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Surface Water Status Assessment in Tisza River Basin and its evolution and updated database

Deliverable 3.3.1: Surface Water Status Assessment in the Tisza River Basin

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Disclaimer

This Report is based on data delivered by the Tisza River Basin countries as of July 2018. Data were incorporated in to the Danube GIS database as well as into questionnaires send out in December 2017.

Sources other than project partners have been clearly identified in this report.

This report has been elaborated in line with the methodology for the Danube River Basin Management Plan – Update 2015. A more detail level of information is presented in the national river basin management plans in the Tisza River Basin countries.

Data in this report has been dealt with, and is presented, to the best of our knowledge. Nevertheless cannot be ruled out.

1 Introduction

Surface water status is the general expression of the status of a body of surface water, determined by the poorer of its ecological and chemical status. Good surface water status means that its ecological and chemical status are at least good.

Ecological status is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters. Different quality elements are used for the assessment of ecological status, biological quality elements being represented by: phytoplankton, phytobenthos, macrophytes, benthic invertebrates and fish fauna. Good ecological status is the status of a body of surface water classified in accordance with Annex V of the Water Framework Directive (WFD). Good ecological potential is the status of a heavily modified or an artificial body of water classified in accordance with Annex V of the Water Framework Directive.

Assessment of ecological status and ecological potential is based on national classification schemes. Ecological status classification includes four basic principles:

- Type specific classification,
- WFD required quality elements should reflect the pressures
- Classification by used quality elements should fulfil WFD normative definitions,
- The procedure of assessment is based on the comparison to the reference conditions.

Chemical status assessment is regulated on EU level. With regards to reference period used for status assessment of surface water bodies in Tisza River Basin the baseline for the assessment of the chemical status is the list of priority substances and the certain other pollutants given by Directive 2008/105/EC on environmental quality standards in the field of water policy, which was amended by the Directive 2013/39/EU. However, for the chemical status assessment of the surface water bodies in the period 2009-2012 the Directive 2008/105/EC has been used. For Romania only, the chemical status assessment of the surface water bodies was done for the period 2011-2014 (but mainly 2013) and the threshold values set in the Directive 2013/39/EU.

Additionally, the Directive 2009/90/EC laying down, pursuant to Directive 2000/60/EC of the European Parliament and of the Council (WFD), technical specifications for chemical analysis and monitoring of water status has to be considered.

Surface water body status assessment in the Tisza River Basin takes into account the rivers with catchment size larger than 1,000 km^2; lakes larger than 10 km^2 and the main canals of basin-wide importance.

2 Surface water monitoring

Basic tool for the status[1] overview and status assessment as well as the water management planning is monitoring activity. The surface water monitoring network shall be established in accordance with the requirements of Article 8 of the WFD. The monitoring network shall be designed so as to provide a coherent and comprehensive overview of ecological status within each river basin and shall permit classification of water bodies into five classes, respectively in four classes in the case of ecological potential.

On the basis of the characterisation and impact assessment for each river basin management plan period applies, surveillance, operational and investigative monitoring should be established (Map 1).

2.1 National monitoring networks

In Ukraine the three types of monitoring required by EU WFD are not implemented yet. It is planned to be implemented after 2019. Present monitoring network in Tisza River Basin includes 32 stations, but they are not related to water bodies. The parameters include 12 physical-chemical parameters and 4 heavy metals with frequency 4-12 times per year measured in the water matrix only. Following bilateral agreements on transboundary water courses, the monitoring is carried out at 8 transboundary stations on monthly basis. The parameters include 12 chemical and physical-chemical determinants, specific non-synthetic (heavy) metals and 27 priority substances. Biological quality elements are missing.

In Romania the Integrated Monitoring System of Waters (IMSW) was implemented at the national level, according with the requirements of the WFD since 2007. The monitoring system integrates six subsystems: rivers, lakes, coastal and transitional waters, groundwaters, waste waters and is run through the three monitoring programmes for surface water bodies (surveillance monitoring, operational monitoring, investigative monitoring). The main role of the surveillance programmes is to provide an assessment of the overall water bodies status. Based on some criteria (same typology, the same pressures type and size and representativity) a part of water bodies are grouped for the monitoring purpose, since not all water bodies can be monitored. All biological quality elements and supporting elements (hydromorphological, physico-chemical general and specific pollutants and priority substances) are monitored according with the WFD frequencies. Water, sediments and biota as matrices have been included. Operational monitoring is established for those water bodies identified as being at risk of failing their environmental objectives and to assess any changes in their status resulting from specific measures implementation. Investigative monitoring is provided in specific cases: where the reason for any exceedances of the environmental objectives is unknown and to establish the magnitude and impacts of accidental pollution.

[1] *Status includes status (for natural water bodies) and potential (for heavily modified and artificial water bodies)*

In Slovakia only, river category is relevant. The natural lakes as it is required according to the WFD concerning the size of lakes are not located in Slovakia. All types of monitoring have been established (surveillance, operational, investigative). Surveillance monitoring was established for surface water status assessment in order to assess water status of all very large, large and medium size rivers with higher importance. Small types of rivers were grouped according selected criteria and representatives of groups are monitored. Transboundary water bodies are included into surveillance monitoring as well. The monitoring programmes are approved each year in the frame of the relevant international bilateral water quality commissions and ~~is~~ are focused on verification of reference conditions as well as the verification of surface water characterization (water body in risk of failing good ecological or chemical status). Operational monitoring is focused on diffuse and point sources of pollution, on the hazardous substances exceeding environmental quality standards (EQS), on development of the classification schemes (for ecological status/potential), selected sampling points are focused on the trends of the hazardous substances occurrence. Investigative monitoring was aimed on validation of background concentration of heavy metals in the year 2009, on screening of specific (synthetic and non-synthetic) substances in waste waters in the period 2010 – 2012 and on evaluation of mercury, hexachlorobenzene and hexachlorobutadiene in fish tissue in 2011. Monitoring of sediments has been included in the programme in 2012. All required quality elements and frequencies are included except of fish, which were monitored in 2011 only. Three matrices were included as water, sediments and biota.

In Hungary the 10 natural river-types and 8 natural lake-types based on B typology system according to WFD requirements have been designed. Surveillance and operational monitoring systems were established for routine monitoring, investigative monitoring has been focused on special cases, like accident pollution. Surveillance monitoring assesses the long term changes in human activity on waterbodies, including monitoring of transboundary water courses. Operational monitoring was established to review the impact of organic pollution, nutrients, hydromorphology, priority substances as pressures on status of waterbodies, which are failing to achieve the environmental objectives as well as for assessing of effectiveness of programme of measures. All required quality elements and frequencies are included except of fish which were monitored in the year 2015 however in the water matrix only. Among priority substances some of the organic compounds were not measured due to technical difficulties.

In Serbia there are altogether three monitoring sites on the Tisza River of which two sites are used for surveillance monitoring program and all three sites for operational monitoring program. Surface water quality monitoring is realized based on annual monitoring plans. This does not include monitoring stations on the tributaries of the Tisza River. National Water Quality Monitoring in Serbia is not fully aligned with the requirements of the WFD (WFD is not fully transposed in the national legislation).

In the most of the Tisza River Basin counties the standard methods for sampling and analysis are used. Accredited laboratories have implemented QA/QC system as well as the system according to the ISO/IEC 17025.

