values are in some cases different from what is used in the on-going assessment.

The complete data set used for this analysis is provided in a supplementary Excel file.

Within the ENIRED project EMEP made projections of expected nitrogen deposition from emissions in countries and from the shipping sector to the Baltic sub-basins at present (2005) and in the future (2030) given implementation of NECA and Gothenburg protocol/EU-NEC[2]. These data were used to estimate expected reductions of atmospheric deposition as described in the next Section.

[1] North Sea shipping was not included in the 2013 Ministerial Declaration CART calculations

[2] See Estimation of Country-wise Reductions of Atmospheric Nitrogen Deposition, achievable by 2030 through Implementation of the Gothenburg Protocol / EU-NEC Directive by Gauss et al., In press EMEP (MSC-W)

6. Suggestion for Nutrient input ceilings tables

6.1. Atmospheric deposition from non-HELCOM countries, shipping and other sources

The calculations scenarios from ENIRED II project projects that between 2005 and 2030 the contributions from the Baltic Sea and North Sea shipping will reduce with about 50 and 60%, respectively. Further, it is expected that deposition from sources outside HELCOM countries will decrease with almost 50%. In this analysis, we apply the percentage change to the normalized time-series data for 2005 to compute the nutrient input ceilings for "other countries" and shipping rather than using the ENIRED II 2030 results directly, because the two data-sets are somewhat incompatible due to methodological differences. The difference between the ENIRED II 2030 results and the projection using the normalized time-series is relatively large for a few country-basin combinations, but varies randomly so overall basin-wise or country-wise sums are conforming well.

The calculation of input ceilings for these sources is presented in Table 1. There are notable changes in the new figures compared to what was used in 2013. Then only Baltic Sea shipping was considered, but a much larger reduction of 80% was assumed compared to about 50% in the current data. Also, the expected reductions from implementation of Gothenburg protocol/NEC directive changed significantly, formerly it was assumed that nitrogen deposition would decrease with about 30% while the new expected reduction is more than 50%. In addition, EMEP have recalculated depositions in general using improved models and revised emission data, which have resulted in significant overall higher deposition than was used in preparation of the 2013 MD CARTs, see Table A2.8. These changes results in a somewhat lower overall ceiling on the combined OC+NOS source and a much higher ceiling on the Baltic Sea shipping, see Table 8 below.

Table 1: Expected reductions and ceilings on atmospheric deposition from non-HELCOM countries and North and Baltic Sea shipping.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
REFERENCE INPUTS								
OC	2877	10423	56263	5735	4169	10911	10318	100696
BSS	604	2360	10412	1308	776	1282	1225	17967
NOS	389	1292	6561	548	414	1717	1885	12806
EXPECTED REDUCTION								
OC	1502	5415	29316	2750	1981	5978	5816	52758
BSS	320	1219	5232	633	431	631	524	8989
NOS	258	817	4134	352	264	988	1001	7814
NUTRIENT INPUT CEILINGS								
OC	1375	5008	26947	2985	2188	4933	4502	47938
BSS	284	1141	5180	675	345	651	701	8978
NOS	131	475	2427	196	150	729	884	4992

The ceiling on atmospheric deposition of phosphorus is the same as the estimated reference inputs and this is unchanged since the 2013 MD CART.

6.2. New nutrient input ceilings

Nutrient input ceilings for TN and TP are presented in Table 2 and 3. Separate NIC are calculated for each of the transboundary rivers and not included in the country ceilings in these tables.

Table 2: Nutrient input ceilings for TN.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	946	3923	32281	1645	1747	23647	4662	68852
DK	281	1149	9026	420	463	28067	28525	67931
EE	113	404	1478	11330	13099	22	24	26471
FI	35086	28677	1827	15627	295	76	89	81677
LT	108	495	3620	305	462	65	80	5135
LV	74	330	2789	246	12223	31	34	15727
PL	668	3127	35486	1406	1595	1481	1444	45206
RU	839	1994	7321	22875	662	238	246	34175
SE	17718	32651	30691	625	525	6056	32810	121076
OC	1375	5008	26947	2985	2188	4933	4502	47938
BSS	284	1141	5180	675	345	651	701	8978
NOS	131	475	2427	196	150	729	884	4992
NEMUNAS			29338					29338
BARTA			957					957
VENTA			6033					6033
LIELUPE					15864			15864
DAUGAVA					38801			38801
ODER			49298					49298
VISTULA			74808					74808
PREGOLYA			5494					5494
NEVA				43462				43462
MAI	**57622**	**79372**	**325000**	**101800**	**88417**	**65998**	**74000**	**792209**

