The Danube River Basin District Management Plan – Update 2015

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Disclaimer

This DRAFT DRBM Plan – Update 2015 is based on data delivered by Danube countries as of 13 May 2015 and was elaborated for the public consultation process (WFD Article 14). The document constitutes an updated draft version for an intensified public consultation phase following the publication of a first draft in December 2014. The DRBM Plan – Update 2015 will be finalised in December 2015, taking into account the results from the public consultation process.

A more detailed level of information is presented in the national DRAFT RBM Plans. Hence, the DRAFT DRBM Plan – Update 2015 should be read and interpreted in conjunction with the national DRAFT RBM Plans.

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

Table of Contents

List of Acronyms

AAA	4-acetylaminoantipyrine
AEWS	Accident Emergency Warning System
AGR	Agriculture
AL	Albania
AMPA	Aminomethylphosphonic Acid
ARS	Accident Risk Spots
AQC	Analytical Quality Control
AT	Austria
AWB	Artificial Water Body
BA	Bosnia and Herzegovina
BAT	Best Available Techniques
BDI	Biological Diatom Index
BG	Bulgaria
BLS	Baseline Scenario
BOD	Biochemical Oxygen Demand
CAL	Caloric Energy
CAP	Common Agricultural Policy
CBA	Cost-Benefit Analysis
CEA	Cost-Effectiveness Analysis
CF	Cohesion Fund
CIS	Common Implementation Strategy
CH	Switzerland
COD	Chemical Oxygen Demand
CP	Contracting Party
CR	Cost Recovery
CS	Contaminated Sites
CZ	Czech Republic
CZI	Czech multimetric index
DBA	Danube Basin Analysis
DDT	Dichloro-Diphenyl-Trichloroethane
DE	Germany
DEHP	Di (2-ethylhexyl) phthalate
DMCSEE	Drought Management Centre for Southeastern Europe
DOC	Dissolved Organic Carbon
DPSIR	Drivers-Pressures-State-Impact-Response
DRB	Danube River Basin
DRBD	Danube River Basin District
DRBM	Danube River Basin District Management Plan
DRW	Drinking Water
DRPC	Danube River Protection Convention
DSTF	Danube Sturgeon Task Force
DWS	Deep Water Sampling
EAFRD	European Agricultural Fund for Rural Development
EBRD	European Bank for Reconstruction and Development
EEA	European Environment Agency
EIA	Environmental Impact Assessments
EIB	European Investment Bank
EMFF	European Maritime and Fisheries Fund
ENI	European Neighbourhood Instrument
E-PRTR	European Pollutant Release and Transfer Register
ERC	Environmental and Resource Costs
ERDF	European Regional Development Fund
ETC	European Territorial Cooperation
EQS	Environmental Quality Standard
EQSD	European Directive on Priority Substances
ESF	European Social Fund
EU	European Union
EU MS	EU Member States
EUSDR	EU Strategy for the Danube Region
FAA	4-Formylaminoantipyrine
FIA	Fish Index Austria
FIP	Future Infrastructure Projects
FIS	Fish Index Slovakia
FRMD	Flood Risk Management Directive
FRMP	Flood Risk Management Plan
GAEC	Good Agricultural and Environment Conditions
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEP	Good Ecological Potential
GES	Good Environment Status
GLC	Global Land Cover
GW	Ground Water
GWB	Ground Water Body
GWP	Global Water Partnership
ha	hectare
HBCDD	Hexabromocyclododecane
HMWB	Heavily Modified Water Body
HR	Croatia
HU	Hungary
IDMP	Integrated Drought Management Programme
IAD	International Association for Danube Research
IAS	Invasive Alien Species
IBRD	International Bank for Reconstruction and Development
ICPBS	International Commission for the Protection of the Black Sea
ICPDR	International Commission for the Protection of the Danube River
IDA	International Development Association
IED	Industrial Emissions Directive
IND	Industry
IPA	Instrument for Pre-Accession Assistance
IPPCD	Integrated Pollution Prevention and Control Directive
IRR	Irrigation
IT	Italy
IUCN	International Union for Conservation of Nature
JDS	Joint Danube Survey
JPM	Joint Program of Measures
JRC	Joint Research Centre
kg	kilogram
km	kilometre
LDM	Long Distance Migrants
LOQ	Limit of Quantitation
MD	Moldova
MDM	Medium Distance Migrants
ME	Montenegro
MK	Macedonia
mm	millimetre
MS	Member State
MoU	Memorandum of Understanding
MSFD	Marine Strategy Framework Directive
N	Nitrogen
ND	Nitrate Directive
NGO	Non-Governmental Organization
NVZ	Nitrate Vulnerable Zones
OPC	Organophosphorus compounds
P	Phosphorus
PA	Priority Area
PAH	Polycyclic Aromatic Hydrocarbons
PE	Population Equivalent
PCDD	Polychlorinated Dibenzo-p-Dioxins
PFOS	Perfluorooctansulfonic Acid
PFRA	Preliminary Flood Risk Assessment
PL	Poland
PM EG	Pressures and Measures Expert Group
PPP	Purchase Power Parities
RBM	River Basin Management
RBMP	River Basin Management Plan
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RI	Reference index
rkm	River kilometre
RO	Romania
RS	Republic of Serbia
SBC	Site-specific BioContamination Index
SEA	Strategic Environmental Assessment
SK	Slovak Republic
SI	Slovenia
SPA	balneology
SPM	Suspended Particulate Matter
SSD	Sewage Sludge Directive
SWB	Surface Water Body
SWMI	Significant Water Management Issues
TCPP	Tris (1-chloro-2-propyl) Phosphate
TN	Total Nitrogen
TNMN	Trans National Monitoring Network
TOC	Total Organic Carbon
TP	Total Phosphorus
UA	Ukraine
UWWTD	Urban Waste Water Treatment Directive
UWWTP	Urban Waste Water Treatment Plant
WFD	EU Water Framework Directive 2000/60/EC
WRI	Water Risk Index

List of Tables

List of Figures

List of Maps

List of Annexes

1 Introduction and background

1.1 Introduction

Rivers, lakes, transitional and coastal waters, as well as groundwater, are a vital natural resource of the Danube River Basin: they provide drinking water, crucial habitats for many different types of wildlife, and are an important resource for industry, agriculture, transport, energy production and recreation.

A significant proportion of this resource is environmentally damaged or under threat. Protecting and improving the waters and environment of the Danube River Basin is substantial for achieving sustainable development and is vital for the long term health, well-being and prosperity for the population of the Danube region.

Being aware of this issue and due to the fact that the sustainable management of water resources requires transboundary cooperation, the countries sharing the Danube River Basin agreed to jointly work towards the achievement of this objective. The Danube River Protection Convention[1] (DRPC), signed in 1994, provides the legal framework for cooperation on water issues within the Danube basin, which is the most international river basin in the world. All Danube countries with territories >2,000 km^2 in the Danube River Basin are Contracting Parties to the DRPC: Austria (AT), Bosnia and Herzegovina (BA), Bulgaria (BG), Croatia (HR), the Czech Republic (CZ), Germany (DE), Hungary (HU), Moldova (MD), Montenegro (ME), Romania (RO), the Republic of Serbia (RS), the Slovak Republic (SK), Slovenia (SI) and Ukraine (UA). In addition, the European Union (EU) is also a Contracting Party to the DRPC. The International Commission for the Protection of the Danube River (ICPDR) is the organisation which was established by the DRPC Contracting Parties to facilitate multilateral cooperation and for implementing the DRPC.

In October 2000 the EU Water Framework Directive[2] (WFD) was adopted and came into force in December 2000. The purpose of the Directive is to establish a framework for the protection and enhancement of the status of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater, and to ensure a sustainable use of water resources. It aims to ensure that all waters meet ‘good status’, which is the ultimate objective of the WFD, respectively to avoid their deterioration.

EU Member States (EU MS) should aim to achieve ‘good status’ in all bodies of surface water and groundwater by 2015, respectively by 2027 at the latest. Currently not all Danube countries are EU MS and therefore not legally obliged to fulfil the WFD requirements. Five countries (BA, MD, ME, RS and UA) are Non EU Member States (Non EU MS). Out of these Non EU MS, two countries (ME and RS) carry the status of candidate countries. However, when the WFD was adopted in the year 2000, all countries cooperating under the DRPC decided to make all efforts to implement the Directive throughout the whole basin.

The WFD establishes several integrative principles for water management, including public participation in planning and the integration of economic approaches, beside aiming for the integration of water management into other policy areas. It envisages a cyclical process where river basin management plans are prepared, implemented and reviewed every six years. There are four distinct elements to the river basin planning cycle: characterisation and assessment of impacts on river basin districts; water status monitoring; the setting of environmental objectives; and the design and implementation of the programme of measures needed to achieve them. These tasks have been accomplished for the Danube River Basin in 2009 for the first time and are now updated according to the WFD cyclic approach, allowing for an adaptive management of the basin.

[1] Convention on Cooperation for the Protection and Sustainable Use of the Danube River (Sofia, 1994).

[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

1.2 The EU Water Framework Directive and development of the DRBM Plan – Update 2015

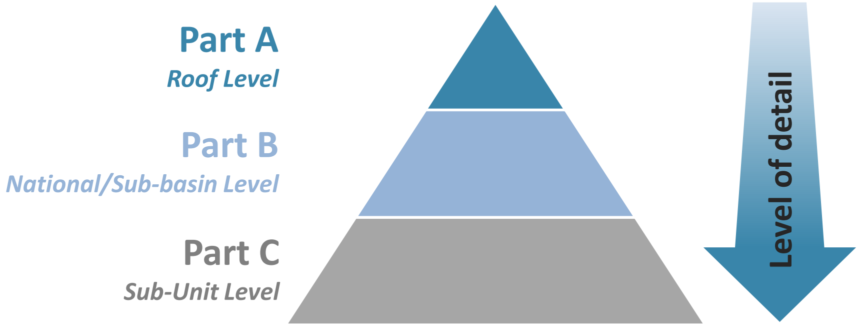
River basins, which are defined by their natural geographical and hydrological borders, are the logical units for the management of waters. This innovative approach for water management is also followed by the WFD. In case a river basin covers the territory of more than one country, an international river basin district has to be created for the coordination of work in this district.

The Danube and its tributaries, transitional waters, lakes, coastal waters and groundwater form the Danube River Basin District (DRBD), which is illustrated in Map 1. The DRBD covers the Danube River Basin (DRB), the Black Sea coastal catchments in Romanian territory and the Black Sea coastal waters along the Romanian and partly Ukrainian coasts.

Due to reasons of efficiency, proportionality and in line with the principle of subsidiarity, the management of the DRBD is based on the following three levels of coordination (see Figure 1):

- ⇨ **Part A**: International, basin-wide level – the Roof Level;
- ⇨ **Part B**: National level (managed through the competent authorities[3]) and/or the international coordinated sub-basin level for selected sub-basins (Tisza, Sava, Prut, and Danube Delta);
- ⇨ **Part C**: Sub-unit level, defined as management units within the national territory.

Figure 1: Three levels of management for WFD implementation in the DRBD showing the increase of the level of detail from Part A to Part B and C



The investigations, analyses and findings for the basin-wide scale (Part A) focus on:

- rivers with catchment areas >4,000 km^2;[4]
- lakes >100 km^2;
- transitional and coastal waters;
- transboundary groundwater bodies of basin-wide importance.

The ICPDR serves as the coordinating platform to compile multilateral and basin-wide issues at Part A ("Roof Level"[5]) of the DRBD. The information increases in detail from Part A to Parts B and C. Waters with smaller catchment and surface areas are subject to planning at sub-basin/national (Part B), respectively sub-unit level (Part C). All plans together provide the full set of information for the whole DRBD, covering all waters (surface as well as groundwater), irrespectively of their size.

Since 2000 the following major milestones were achieved in managing the DRBD and in line with the principles as set by the WFD:

[3] A list of competent authorities can be found in Annex 1

[4] The scale for measures related to point source pollution is smaller and therefore more detailed.

[5] At the roof level (Part A), the ICPDR agreed on common criteria for analysis related to the DRBM Plan as the basis to address transboundary water management issues. The level of detail of the roof level (Part A) is lower than that used in the national Part B Plans of each EU MS.

- 2004 – Accomplishment of first Danube Basin Analysis Report according to WFD Article 5
- 2006 – Summary Report on Monitoring Programmes in the DRBD
- 2007 – Interim Overview on the Significant Water Management Issues in the DRBD
- 2009 – Adoption of the 1st Danube River Basin District Management Plan (1st DRBM Plan)
- 2012 – Interim Report on the Implementation of the Joint Programme of Measures

As a first step in the preparation of the second WFD management cycle (2015-2021), a timetable, work program and statement on consultation measures for the development of the DRBM Plan – Update 2015 was adopted by the ICPDR in December 2012. Following, an updated Interim Overview on the Significant Water Management Issues in the DRBD was developed according to WFD Article 14 by the end of 2013 and therefore two years before the deadline for the finalisation of the DRBM Plan – Update 2015. Both documents were made available to the public, allowing for six months to comment in writing in order to allow for active involvement and consultation. The feedback provided was taken into account for the elaboration of the draft DRBM Plan – Update 2015.

Even though the WFD does not require a coordinated update of the WFD Article 5 analysis for the Level A (Roof Level), the ICPDR decided to elaborate a 2013 Update of the Danube Basin Analysis (2013 DBA) as a preparatory step and analytical basis for the DRBM Plan – Update 2015. The 2013 Update of the DBA Report was finalised in 2014.

1.3 The Danube Basin Analysis 2013 – analytical basis for the DRBM Plan – Update 2015

The 2013 DBA provides updated information for the DRBD on the

- Analysis of its characteristics,
- Review of the impact of human activity on the status of surface waters and on groundwater, and
- Economic analysis of water use

in line with WFD Article 5 and in accordance with the technical specifications set out in Annexes II and III of the Directive. Table 1 provides information on the basic characteristics of the DRBD.