All together 276 sampling sites are used for surveillance (121), operational (196) and investigative (1) monitoring in the countries of Tisza River Basin. 22 sites are included into ICPDR surveillance monitoring for specific pressures (TransNational Monitoring Network). Romania has 18 sites for evaluation of reference conditions. There are also sites (27) which were included in the process of intercalibration of the biological methods (Romania 11, Slovakia 16) on the European level. The overview of the surface water monitoring sites in the countries of the Tisza River Basin is given in the Table II.1 as well as on the Map 1.

Table II.1: Overview of the surface water monitoring stations in the Tisza River Basin

Country	Total number of monitoring stations	Surveillance monitoring	Operational monitoring	Investigative monitoring	ICPDR surveillance monitoring (TNMN)
Ukraine	5	0	5	0	3
Romania	129	56	66	1	6
Slovakia	24	22	23	0	0
Hungary	115	41	99	0	10
Serbia	3	2	3	0	3
Total	276	121	196	1	22

2.2 Monitoring under TNMN

The TransNational Monitoring Network (TNMN) was established to support the implementation of the Danube River Protection Convention in the field of monitoring and assessment. The TNMN was formally launched by the ICPDR in 1996, although the history of international monitoring of the Danube River is much longer.

The main objective of the TNMN is to provide a structured and well-balanced overall view of pollution and long-term trends in water quality and pollution loads in the major rivers in the Danube River Basin.

The integral part of TNMN is also Tisza River Basin. There are all together 16 sites in the Tisza River Basin, while the most sites are located in Hungary (10), Romania (6), Ukraine and Serbia have 3 TNMN sites. TNMN sites are presented on the Map 1.

3 Surface water status assessment

3.1 Typology

The delineation of the river and lake water bodies according to the Annex II of the WFD depends on typology and on other factors (e.g. pressures types, pressures magnitude and status). In addition, typology is a basis for development of classification schemes for the status assessment.

Based on system A of the WFD, ecoregion, catchment area, altitude and geology are the main descriptors for rivers, while altitude, depth, size and geology are the main descriptors for lakes. However, all the Tisza River Basin countries except Slovakia used additional descriptors as they are given in the system B of the WFD. These optional descriptors are for rivers e.g. distance from river source, mean water width, mean water depth, mean slope, form a shape of main river bed, flow category, acid neutralising capacity, mean substratum composition, transport of solids. For lakes optional descriptors can be as residence time, lake shape, mixing characteristics, acid neutralising capacity, background nutrient status, substratum composition, water level fluctuation.

All the Tisza River Basin countries have developed their typology for rivers and/or lakes. All of them except Slovakia used system B according to the Annex II of the WFD. The adopted systems for typology are different in different basin countries.

3.2 Reference conditions

For each characterized surface water body type, the type of specific biological, hydromorphological and physico-chemical conditions shall be established representing the values of the biological, hydromorphological and physico-chemical quality elements for classification of ecological status specified among normative definitions for all surface water body types as high ecological status.

For heavily modified and artificial surface water bodies references to high ecological status shall be constructed as references to maximum ecological potential defined for all relevant quality elements by normative definitions. Values for maximum ecological potential could be reviewed every six years.

Type specific reference conditions for biological quality elements may be either spatially based (reference sites) or based on modelling or may be derived using combination of these methods. Where it is not possible to use these methods, the expert judgement can be used.

High status values in respect of concentrations of specific synthetic pollutants are those of detection limits or limits of quantification of the most advanced analytical methods, and they are those which can be achieved in accordance with required analytical techniques. For the specific non-synthetic pollutants (heavy metals) the reference values are equal to the natural background concentrations.

Most of the Tisza River Basin countries, especially EU members, used above mentioned approaches for setting of the reference conditions for development of the classification systems for required quality elements.

3.3 Classification schemes

Surface water status assessment has to be done independently for each of category of surface water, it means for rivers and lakes in the Tisza River Basin.

3.3.1 Ecological status and potential

For ecological status following quality elements should be used:

- Biological quality elements (composition and abundance of aquatic flora, of benthic invertebrate fauna and composition, abundance and age structure of fish fauna);
- Hydromorphological quality elements (hydrological regime, river continuity and morphological conditions);
- General physico-chemical quality elements (thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions);
- Chemical quality elements–river basin specific pollutants.

Based on the results of quality elements assessment, the ecological classification is provided using classification schemes. Basic principles of classification of ecological status as they are already generally mentioned in the Chapter 1 are:

- Type specificity means that typology for all categories (e.g. rivers and lakes) have to be available;
- Pressure specificity means that sensitive biological quality elements and their metrics/indices should reflect to all available pressures;
- Fulfilling of the ecological status normative definitions according to the Annex V of the WFD (Annex 2);
- Identification of anthropogenic induced deviation from reference values.

For the classification of ecological status of surface water bodies, the results of analysis of biological quality elements are expressed as Ecological Quality Ratio (EQR). Ecological Quality Ratio is relation among measured values of biological parameter/metric in the water body and reference values of parameter/metric for respective category and type. The range of Ecological Quality Ratio is between 0 and 1, the ecological status being high and good as the values are closer to 1. For the supportive physical-chemical quality elements the classification of ecological status consists of boundary values among high, good and moderate quality class for all selected parameters. Supportive hydromorphological quality elements classify ecological status in to high and good status. For evaluation of the river basin (or water body) specific substances the national environmental quality standards (EQS) have to be set for evaluation.

For the ecological status assessment, the all relevant and required quality elements for particular water body are evaluated altogether using rule “one out all out” (the worst quality class is the final one).

The ecological status of natural surface water bodies has to be classified as high, good, moderate, poor and bad.

For the heavily modified water body and artificial water body the environmental objective means to achieve ecological potential. The quality elements and the frequencies applicable to the artificial and heavily modified surface water bodies shall be those applicable to whichever of the natural surface water categories above most closely resembles the heavily modified or artificial water body concerned. However, the relevant quality elements should be selected. Ecological potential of heavily modified surface water body or artificial water body can be classified as good and above, moderate, poor and bad.

Type-specific classification schemes for the natural water bodies and individual quality elements are the baseline for the determination of the ecological potential of heavily modified surface water body or artificial water body. When determining the ecological potential consideration shall be given to information on a particular water body and possible impacts of hydromorphological changes on biological elements. Alternatively, the "PRAGUE" [2] approach, taking into account the mitigation measures can be applied. Assessment of pollution has to be included as well.

The situation is different in the Tisza River Basin countries. In Ukraine classification schemes for biological quality elements, general physico-chemical quality elements, hydromorphological elements and specific substances are missing.

In Romania classification systems for all biological quality elements and physico-chemical elements were established and published officially within the frame of the up-dated National River Basin Management Plan except macrophytes, which were developed later on. For ecological potential, classification schemes for several QEs and "PRAGUE" approach were used. Besides the general physico-chemical parameters, 4 relevant specific non synthetic substances (heavy metals) and 7 organic compounds were included into assessment system including national environmental quality standards.

In Slovakia the classification schemes were developed and officially published for all quality elements required by WFD including national environmental quality standards. There were 27 specific substances selected (22 synthetic and 4 heavy metals). Method for assessment of ecological potential is under development.

Hungary similarly to other EU members uses officially published assessment systems for all relevant biological quality elements and 12 physico-chemical elements. Four metals have been selected as river basin specific pollutants with modelled national environmental quality standards. Schemes for assessment of ecological potential are not developed yet.