Table 3: Nutrient input ceilings for TP.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			71			401		472
DK			21			979	815	1815
EE			9	225	185			418
FI	1683	1245		297				3224
LT			50					50
LV			62		499			560
PL			543					543
RU			146	1531				1677
SE	811	1134	318			116	754	3133
OC	181	394	1046	150	93	105	118	2087
NEMUNAS			914					914
BARTA			25					25
VENTA			106					106
LIELUPE					302			302
DAUGAVA					942			942
ODER			1554					1554
VISTULA			2350					2350
PREGOLYA			147					147
NEVA				1398				1398
MAI	**2675**	**2773**	**7360**	**3600**	**2020**	**1601**	**1687**	**21716**

The NIC for the transboundary rivers are subsequently split into country-wise NIC describing the cap on the nutrient inputs to the sea from that country, i.e., after retention using the data presented in Annex 2 and Annex 3.

Table 4: Nutrient input ceilings (TN) for on the country contributions to each of the transboundary rivers.

RIVER	NIC	DE	FI	LT	LV	PL	RU	BY	CZ	UA
NEMUNAS	29338			18934				10404		
BARTA	957			377	581					
VENTA	6033			3730	2303					
LIELUPE	15864			5867	9996					
DAUGAVA	38801			897	22450		2634	12820		
ODER	49298	1796				43951			3551	
VISTULA	74808					70063		3052		1693
PREGOLYA	5494					2498	2995			
NEVA	43462		4855				38607			

Table 5: Nutrient input ceilings (TP) for on the country contributions to each of the transboundary rivers.

RIVER	NIC	DE	FI	LT	LV	PL	RU	BY	CZ	UA
NEMUNAS	914			628				286		
BARTA	25			5	20					
VENTA	106			26	80					
LIELUPE	302			109	193					
DAUGAVA	942			33	403		99	407		
ODER	1554	38				1459			57	
VISTULA	2350					2240		63		47
PREGOLYA	147					51	96			
NEVA	1398		20				1378			

6.3. Reduction requirements

The new ceilings imply somewhat changed reduction requirements. It is here illustrated by tables showing the required percentage reductions compared to the reference period.
The generally higher atmospheric deposition caused reference TN inputs to be higher than MAI in all basins, so reductions are necessary in all basins (Table 6). This does not, however, necessary imply that NIC are lower, see 6.4 below. Notable is that the higher reduction requirement in GUR and DS are taken care of fully by the expected reductions on shipping and other countries making NIC for HELCOM countries slightly higher than reference inputs. MAI for TP in DS is actually higher than the revised reference input, making reduction requirements for DS negative (Table 7). The percentage reductions are otherwise small for the basins that previously did not have reduction requirements (BOB, BOS, DS and KAT). The new Latvian TP data has significantly increased inputs to GUR (see Table A2.7 and Table A2.10), therefore 32% reduction is necessary on the TP inputs to GUR.

Table 6: Percentage needed reductions to obtain NIC for TN relative to the reference period.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	6	1	23	19	-1	-1	7	13
DK	6	1	23	19	-1	-1	7	7
EE	6	1	23	19	-1	-1	7	10
FI	6	1	23	19	-1	-1	7	8
LT	6	1	23	19	-1	-1	7	19
LV	6	1	23	19	-1	-1	7	5
PL	6	1	23	19	-1	-1	7	20
RU	6	1	23	19	-1	-1	7	18
SE	6	1	23	19	-1	-1	7	10
OC	52	52	52	48	48	55	56	52
BSS	53	52	50	48	55	49	43	50
NOS	66	63	63	64	64	58	53	61
NEMUNAS			23					
BARTA			23					
VENTA			23					
LIELUPE					-1			
DAUGAVA					-1			
ODER			23					
VISTULA			23					
PREGOLYA			23					
NEVA				19				
TOTAL	**9**	**10**	**28**	**21**	**2**	**10**	**15**	**19**