Table 1: Basic characteristics of the Danube River Basin District

Country	Code	Coverage in DRB (km²)	Share of DRB (%)	Percentage of territory within the DRB (%)	Population within the DRB (Mio.)
Albania	AL	126	< 0.1	0.01	< 0.01
Austria*	AT	80,423	10.0	96.1	7.7
Bosnia and Herzegovina*	BA	36,636	4.6	74.9	2.9
Bulgaria*	BG	47,413	5.9	43.0	3.5
Croatia*	HR	34,965	4.4	62.5	3.1
Czech Republic*	CZ	21,688	2.9	27.5	2.8
Germany*	DE	56,184	7.0	16.8	9.4
Hungary*	HU	93,030	11.6	100.0	10.1
Italy	IT	565	< 0.1	0.2	0.02
Macedonia	MK	109	< 0.1	0.2	< 0.01
Moldova*	MD	12,834	1.6	35.6	1.1
Montenegro*	ME	7,075	0.9	51.2	0.2
Poland	PL	430	< 0.1	0.1	0.04
Romania*	RO	232,193	29.0	97.4	20.2
Serbia*	RS	81,560	10.2	92.3	7.5[6]
Slovak Republic*	SK	47,084	5.9	96.0	5.2
Slovenia*	SI	16,422	2.0	81.0	1.7
Switzerland	CH	1,809	0.2	4.3	0.02
Ukraine*	UA	30,520	3.8	5.0	2.7
Total		**801,463**	**100**	**-**	**81.00**

*) Contracting Party to the ICPDR

[6] The data from Serbia do not include any data from the Autonomous Province of Kosovo and Metohija.

Surface waters of the DRBD were generally characterised by ecoregions (see Map 2) and information on typology and reference conditions for the EU WFD biological quality elements was updated. Further information can be obtained from Annex 2 and in the 2013 DBA.

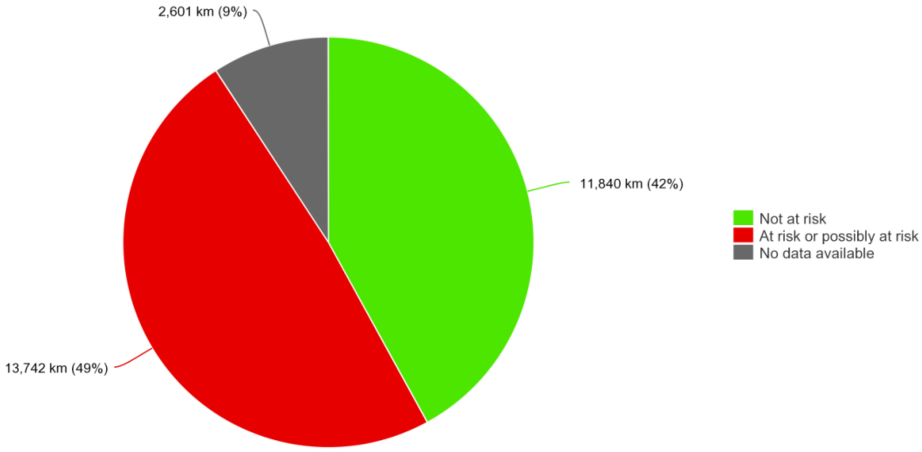
Further, the water body delineation has been revised. Water bodies are the basic management units according to the WFD. Therefore, all WFD assessments and activities (i.e. water status, final heavily modified water body designation, measures to improve status etc.) are linked to the unit of water bodies. Surface water bodies are discrete and significant elements of surface water (WFD Art. 2 (10)).

All Danube countries – except ME - have performed or are performing water body delineations for surface waters (see Map 3) and groundwater (see Map 4). Water bodies were identified and updated based on the analysis of the pressures and monitoring data. Moldova has identified the preliminary number of the water bodies in the Danube River Basin District focussing on the Prut River Basin and in Ukraine the water bodies were identified in the Tisza basin. Bosnia and Herzegovina has not finalised the identification of water bodies. The water bodies described here refer to those relevant for the Danube basin-wide scale. All other water bodies are dealt with in detail in the National Reports (Part B). 59 water bodies have been identified on the Danube River, and 644 water bodies have been identified on the tributaries with catchments >4000km^2. Further, five lake water bodies have been delineated and overall, 2 transitional and 4 coastal water bodies have been reported.

The overall aim of the 2013 DBA's pressure/impact analysis was inter alia the identification/estimation of surface water bodies at risk / possibly at risk or not at risk of failing the WFD environmental objectives in 2021. The risk analysis was made at the national level taking into account the ongoing pressures persisting from the past and the pressures which may emerge in future due to long-term trends and new developments.

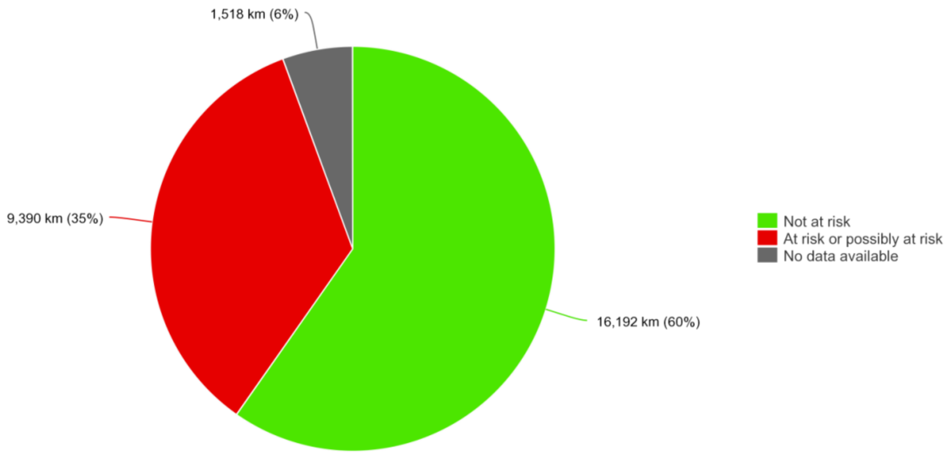
Figure 2[7] illustrates the length of the river water bodies having the risk of failure to achieve a good ecological status or potential, and Figure 3[7] illustrates the length of the river water bodies having the risk of failure to achieve good chemical status by 2021. Altogether 25,582 km of river water bodies were evaluated. 11,840 km of rivers will be not at risk of failure to achieve good ecological status or ecological potential (42%), and 16,192 km of rivers will be not at risk of failure to achieve good chemical status (60%).

Figure 2: Risk Assessment Surface Waters (River WBs) – Ecological Status



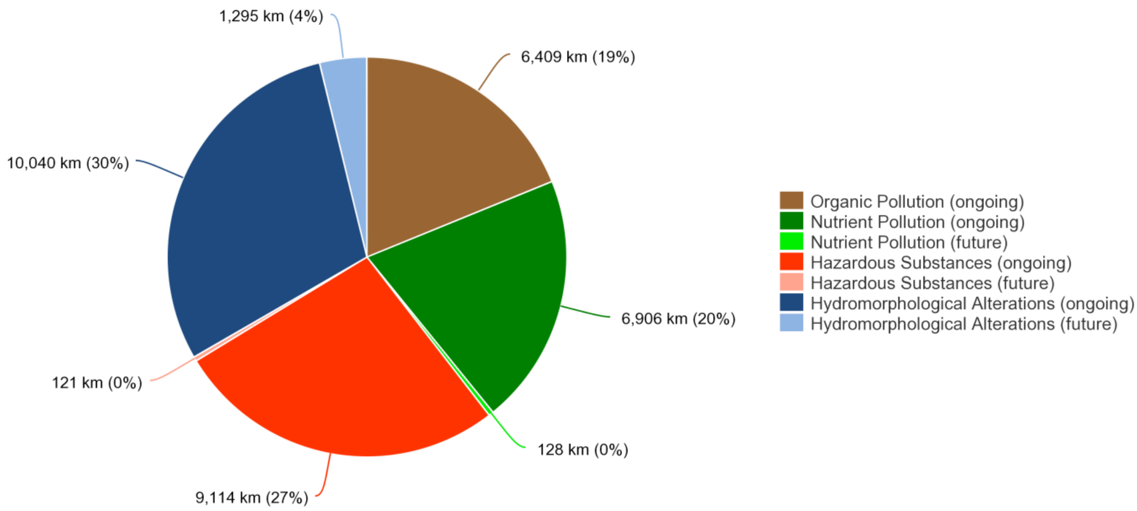
[7] In this graph, the length in kilometres of river water bodies reported for level A (rivers with catchment size larger than 4,000km²) is summed up, so the total (100%) includes duplicated river water bodies if they are located on border rivers.

Figure 3: Risk Assessment Surface Waters (River WBs) – Chemical Status



The reasons of the risk of failure to achieve a good ecological status / potential or good chemical status by 2021 expressed in terms of pressures by organic pollution, nutrient pollution, hazardous substances pollution and hydromorphological alterations are shown on Figure 4[8]. This figure distinguishes between the ongoing pressures persisting from the past and the pressures which may emerge in the future due to long-term trends and new developments. This information is crucial for the design of the JPM and for taking the necessary actions for achieving the environmental objectives by the year 2021.

Figure 4: Surface Waters (River WBs) - Risk by Pressures



Out of 11 transboundary GWBs of basin-wide importance, which altogether consist of 23 national shares, a risk of failure to achieve good chemical status by 2021 was identified in 6 national shares (located in 4 different transboundary GWBs of basin wide importance). In 5 national shares the failing parameter is nitrates and in one national share the failing parameter is ammonium. With regard to

[8] In this graph, the length in kilometres of river water bodies reported for level A (rivers with catchment size larger than 4,000km²) affected by each pressure type are summed up, so the total (100%) includes duplicated river water bodies if they are located on border rivers or are affected by multiple pressures.

groundwater quantity, the risk of failure to achieve good quantitative status by 2021 was identified in 4 national shares (located in two transboundary GWBs).

In conclusion, large parts of the DRBD are still subject to multiple pressures which are in need to be addressed in order to achieve the WFD environmental objectives.

The assessments performed for the 2013 DBA and discussion on the updated Interim Overview on the Significant Water Management Issues in the DRBD confirmed the four Significant Water Management Issues (SWMI) identified in 2007 for the Danube basin-wide scale that can directly or indirectly affect the status of both surface water and transboundary groundwater:

- Pollution by organic substances
- Pollution by nutrients
- Pollution by hazardous substances
- Hydromorphological alterations

These SWMIs were derived on the basis of the requirements of the EU WFD and mainly relate to quality aspects. For transboundary groundwater bodies, both, the qualitative and quantitative issues are addressed.

1.4 Role of Significant Water Management Issues

The DRBM Plan – Update 2015 and the Joint Program Measures (JPM) in Chapter 8 clearly focus on these SWMIs. In addition, the important transboundary groundwater bodies are dealt with as a separate item. In particular, the identified significant pressures, status information and the JPM refer individually to each SWMI and groundwater.

For each SWMI and groundwater, visions have been agreed and the operational management objectives have been updated to guide the Danube countries and the DRBM Plan – Update 2015 (see Chapter 8). Visions and management objectives have been developed for each SWMI and groundwater. The visions are based on shared values and describe the principle objectives for the DRBD with a long-term perspective. The respective management objectives describe the steps towards the environmental objectives in the DRBD in a more explicit way. EU Member States are obliged to apply the WFD which requires more detailed environmental objectives on a water body level. All other Contracting Parties to the DRPC have signed up to follow the WFD as well. The visions and management objectives serve the purpose to reflect this joint approach among all Danube countries and to support the achievement of the WFD objectives in this very large, unique and heterogeneous European river basin.

The visions as agreed in the frame of the 1st DRBM Plan in 2009 are again indicated in Chapter 8 of this document. Since the visions describe the principle objectives for the DRBD with a long-term perspective, no major updates of the visions were required for the preparation of the DRBM Plan – Update 2015. However, updates of the management objectives have been performed with the perspective of 2021 (timeframe to which the DRBM Plan – Update 2015 refers to). For the update, in particular the ongoing progress in measures implementation, the results of the 2013 DBA and other relevant information was taken into account.

Other important activities and emerging issues

Since the adoption of the 1st DRBM Plan in 2009, more intensive work has been done and additional topics were investigated, in order to identify their relevance and significance on the basin-wide scale. These include aspects of sediment quality and quantity, invasive alien species, adaptation to climate change, water scarcity and drought and the sturgeon issue.

Furthermore, new activities were launched and work has been continued to enhance inter-sectoral cooperation, especially with regard to inland navigation, sustainable hydropower and agriculture, as well as the linkages between the EU WFD 2000/60/EC, flood risk management under the EU Floods

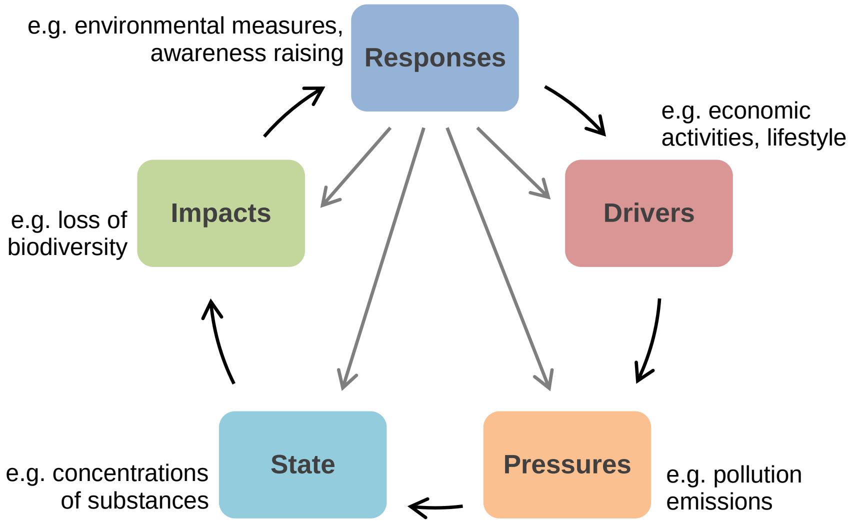
Directive 2007/60/EC[9] and the linkage to the marine environment via the EU Marine Strategy Framework Directive 2008/56/EC[10]. These sector policies are closely interlinked with the different Significant Water Management Issues. Infrastructure projects (i.e. navigation, hydropower and flood protection measures) are of specific relevance for the SWMI “Hydromorphological alterations”, while agricultural activity is a specific issue for the SWMIs “Organic pollution”, “Nutrient pollution” and “Hazardous substances pollution” and are addressed accordingly. Also, the measures applied at the basin-wide level for the reduction of nutrient pollution and hazardous substances pollution will contribute to the improvement of the Black Sea status.