In Serbia classification schemes for some biological quality elements are missing (macrophytes and fish) as it is required by the scheme for morphological quality elements. Existing classification schemes should be revised in terms of boundary values between classes for some parameters and also for a list of parameters where some overlapping's were identified.

[2] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC103830/kj-na-28413-en-n.pdf

3.3.2 Chemical status

The basis for surface water chemical status assessment is the list of priority substances and the certain other substances according to the Directive 2008/105/EC (which was later on amended by Directive 2013/39/EU), which gives environmental quality standards. The requirements of the Directive 2009/90/EC regarding minimum working criteria applied analytical methods (value of uncertainty have to be lower than 50% (k=2) and limit of quantification equal or lower than 30% of respective environmental quality standard) should be considered.

The principle of chemical status evaluation of the priority substances is comparison of calculated statistical value of individual substance to concerned environmental quality standard and identification of conformity. Statistical values are annual average concentration and the maximum allowable concentration laid down in the Part A of Annex 1 of the Directive 2008/105/EC. If measured value is below limit of quantification (LOQ), for statistical calculation the half of value of LOQ is used for respective substance. When summarising of some substances (e.g. polyaromatic hydrocarbons, DDT) and measured value is below LOQ, 0 is used for calculation of statistical value. For the non-synthetic priority substances (heavy metals) the background concentration should be taken into account for all water bodies. In the selected parameters that are measured in biota, frequency once a year is required while parameters in water have to be measured each month.

Chemical status assessment of the water body is related to the representative monitoring sampling site which provides objective assessment of the status of water body as a whole. Surface water body is classified as good chemical status if statistical values of concentrations of priority substances and other certain substances do not exceed environmental quality standards.

Romania declared that 29 priority substances were used for chemical status assessment considering also the more stringent standards adopted by the Directive 2013/39/EU (all priority substances except brominated diphenylethers, chloroalkanes, tributyltin compounds, pentachlorophenol), while Slovakia used all 33 priority substances. In Hungary the assessment of chemical status was based on 28 priority substances because there were difficulties with PBDEs, SCCPs, tin organic compounds, urea pesticides. There were no data for assessment of chemical status in Ukraine. In Serbia chemical assessment is based on regulatory basis for 33 PS and 19 specific pollutants. Nickel and mercury are excluded from the assessment due to inability with laboratory equipment in the reference year (2015).

The requirements of the Directive 2009/90/EC regarding minimum working criteria applied analytical methods were not fulfilled in the Tisza River Basin countries for all priority substances while for some parameters the limits of quantification should be very low and therefore they are limited by analytical techniques.

3.4 Intercalibration

In accordance with Directive 2000/60/EC the intercalibration exercise is to be carried out at biological element level, comparing the classification results of the national monitoring system for each biological element and for each common surface water body type among countries and ensuring the consistency of the results with the normative definitions set out in Section 1.2 of Annex V to that Directive.

By 2007 the European Commission had received intercalibration results for a number of biological quality elements. They were included in Commission Decision 2008/915/EC, which sets out the values of the boundaries between classes that countries were to use in their national monitoring system classifications. The results of the first phase of the intercalibration exercise were incomplete, in so far as not all biological quality elements were covered.

In order to close the gaps and to improve the comparability of the intercalibration results in time for the second river basin management plans due in 2015, the EU initiated a second phase of the intercalibration exercise. The results of this exercise were included in Commission Decision 2013/480/EU. The results revealed that in some cases intercalibration was only partially achieved. There were also Geographical Intercalibration Groups and biological quality elements for which there were no intercalibration results for inclusion in that Decision.

The third phase of the intercalibration exercise was therefore necessary in order to close these gaps and to improve the comparability of the intercalibration results in time for the third river basin management plans due in 2021. The results of this third phase of the intercalibration exercise are included in the Annex to the Commission Decision 2018/229/EU. The cases referring to GIGs and BQEs where intercalibration has been unfeasible, are included in the Decision as well.

Only the EU member countries in the Tisza River Basin were involved in the process of intercalibration. Based on above mentioned Decision in the frame of Eastern Continental rivers Geographical Intercalibration Group Hungary, Slovakia and Romania intercalibrated class boundaries (between high - good and good - moderate) of the classification schemes for benthic invertebrate and fish fauna, for phytobenthos and macrophytes for relevant types of rivers in the Tisza River Basin.

As for the lakes only Romania and Hungary intercalibrated lowland, very shallow, hard water type of lakes. However, for Romania in the frame of ITRBMP, there is no lake type described above having relevance in this context. Water body type of Csaj lake and Lake Tisza correspond with this intercalibration type. Among biological quality elements phytoplankton, macrophytes and benthic invertebrate fauna were successfully intercalibrated.

3.5 Confidence of the status assessment

According to the requirements of the Annex V of WFD, the assessment of the surface water bodies should be completed by the estimation of confidence and precision. For this purpose, a three levels confidence assessment system can be used for both ecological and chemical status assessment.

Such system has been already used for preparation of the International Danube River Basin management plans (2009, 2015) and for the first ITRBMP as well as for the national river basin management plans in some of Danube countries including Romania, Slovakia and Hungary. For national RBM Plans, some Tisza countries (e.g. Romania) have developed criteria based on the recommendations of the WFD Reporting Guidance 2016, as well.

General indication/guidance on the confidence level for chemical and ecological status are given in the Table III.1 and III.2.

Table III.1: General indication/guidance on confidence levels for chemical status

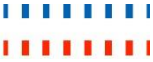
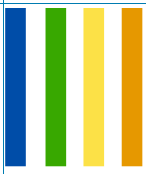
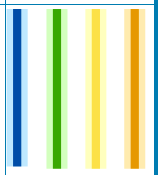
Confidence level of correct assessment	Description	Illustration in map
HIGH Confidence	**Either:**No discharge of priority substances; ***Or all of the following criteria apply:*** • Data/measurements are WFD-compliant (12 measurements per year); • Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.	
MEDIUM Confidence	***All of the following criteria apply:*** • Data/measurements are available; • Frequency is not WFD-compliant (less than 12 measurements per year available); • Medium confidence in grouping of water bodies.	
LOW Confidence	***One or more of the following criteria apply:*** • No data/measurements available; • Assumption that good status cannot be achieved due to respective emission (risk analysis).	

Table III.2: General indication/guidance on confidence levels for ecological status

Confidence level of correct assessment	Description	Illustration in map

HIGH Confidence	***All of the following criteria apply:***
	Biology:
	• WFD-compliant monitoring data;
	• Biological monitoring complies fully with preconditions for sampling/analysis
	• WFD compliant methods included in intercalibration process at EU level;
	• Biological monitoring results are supported by:
	  • Results of hydromorphological quality elements (for structural degradation);
	  • Results of physico-chemical quality elements (for nutrient/organic pollution);
	• Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.
	Chemistry:
	• National EQS available for specific pollutants and sufficient monitoring data (WFD compliant frequency) available;
	• Aggregation (grouping procedure) of water bodies in compliance with WFD shows plausible results.
		

MEDIUM Confidence	***One or more of the following criteria apply:***
	Biology:
	• WFD compliant methods not included in intercalibration process at EU level
	• WFD compliant monitoring data, but:
	  • biological results not in agreement with supportive quality elements or
	  • only few biological data available (possibly showing different results);
	• Medium confidence in grouping of water bodies;
	• Biological monitoring does not comply completely with preconditions for sampling and analysis
	(e.g. use of incorrect sampling period).
	Chemistry:
	• National EQS available but insufficient data available (acc. to WFD);
	• Medium confidence in grouping of water bodies.
		