Table 7: Percentage needed reductions to obtain NIC for TP relative to the reference period.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			62			-10		15
DK			62			-10	-1	-3
EE			62	57	32			49
FI	6	2		57				14
LT			62					62
LV			62		32			37
PL			62					62
RU			62	57				57
SE	6	2	62			-10	-1	16
OC	0	0	0	0	0	0	0	0
NEMUNAS			62					
BARTA			62					
VENTA			62					
LIELUPE					32			

DAUGAVA					32			
ODER			62					
VISTULA			62					
PREGOLYA			62					
NEVA				57				
TOTAL	**6**	**2**	**58**	**56**	**31**	**-9**	**-1**	**42**

6.4. Comparison with present net nutrient input ceilings

There is only one principal difference between the new and current input ceilings and that is the inclusion of expected reductions on North Sea shipping. Remaining differences arise from updated reference inputs, including transboundary rivers, and the way ceilings are presented. To compare with the current ceilings, the net ceilings are computed by adding the transboundary NIC from Tables 4 and 5 to the countries in Tables 2 and 3. Further, the ceiling on North Sea shipping is added to OC. The nutrient input ceilings on the net inputs following this calculation are shown in Tables 8 and 9. For reference the current net nutrient input ceilings are presented in Annex 4.

Table 8: Country-basin net TN nutrient input ceilings.

	BOB	**BOS**	**BAP**	**GUF**	**GUR**	**DS**	**KAT**	**BAS**
DE	946	3923	34077	1645	1747	23647	4662	70648
DK	281	1149	9026	420	463	28067	28525	67931
EE	113	404	1478	11330	13099	22	24	26471
FI	35086	28677	1827	20482	295	76	89	86532
LT	108	495	26661	305	7226	65	80	34940
LV	74	330	5673	246	44669	31	34	51058
PL	668	3127	151998	1406	1595	1481	1444	161719
RU	839	1994	10316	61483	3296	238	246	78411
SE	17718	32651	30691	625	525	6056	32810	121076
OC (INCL NOS)	1506	5483	29374	3182	2337	5662	5385	52930
BSS	284	1141	5180	675	345	651	701	8978
BY			13456		12820			26276
CZ			3551					3551
UA			1693					1693
MAI	**57622**	**79372**	**325000**	**101800**	**88417**	**65998**	**74000**	**792209**

Table 9: Country-basin net TP nutrient input ceilings.

	BOB	**BOS**	**BAP**	**GUF**	**GUR**	**DS**	**KAT**	**BAS**
DE			109			401		510
DK			21			979	815	1815
EE			9	225	185			418
FI	1683	1245		316				3244
LT			709		142			851
LV			162		1094			1256
PL			4291					4291
RU			242	2909	99			3249
SE	811	1134	318			116	754	3133
OC	181	394	1046	150	93	105	118	2087
BY			349		407			756
CZ			57					57
UA			47					47
MAI	**2675**	**2773**	**7360**	**3600**	**2020**	**1601**	**1687**	**21716**

Table 10: Change (%) between the new and current net nutrient input ceilings (TN).

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	16	24	24	25	19	8	42	19
DK	21	27	14	26	21	-7	-3	-2
EE	19	27	5	1	1	23	21	1
FI	0	-3	16	-1	16	19	16	-1
LT	-2	1	-19	17	25	21	33	-12
LV	17	21	-7	35	-17	30	37	-16
PL	4	12	-6	21	17	32	31	-4
RU	18	29	11	-2	31	37	41	2
SE	-1	-2	-1	25	17	-3	-4	-2
OC (INCL NOS)	-20	-17	-11	-8	-17	-4	-3	-11
BSS	294	291	261	359	208	295	371	278
BY			84		102			92
CZ			32					32
UA			-13					-13
MAI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 11: Change (%) between the new and current net nutrient input ceilings (TP).

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			8			14		13
DK			-1			-6	-2	-4
EE			9	-5	-23			-13
FI	1	-1		-2				0
LT			-15		-14			-15
LV			119		102			104
PL			0					0
RU			-13	1	-47			-3
SE	-2	1	3			11	2	1
OC	0	0	0	0	0	0	0	0
BY			43		-49			-27
CZ			-47					-47
UA			43					43
MAI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

5. Discussion

There are significant differences between the new and current the nutrient input ceilings. Primary causes are the rather large changes in the nitrogen atmospheric deposition and waterborne transboundary inputs in the reference period (see Annex 2) due to updated data sets. There are also a few cases where new waterborne input data have been reported by the countries, primarily DK and LV.

