Baltic Marine Environment Protection Commission

Seventh Baltic Sea Pollution Load Compilation (PLC-7)
Project Implementation Group

PLC-7 IG 9-2019

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Submitted by	Finland (SYKE)
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Background

PLC-7 IG 8-2019 discussed the status of the PLC-7 task to evaluate effectiveness of measures to reduce nutrient loads and recalled that PLC-7 IG 7-2019 had agreed to focus the evaluation on effectiveness of measures to reduce nutrient loads from point sources and scattered dwellings.

This task is tightly linked with implementation of ACTION Project WP 4.1 Following up existing measures. A Report describing potential reduction of nutrient input from point source is prepared by SYKE utilizing data from PLC-Water database.

This document contains a first draft assessment of potential reduction of input of nutrients from point sources based on the periodic 2017 PLC data reporting.

Action requested

The Meeting is invited to consider the results of the study, reflect on its completeness of data and reliability of the assessment results.

Specific open issues are:

- Can Russian aggregated data be used?
- -What to do with Polish data (691 plants with missing loads)?

Second draft 10.12.2019

WP 4 Input of nutrients: effectiveness of measures

4.1 Following up existing measures

c) Contributions from point sources

Aim of the study

Differences in the flow-normalized annual mean concentrations of discharges from direct point sources will be analysed in order to estimate the relative efficiency of the treatment of water discharges across the region. Inland (indirect) point sources will be assessed in regions where previous HELCOM analyses (HELCOM 2018c) have shown that these are a significant contribution to the total load. This analysis has the potential to indicate differences in the potential for measures across the region and variations between similar water treatment facilities in different countries.

To estimate the reduction capacity of municipal wastewater treatment plants (MWWTP) PLC-7 data was collected from the PLC-database. The data includes both treatment plants discharging wastewaters directly to marine wasters and inland plants. Total phosphorus (PTOT) and total nitrogen (NTOT) loads of individual plants were divided by flows to get concentrations, which were compared to the limit values of the HELCOM recommendation 28E/5 and the EU urban wastewater directive (Table 1). Since the HELCOM values are stricter for PTOT than the respective EU values, the comparison was done with HELCOM recommendation values. If calculated concentration was above the limit value, the difference in mg/l was calculated back to tons for the estimation of the remaining reduction potential. Also retention of nutrients in inland waters was taken into account to get the estimate of the actual reduction potential benefitting the Baltic Sea.

Table 1. Municipal wastewater treatment requirements according to HELCOM recommendation 28E/5 and the respective requirements of the EU urban wastewater directive. PE = population equivalent.

	HELCOM				**EU**			
PE	PTOT		NTOT		PTOT		NTOT	
	mg/l	%	mg/l	%	mg/l	%	mg/l	%
300-2000	2	70	35	30				
2001-10000	1	80	35	30				
10001-100000	0.5	90	15	70-80	2	80	15	70-80
> 100000	0.5	90	10	70-80	1	80	10	70-80

Material and Methods

Data sources and calculation methods

Data of MWWTPs for the year 2017 (PLC-7 data) was collected from the PLC-database. Russia has only aggregated data and also the Swedish data concerning inland MWWTPs

was aggregated, but for this study Sweden submitted data of individual plants. The data consisted of altogether 3233 (Table 2) excluding 691 Polish plants with missing loads (only discharge is available).

Table 2. Number of MWWTPs in the PLC-database in 2017 by countries and sub-regions.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
DE	52	64								**116**
DK	44	319	217	42						**622**
EE					44	13				**57**
FI					308		36	113	83	**540**
LT	556					75				**631**
LV	9				1	28				**38**
PL	782									**782**
RU	4				16					**20**
SE	163		120	14				29	101	**427**
Sum	**1610**	**383**	**337**	**56**	**369**	**116**	**36**	**142**	**184**	**3233**

Population equivalent numbers (PE) were mostly missing in the database, but some countries (Denmark, Finland, Germany and Sweden) could submit this information enabling the classification of plants according PE numbers (Table 1). Since the correlation between wastewater flow and PE is tight (r^2 0.81, n = 1741), we used flow to estimate missing PE values according to this formula:

PE = flow*0.00904+4265

To be able to estimate the actual loads reaching the Baltic Sea retention in inland has to be taken into account. For that purpose MWWTPs were first divided into two categories: direct (zero retention) and indirect (variable retention depending on e.g. distance from sea and lake area). Since there is no estimate of retention of individual plants in the PLC-database other ways of retention were applied: A) for Danish plants 25% NTOT retention and 10% PTOT retention were used (Lars Svendsen personal communication). B) To estimate the retention for other countries MWWTP loads per sub-catchments were summed and the sums were compared with source apportionment figures (MWWTP loads reaching the Baltic Sea) derived from the PLC-7 data. C) Many countries (LT, LV, PL, RU) were lacking MWWTP loads in their source apportionment figures and for those countries published retention estimates were applied (Stålnacke et al. 2015, and Stålnacke Excel spreadsheet with P retention coefficients).