Confidence level of correct assessment	Description	Illustration in map
LOW Confidence	***One or more of the following criteria apply:*** **Biology**: • No WFD-compliant methods and/or monitoring data available; • Simple conclusion from risk assessment to EQS (updated risk assessment is mandatory). **Chemistry:** • No national EQS available for specific pollutants, but data available (pollution detectable).	

4 Heavily modified and artificial water bodies

4.1 Approach for the designation of Heavily Modified Water Bodies

For surface waters the overall goal of the WFD is to achieve "good ecological and chemical status" in all bodies of surface water. Some water bodies may not achieve this objective for different reasons. Under certain conditions the WFD permits to identify and designate artificial water bodies and heavily modified water bodies according to Article 4(3) WFD. The assignment of less stringent objectives to heavily modified and artificial water bodies and the extension of the timing for achieving their environmental objectives are possible under other particular circumstances. These exemptions are laid out in Articles 4(5), respectively 4(4) of the WFD as it is described in the Chapter 6.

Heavily modified water bodies (HMWB) are bodies of water which, as a result of physical alterations by human activity, are substantially changed in character and cannot, therefore, meet "good ecological status". Artificial water bodies (AWB) are water bodies created by human activity. Instead of "good ecological status", the environmental objective from ecological point of view for HMWB and for AWB is good ecological potential (GEP). In terms of chemical status, their objective is represented by “good chemical status”.

Article 4(3)(a) lists the following types of activities which were considered likely to result in a water body being designated as a HMWB and the changes to the hydromorphological characteristics of that body which would be necessary for achieving good ecological status would have significant adverse effects on:

- Water regulation, flood protection, land drainage;
- Activities for purpose of which water is stored, such as drinking water supply;
- Power generation or irrigation;
- Navigation, including port facilities, or recreation
- Other equally important sustainable human development activities.

These specified uses tend to require considerable hydromorphological changes to water bodies of such a scale that restoration to “good ecological status” may not be achievable even in the long-term without preventing the continuation of the specified use. The concept of HMWB was created to allow for the continuation of these specified uses which provide valuable social and economic benefits but at the same time allow mitigation measures to improve water status[3].

Good ecological potential is a not a less stringent objective; good ecological potential makes allowances for the ecological impacts resulting from those physical alterations that are necessary to support a specified use or must be maintained to avoid adverse effects on the wider environment.

This means that appropriate objectives can be set for the management of other pressures, including physical pressures, not associated with the specified use, while ensuring that the adverse ecological effects of the physical alteration can be appropriately mitigated without undermining the benefits they serve.

[3] *Under this context, status should be seen as potential*

4.2 Results of the designation of Heavily Modified and Artificial Water Bodies

Out of 237 river water bodies in the Tisza River Basin 75 of them (31 %) were designated as heavily (or possibly heavily) modified water bodies. The total length of heavily modified river water bodies in the Tisza River Basin is 3,302 km. 6 water bodies with length of 530.2 km are on the Tisza River itself while the others (69 water bodies) with length of 2,771.73 km belong to the tributaries. Heavily modified river water bodies include three "possibly modified" water body of non-EU members (Serbia and Ukraine). Overview of the heavily modified and artificial river water bodies in the Tisza River basin is given in the Table IV.1

27 water bodies representing 11 % out of the total number of the Tisza River Basin water bodies are artificial water bodies, summing 563.26 km length.

The results on designation of heavily modified and artificial river water bodies are given in the Map 4.

All lake water bodies in the Tisza River Basin have been designated a heavy modified with the total area of 162.02 km^2.

Table IV.1: Overview of the heavily modified and artificial river water bodies in the Tisza River basin

Country	Number of HMWB		Number of AWB		Length of HMWB (km)		Length of AWB (km)	
	Tisza River	Tributaries	Tisza River	Tributaries	Tisza River	Tributaries	Tisza River	Tributaries
Ukraine	0	1	0	0	0	6.31	0	0
Romania	0	42	0	1	0	1,743.64	0	44.71
Slovakia	0	2	0	0	0	37.94	0	0
Hungary	4	21	0	5	361.18	912.51	0	165.10
Serbia	2	3	0	21	169.01	71.33	0	353.45
Total	6	69	0	27	530.19	2,771.73	0	563.26

5 Ecological status/potential and chemical status

This chapter is focused to the results of monitoring programmes concerning the ecological status, ecological potential and chemical status assessment of the rivers and lakes in the Tisza River Basin. The detail information on individual water bodies are given in Annex 1, Map 2 and Map 3.

5.1. Rivers

5.1.1. Ecological status/potential

The ecological status and ecological potential have been assessed in the 237 water bodies in the reference period 2009-2012, as following: 3 water bodies (in Ukraine) were assessed in high status (1.27 % out of total water body assessed); 93 water bodies in good ecological status and good ecological potential (39.24 % of water bodies); 114 water bodies were in moderate status (48.10 %); 25 water bodies were assessed in poor and bad ecological status/potential (10.55 %). Status of 2 water bodies (0.84 %) was unknown. The ecological status/potential in details in the individual Tisza River Basin countries is given in the Table V.1. Figure V.1 shows the number of water bodies and their length in the Tisza River Basin concerning individual classes of ecological status/potential.

Table V.1: Assessment of ecological status/potential in the Tisza River Basin (number of water bodies)

Country	High	Good (good and above)	Moderate	Poor	Bad	Unknown
Ukraine	3	8	12	5	0	2
Romania	0	71	30	0	0	0
Slovakia	0	9	18	4	0	0
Hungary	0	5	36	5	2	0
Serbia	0	0	18	9	0	0
Total	3	93	114	23	2	2

In terms of the length of river water bodies, 3,412.03 km (38.96% of the total length of the river water bodies) were in high and good ecological status and good and above ecological potential; 4,584.50 km (52.34% of the total length of the river water bodies) were in moderate ecological status/potential; 656.31 km (7.49 %) were in poor status and 94.84 km (1.08%) in bad status. Ecological status/potential was unknown for 11.08 km (0.13% of the total length of the river water bodies). Assessment of ecological status/potential in the Tisza River Basin in length of water bodies is given in the Table V.2

Table V.2: Assessment of ecological status/potential in the Tisza River Basin (length in km)

Country	High	Good (good and above)	Moderate	Poor	Bad	Unknown
Ukraine	73.87	235.19	475.32	154.01	0.00	11.08
Romania	0.00	2,740.42	1,217.78	0.00	0.00	0.00
Slovakia	0.00	194.69	628.99	162.13	0.00	0.00
Hungary	0.00	167.86	1,801.92	169.30	94.84	0.00
Serbia	0.00	0.00	460.49	170.88	0.00	0.00
Total	73.87	3,338.16	4,584.50	656.31	94.84	11.08

The comparison of the ecological status/potential of the period of 2009-2012 with the period of 2007-2008 refers to that the number of surface water bodies in high and good ecological status including good and above do not increased (from 39% to 38.96%). However the number of water bodies in moderate, pure and bad ecological status/potential raised from 44% to 60.91%. The number of water bodies with unknown status reduced significantly (from 17% to 0.13%).