1.5 Structure and updates compared to the 1st DRBM Plan

The nine chapters of the DRBM Plan – Update 2015 follow the logic and requirements of the EU WFD. The structure is further determined through the SWMIs of the DRBD and related to the Drivers-Pressures-State-Impact-Response (DPSIR) Framework (Figure 5) according to the European Environment Agency (EEA)[11].

The DPSIR Framework provides an overall mechanism for analysing environmental problems and responses with regards to sustainable development. ‘Driving Forces’ are considered to be economic and social policies of governments and economic and social goals of involved industries. ‘Pressures’ are the ways that ecosystems and their components are perturbed, e.g. through emissions. These pressures degrade the ‘State’ of the environment, which then ‘Impacts’ upon ecosystems, causing society to ‘Respond’ with various policy measures, such as regulations; these can be directed at any other part of the system.

Figure 5: DPSIR approach according to the European Environment Agency (EEA)



Chapter 2 is dedicated to the existing ‘Pressures’ and their analyses for each SWMI, important transboundary groundwater bodies and other issues (i.e. sediment quality/quantity, invasive alien species). ‘State’ and ‘Impacts’, resulting from the existing ‘Pressures’, are addressed in Chapter 4, where information from the monitoring networks leads to the status assessment for surface and groundwater bodies. The chapter also includes information on the designation of Heavily Modified and Artificial Water Bodies.

[9] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.

[10] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive

[11] The DPSIR framework used by the EEA: http://ia2dec.ew.eea.europa.eu/knowledge_base/Frameworks/doc101182

This information, in combination with environmental objectives and exemptions according to WFD Articles 4(4), 4(5) and 4(7), which are indicated in Chapter 5, leads to ‘Responses’ with respective measures to be implemented for each SWMI – the JPM which is outlined in Chapter 8. These are the actions which are taken to improve water status in the DRBD. Actions can also be directed towards ‘Drivers’, which are inter alia addressed and assessed in Chapter 6 (Integration issues) and in Chapter 7 (Economic analysis).

Finally, the DRBM Plan – Update 2015 includes an updated inventory of protected areas (Chapter 3) and outlines the steps which are taken to ensure public information and consultation (Chapter 9). The findings are illustrated in a number of thematic maps; more detailed information is part of the Annex.

Sturgeons – Flagship species and an example for the DPSIR approach

As “charismatic” flagship species, sturgeons serve as symbols for the sustainable management of the Danube River Basin. Located in the “upper floor” of the aquatic food chain and ecosystem, and as long-distance migratory species, their well-being relies on many aspects of river basin management. The basic concept of the DPSIR approach which forms the basis for the DRBM Plan is herewith practically illustrated with the sturgeon example.

Key **DRIVERS** relevant for sturgeons comprise in principle economic and human activities like industrial development, transport, energy generation, agriculture or urban and rural settlements, leading to **PRESSURES** on sturgeon populations. These include for instance water pollution from untreated or not sufficiently treated wastewater, or the emissions of nutrients and pesticides from agriculture. Channelization and other physical modifications of the river system has led to a loss of habitats and interruption of migration routes from the Black Sea to spawning grounds in upstream regions.

Illegal fishing is another example for these pressures, which in sum change the **STATE** of the environment and **IMPACT** sturgeon populations. Until well into the 20th century, six sturgeon species lived in large parts of the Danube River Basin. Today, four out of the six species are critically endangered, one is considered vulnerable and one is extinct. Populations of all sturgeon species were observed in the past to decline. However, there still remain populations in many of the Danube basin countries, often with potential for recovery. This is in particular the case for the lower basin, but with regard to specific species also for the middle and upper part. Therefore, sturgeons are an issue of basin-wide concern.

As a **RESPONSE**, the complex nature of sturgeon conservation calls for manifold actions under the umbrella of basin-wide coordination. The DRBM Plan with its Joint Program of Measures provides important contributions: Pollution reduction, the restoration of habitats, promoting the sustainability of future infrastructure like hydropower, inland navigation and flood protection, and the development of fish migration aids are elements of this program. For sturgeons, the Danube river itself was in the past the most important migration corridor within the basin. Opening this corridor by making dams passable is a fundamental issue.

These considerable efforts towards reaching and securing a healthy river system for current and future generations require an understanding of the issue and broad support. Therefore, sturgeons have become an important symbol for public information and awareness raising in the complex field of river basin management.

Updates compared to the 1st DRBM Plan 2009 (WFD Annex VII B. 1.)

The DRBM Plan – Update 2015 is building on the structure and assessments which were performed for the 1st DRBM Plan in 2009. Relevant information is updated, also based on the work done for the 2013 DBA, including e.g. the pressures assessment, designation of water bodies, monitoring networks and status assessment, as well as the results from the Joint Danube Survey 3 (JDS3). Furthermore, the environmental objectives and exemptions are updated and the management objectives and JPM are revised, addressing now the period 2015 until 2021. Finally, also the inventory of protected areas and the economic analysis have been updated with latest data and information.

Compared to the previous version, the DRBM Plan – Update 2015 puts a stronger emphasis on the topic of integration with other sectorial policies by devoting a separate chapter on this issue, taking into account that important steps were taken during recent years and are still about to come. The integration with flood risk management, inland navigation, sustainable hydropower and climate adaptation receive particular attention, beside the inter-linkage with the marine environment and the issue of water scarcity and drought which are also addressed. Despite the fact that some data gaps still exist, significant efforts were made by the countries for the provision of data for the elaboration of the DRBM Plan – Update 2015.

2 Significant pressures in the DRBD

Human activities and needs such as agricultural activities, transportation, energy production or urban development exert pressures on the water environment which are in need to be assessed for the management of the river basin and for taking decisions on adequate measures for addressing and reducing these pressures. The WFD requires information to be collected and maintained on the type and magnitude of significant anthropogenic pressure. When addressing pressures on the DRB at the basin-wide scale, it is clear that cumulative effects may occur (this is one reason why the basin-wide perspective is needed). Effects can occur both in a downstream direction (e.g. pollutant concentrations) and/or a downstream to upstream direction (e.g. river continuity). Addressing these issues effectively requires a basin-wide perspective and cooperation between countries.

In preparation of the 1st DRBM Plan, Significant Water Management Issues were identified for the DRBD and confirmed in 2013/2014, which represent pressures having a significant impact on the basin-wide level. This chapter addresses each of the significant pressures on concerning surface waters, addresses groundwater issues and includes revised information since the 1st DRBM Plan. Some activities with only local effects will not be discussed in this report and are subject to National Reports. Further, the country specific emissions regarding organic, nutrient and hazardous substance pollution in this chapter should in general be seen in relation to the respective countries share in the DRBD.

2.1 Surface waters: rivers

2.1.1 Organic pollution

Organic pollution refers to emissions of non-toxic organic substances that can be biologically decomposed by bacteria to a high extent. The key emitters of organic pollution are point sources. Collected but untreated municipal waste water that discharge organic substances from households and industrial plants connected to the sewer systems are the most important contributors. Significant organic pollution can also be generated by waste water treatment plants of agglomerations without appropriate treatment. Direct industrial dischargers and animal feeding and breeding lots are other important point sources if their waste water is insufficiently treated.

Diffuse organic pollution is less relevant in comparison to that of point sources and related to polluted surface run-off from agricultural fields (manure application and storage) and urban areas (e.g. litter scattering, gardens, animal wastes). A specific case of diffuse organic pollution is the emission from combined sewer overflows that represent a mixture of polluted run-off water and untreated waste water. Background emissions of organic substances are related to sediment input arising from soil erosion, surface run-off from naturally covered land and groundwater flow.

The primary impact of organic pollution on the aquatic environment is the influence on the dissolved oxygen balance of the water bodies. Significant oxygen depletion can be experienced downstream of pollution sources mainly due to biochemical decomposition of organic matter. Microorganisms consume oxygen available in the water bodies for the breakdown of organic compounds to simple molecules. However, dissolved oxygen concentrations are increasing again once the oxygen enrichment rate via diffusion from the atmosphere and photosynthesis ensured by algae and macrophytes is higher compared to the consumption rate.

Due to the self-purification capacity of water bodies the water quality impacts of a particular source are mostly local. The decrease in oxygen concentration and the length of the affected downstream river section depend on the amount of the organic matter received, the treatment degree of the waste water, the dilution rate and the hydraulic conditions of the recipient. The affected river length usually ranges from several tens to hundreds of kilometres downstream of the source. Decreased oxygen content may seriously affect aquatic organisms especially sensitive species that can be damaged or killed even at low fluctuations in oxygen concentration.

In the most severe cases of oxygen depletion anaerobic conditions might occur, to which only some specific organism can accommodate. Additional impacts of anaerobic conditions could be the formation of methane and hydrogen sulphide gases and dissolution of some toxic elements. Organic pollution can be associated with the health hazard due to possible microbiological contamination. The usual indicators of organic pollution are biochemical oxygen demand, chemical oxygen demand, total organic carbon, Kjeldahl-nitrogen (organic and ammonium-nitrogen) and coliform bacteria. Secondary (biological) waste water treatment and runoff management practices provide adequate solutions to the organic pollution problem.

2.1.1.1 Organic pollution from urban waste water

According to the recent reporting of the Danube countries on the status of waste water treatment (for the EU MS this is in line with the obligatory data submission for the reference year 2011/2012 to the European Commission under the UWWTD) there are 5,612 agglomerations with a population equivalent (PE, the ratio of the total daily amount of BOD produced in an agglomeration to the amount generated by one person per day) more than 2,000 in the basin (Table 2 and Map 5). 78% (4,367) of these agglomerations are small-sized settlements having a PE between 2,000 and 10,000, 20% (1,125) are middle-sized agglomerations (between 10,000 and 100,000 PE) whilst only 2% (120) have a PE higher than 100,000 (large cities).

The proportion of the agglomerations without appropriate collection system is still relatively high (34%,). These are mainly small-sized settlements with PE between 2,000 and 10,000. Seven percent of the agglomerations have constructed public sewerage but are not connected to urban waste water treatment plants at all. At additional 7% of the agglomerations waste water collection is addressed by individual and other appropriate systems where waste water is collected in appropriate storage tanks and then transported to treatment plants or treated locally. On basin-wide level, 52% of the agglomerations with PE higher than 2,000 have connection to operating waste water treatment plants. The majority (84%) of the middle-sized and big settlements discharges municipal waste water into the recipients after treatment is applied (at least partly). However, waste water is conveyed to treatment plants at only 43% of the small-sized agglomerations.

Regarding the treatment stages 2% of the agglomerations are only served by primary (mechanical) treatment. The proportion of the secondary (biological) treatment is 18%. Waste water at 32% of the settlements undergoes tertiary treatment aiming to remove nutrients besides organic matter. In case of small agglomerations the share of the secondary and tertiary treatment is 16% and 26%, respectively. For agglomerations above 10,000 PE, where nutrient removal is either obligatory (EU MS) or recommended (Non-EU MS) these respective figures are 25% and 56%. Twenty-seven percent of the agglomerations have combined collection and treatment system where the proportion of the highest technological level from the total PE is less than 80%. In these agglomerations there is another significant treatment system besides the most enhanced one or more different systems are used simultaneously.

Table 2: Number of agglomerations and generated urban waste water loads in the Danube Basin (reference year: 2011/2012)

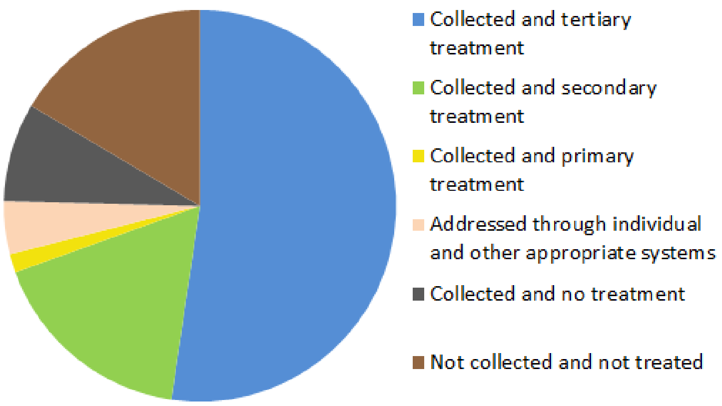
Type of collection and treatment system[1]	Proportion of the connected PE	Number of agglomerations	Generated load (PE)
Collected and tertiary treatment	≥ 80%	1,584	41,058,538
	< 80%	241	8,622,186
Collected and secondary treatment	≥ 80%	434	10,177,826
	< 80%	569	7,932,891
Collected and primary treatment	≥ 80%	19	342,045
	< 80%	89	1,508,810
Addressed through individual and	≥ 80%	101	376,237

other appropriate systems	< 80%	304	4,230,551
Collected and no treatment	≥ 80%	53	682,132
	< 80%	325	3,147,594
Not collected and not treated	100%	1,893	6,827,297
Total		**5,612**	**84,906,107**

[1] Categorisation is based on the highest technologic level that is available for the agglomeration