Results

In 2017 the reported sum of MWWTP NTOT load in the PLC-database load was 68 295 t (Table 3). Polish NTOT load was less than the respective Swedish load, which indicates lacks in Polish reporting, since population of Poland is nearly four times higher.

Table 3. NTOT load of MWWTPs in 2017.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
DE	543	875								**1419**
DK	48	1065	850	1047						**3010**
EE					659	87				**746**
FI					6425		550	2809	2275	**12059**
LT	1823					163				**1986**
LV	119				20	1181				**1320**
PL	15870									**15870**
RU	525				15506					**16031**
SE	6387		3457	1005				1393	3614	**15855**
Sum	**25314**	**1940**	**4307**	**2052**	**22610**	**1431**	**550**	**4202**	**5889**	**68295**

In 2017 the reported sum of MWWTP PTOT load in the PLC-database load was around 3000 t with many gaps in Polish data (Table 4).

Table 4. PTOT load of MWWTPs in 2017.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
DE	37	27								**64**
DK	5	108	77	115						**305**
EE					31	5				**36**
FI					108		9	23	19	**158**
LT	136					15				**151**
LV	13				3	141				**157**
PL	956									**956**
RU	20				943					**963**
SE	104		70	26				11	31	**243**
Sum	**1271**	**136**	**147**	**142**	**1085**	**160**	**8.6**	**33.6**	**50.4**	**3033**

If all MWWTPs would follow HELCOM recommendation 28E/5 NTOT loads discharged into inland waters or to the Baltic Sea would decrease by 13607 t (Table 5) and the respective PTOT loads would decrease by 1059 t (Table 6). In Estonia and Sweden there is no potential for further PTOT reductions.

Table 5. NTOT reduction potential in MWWTPs at source.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
	t	t	t	t	t	t	t	t	t	
DE	26	78								**103**
DK		4	3	0						**7**
EE					5					**5**
FI					2271		89	1703	1297	**5360**
LT	119					0				**119**
LV	8				9	207				**224**
PL	469									**469**
RU					4638					**4638**
SE	377		83	104				618	1498	**2680**
Sum	**999**	**82**	**86**	**105**	**6924**	**207**	**89**	**2322**	**2795**	**13607**

Table 6. PTOT reduction potential in MWWTPs at source.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
	t	t	t	t	t	t	t	t	t	
DE	11	2.6								**14**
DK	1.0	21	14	29						**65**
EE					0.1	0.0				**0**
FI					5.1		0.2	2.3	3.2	**11**
LT	48					4.9				**53**
LV	7.5				2.3	81				**91**
PL	252									**252**
RU	0.8				573					**573**
SE	0.1								0	**0**
Sum	**321**	**24**	**14**	**29**	**580**	**86**	**0**	**2**	**3**	**1059**

The reduction potential of loads discharged into inland waters would not totally benefit the Baltic Sea, since part of the loads would be retained along the route towards the sea. Approximately 25% of the NTOT reduction potential is lost, because of retention and one 10% of the PTOT reduction potential (Tables 7 and 8). Thus, NTOT load into the Baltic Sea would decrease by 10083 t and the respective PTOT load by 905 t, if all MWWTPs would follow HELCOM recommendation 28E/5.

Table 7. NTOT reduction potential in MWWTPs at sea.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
	t	t	t	t	t	t	t	t	t	
DE	26	78								**103**
DK		3	2	0						**6**
EE					2					**2**
FI					991		89	1535	811	**3426**
LT	84					0				**84**
LV	7				4	148				**158**
PL	452									**452**
RU					3575					**3575**
SE	83		49	104				653	1387	**2277**
Sum	**651**	**81**	**51**	**105**	**4572**	**148**	**89**	**2188**	**2199**	**10083**

Table 8. PTOT reduction potential in MWWTPs at sea.

COUNTRY	BAP	WEB	KAT	SOU	GUF	GUR	ARC	BOB	BOS	Sum
	t	t	t	t	t	t	t	t	t	
DE	11	2.6								**14**
DK	1.0	21	13	29						**63**
EE					0.0	0.0				**0**
FI					2.1		0.2	2.2	2.3	**7**
LT	26					2.1				**28**
LV	4.1				1.2	50				**55**
PL	243									**243**
RU	0.6				494					**495**
SE	0.1								0	**0**
Sum	**286**	**23**	**13**	**29**	**497**	**52**	**0**	**2**	**2**	**905**

References

Stålnacke, P. Pengerud, A., Vassiljev, A., Smedberg, E., Mörth, C.-M., Hägg, H. E., C. Humborg, C. and. Andersen H. E. 2015. Nitrogen surface water retention in the Baltic Sea drainage basin. Hydrol. Earth Syst. Sci., 19, 981–996.