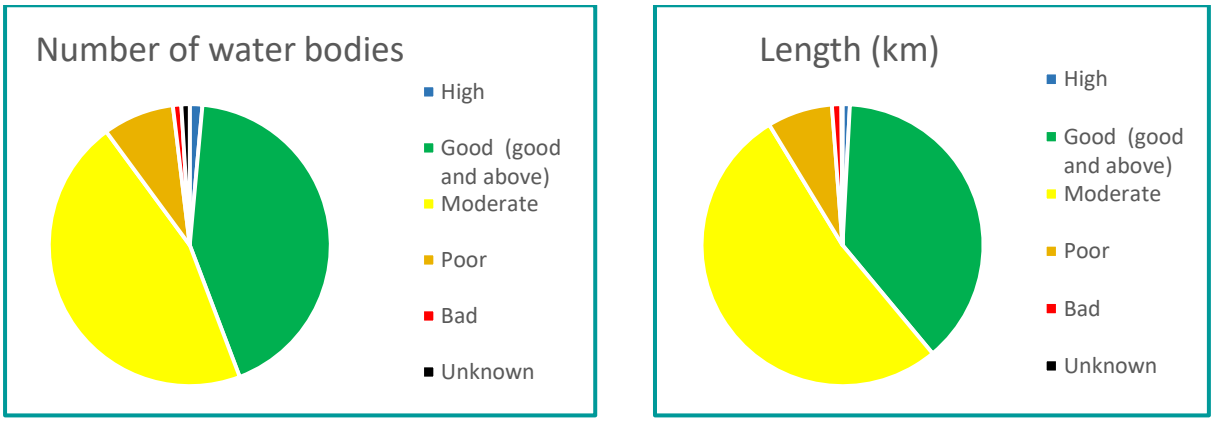


Figure V.1: Ecological status and ecological potential of the surface water bodies in the Tisza River Basin

In principle ecological status/potential has been assessed based on the biological quality elements (phytoplankton, phytobenthos and macrophytes, benthic invertebrates and fish), general physico-chemical elements and specific pollutants and hydromorphological quality elements.

The percentage of ecological status assessed by individual **biological quality elements** and the overall biological status for all surface water bodies in the Tisza River Basin are shown in Figures V.2 and V.3.

Phytobenthos and macrophytes (in 172 water bodies), benthic invertebrates (in 181 water bodies) and fish (in 128 water bodies) have been the most frequent biological elements which were applied for ecological status/potential assessment. Phytoplankton is relevant to quality element for 122 water bodies, which are mostly lowland, very large, large or middle size types.

General physico-chemical conditions are represented by the parameters of thermal regime, nutrient conditions and oxygenation conditions as well as the salinity and acidification status. Based on the categories of parameters listed above the result is as follows: 55% of water bodies (130) have been classified as good and above ecological status/potential and are represented 5,187.83 km (59 % out of the total length of the water bodies); 30% of water bodies (71) were in moderate and worst status and are represented 2,525.61 km (29% out of the total length of the water bodies). In case of 36 water bodies (1,045.3 km) the data were not available.

The results of the ecological status/potential of water bodies in the Tisza River Basin in terms of general physico-chemical quality elements expressed in % taking into account the number and the length of water bodies are presented in the Figure V.4.

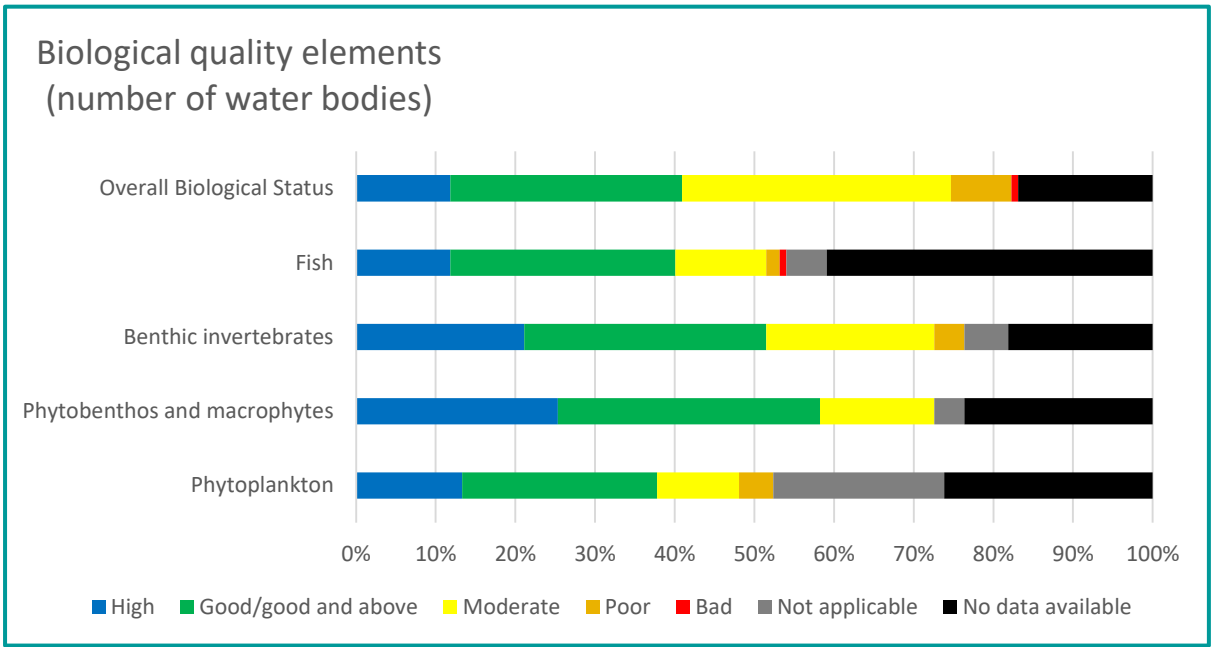


Figure V.2: Ecological status/potential in terms of biological elements of rivers water bodies in the Tisza River Basin (expressed in % based on the number of water bodies)