There are large differences in net inputs (Tables A2.6-A2.7) and net input ceilings (Tables 8-9) for countries with large proportions of waterborne transboundary, such as for example Lithuania and Latvia. This highlights that singling out nutrient input ceilings for the transboundary rivers as done in Tables 2 and 3 make the overall ceilings more robust to future improvements in the estimation of contributions from different countries to the transboundary river loads. When for example new modeling provide updated estimates on retention, only Tables 4 and 5 are affected.

The new outline of having ceilings for individual rivers is fully compatible with the current presentation of net nutrient input ceilings on country by basin division.

Annex 1: Calculation of nutrient input ceilings

It turns out that the whole allocation scheme of 2013 Ministerial Declaration can be formulated in terms of NIC with just one equation.

The nutrient input ceiling $NIC_{i,j}$ for source/country j to sub-basin i can be computed from

$$NIC_{i,j} = \frac{L_{i,j}}{\sum_{j \neq other} L_{i,j}} (MAI_i - NIC_{i,other}) \tag{1}$$

Where $L_{i,j}$ is the reference inputs from source/country j to sub-basin i and $NIC_{i,other}$ is the nutrient input ceiling for other sources which are not sharing reduction requirements (i.e. atmospheric deposition from non-sharing countries, international shipping etc). MAI_i is the maximum allowable input for the sub-basin.

$NIC_{i,other}$ for nitrogen includes expected reductions from non-HELCOM countries according to the Gothenburg protocol and from international shipping according to implementation of the IMO-NECA. Nitrogen deposition from countries that have not signed the Gothenburg protocol and other sources are assumed to stay at the level computed for the reference period 1997-2003. For phosphorus, $NIC_{i,other}$ comprise of the estimated atmospheric deposition which is assumed to not change in the future.

Annex 2: Reference inputs, including comparison with old reference inputs.

The new reference inputs used in the calculation of ceilings are presented in Tables A2.1 and A2.2. The atmospheric input part of the nitrogen inputs is shown in Table A2.3. The transboundary shares of the transboundary rivers are shown in Tables A2.4 and A2.5.

Table A2.1: TN reference inputs (t/y) for 1997-2003. OC comprise of all other countries/sources to atmospheric deposition, BSS and NOS are Baltic and North Sea shipping, respectively.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	1002	3971	42011	2030	1737	23526	5025	79302
DK	297	1163	11746	519	460	27923	30744	72852
EE	120	409	1924	13985	13022	22	26	29508
FI	37149	29029	2378	19288	293	76	96	88309
LT	114	501	4711	377	459	65	86	6313
LV	78	334	3629	304	12151	31	37	16565
PL	707	3165	46182	1736	1586	1473	1556	56405
RU	888	2018	9528	28235	658	237	265	41828
SE	18760	33052	39941	772	522	6025	35362	134434
OC	2877	10423	56263	5735	4169	10911	10318	100696
BSS	604	2360	10412	1308	776	1282	1225	17967
NOS	389	1292	6561	548	414	1717	1885	12806
NEMUNAS			38181					38181
BARTA			1246					1246
VENTA			7852					7852
LIELUPE					15771			15771
DAUGAVA					38574			38574
ODER			64157					64157
VISTULA			97355					97355
PREGOLYA			7149					7149
NEVA				53644				53644
TOTAL	**62985**	**87717**	**451226**	**128481**	**90592**	**73288**	**86625**	**980914**

Table A2.2: TP reference inputs (t/y) for 1997-2003.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			187			366		553
DK			55			893	807	1755
EE			23	521	271			815
FI	1790	1276		687				3753
LT			131					131
LV			162		732			894
PL			1429					1429
RU			385	3543				3928
SE	863	1163	837			106	746	3715
OC	181	394	1046	150	93	105	118	2087
NEMUNAS			2407					2407
BARTA			67					67
VENTA			279					279
LIELUPE					443			443
DAUGAVA					1382			1382
ODER			4093					4093
VISTULA			6191					6191
PREGOLYA			386					386
NEVA				3236				3236
TOTAL	**2834**	**2833**	**17678**	**8137**	**2921**	**1470**	**1671**	**37544**