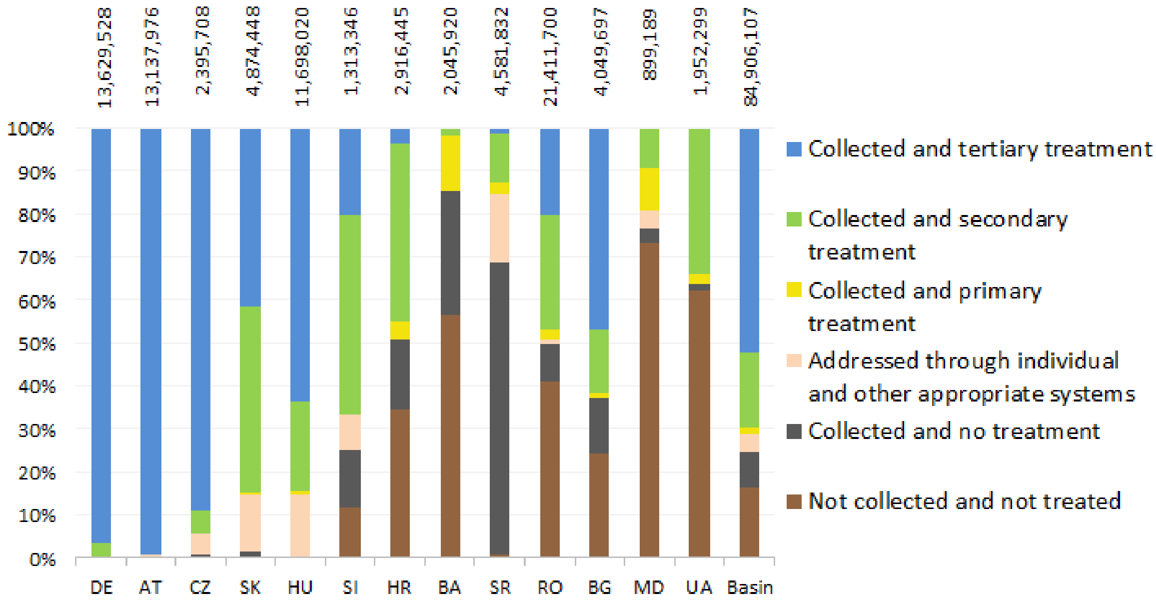
In total, a waste water load of about 85 Mio. PE is generated in the basin. Despite the high number of small agglomerations they have the smallest contribution (21%) to the total loads, whilst middle-sized agglomerations produce about one-third of the loads. Almost half (44%) of the generated total waste water load stems from the big agglomerations indicating the necessity to use appropriate treatment technologies in these cities. The distribution of the agglomerations according to their size and connection rates to collecting systems and treatment plants clearly influences that of the generated loads (Figure 6). Only 17% of the generated loads arise from settlements having no sewerage. Additional 8% can be linked to collection systems without treatment, whilst 4% of the total loads are addressed through individual systems. The majority (71%) of the loads is conveyed via sewers to urban waste water treatment plants. Only two percent of the loads are related to primary treatment, the loads are mainly transported to either secondary (17%) or tertiary (52%) phases. Sixty-nine percent of the overall PE of the basin are effectively treated with at least secondary treatment, whilst 27% need basic infrastructural development aiming to achieve biological treatment.

Figure 6: Share of the collection and treatment stages in the total population equivalents in the Danube Basin (reference year: 2011/2012)



Country contributions to the basin-wide generated loads and proportions of the treatment and collection stages are presented in Figure 8 (see also Annex 3 on urban waste water inventories). Collection and treatment of waste water are in a highly enhanced status in the upstream countries, at good conditions in some countries in the middle-basin whilst significant proportions of the generated loads are not collected or collected but not treated in the downstream states.

Figure 7: Share of the collection and treatment stages in the total population equivalents in the Danube countries (reference year: 2011/2012, absolute numbers on the top refer to PE)

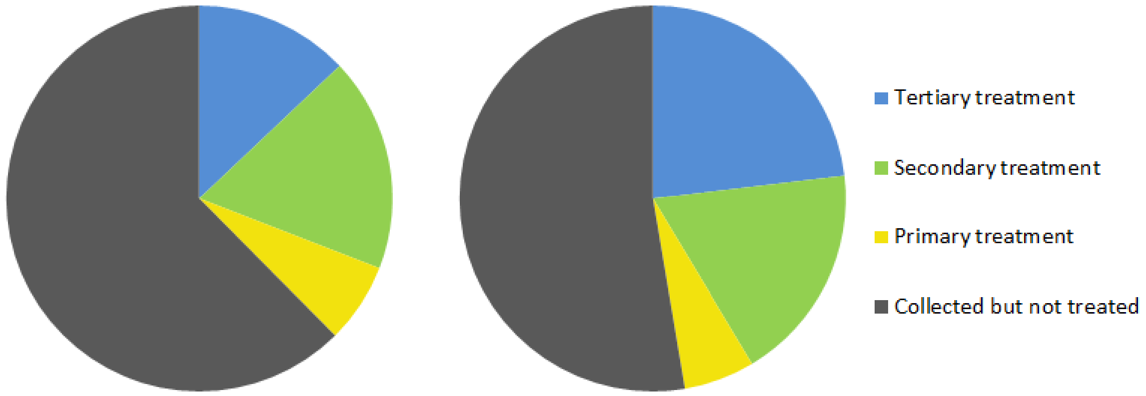


Regarding the discharges of the organic substances into the river systems, about 220,000 tons per year BOD and 490,000 tons per year COD are released from the agglomerations with more than 2,000 PE throughout the basin (Table 3). The ratio of COD to BOD of about 2.2 indicates a considerable fraction of biodegradable organic matter being still released. Significant fractions of the total discharges (62% and 53%, respectively) stem from the collected but untreated waste water amounts (Table 3 and Figure 9). Despite the smaller waste water amounts subject to primary treatment, its share in the discharges are higher (BOD: 7%, COD: 6%) due to the limited treatment efficiency. The secondary treatment class produces 18% of the BOD and 18% of the COD discharges. Plants with tertiary treatment emit 13% (BOD) and 23% (COD) of the total releases due to their very high elimination rates (over 90%).

Table 3: BOD and COD discharges via urban waste water in the Danube Basin (reference year: 2011/2012)

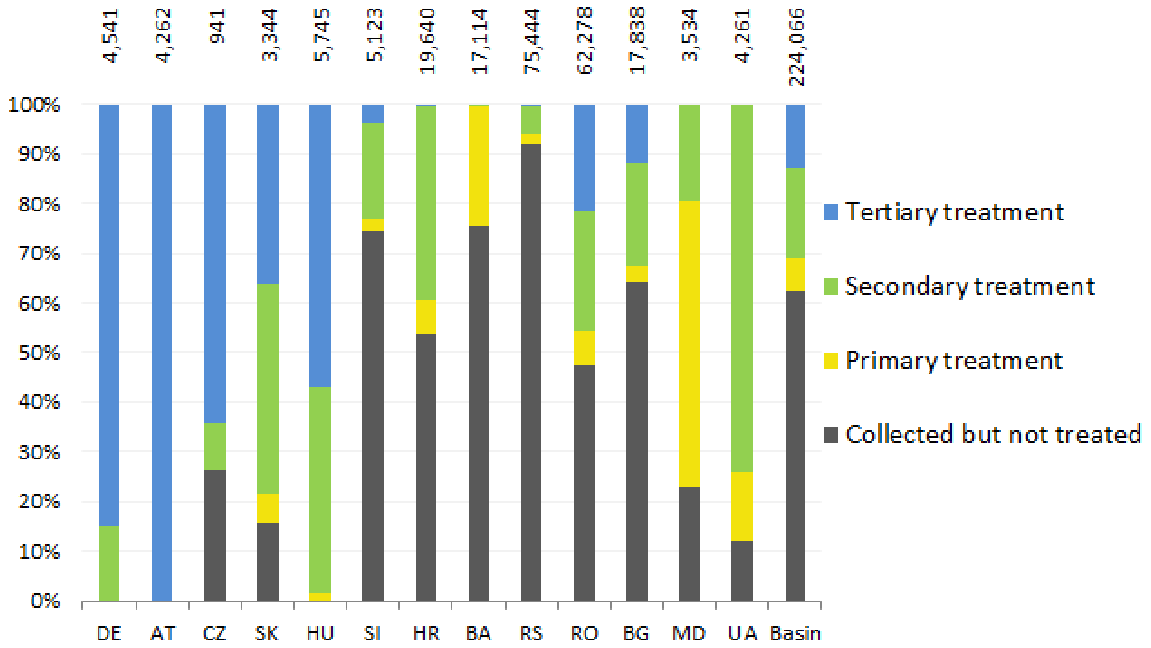
Type of treatment	Discharge	
	BOD (t/year)	COD (t/year)
Tertiary treatment	29,206	114,7924
Secondary treatment	40,235	90,192
Primary treatment	14,985	29,392
Collected but not treated	139,640	258,436
Total	**224,066**	**492,814**

Figure 8: Share of the collection and treatment stages in the total organic pollution of surface waters via urban waste water in the Danube Basin (reference year: 2011/2012); left: BOD discharge, right: COD discharge



BOD discharges per county are shown in Figure 9 according to different collecting and treatment systems (see also Annex 3 on urban waste water inventories). As a consequence of the less developed waste water infrastructure in the downstream countries, the BOD discharges of the new EU MS and the non-EU MS (except Ukraine) are substantially influenced by untreated waste water releases. Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Romania and Bulgaria have still great potential to reduce organic pollution of the surface waters in the Danube Basin by introducing at least biological treatment technology (Bulgaria, Croatia and Romania have a transition period for the implementation of the UWWTD).

Figure 9: Share of the collection and treatment stages in the total organic pollution of the surface waters via urban waste water in the Danube countries (reference year: 2011/2012, absolute numbers on the top refer to tons BOD per year)



2.1.1.2 Organic pollution from industry and agricultural point sources

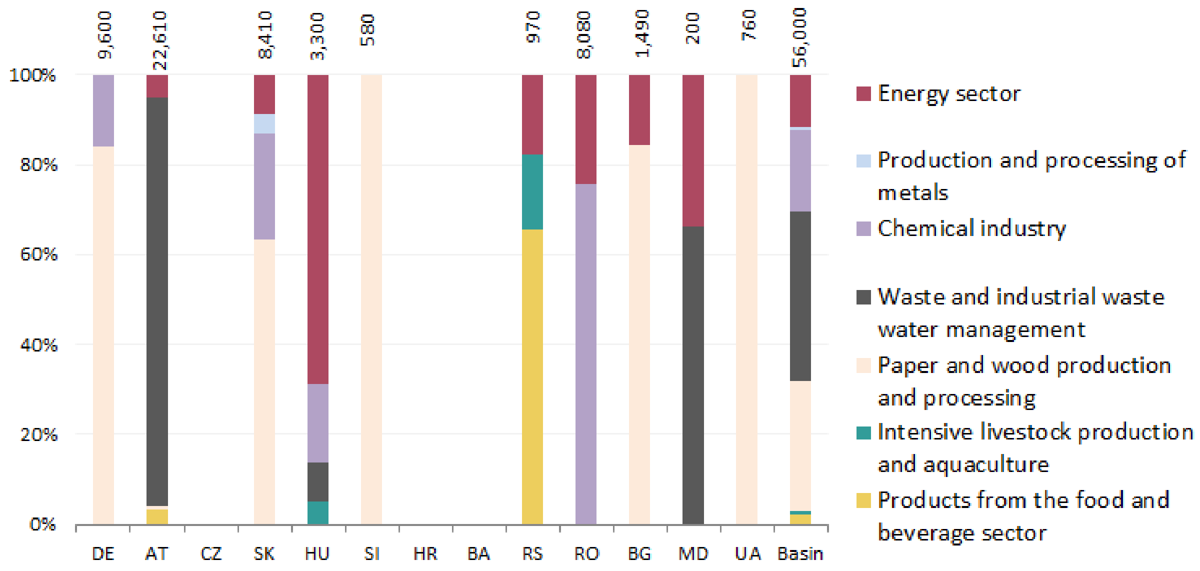
Data for the industrial and agricultural direct dischargers were derived from the E-PRTR database which contains the main industrial facilities and their discharges above certain capacity and emission levels (Map 6, showing all industrial facilities reported to E-PRTR). In total, 56 installations from 7 main industrial sectors were reported by the countries which have significant direct organic substance discharges (above a threshold of 50 tons TOC per year, see Annex 4 on industrial emission inventories). Out of these, waste and industrial wastewater management sector (37%, mainly waste recycling and disposal sites and specific industrial waste water treatment plants, excluding urban waste water treatment plants), paper and wood processing (29%) and chemical industry (18%) are the most important fields in terms of organic pollution (Figure 10, last column). In the reference year (2012) some 56,000 tons per year organic substances (expressed in COD) were released (Table 4). The type of activities, their total releases and proportions are differing among the countries. Germany, Austria, Slovakia, Hungary and Romania contribute the highest COD discharges via industrial activities (Figure 10). Czech Republic, Croatia and Bosnia and Herzegovina have no facilities reported over the given release threshold.

Table 4: Organic pollution via direct industrial discharges in the DRBD according to different industrial sectors (reference year: 2012)

Activities	Releases to water COD (t/year)
Energy sector	6,600
Production and processing of metals	360
Chemical industry	10,190
Waste and industrial waste water management[1]	20,910
Paper and wood production and processing	16,250
Intensive livestock production and aquaculture	330
Products from the food and beverage sector	1,360
Total	**56,000**

[1] excluding urban waste water treatment plants

Figure 10: Share of the industrial sectors in the total organic pollution via direct industrial discharges in the Danube countries (reference year: 2012, absolute numbers on the top refer to tons COD per year)



2.1.1.3 Summary and key findings

At the basin scale, the urban waste water sector generates about 220,000 tons per year BOD and 490,000 tons per year COD discharges into the surface water bodies of the Danube Basin (reference year: 2011/2012). The direct industrial emissions of organic substances total up to ca. 56,000 tons per year COD for the reference year (2012). This means an overall COD emissions of 550,000 tons per year, out of which 89% are released by the urban waste water sector. More than 60% of the surface water emissions via urban waste water stem from agglomerations with existing sewer systems but without treatment. Taking into account that these agglomerations represent only 8% of the total PE and 7% of the total number of agglomerations in the basin, implementation of measures for a relatively small proportion of the agglomerations can result in substantial progress. However, 34% of the agglomerations (representing 17% of the PE) have no collection systems which should be constructed together with appropriate treatment in the future. Twenty-seven percent of the total PE of the basin need further infrastructural development aiming to achieve at least biological treatment.