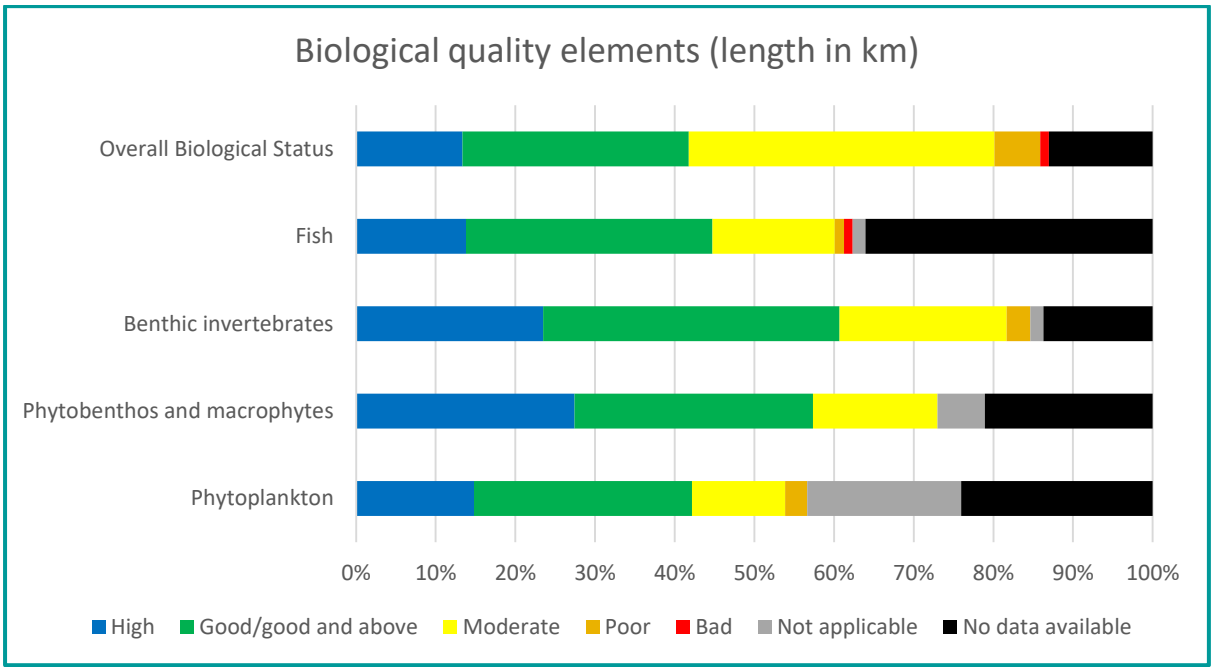


Figure V.3: Ecological status/potential in terms of biological elements of rivers water bodies in the Tisza River Basin (expressed in % based on the length of water bodies)

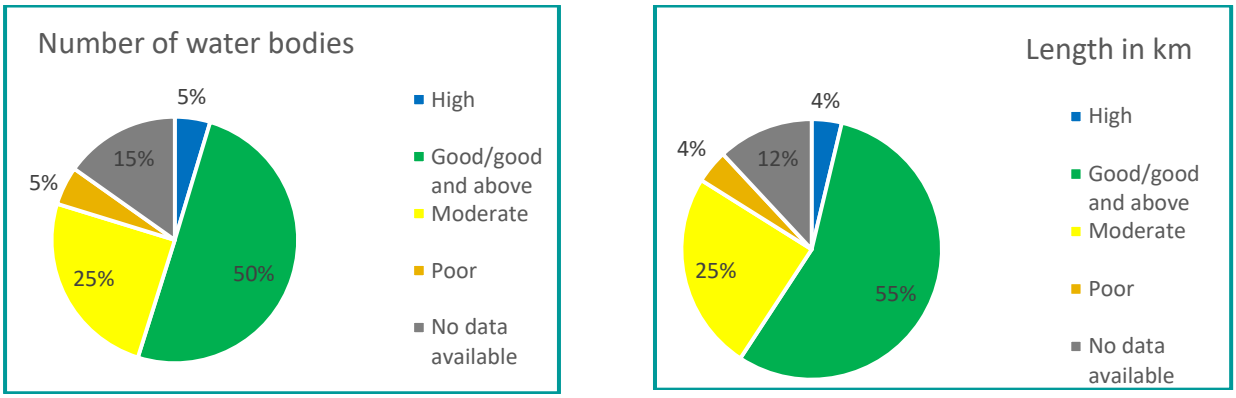


Figure V.4. Ecological status/potential in terms of general physico-chemical quality elements of rivers water bodies in the Tisza River Basin (expressed in % based on the number and the length of the water bodies)

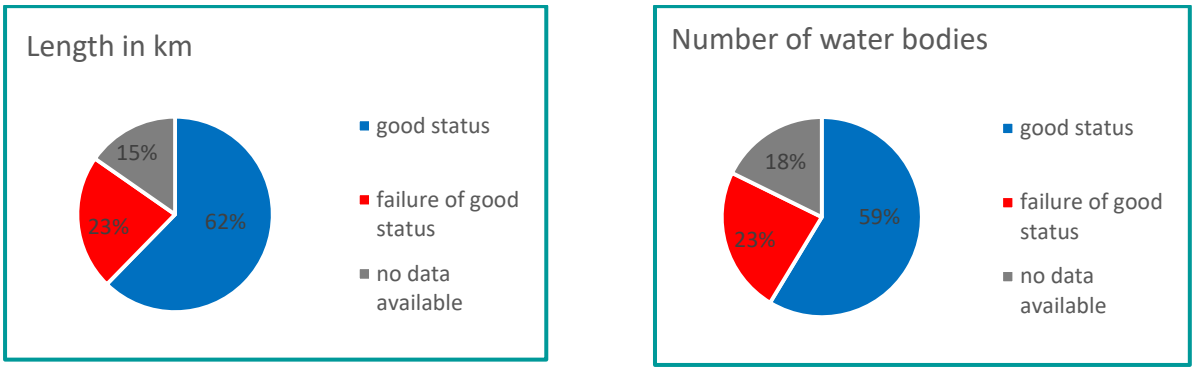


Figure V.5. Ecological status/potential in terms of specific pollutants of rivers water bodies in the Tisza River Basin (expressed in % based on the number and the length of the water bodies)

Based on the assessment of **specific pollutants** the environmental quality standards have been achieved for 139 water bodies (59%) while in case of 56 water bodies (23%) exceeded those standards. There were unavailable data for 42 water bodies (1,341 km, 18 %). Taking into account the length of water bodies, 5,457.93 km (62%) were assessed in good ecological status while 1,959.81 km (23%) have not achieved the environmental objective. The results of the ecological status/potential of water bodies in the Tisza River Basin in terms specific pollutants expressed in % taking into account the number and the length of river water bodies are presented in the Figure V.5.

Based on the information from the Tisza River Basin countries concerning the river basin specific pollutants for assessment of ecological status/potential in Romania only anionic-active detergents caused failure of achieving good ecological status/potential. In case of Slovakia, there were two parameters (total cyanides and zinc) causing failure of good ecological status/potential. In Hungary the problem occurred with pollution by chromium, copper and zinc.

The comparison of the results of assessment of ecological status/potential referring individual quality elements from the First ITRBMP (period 2007-2008) with its update covering period 2009-2012, can be generally concluded as follow:

- Increase of individual quality elements for assessment of water bodies,
- Increase of confidence classes of ecological status and ecological potential,
- More methods of biological quality elements have been intercalibrated.

5.1.2 Chemical status

In the period of 2009-2012 176 (74.26 %) out of the total number of water bodies (237) in the Tisza River Basin were in good chemical status while 57 (24.05 %) water bodies were not, because the environmental quality standards were exceeded. Only 4 water bodies (1.69 %) were not assessed.

In terms of the length of the water bodies 6,219.16 km were in good chemical status which presents 71.01 % out of the total river water body length. Failing at not achieving the good chemical status has

been found in case of 2,440.06 km (27.86 % out of the total river water body length). Similarly, as number of water bodies, also the unknown length of rivers water bodies was 99.53 km (1.14 %).

Table V.1 and Figure V.1 show the chemical status overview of different countries of Tisza River Basin.