Table A2.3: TN atmospheric deposition reference inputs (t/y) 1997-2003.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	1002	3971	34473	2030	1737	9799	5025	58037
DK	297	1163	9651	519	460	5211	6090	23391
EE	120	409	810	980	269	22	26	2635
FI	2125	2991	2378	1463	293	76	96	9421
LT	114	501	2561	377	459	65	86	4164
LV	78	334	1239	304	517	31	37	2539
PL	707	3165	24229	1736	1586	1473	1556	34452
RU	888	2018	5356	2591	658	237	265	12012
SE	968	3207	8853	772	522	468	1108	15899
OC	2877	10423	56263	5735	4169	10911	10318	100697
BSS	604	2360	10412	1308	776	1282	1225	17967
NOS	389	1292	6561	548	414	1717	1885	12806
TOTAL	**10168**	**31835**	**162785**	**18363**	**11860**	**31293**	**27717**	**294022**

Table A2.4: TN transboundary river reference inputs (t/y) 1997-2003.

RIVER	TOTAL	DE	FI	LT	LV	PL	RU	BY	CZ	UA
NEMUNAS	38181			24641				13540		
BARTA	1246			490	756					
VENTA	7852			4854	2997					
LIELUPE	15771			5833	9938					
DAUGAVA	38574			892	22319		2619	12745		
ODER	64157	2337				57198			4622	
VISTULA	97355					91181		3972		2203
PREGOLYA	7149					3251	3898			
NEVA	53644		5992				47652			

Table A2.5: TP transboundary river reference inputs (t/y) 1997-2003.

RIVER	TOTAL	DE	FI	LT	LV	PL	RU	BY	CZ	UA
NEMUNAS	2407			1655				752		
BARTA	67			14	53					
VENTA	279			68	211					
LIELUPE	443			160	283					
DAUGAVA	1382			48	591		145	598		
ODER	4093	101				3842			150	
VISTULA	6191					5899		167		124
PREGOLYA	386					133	253			
NEVA	3236		45				3191			

Comparison with old reference inputs

In order to compare with reference inputs used to compute the present ceilings from the MD 2013 CART, the net country by basin inputs are computed including the transboundary shares (following Annex 3). Further, North Sea shipping is included into the OC category. The percentage change from the old reference inputs are shown in Tables A2.6 and A2.7. In Table A2.8, the change of the atmospheric nitrogen deposition between the new and the old reference inputs presented and in Tables A2.9 and A2.10 the changes in waterborne inputs are presented.

Table A2.6: Change (%) of the net country-basin reference inputs for TN.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	25	33	27	37	21	14	49	24
DK	31	36	17	38	23	-2	2	3
EE	29	37	7	10	2	29	30	7
FI	8	4	19	9	17	27	22	7
LT	6	8	-17	28	26	27	41	-12
LV	26	29	-5	48	-16	35	42	-14
PL	12	20	-3	32	19	39	37	-2
RU	28	38	14	8	33	45	49	10
SE	7	5	2	37	19	3	1	3
OC INCL NOS	22	24	32	27	14	46	51	33
BSS	67	62	45	77	38	55	63	51
BY			88		105			95
CZ			35					35
UA			-11					-11
TOTAL	**9**	**11**	**6**	**11**	**2**	**11**	**10**	**8**

Table A2.7: Change (%) of the net country-basin reference inputs for TP.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			4			4		4
DK			-7			-14	-3	-9
EE			0	3	-2			1
FI	7	2		7				5
LT			-18		9			-16
LV			110		156			145
PL			-4					-4
RU			-16	9	-33			5
SE	4	3	-1			1	1	2
OC	0	0	0	0	0	0	0	0
BY			38		-35			-5
CZ			-49					-49
UA			37					37
TOTAL	**6**	**2**	**-4**	**8**	**25**	**-8**	**-1**	**2**