Comparing the actual figures of the waste water sector to those of the 1st DRBM Plan, remarkable reduction of the organic pollution can be recognised according to the reported data. For the reference year (2005/2006) of the first DRBM Plan 480,000 tons per year BOD and 1,040,000 tons per year COD pollution were reported via urban waste water discharges (excluding the agglomerations without collection system and therefore without direct discharges into surface waters). The recently reported emissions are significantly lower, the BOD and COD discharge reduction rates are 54% and 53%, respectively. The reported industrial emissions increased by 30% in comparison to the reference year (2006) of the 1st DRBM Plan which is likely to be a consequence of the better data availability and extended reporting through the E-PRTR system.

2.1.2 Nutrient pollution

Nutrient pollution is caused by significant releases of nitrogen (N) and phosphorus (P) into the aquatic environment. Nutrient emissions can originate from both point and diffuse sources. Point sources of nutrient discharges are highly interlinked to those of the organic pollution. Municipal waste water treatment plants with inappropriate technology, untreated waste water, industrial enterprises, animal husbandry can discharge considerable amounts of nutrients into the surface waters besides organic matter. Diffuse pathways, however, have higher importance considering nutrients. Direct atmospheric deposition, overland flow, sediment transport, tile drainage flow and groundwater flow can remarkably contribute to the emissions into rivers, conveying nutrients from agriculture, urban areas, atmosphere and even from naturally covered areas.

The importance of the pathways for diffuse pollution is different for N and P. For N, groundwater flow and urban run-off are the most relevant diffuse pathways. In case of P, groundwater is usually replaced by sediment transport generated by soil erosion. Regarding the sources, agriculture can play a key role in nutrient pollution. Surface waters can receive significant nutrient emissions from agricultural fields due to the high nutrient surpluses of the cultivated soils and/or inappropriate agricultural practices. Agglomerations with sewer systems but without connection to treatment plant having nutrient removal technology and combined sewer overflows are important urban sources. Deposition from the atmosphere is especially relevant for N as many combustion processes and agricultural activities produce N gases and aerosols that can be subject to deposition. The role of background fluxes is often overlooked even though they might have significant regional contribution especially from poorly covered areas, mountainous catchments or glaciers.

Impacts on water status caused by nutrient pollution can be recognized through substantial changes in water ecosystems. The natural aquatic ecosystem is sensitive to the amount of the available nutrients which are limiting factors. In case of nutrient enrichment the growth of aquatic algae and macrophytes can be accelerated and water bodies can be overpopulated by specific species. Many lakes and seas have been suffering from eutrophication that severely impairs water quality and ecosystem functioning (substantial algae growth and consequently oxygen depletion, toxicity, pH variations, accumulation of organic substances, change in species composition and in number of individuals) as well as limits or hinders human water uses (recreation, fisheries, drinking water supply). Even though river systems, floodplains and reservoirs can retain nutrients during their in-stream transport (e.g. denitrification, uptake, settling), significant amounts of them can reach lakes and even seas, transposing water quality impacts far downstream from the sources. Therefore, nutrient pollution is clearly a Danube-basin wide problem.

Control of point source nutrient emissions is closely linked to that of the organic pollution and requires nutrient removal at the waste water treatment plants. The management of diffuse nutrient emissions is a challenging task due to their temporal and spatial variability and strong relation to hydrology. Since the diffuse emissions are almost immeasurable at source, catchment-scale assessments and water quality modelling are widely used to help in dealing with the issue. Management actions usually concern a wide range of agricultural best management practices and their combinations. Recovery of an eutrophic water body following management efforts especially on diffuse sources of pollution can take longer time (even several decades) due to the time delay of several contributing pathways (e.g. nitrogen loads via groundwater) and the stored nutrients in the bottom sediments that can re-enter water body (e.g. phosphorus internal loads of lakes). Typical parameters related to nutrient pollution are total nitrogen, dissolved inorganic nitrogen, total phosphorus, orthophosphate-phosphorus and chlorophyll-a.

2.1.2.1 Nutrient pollution from urban waste water

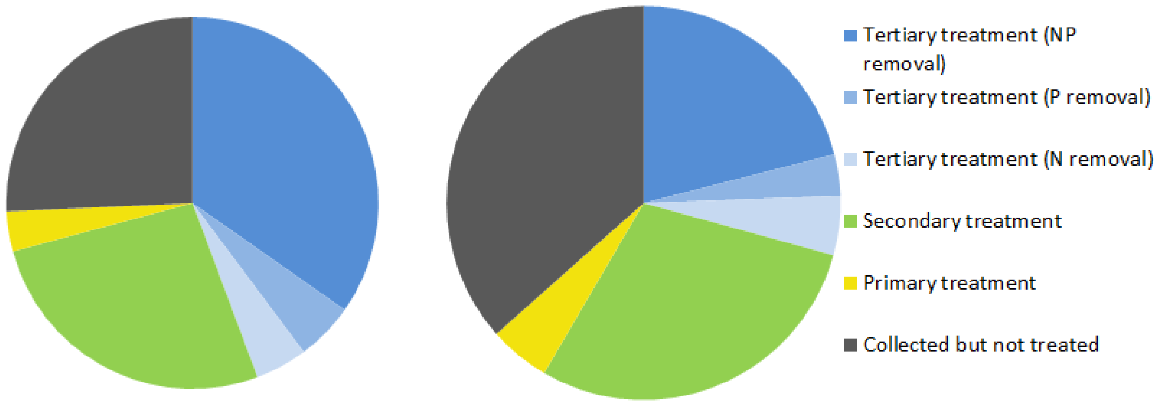
In total, 1,825 agglomerations with a PE of about 50 million are equipped (at least partially) with tertiary treatment aiming nutrient removal in the basin (Map 5, reference year: 2010/2012). Majority of them (79%) addresses the elimination of both nutrients. Out of the 1,245 agglomerations with a size over 10,000 PE 697 agglomerations (56%) have tertiary technology already in place. In terms of PE, the overall load generation at agglomerations above 10,000 PE is 67 million PE, 60% of this load (40 million PE) is effectively subject to tertiary treatment. This indicates that waste water treatment for 27 million PE at agglomerations above 10,000 PE should be further improved.

At the basin scale 84,000 tons per year TN and 11,000 tons per year TP are emitted into the surface waters from the waste water collection and treatment facilities (Table 5). 25% (TN) and 36% (TP) of the emissions can be linked to untreated waste water discharged directly into the recipients (Figure 11). About 3% and 5% of the nutrient releases stem from plants having mechanical treatment, whilst the proportion of the waste water treatment plants with secondary treatment is 26% (TN) and 29% (TP). Some 45% and 30% of the nutrient emissions are discharged from plants with stringent technologies. Regarding the middle sized and big agglomerations (above 10,000 PE), 43% (nitrogen) and 57% (phosphorus) of the nutrient emissions are related to less stringent technologies indicating that further improvement of the treatment at these settlements can significantly reduce the nutrient discharges at the basin scale.

Table 5: Nutrient pollution of surface waters via urban waste water in the Danube Basin (reference year: 2011/2012)

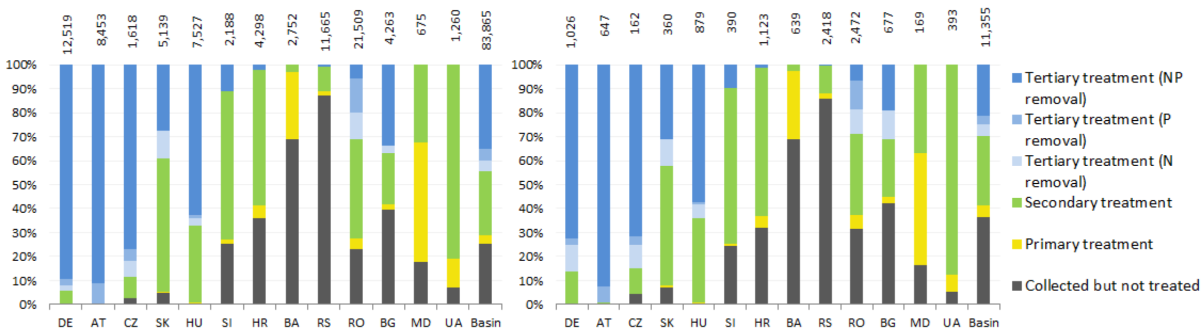
Type of treatment	Discharge	
	TN (t/year)	TP (t/year)
Tertiary treatment (NP removal)	29,356	2,422
Tertiary treatment (P removal)	4,226	385
Tertiary treatment (N removal)	3,793	552
Secondary treatment	22,265	3,305
Primary treatment	2,908	569
Collected but not treated	21,318	4,122
Total	**83,865**	**11,355**

Figure 11: Share of the collection and treatment stages in the total nutrient pollution of surface waters via urban waste water in the Danube Basin (reference year: 2011/2012); left: TN discharge, right: TP discharge



Country performances are presented in Figure 12 (see also Annex 3 on urban waste water inventories). The variation at the country level is similar to the situation discussed by the organic pollution. Upstream countries have only limited possibilities as they have already introduced nutrient removal at the vast majority of the agglomerations, even for the smaller sized settlements. Middle and downstream countries can, however, remarkably enhance the overall treatment status of the plants, particularly at the agglomerations over 10,000 PE, where the introduction of the tertiary treatment technologies is lagging behind.

Figure 12: Share of the collection and treatment stages in the total nutrient pollution via urban waste water in the Danube countries (reference year: 2011/2012); on the left: TN, on the right: TP (absolute numbers on the top refer to tons TN and TP per year)



2.1.2.2 Nutrient pollution from industry and agricultural point sources

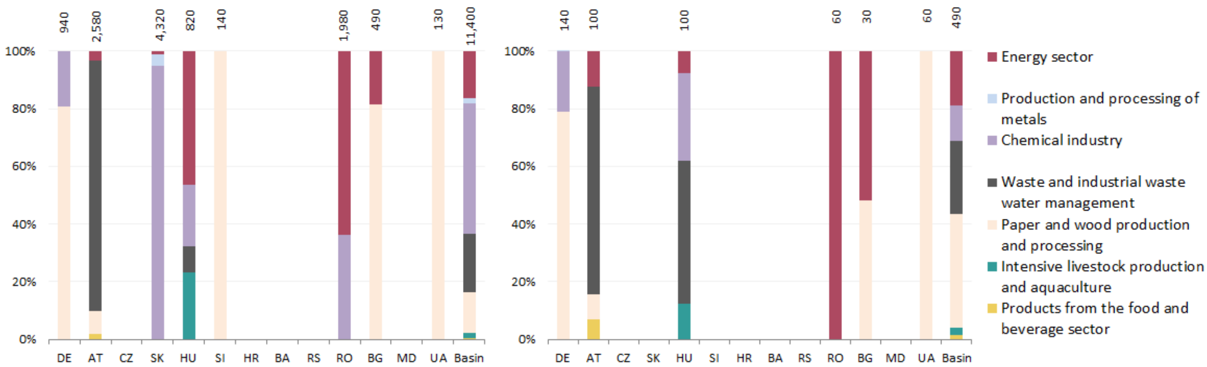
Regarding the industrial discharges, the main sectors with nutrient pollution have been reported (Annex 4 on industrial emission inventories, reference year: 2012) by the countries are the same as those of the organic pollution. In total, 11,400 tons per year nitrogen and 490 tons per year phosphorus were released in the reference year (Table 6). For the nitrogen, the chemical industry has the highest importance emitting almost 45% of the total discharges (Figure 13 left, last column). Besides this, waste and industrial waste water management, energy sector, and paper industry are remarkable contributors. In case of phosphorus, paper industry has the highest share with 39% (Figure 13 right, last column). Energy sector, chemical industry and waste and industrial waste water management sector are other significant industrial fields releasing phosphorus. The reported industrial emissions are relatively small in comparison to those of the urban waste water, only 14% (TN) and 4% (TP) of the waste water discharges are emitted via industrial facilities. Germany, Austria, Slovakia (TN), Romania, and Hungary (TP)produce the highest direct industrial emissions (Figure 13).

Table 6: Nutrient pollution of surface waters via direct industrial waste water discharges in the Danube Basin (reference year: 2012)

Type of treatment	Releases to water	
	TN (t/year)	TP (t/year)
Energy sector	1,890	90
Production and processing of metals	180	-
Chemical industry	5,200	60
Waste and industrial waste water management[1]	2,300	130
Paper and wood production and processing	1600	190
Intensive livestock production and aquaculture	190	10
Products from the food and beverage sector	50	10
Total	**11,400**	**490**

[1] excluding urban waste water treatment plants

Figure 13: Share of the industrial activities in the total nutrient pollution via direct industrial waste water discharges in the Danube countries (reference year: 2012); on the left: TN, on the right: TP (absolute numbers on the top refer to tons TN/TP per



2.1.2.3 Diffuse nutrient pollution

To estimate the spatial patterns of the nutrient emissions in the basin and assess the different pathways contributing to the total emissions, the MONERIS model (Venohr et al., 2011) was applied for the entire basin and for current hydrological conditions (2009-2012). The model is an empirical, catchment-scale, lumped parameter and long-term average approach which can supply decision making to facilitate the elaboration of larger scale watershed management strategies. It can reasonably estimate the regional distribution of the nutrient emissions entering the surface waters within the basin at sub-catchment scale and determine their most important sources and pathways. Moreover, taking into account the main in-stream retention processes the river loads at the catchment outlets can be calculated that can be used for model calibration and validation.

The application of the model has a quite long story in the Danube countries and at the basin scale as well in the field of river basin management and nutrient balancing. The model has been enhanced and adapted to the specific ICPDR needs by several regional projects accomplished in the basin. The model reasonably and reliably works that has been proven by comparison of the results to observed river loads at several gauges for a long time period. It can be easily supported by available data, run for the entire basin and frequently updated according to the actual conditions. The model is sensitive for some key management parameters, allowing to elaborate realistic future management scenarios of basin-wide relevance and assess their impacts on water quality. Recently, the input dataset has been updated and extended according to the available latest spatial information. Moreover, the model algorithm has been improved resulting in updated nutrient emission patterns for the Danube basin.