Table V.3: Chemical status in the Tisza River Basin

	Number of water bodies			Length (km)		
	Good	Failing	Unknown	Good	Failing	Unknown
Ukraine	21	8	1	689.87	254.82	4.77
Romania	93	8	0	3,565.99	392.21	0.00
Slovakia	30	1	0	957.93	27.87	0.00
Hungary	22	23	3	924.23	1,214.93	94.76
Serbia	10	17	0	81.14	550.23	0.00
Total	176	57	4	6,219.16	2,440,06	99.53

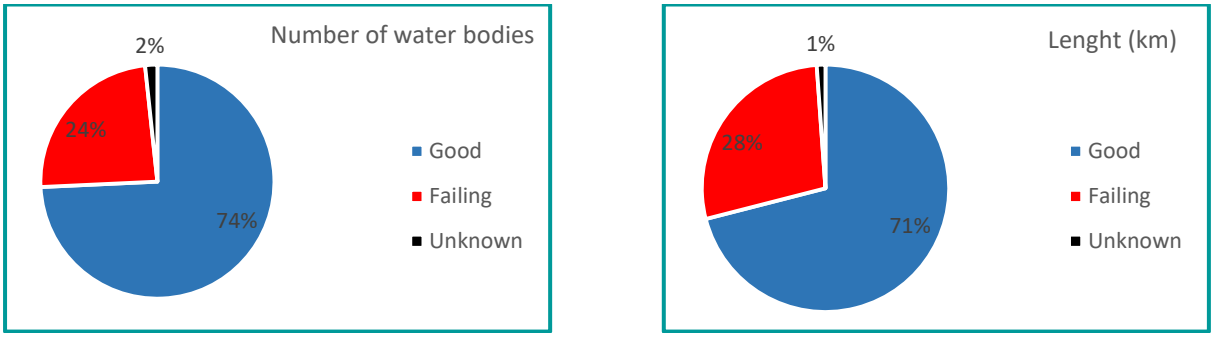


Figure V.6. Chemical status in the Tisza River Basin (expressed in % based on the number and the length of the water bodies)

As for the chemical status assessment the substances causing failure of good chemical status were heavy metals (lead, cadmium, mercury and nickel) in Romania, DEHP (di (2-ethylhexyl) phthalate) in Slovakia and lead, cadmium, mercury in Hungary.

According to the Directive 2008/105/EC three pollutants (mercury and its compounds, hexachlorobenzene, hexachlorobutadiene) have to be monitored in biota and should be included into chemical status assessment. The environmental quality standard for biota is for mercury and its compounds 20 µg/kg, for hexachlorobenzene 10 µg/kg and for hexachlorobutadiene 55 µg/kg.

However, based on information from the Tisza River Basin countries in the reference period only Slovakia measured mercury and its compounds, hexachlorobenzene, hexachlorobutadiene in fish tissue (the whole fish body). Chemical status based on these three pollutants in biota has been assessed independently. Among all 31 water bodies belonging to the Tisza River Basin in 3 of them the concentrations of three pollutants were measured in the year 2011.

The concentrations of hexachlorobenzene and hexachlorobutadiene were below limit of quantification of analytical method (< 5 µg/kg; < 2 µg/kg) in all 3 water bodies in Slovakia. However, all measured concentrations of mercury exceeded EQS for mercury. The results showed the range of 47.1– 233.0 µg/kg of mercury.

Based on the comparison of two reference periods (2007-2009 and 2009-2012) concerning the chemical status assessment in the Tisza River Basin water bodies the following remarkable changes can be seen:

- Significant increase of % of water bodies in good chemical status (from 48 % to 74.26%);
- Slight increase of % of water bodies which did not achieved good chemical status (from 19% to 24.05 %);
- Significant reduction of % of water bodied which were not assessed (from 32% to 1.69 %);
- At least in 12 water bodies in the Tisza River Basin the application of the environmental quality standards for biota for chemical status assessment have been implemented.

5.2 Lakes

Four heavily modified lake water bodies of Hungary were designated as basin wide importance in the whole Tisza River Basin belonging to Hungary. Only two of them have been assessed in the period of 2009-2012. The overview of the ecological potential and chemical status for lakes relevant for Tisza River Basin is given in the Table V.4.

Hortobágyi lakes, Szegedi Fehér lake and Csaj lake are systems of fishponds. Lake Tisza is a reservoir on the river Tisza. The four lake water bodies are differently used. Main usage is water supply of the plain areas in the Tisza River Basin, while in 3 lake water bodies the nature protection has also priority.

Csaj lake is the smallest one with moderate ecological potential. Among biological quality elements the phytoplankton, phytobenthos and macrophytes and benthic invertebrates referred to the moderate ecological potential, while general physico-chemical parameters showed poor class. Chemical status was not assessed. The fishponds represent high importance in bird nesting and nutrition.

Lake Tisza, the largest lake, has good and above ecological potential, however the only phytobenthos and macrophytes were assessed resulted into good and above ecological potential. The general physico-chemical parameters and specific substances resulted into good and above class as well. The environmental quality standards were exceeded for the priority pollutants (mercury and its compounds) which resulted to failing of good chemical status for the reference period.

Table V.4: Ecological potential and chemical status of the lakes in the Tisza River Basin

LWB name	LWB code	LWB character	Area [km2]	Ecological potential	Chemical status
Hortobágyi lakes	HUAIG967	HMWB	16,48	unknown	unknown
Csaj lake	HUAIH054	HMWB	10,23	moderate	unknown
Szegedi Fehér lake	HUAIH127	HMWB	14,48	unknown	unknown
Lake Tisza	HUANS560	HMWB	120,83	good and above	failing

5.3. Gaps and uncertainties

The assessment of the ecological status according to the requirements of the WFD shows that a remarkable improvement since the first ITRBMP in 2011 have been achieved, but some gaps and uncertainties still exist.

For the reference period (2009-2012) compliance with the WFD requirements in the field of the biological sampling methods is in place for small and medium sized rivers in most of the Tisza River Basin countries. On the other hand, the situation is more complicated in case of large rivers, in particular the Tisza River. The reason for this situation is that the representative and quantitative sampling for some quality elements requires taking samples from deep areas which is technically difficult and expensive. This is especially the case for fish and benthic invertebrates, in some countries.

As regards the assessment of methods for biological quality elements, in some of the Tisza River Basin countries for the reference years the WFD required assessment methods were not available in Ukraine and in other countries for some of the quality elements (e.g. phytoplankton, fish).

The way forward in improving the sampling and assessment methods includes also the following actions:

- The missing sampling and assessment methods shall be developed, especially in Ukraine and Serbia. The requirements of the WFD result in availability of similar sampling and assessment methods in the Tisza River Basin. This means that the already existing sampling and assessment methods can be transferred between the countries and adapted to the local needs. Special attention should be given to further development of ecological assessment methods for phytobenthos, phytoplankton, macrophytes and fish. Information exchange between the national experts is an important prerequisite for this process.
- Results of the Joint Danube Survey 3 (JDS3) showed differences between national sampling and assessment approaches and underlined the need for further harmonization of the sampling method. This approach should be applied also in the Tisza River Basin. The discussion on sampling and assessment methods shall be continued within the ICPDR but also on bilateral level between respective countries.

Invasive alien species may be a significant pressure in ecological status assessment. They replace the native species which however would not always lead to a substantial change of the ecosystem quality. The problem is that neobiota colonize habitats with an anthropogenic origin (like flood protection fortifications), making the relation to natural reference conditions impossible. Therefore, the evaluation of the impact of the invasive alien species on the assessment of the ecological status needs further investigation and a coherent approach in the Tisza River Basin.

The Directive 2013/39/EU (EQS Directive) amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy which has been adopted in 2013. This directive set revised environmental quality standards with effect from 22 December 2015, aiming on achieving good surface water chemical status in relation to those substances by 22 December 2021 by implementation of programmes of measures included in the 2015 river basin management plans. Directive 2013/39/EU also identified new priority substances with effect from 22 December 2018, with the aim of achieving good surface water chemical status in relation to those substances by 22 December 2027 and preventing deterioration in the chemical status of surface water bodies in relation to those substances.