Table A2.8: Change (%) of the nitrogen deposition reference inputs.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	25	33	34	37	21	25	49	33
DK	31	36	18	38	23	-2	8	12
EE	29	37	23	44	9	26	27	31
FI	20	28	19	47	17	28	22	26
LT	5	8	7	28	5	27	41	10
LV	27	29	28	48	17	34	42	28
PL	12	20	23	32	19	39	37	24
RU	28	38	38	48	29	45	49	39
SE	28	26	12	37	19	22	18	17
OC (INCL NOS)	36	40	46	48	23	60	69	48
BSS	67	62	45	77	38	55	63	51
TOTAL	**24**	**29**	**29**	**38**	**18**	**28**	**37**	**29**

Table A2.9: Change (%) of the waterborne TN reference inputs.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			10			7		8
DK			12			-2	1	0
EE			-2	8	2			5
FI	7	2		5				5
LT			-5					-5
LV			13		0			2
PL			-5					-5
RU			3	7				7
SE	6	3	-1			1	0	2
TOTAL	**7**	**2**	**-3**	**7**	**0**	**1**	**1**	**1**

Table A2.10: Change (%) of the waterborne TP reference inputs.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			7			4		5
DK			-7			-14	-3	-9
EE			0	3	-2			1
FI	7	2		8				5
LT			-4					-4
LV			89		31			38
PL			-5					-5
RU			-20	9				5
SE	4	3	-1			1	1	2
TOTAL	**6**	**3**	**-4**	**9**	**27**	**-9**	**-1**	**2**

Annex 3: Transboundary input estimates

Table A3.1 contains a description of the data sets and processing performed to estimate transboundary load estimates for the reference period. In Table A3.2, the border loads and transboundary loads are compared on an aggregated level with the data set used for the 2013 MD CART.

Table A3.1: Data set and retention values used in estimation of transboundary inputs.

River	**Upstream country**	**Data set**	**TN Retention**	**TP Retention**
Nemunas	BY	Lithuanian border loads from Nemunas and Neris	0.11[1]	0.22[1]
Barta	LT	Both Lithuania and Latvia monitor close to the border and averaged data should be used. Latvian data is available from 2001	0.16	0.4
Venta	LT	Both Lithuanian and Latvian monitoring (from 2001), but both stations are at some distance from the border. Average stations give approximate loads at the border. Prior 2001 that border loads = 1.228 * LT loads	0.16	0.48
Lielupe	LT	Lithuanian monitoring in Musa and Nemunelis used. Add unmonitored area (1714 km^2) to monitored (7141 km^2), i.e., multiply with 1.24.	0.15	0.6
Daugava	LT	Contribution not monitored, estimate by using annual area specific loads from Musa and Nemunelis. Area in LT is 1821 km2, i.e. multiply Musa and Nemunilis loads with 0.26 to get border loads	0.38	0.43
Daugava	BY	Latvian monitoring data at the border	0.38	0.43
Daugava	RU	BY monitoring data is available 2004-16. TN not monitored but estimated by multiplying DIN with a factor of 1.76 deduced from comparing Latvian and Belarussian monitoring data at the Latvian-Belarussian border. For 1995-2003, border loads are assumed to be TN 34% and TP 56% of the loads at the BY-LV border based on average ratio 2004-2010. 2017 is estimated as TN 23% and TP 18% of the BY-LV border load based on average ratio for 2014-2016.	0.38 (in BY) 0.62 (total)	0.43 (in BY) 0.68 (total)
Neva	FI	Finnish border load data	0.3[2]	0.7[2]
Oder	DE	In the reference period German contribution 5.5% (TN) and 3.1% (TP) of total Odra according to German modeling. This percentages are still used.	0	0
Oder	CZ	Polish border load data, 1995-2010 previously supplied, 2012-2017 reported to PLC, 2011 estimated 9.5% of total Oder loads	0.3	0.64
Vistula	BY	Estimated as 6% of total Vistula loads based on 2012-2017 data reported to PLC	0.32	0.55
Vistula	UA	Polish load data from Bug, 1995-2010, 2012-2017 reported to PLC, 2011 estimated as 7.5% of the total Vistula loads	0.32	0.55
Pregolya	PL	Polish data time-series provided 1995-2010, 2012-2017 reported to PLC, 2011 estimated as 49% of total Pregolya loads	0.25	0.58

[1]Retention figures supplied by LT

[2]Retention figures supplied by FI

Table A3.2: Comparison of border loads, retention coefficients and transboundary inputs of the present data set and the data set used for CART calculations in 2013.