According to the recent calculations (Annex on nutrient emission modelling), the total nitrogen emissions in the Danube river basin are 675,000 tons per year (8.6 kg per hectare and year) for the reference period 2009-2012 (Table 7, right column). The groundwater (base flow) pathway is responsible for 52% of all TN emissions in the Danube basin and thus the most important pathway (Figure 14 left). Nitrogen inputs via tile drainages have a proportion of 14 %, whilst urban runoff, surface runoff, direct atmospheric deposition and erosion show a contribution of 10%, 7%, 2% and 2% respectively.

Diffuse inputs dominate the basin-wide nitrogen emissions as they have a proportion of 88% in total. Emissions via point sources contribute with 12 % to total nitrogen emissions. Regarding the main sources (Figure 14 right), agricultural fields dominate the emission sources showing a proportion of 54%, although only 36% of the emissions from agricultural areas are related to fertiliser or manure application, whilst the remaining 18% are caused by atmospheric deposition. Urban areas (waste water discharges, runoff from paved surfaces and combined sewer overflows) and natural lands where atmospheric deposition provides N input are significant source areas as well. This indicates that a part of the N emissions might stem from outside the basin and transported via atmospheric deposition that can difficultly be controlled. Natural background pollution is less important on basin-wide level. The regional distribution of the emissions is shown in Map 7. Regions with high agricultural surplus and shorter groundwater residence time and/or bedrock layers with lower denitrification capacity produce the highest area-specific emissions. Urban areas with significant point sources and urban runoff generate remarkable local fluxes as well.

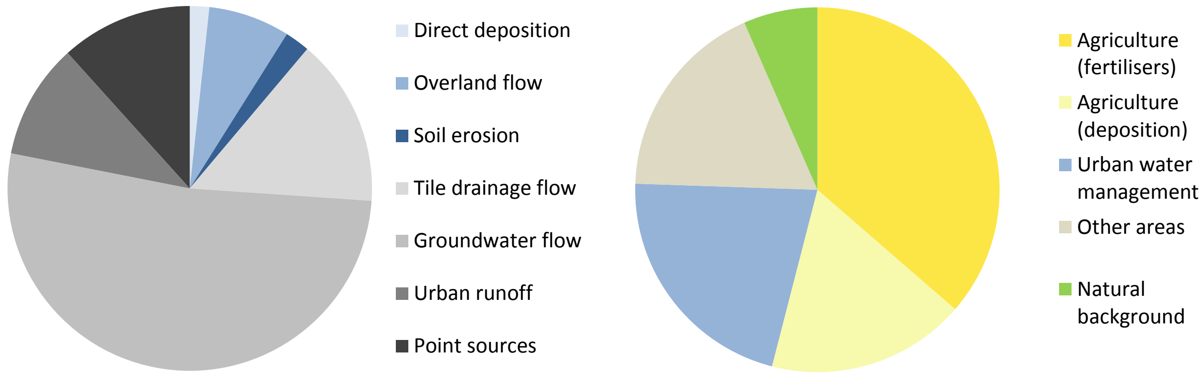
Table 7: Diffuse nutrient emissions of the Danube basin according to different pathways for the reference period (2009-2012)

Pathway	Water emissions TN (t/year)	Water emissions TP (t/year)
Direct deposition	11,646	330
Overland flow	48,829	372
Erosion	14,965	10,124
Tile drainage flow	100,904	675
Groundwater flow	351,495	5,791
Urban runoff[1]	69,178	13,254
Point sources[2]	78,960	9,782
Total	**675,976**	**40,327**

[1] summed emissions via urban runoff, combined sewer overflows and not connected population

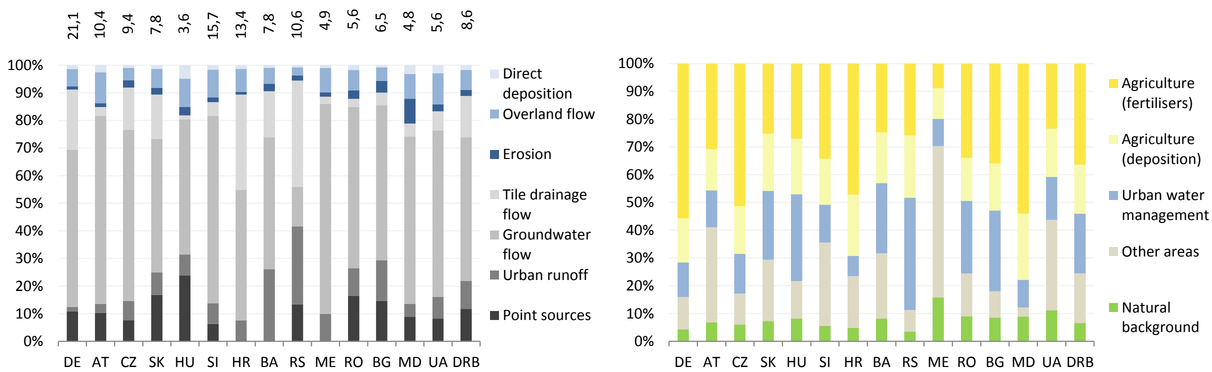
[2] summed emissions of urban waste water treatment plants, population connected to sewer systems without treatment plant and industrial direct dischargers

Figure 14: Share of pathways and sources in the overall TN emissions in the Danube Basin for the reference period (2009-2012); on the left: pathways, on the right: sources



Country contributions can be seen in Figure 15. Germany, Slovenia, Croatia and Serbia produce the highest area-specific N emissions in the basin. Groundwater flow dominates the distribution of the pathways in most of the countries Point sources and urban runoff show significant relative contributions in the downstream countries. Regarding the sources, agricultural activities have a principal role in nitrogen emission generation, whereas atmospheric deposition is an equally important nitrogen input than fertilisers in many countries. Urban water management is still an important source, especially in the new and non EU MS. Share of the background emissions usually remains below 10%. In countries with significant proportion of natural landscapes (Austria, Croatia, Bosnia and Herzegovina, Montenegro and Ukraine) remarkable relative emissions are produced from these areas.

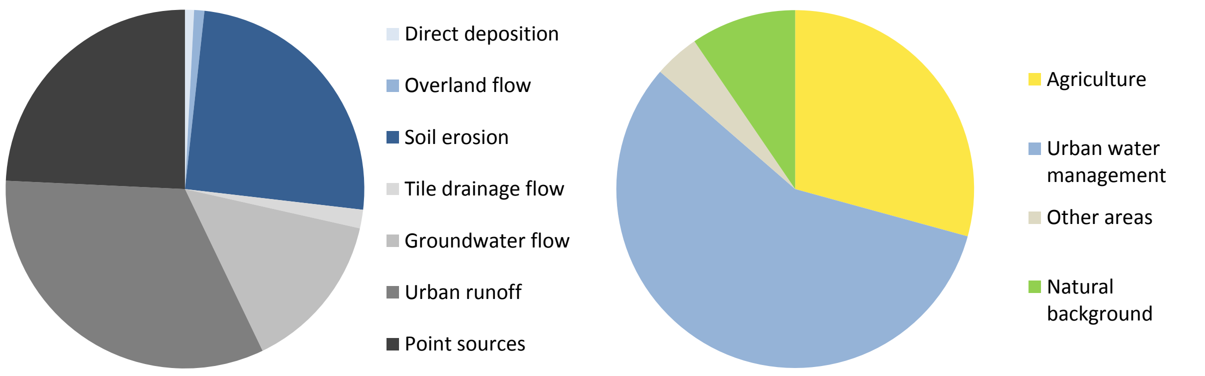
Figure 15: Share of the pathways in the overall TN emissions in the Danube countries for the reference period (2009-2012); on the left: pathways, on the right: sources (absolute numbers on the top refer to kg N per hectare and year)



Total phosphorus emissions in the Danube river basin are 40,000 tons per year (530 g per hectare per year) for the reference conditions (Table 7, left column). TP emissions via the different pathways are presented in Figure 16 (left). The most important diffuse pathway in the Danube river basin is the runoff from the urban systems which is responsible for 33% of all TP emissions. Emissions via erosion contribute with 25% to total phosphorus emissions, base flow has a proportion of 14%. Emissions via surface runoff, atmospheric deposition and tile drainages contribute with 2% or less to the total phosphorus emissions. All diffuse sources have a total share of 76%, whilst point sources pathway has a contribution of 24%. Source apportionment (Figure 16 right) shows the clear dominance of the urban areas producing 57% of the emissions. Agriculture is responsible for 29% of the total emissions, whilst the rest belongs mainly to background emissions.

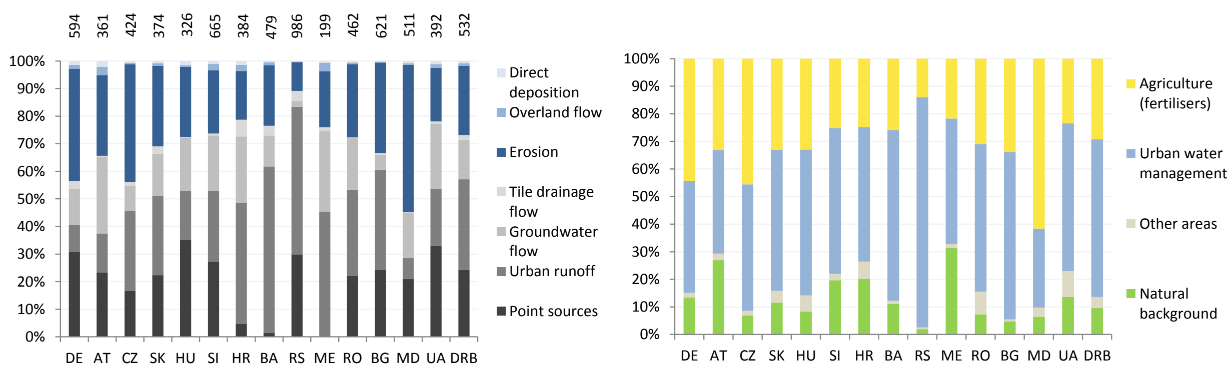
This suggests a high potential of measures addressing the urban water management to reduce the nutrient emissions. However, the agricultural pressure could strengthen due to the potential future agricultural development especially in the middle and lower parts of the Danube. Hilly regions with intensive agricultural activity or mountainous areas producing high background emission rates generate the largest P inputs of the surface waters (Map 8). Similarly to N, point sources and paved urban surfaces significantly contribute to the total emissions as well.

Figure 16: Share of the pathways and sources in the overall TP emissions in the Danube Basin for the reference period (2009-2012); on the left: pathways, on the right: sources



Pathway and source apportionments per country are presented in Figure 17. Serbia, Slovenia, Bulgaria, and Germany generate the highest P emission rates. Point sources, soil erosion and urban runoff are the most relevant emission components. Their proportion varies according to the state of development in the urban waste water sector and the topographic and land use conditions. Upstream countries show similar importance of the urban water management and agricultural sectors regarding the sources of the P emissions. Moving downstream in the basin urban areas become more dominant indicating the high potential to improve waste water treatment by introducing P removal.

Figure 17: Share of the pathways in the overall TP emissions in the Danube countries for the reference period (2009-2012); on the left: pathways, on the right: sources (absolute numbers on the top refer to g P per hectare and year)



The calculated river loads are 440,000 tons per year (TN) and 17,000 tons per year (TP) for the reference period (2009-2012). These numbers indicate remarkable retentions in the river network comparing them to the total emission values. Thirty-five percent of the TN emissions entering the river systems are retained during the in-stream transport mainly by denitrification. Some 58% of the TP emissions do not reach the river mouth particularly due to settling in reservoirs and floodplains. Modelling results reasonably fit the observed river loads at both, the basin-wide and the regional scale.

2.1.2.4 Summary and key findings

The estimated recent, basin-wide nutrient emissions for the reference period (2009-2012)are 675,000 tons per year TN and 40,000 tons per year TP. Diffuse pathways clearly dominate the overall emissions having a contribution of 88% (TN) and 76% (TP). For N, groundwater (base flow) is the most important diffuse pathway with a proportion of 52%. In case of P, urban runoff (33%) and soil erosion (25%) generate the highest emissions. Regarding the sources, agriculture (N: 54%, P: 29%) and urban water management (N: 22%, P: 57%) are responsible for the majority of the nutrient emissions indicating the necessity of appropriate measures to be implemented in these sectors. Similarly to organic pollution, point source emissions are significantly influenced by untreated waste water discharges being responsible for about 30% (TN) and 40% (TP) of the total emissions. Besides this, enhanced treatment of the existing plants at agglomerations above 10 000 PE (more than 500 agglomerations) has also great potential to reduce nutrient emissions concerning 27 million PE in total.

The current long-term average (2003-2012) observed river loads estimated from measured river discharge and nutrient concentration data at the river mouth (station Reni are 490,000 tons per year (TN) and 25,000 tons per year (TP). Analysing the trends in nutrient river loads over the past decades a significant reduction in the transported nutrient fluxes to the Black Sea can be detected. However, the recently transported fluxes are still considerably higher than that of the early 1960ies representing desired load targets (TN: 300,000 tons per year, TP: 20,000 tons per year), which means a TN and TP load reduction need of 40% and 20%, respectively. This requires further decrease of both, the point source and diffuse emissions generated in the Danube basin.

Similarly to the organic pollution, remarkable decrease is visible regarding the nutrient point source emissions in the Danube basin. For the reference year of the 1st DRBM Plan (2006) 130,000 tons per year TN and 22,000 tons per year TP pollution was reported via direct urban waste water discharges. The recently reported point source nutrient emissions are significantly lower in comparison to those of the first DRBM Plan, the TN and TP discharges declined by 36% and 48%, respectively. However, the reported industrial direct emissions rose by about 46% (TN) and 10% (TP) which is probably caused by the improved reporting quality. The recent modelling results of the MONERIS for the basin-wide total emissions reflect the impacts of a comprehensive update of the input database, the change in nutrient inputs (e.g. urban waste water, agriculture)and some methodological improvements in the model algorithm on the model results. N emissions remained at the same level in comparison to the 1st DRBM Plan although point source emissions via waste water significantly decreased. This is, however, compensated by a higher emission from agriculture via fertilisers and manure which is a consequence of the modified input data set rather than that of intensified agriculture. Total P emissions declined by 30% due to the improved waste water treatment. In addition, higher differences can be found for the proportion of the various pathways and for several regions of the basin. These differences are consequences of the model developments and the updated input data.