The determination of surface water chemical status by the 2015 deadline was based on the substances and EQSs set out in the Directive 2008/105/EC in the version in force on 13 January 2009. However, the Directive 2013/39/EU requires achieving good chemical status by 2021 for those existing substances for which a more stringent standard has been adopted. This would require that an assessment is included in the second RBMPs to be adopted in 2015 on the basis of the new EQSs and, if necessary, measures should be included in the Programmes of Measures to be operational by 2018 at the latest.

Based on information from the countries on priority substances for which more stringent standards were used for updating of the ITRBMP caused the change of the chemical status of the surface water bodies from good in first ITRBMP into failure of good status in update of ITRBMP. Most of the Tisza River Basin countries set out that for update of ITRBMP the Directive 2008/105/EC were applied except Serbia and Ukraine.

A specific problem in the assessment of the chemical status is the application of the EQS in biota. According to the Article 3(2 a) of the Directive 2008/105/EC, EQSs for mercury and its compounds, hexachlorobenzene and/or hexachlorobutadiene in biota. Even though limited results of monitoring of mercury in biota generated in Slovakia led to failure in achieving good chemical status the concentrations showed the problems of mercury.

In case of future availability of data from other Tisza River Basin countries due to a better monitoring performance, the chemical status of water bodies in the Tisza River Basin will very probably further change negatively.

In many cases not all substances from the Directive 2008/105/EC have been assessed in all the Tisza River Basin countries due to methodological problems (no method was available or a method was available but its limit of quantification did not meet with the EQS criteria).
No methods are available in the countries e.g. for brominated diphenylethers, C10-13-chloroalkanes and tributyltin compounds. In some countries a large number of priority substances is still not analysed because of lacking analytical instrumentation and because no proper methods are available. Here the monitoring practices need further improvement in terms of method development, capacity building and enhancing of equipment.

All those specific reasons mentioned above can act towards an increase of the number of water bodies not achieving good chemical status in future not because the implementation of the programme of measures failed but as a consequence of having available more comprehensive information on polluting substances in surface waters.

For all efforts taken there is still no adequate hydromorphological methodology used in the Tisza river basin which allows to fully underpin biological assessments. In some cases, this can be generated by the presence of multiple pressures which act on the same water bodies. New developments on EU (including CEN) level will help the revision of national hydromorphological methodologies.

6. Environmental objectives and exemptions

6.1 Management objectives for the TRB and WFD environmental objectives

The WFD requires achievement mainly of the following environmental objectives:

- Good ecological and good chemical status of surface water bodies;
- Good ecological potential and good chemical status of HMWBs and AWBs;
- Good chemical and good quantitative status of groundwater bodies.

The update of ITRBMP provides an upgraded overview of the status assessment results of surface water bodies for the entire Tisza River Basin, in comparison with the first ITRBM Plan. Regarding the basin-wide scale, the Update of ITRBMP may differ from the national RBMPs in terms of the respective management objectives and respective complexity related to each significant water management issues.

In order to make the approach on the basin-wide level complementary and inspirational to national planning and implementation, visions and specific operational management objectives have been defined for all significant water management issues. They guide the Tisza River Basin countries towards agreed aims of basin-wide importance by 2021 and also assist the achievement of the overall WFD environmental objectives. The visions are based on shared values and describe the principle objectives for the Tisza River Basin with a long-term perspective.

The respective management objectives describe the steps towards year 2021. Environmental objectives in an explicit way are less detailed than at the national level and more detailed than expressed in the Danube River Protection Commission and the Danube Declaration.

The Tisza River sub-basin wide management objectives:

- Describe the measures that need to be taken to reduce or eliminate existing significant pressures for each significant water management issue on the sub-basin wide scale,
- Help to link the gap between measures on the national level and their agreed coordination on the sub-basin wide level to achieve the overall WFD environmental objective.

Based on the management objectives to be realised by 2021 as the target, measures reported from the national to the international sub-basin level have been compiled in such a way that they give an estimation of their effectiveness in reducing and/or eliminating existing pressures/impacts on the basin-wide scale. The visions and management objectives are listed for each significant water management issues in Report on Joint Programme of Measures, which includes the relevant conclusions regarding the level of achievement of the management objectives.

6.2 Exemptions according to WFD Articles 4(4), 4(5) and 4(7)

Improvement of aquatic environment status requires the implementation of measures. These can be disproportionate costly or technical challenges might occur which can delay the implementation of

measures or make it even not feasible. The application of WFD Article 4(4) indicates that a water body will not achieve the environmental objectives by 2015, but afterwards, whereas less stringent environmental objectives are aimed for in water bodies subject to WFD Article 4(5).

Furthermore, new sustainable human development activities might cause a deterioration of water status. The WFD allows for the application of exemptions from the achievement of the environmental objectives in case certain conditions as outlined in WFD Article 4(7) are met. Future Infrastructure Projects may need an exemption according to WFD Article 4(7) in the case that they would provoke deterioration of water status/potential – the information on these exemptions is also summarised. Details on the application of the three Articles on exemptions are part of the national Part B or Part C reports.

Out of the total 216 river water bodies of the Tisza River Basin, the application of the exemptions can be summarised as follows:

- The Article 4(4) is applied for 98 water bodies (45.4%) in Romania, Slovakia and Hungary
- The Article 4(5) was applied only for one water body in Romania (0.46%).

Exemptions according to WFD Article 4(4) were reported for 3 lake water bodies because of ecological potential and for one lake water body with known less than good chemical status. Article 4(5) was not applied for any lake water bodies.

All together 12 flood protection future infrastructure projects have been reported by Hungary (3) and Romania (9). For two of them the deterioration of water body status is expected and for nine of them the transboundary impact is predicted. Nine future infrastructure projects are planned to be located in the Tisza River itself. For two future infrastructure projects the exemptions according to WFD Article 4(7) are applied.

Further details on exemptions according to WFD Articles 4(4), 4(5) and 4(7) are part of D3.5.1 Evaluation of the Significant Water Management Issues and proposal of effective measures with respect to expected development in the future as well as D3.2.1 Report on Significant pressures relevant for Tisza River Basin.

7. Abbreviations

AWB	Artificial Water Body
BQE	Biological Quality Element
DDT	Dichloro-diphenyl-trichloroethane
EQS	Environmental Quality Standard
GEP	Good Ecological Potential
GES	Good Ecological Status
GIG	Geographical Intercalibration Group
HMWB	Heavily Modified Water Body
ICPDR	International Commission for the Protection of the Danube River
IMSW	Integrated Monitoring System of Waters
ITRBMP	Integrated Tisza River Basin Management Plan
LOQ	Limit of Quantification
PBDEs	Polybrominated Diphenyl Ethers
QA/QC	Quality Assurance/Quality Control
RBM	River Basin Management
TNMN	TransNational Monitoring Network
TRB	Tisza River Basin
SCCPs	Short-Chain Chlorinated Paraffins
SWMI	Significant Water Management Issue
WFD	Water Framework Directive (2000/60/EC)

8. References

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River Basin Management Plan of the Hungarian part of the Danube River Basin District 2015
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9. List of Annexes

Annex 1. Tisza River Sub-Basin: Results on status classification of all assessed surface water bodies

10. List of Maps