			Data used for 2013 CART						New data set					
From	Via	To	Border		Retention		To Baltic		Border		Retention		To Baltic	
			TN	TP	TN	TP	TN	TP	TN	TP	TN	TP	TN	TP
			t/y	t/y			t/y	t/y	t/y	t/y			t/y	t/y
From non-Contracting Parties:														
Czech	Poland	BAP	5700	410	0.4	0.28	3420	295	6602	416	0.3	0.64	4622	150
Belarus	Lithuania	BAP	13600	914	0.54	0.53	6256	430	15213	964	0.11	0.22	13540	752
Ukraine	Poland	BAP	4124	127	0.4	0.28	2474	91	3239	277	0.32	0.55	2203	124
Belarus	Poland	BAP	5071	331	0.4	0.28	3043	238	5841	371	0.32	0.55	3972	167
Total		**BAP**					**15193**	**1055**					**24336**	**1193**
Belarus	**Latvia**	**GUR**	**8532**	**1360**	**0.27**	**0.32**	**6228**[1]	**925**[1]	**24780**	**1303**	**0.38**	**0.43**	**15364**[1]	**743**[1]
Between Contracting Parties														
Lithuania	Latvia	BAP	5516	158	0.39	0.58	3365	66	6362	153	0.16	0.47[2]	5344	82
Poland	Russia	BAP	4400	320	0.3	0.37	3080	202	4335	318	0.25	0.58	3251	133
Germany	Poland	BAP					2.337	101					2337	101
Total		**BAP**					**8782**	**369**					**10933**	**316**
Lithuania	Latvia	GUR	7185	282	0.27	0.32	5245	192	8300	485	0.19[3]	0.57[3]	6725	208
Russia	Latvia	GUR	4256	734	0.54	0.71	1957	215	6813	377	0.62	0.68	2619	145
Total		**GUR**					**7202**	**407**					**9275**	**433**
Finland	**Russia**	**GUF**			**0.48**	**0.82**	**5353**	**49**	**8560**	**151**	**0.3**	**0.7**	**5992**	**45**

[1]Includes also the Russian contribution to Baltic Sea loads via Daugava.
[2]Weighted average retention in Barta and Venta.
[3]Weighted average retention in Daugava and Lielupe.

Annex 4: 2013 MD CART based nutrient input ceilings

The country-basin net nutrient input ceilings based on the CARTs from the 2013 Ministerial Declaration are provided here for reference.

Table A4.1: Country-basin net TN nutrient input ceilings based on the CARTs from the 2013 Ministerial Declaration.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE	817	3170	27473	1312	1465	21957	3285	59480
DK	231	904	7910	334	381	30313	29319	69392
EE	95	317	1413	11265	13029	18	20	26156
FI	35081	29619	1569	20653	255	64	77	87318
LT	110	491	33093	261	5795	54	60	39864
LV	63	273	6091	183	53898	24	25	60558
PL	644	2802	160857	1166	1361	1125	1106	169062
RU	710	1551	9253	62522	2516	174	174	76900
SE	17924	33350	30942	502	449	6224	34206	123597
OC	1876	6603	33002	3455	2804	5880	5579	59199
BSS	72	292	1434	147	112	165	149	2372
BY			7322		6352			13673
CZ			2693					2693
UA			1948					1948
MAI	**57622**	**79372**	**325000**	**101800**	**88417**	**65998**	**74000**	**792212**

Table A4.2: Country-basin net TP nutrient input ceilings based on the CARTs from the 2013 Ministerial Declaration.

	BOB	BOS	BAP	GUF	GUR	DS	KAT	BAS
DE			101			351		451
DK			21			1040	829	1890
EE			8	236	239			483
FI	1668	1255		322				3245
LT			831		166			996
LV			74		541			615
PL			4309					4309
RU			277	2892	185			3354
SE	826	1125	308			105	740	3104
OC	181	394	1046	150	93	105	118	2087
BY			244		797			1041
CZ			108					108
UA			33					33
MAI	**2675**	**2773**	**7360**	**3600**	**2020**	**1601**	**1687**	**21717**