2.1.3 Hazardous substances pollution

Hazardous substances pollution involves contamination with priority substances laid down in Annex X of the WFD and other specific pollutants listed in Annex VIII of the WFD that might be toxic, heavily degradable or accumulative and have regional relevance. They include both inorganic and organic micro-pollutants such as heavy metals, arsenic, cyanides, oil and its compounds, trihalomethanes, polycyclic aromatic hydrocarbons, biphenyls, phenols, pesticides, haloalkanes, endocrine disruptors, pharmaceuticals, etc. Hazardous substances can be emitted from both point and diffuse sources. Households and public buildings connected to sewerage can contribute to water pollution by emitting chemicals used in the course of daily routine. Industrial facilities that process, utilise, produce or store hazardous substances can release them with waste water discharges. Indirect dischargers are connected to public sewer systems and can transport contaminated industrial waste water to the treatment plants if their own treatment system is not sufficient. Direct dischargers without specific removal technology for hazardous substances can potentially deteriorate water quality.

Diffuse emission pathways are substance-specific. Surface run-off, sediment transport and groundwater flow are the main contributing routes. Urban systems (deposited air pollutants, litter, combined sewer overflows), agriculture (pesticide and contaminated sludge application), contaminated sites (industrial areas, landfills, abandoned areas) and mining sites are the most important source sectors. Background geochemical loads can be considerable in specific regions where the parent rock layers naturally contain hazardous substances (e.g. heavy metals). Hazardous substances contamination can specially be realized through accidental pollutions. Industrial facilities, mining areas and contaminated sites that process or contain such substances in substantial amounts pose hazard (potential risk) to cause pollution even though they might not have any release in their regular operation. However, in case of emergency situations (natural disasters like flood or earthquake as well as operation failures) and without appropriate safety measures in place they might be at real risk to cause water pollution.

Due to the rapid development of the chemical industry that is continuously producing new chemicals, their different and complex environmental behaviour and the long-lasting chronic toxicity of many substances the whole mechanism of the hazardous substances pollution has not been fully clarified so far. Hazardous substances can pose serious threat to the aquatic environment. Depending on their concentration and the actual environmental conditions, they can cause acute (immediate) or chronic (latent) toxicity. They usually attack one of the vital systems of the living organism, like nervous, enzymatic, immune, muscular systems or directly the cells.

Some of the hazardous substances are persistent, slowly degradable and can accumulate in the ecosystem. They can deteriorate habitats and biodiversity and also endanger human health as many of these chemicals are carcinogenic, mutagenic or teratogen. They can also alter proteins and different organs, impair reproduction or disrupt endocrine systems. Many of the pollutants tend to attach to organic compounds, they may be taken up by the organisms during feeding and introduced in the food web through bioaccumulation and biomagnification processes. Moreover, some of the pollutants can be attached to the soil and sediment particles and subject to subsequent resuspension and dissolution. Therefore, hazardous substances pollution is considered as regional or even basin-wide water quality problem and its reduction may take a longer time. Elimination of these substances needs up to date technologies at the industrial sites, enhanced waste water treatment, good agricultural practices to appropriately handle these substances, cessation and replacement of the hazardous substances with others whenever possible and well developed safety system to address accidental events. Total and dissolved concentrations of the hazardous substances are used to describe water status. Additionally, concentrations in sediment and/or biota should be monitored especially for those priority substances which tend to accumulate in sediment and/or biota including also long-term trend analysis of their concentrations.

2.1.3.1 Sources of hazardous substances pollution

Danube countries have made substantial efforts to supplement the insufficient information on the hazardous substances pollution at the basin-wide level. Towards a better understanding and a narrowed information gap in this field the compilation of inventories on priority substances emissions, discharges and losses required under the EU Directive on Priority Substances (EQSD, Article 5) provides a promising possibility. This could be also extended in the future to other specific pollutants as well. The current ICPDR activities on the hazardous substances pollution are highly related to the recommendations of the Common Implementation Strategy (CIS) Guidance No. 28 on preparing emission inventories of priority substances and other hazardous substances. Recently, a two-steps approach is being conducted to test the guideline for the Danube River. The first phase is a more general significance analysis of the priority substances and specific pollutants. The aim of this phase is to screen those substances which are clearly of higher relevance at present and in the foreseeable future at the Danube River level and allow to prioritise the resources and efforts necessary for the subsequent detailed investigations on the emission sources. It is based on the information available for the emissions mainly from the E-PRTR and UWWTD databases and immission data derived from the TNMN database and Joint Danube Surveys (JDS).

The outcome of the emission analysis is a preliminary set of relevant priority substances and other specific pollutants for which emission data (releases above certain emission thresholds specified in the PRTR Regulation, Map 6) have been available. Based on the first screening 38 compounds have been found with exceedance of the respective release threshold for at least one facility within the basin. Out of these substances seven organic pollutants, eight heavy metals, eight pesticides and fifteen chlorinated organic substances These results will be overlapped and liaised with the draft list of Danube River Basin specific pollutants determined by the in-stream concentration assessments of the

JDS3 and its follow-up activities in cooperation with the EU FP7 project SOLUTIONS (see Chapter 4.1.2.3). This harmonised draft list will subsequently be supported by additional information and eventually extended once further results of the JDS3 are evaluated, advanced analytical methods are applied in the countries and more data are available from the emission inventories. Moreover, modelling activities on the fate of several hazardous substances are currently being undertaken by the SOLUTIONS project and the JRC which could help to better understand the links between sources and impacts of hazardous substances pollution.

The second phase of the CIS Guidance No. 28. is a more detailed analysis focusing on the sources of the screened relevant substances. It aims to develop a detailed inventory for both, the point and diffuse source hazardous substances emissions. It requires point source discharge data (municipal waste water treatment plants and industrial facilities) and observed river loads at certain monitoring points. River loads should carefully be calculated taking into account the uncertainties of the analytical method (e.g. concentrations below the limit of quantification or detection) and the sampling frequency (e.g. unregistered high flow events with considerable pollutant transport). Knowing the point source emissions and the observed river loads, assuming a certain natural background river load and neglecting the in-stream sources and sinks would allow to roughly estimate the total anthropogenic diffuse inputs from the catchment upstream of the monitoring points. Countries are currently compiling their national inventories on the point and diffuse source emissions of the relevant hazardous substances which will serve the basin-wide assessments.

Analysis of the data obtained from the PS EDL inventories if possible

Map of the facilities with PS emissions according to industrial sectors if possible

2.1.3.2 Hazardous substances pollution from accident risk spots and contaminated sites

Assessment of hazardous substance pollution via accidents is based on risk assessment methods. Their main objectives are to raise awareness to the accidental pollution in the basin, to determine which priority industrial sectors need to be improved in different regions of the basin in order to minimize risk by implementing measures and to give advice for financing institutes and decision makers where financial and/or technical supporting projects should be targeted. A stepwise approach is followed starting with potential risk analysis where rather general methods are used to screen potential hot-spots based on some basic technological properties of the facilities. In a second step, the real risk analysis should be executed based on checking the relevant environmental factors and safety measures already put in place in order to indicate what necessary additional measures have to be taken in order to improve safety. This analysis should be carried out in the responsibility of the riparian countries in order to implement necessary safety measures and it should be in line with sectorial checklists and national catalogues of measures. The ICPDR is currently assessing the potential accident risk hot-spots and updating the catalogue of hazardous sites for the Danube Basin.

Accident risk spots (ARS) represent mainly existing industrial and energy production facilities that process, store, produce or release hazardous substances. The ARS inventories recently being compiled will evaluate the potential risk of the selected facilities based on the WRI (Water Risk Index) values. The WRI assesses the hazard of the industrial sites based on the hazard degree of the processed materials and their volume stored at the sites.

Contaminated sites (CS) include old industrial facilities, abandoned sites and landfills. For the CS the M2 methodology has been applied for risk assessment. The first step of the M2 methodology (M1 method) allows undertaking the initial risk assessment of contaminated sites based on the toxic potential of soil or waste (it depends on the harmful substances to be expected in a particular type of waste or in a specific industrial branch and it is expressed as a risk value) and the magnitude of the contamination (volume of an old deposit or the area of an old industrial site). In a second step the M2 method can roughly assess the real risk based on the flood probability and safety conditions of the sites.

Analysis of the accidental pollution risk derived from the ARS inventories if possible

Analysis of the accidental pollution risk derived from the CS inventories if possible

Map of the ARS and CS according to risk classes if possible (reference situation)

2.1.3.3 Summary and key findings

Danube countries have taken important steps to fill the existing data gaps in the field of hazardous substances pollution. The recent ICPDR investigations (particularly those related to the current JDS3) on the priority and other hazardous substances have provided essential information on the relevance of these substances resulting in a much clearer picture on the pollution problem (relevant substances and their magnitude) than ever before. The elaboration of an inventory of emissions, discharges and losses of the priority substances can help to close information gaps on the sources. Measures under implementation in the waste water, industrial and agricultural sectors (e.g. enhanced waste water treatment and BAT, regulated use of sewage sludge and pesticides) can significantly contribute to the reduction and/or phasing out of the releases of hazardous substances. Danube countries are collecting data on the existing industrial and contaminated sites that might be at potential risk to cause accidental pollution triggered by operation failures or natural disasters like floods.

2.1.4 Hydromorphological alterations

Hydromorphological alterations and their effects gained vital significance in water management due to their impacts on the abiotic sphere as well as on the ecology and ecological status of the river system.

Anthropogenic pressures resulting from various hydro-engineering measures can significantly alter the natural structure of surface waters. This structure is essential to provide adequate habitats and conditions for self-sustaining aquatic species. The alteration of natural hydromorphological conditions can have negative effects on aquatic populations, which might result in failing the EU WFD environmental objectives.

Hydropower generation, navigation and flood protection are the key water uses that cause hydromorphological alterations. In some countries development schemes include reservoirs with multiple purposes. Hydromorphological alterations can also result from anthropogenic pressures related to urban settlements, agriculture and other sources. These drivers can influence pressures on the natural hydromorphological structures of surface waters in an individual or cumulative way.

The following three key hydromorphological pressure components of basin-wide importance have been identified:

a) Interruption of longitudinal river continuity and morphological alterations;

b) Disconnection of adjacent wetlands/floodplains, and;

c) Hydrological alterations, provoking changes in the quantity and conditions of flow.

In addition, potential pressures that may result from future infrastructure projects are also dealt with.

This chapter reflects findings on hydromorphological alterations and their significance from previous EU WFD reports, as well as from the most recent national data taking into account progress in the implementation of the JPM from the 1st DRBM Plan 2009.

The interruption of longitudinal river continuity for fish migration, river morphology, disconnected wetlands/floodplains which have a reconnection potential, and hydrological pressures including impounded river sections, water abstractions and hydropeaking are assessed. Information on the extent of these pressure types was updated in order to gain a full picture on the current situation. With regard to future infrastructure projects, the list of planned hydro-engineering projects has been updated and supplemented with additional information.

In cases where countries share river stretches there is the risk that some hydromophological components (river and habitat continuity interruption, hydrological alterations) are reported twice because the information has been reported separately by the Danube countries. Due to this reason bilateral harmonisation of reported data is important in order to avoid a potential distorting of the overall assessment and discrepancies in the results.

Assessment of hydromorphological alterations in the Danube River – Joint Danube Survey 3

The JDS2 in 2007 delivered results on hydromorphological alterations for the Danube River (from Kelheim (rkm 2,416) to the Danube Delta) for the very first time – information which was also illustrated in the 1st DRBM Plan 2009. JDS3, which was performed in 2013, allowed for updated investigations based on an updated methodology developed for JDS3.

The JDS2 methodology, which was oriented on the CEN standard, was further extended and applied during JDS3 to 10 rkm segments. In addition, the 3Digit approach was applied, by selecting relevant parameters for the assessment of morphological, hydrological and continuity components. The assessment was based on a concise methodology, applicable for the whole 2,400 rkm long Danube river stretch assessed during the survey and should supplement, but not substitute, the national hydromorphological assessments required by WFD. Finally, detailed in-situ measurement and sampling of hydromorphological parameters was accomplished for all of the 68 JDS3 sites.

In the following, the results of the WFD-3Digit analysis are illustrated. It provides information on the parameter groups "Morphology", "Hydrology" and "Continuity". The overall results for the entire Danube are illustrated in Figure 18. The longitudinal visualisation is illustrated in Figure 19, allowing for a comprehensive overview of impounded reaches with the position of dams (middle and right column) and the morphology on the left.

Out of the 241 analysed 10 rkm segments, 13% fall for morphology in class 2 (slightly modified), 39% in class 3 (moderately modified), 31% in class 4 (extensively modified) as well as 17% in class five (severely modified). For hydrology/flow regime and the continuity only the classes 1, 3 and 5 were assessed. For hydrology only 16% fall in the first class whereas class 3 with 50% and class 5 with 34% prevail. Regarding continuity, dams are located in 8% of segments (in total 18 dams, two dams with functioning fish passes and partial sediment management fall in class 3, the rest in class 5). Detailed information on the approach and results can be obtained from the JDS3 report.

Figure 18: Overall results JDS 3 3Digit assessment for the entire Danube

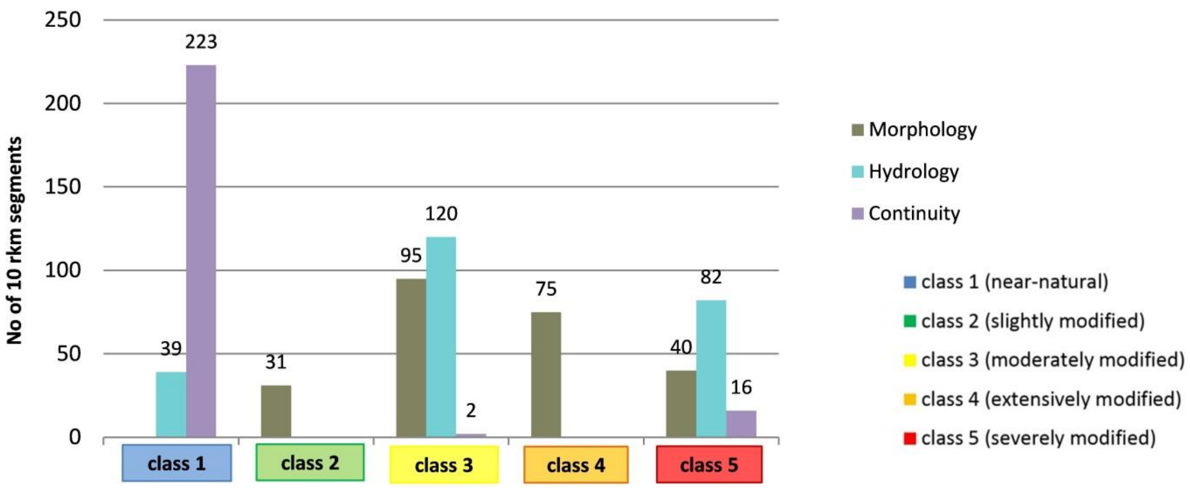


Figure 19: Longitudinal visualisation of the results of the 3Digit assessment[12]

[12] The approach applied by JDS3 for the assessment of the hydromorphological alterations does not replace a WFD compliant status assessment and therefore the JDS3 results do not necessarily correspond to the results of the status assessment for individual water bodies done by the countries at the national level according to the WFD.

2.1.4.1 Interruption of river continuity and morphological alterations

The DRBM Plan 2009 included an assessment of barriers causing longitudinal continuity interruption for fish migration. Morphological alterations were considered as an important pressure component but not assessed on the basin-wide scale. This data gap was for the first time reduced for the 2013 Update DBA, with the collection of information on morphological alterations to water bodies, which are directly linked to habitat degradation.

Alteration of river continuity for fish migration

Table 8 provides information on the applied criteria for the pressures assessment on continuity interruption for fish migration in the DRBD. Compared to data which was provided for the 1st DRBM Plan in 2009, a significant number of barriers which were reported actually do not meet the criteria for the pressures assessments. This because in 2009 e.g. also river bed stabilisation structures for flood risk management like ramps of limited height were reported as barriers equipped with functional fish migration aids. Since these structures do not cause a hindrance for fish migration, this issue has been clarified in the updated data set which was used for the assessments in this report. Due to this reason the total number of barriers is differing from the number reported in 2009.

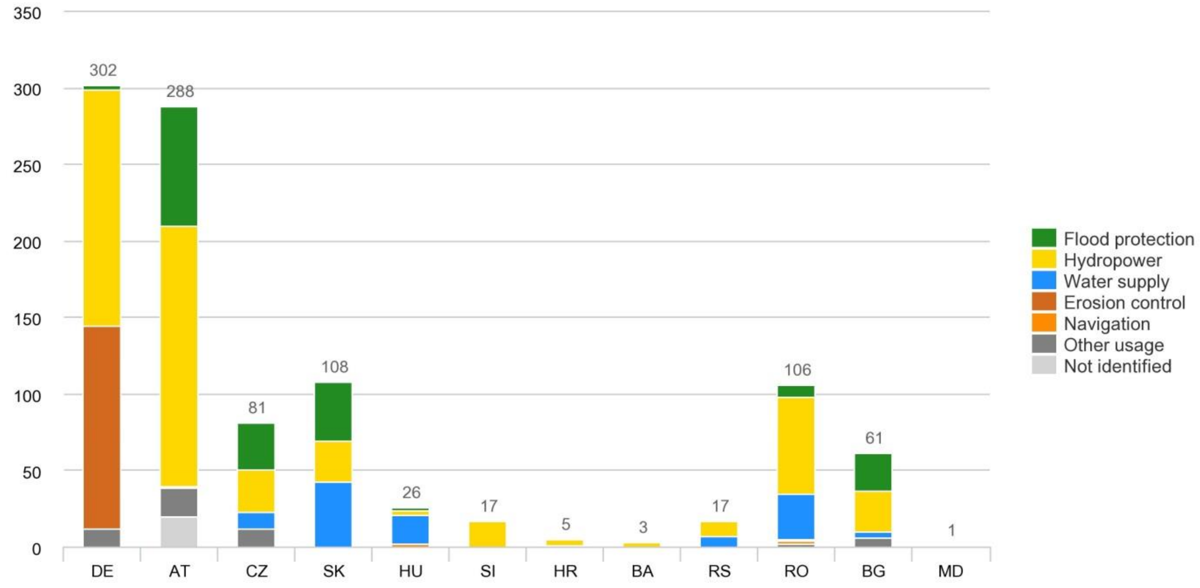
The key driving forces causing continuity interruption are hydropower generation (50%), flood protection (18%) and water supply (11%). More detailed information on the number of continuity interruptions and associated main uses is illustrated in Figure 20 for the different countries. In many cases barriers are not linked to a single purpose due to their multifunctional characteristics (e.g. hydropower use and navigation; hydropower use and flood protection).

Table 8: Continuity interruption for fish migration: Criteria for pressure assessment

Pressure	Provoked alteration	Criteria for pressure assessment
Alteration of river continuity	Interruption of fish migration and access to habitats	Anthropogenic interruption, rhithral >0.7m height, potamal >0.3m height, or lower in case considered as relevant on the national level[13]

[13] Rhithral are the headwater sections of rivers and potamal the lowland sections.

Figure 20: Number of continuity interruptions and associated main uses

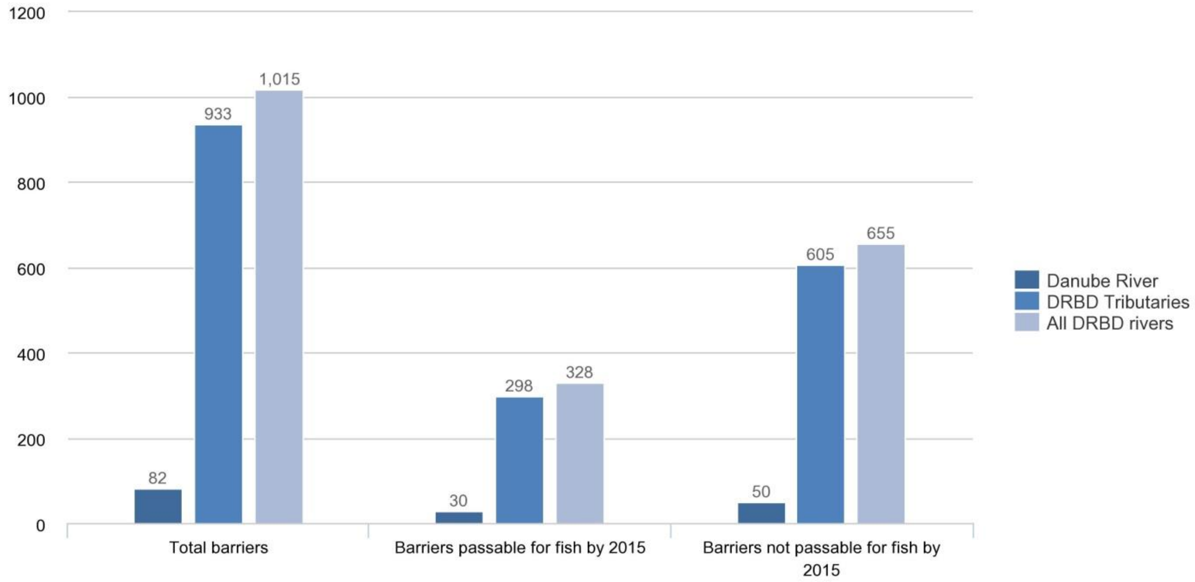


1,015 barriers are located in DRBD rivers with catchment areas >4,000 km^2 (Figure 21 and Map 9). 602 of the 1,015 continuity interruptions are dams/weirs, 287 are ramps/sills and 126 are classed as other types of interruptions. 50% of the barriers were reported to cause a water level difference of less than 5 m under average conditions, 21% cause a water level difference between 5 and 15 m, and 7% are larger dams with water level differences of more than 15 m. For the remaining barriers data on the water level difference is not available.

328 of the barriers were reported by the countries to be already equipped or to be equipped by 2015 with functional fish migration aids. 655 continuity interruptions (65%) will remain a hindrance for fish migration as of 2015 and are currently classified as significant pressures (see Figure 21). For the remaining barriers it either still needs to be determined whether fish migration is possible or they were reported to be located outside of the fish area (details see Map 9).

Out of the total 760 water bodies in the DRBD, 312 are affected by barriers for fish migration, out of which 51 are passable for fish. 256 water bodies in the DRBD are significantly altered by continuity interruptions un-passable for fish species. This is 34% of the total number of DRBD water bodies.

Figure 21: Current situation on river continuity interruption for fish migration in the DRBD



For the Danube River itself, 82 barriers were identified, out of which 30 are expected to be passable for fish by 2015. Although progress on addressing this issue is made, the Austrian/German chain of hydropower dams, the Gabcikovo Dam (SK) and the Iron Gate Dams 1 & 2 (RO/RS) remain significant river and habitat continuity interruptions for the Danube River, posing problems i.e. for long and medium distance migratory fish species.

Alteration of river morphology

The EU WFD requires in Annex II the identification of significant morphological alterations to water bodies. Elements defining river morphology include

- river depth and width variation,
- structure and substrate of the river bed, and
- structure of the riparian zone.

Deterioration of the natural river morphology influences habitats of the aquatic flora and fauna and can therefore impact water ecology. Aggregated information on the alteration of river morphology was collected on the level of the water body. Since most countries have a five class system and others a three class system in place for the assessment of the morphological condition, it was agreed to provide information on the morphological alterations of water bodies in the following three classes:

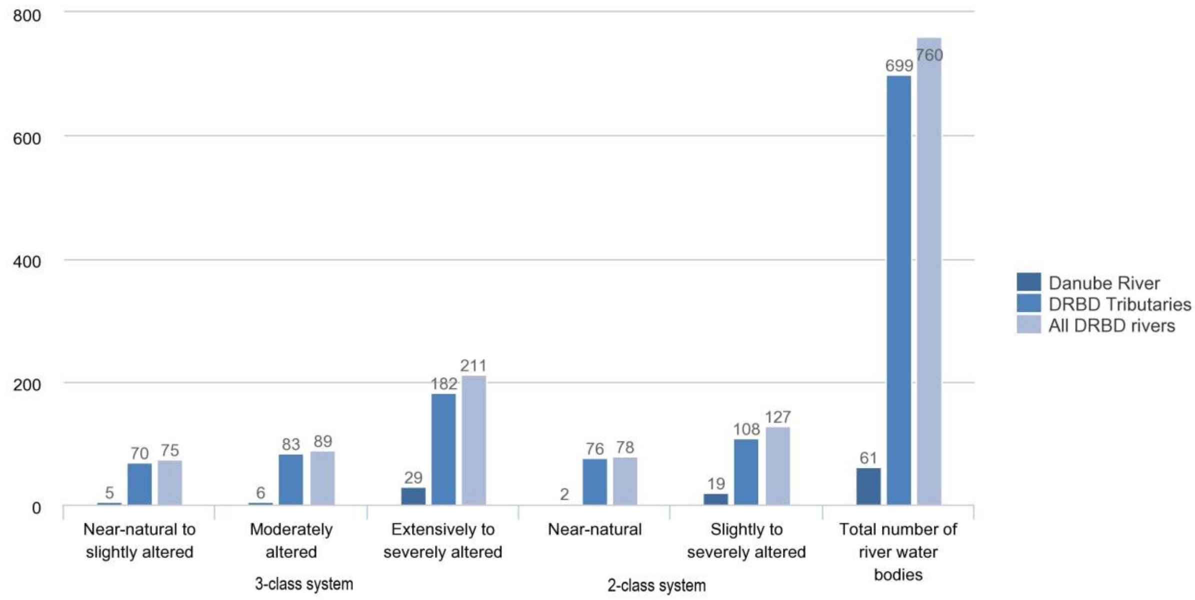
- Near-natural to slightly altered (1-2);
- Moderately altered (3);
- Extensively to severely altered (4-5).

In two countries a two class system is in place, whereas data is indicated separately according to the following classification:

- Near-natural;
- Slightly altered to severely altered.

The pressure analysis concludes that 75 out of a total 760 river water bodies are near natural to slightly altered (10%). 89 water bodies were reported to be moderately altered and 211 are extensively to severely altered (Figure 22 and Map 10). 78 water bodies reported in the 2-class system are near natural (10%) and 127 are slightly to severely altered. For the remaining water bodies no information on the classification of river morphology is yet available.

Figure 22: Morphological alteration to water bodies of the Danube River, the DRBD tributaries and all DRBD rivers



Further harmonisation efforts are required in the future towards a better comparable assessment of morphological alterations to the rivers in the DRBD.

2.1.4.2 Disconnected adjacent wetlands/floodplains

Wetlands/floodplains and their connection to river water bodies play an important role in the functioning of aquatic ecosystems and have a positive effect on water status. Connected wetlands/floodplains play a significant role when it comes to retention areas during flood events and may also have positive effects on the reduction of nutrients and improvement of habitats. As an integral part of the river system they are hotspots for biodiversity, also providing habitats for e.g. fish and waterfowls that use such areas for spawning, nursery and feeding grounds.

The 1st DRBM Plan from 2009 concluded that compared with the 19th Century, less than 19% of the former floodplain area (7,845 km^2 out of a once 41,605 km^2) remain in the entire DRB. This is caused in particular due to the expansion of agricultural uses and the disconnection from water bodies due to river engineering works concerning mainly flood control, navigation and hydropower generation.

The basis of the pressure analysis for the 1st DRBM Plan 2009 was the consideration that disconnected wetlands/floodplains are potential pressures to aquatic ecosystems on the basin-wide level and that the highest possible area of those which have a reconnection potential should be re-connected in order to support the achievement of the environmental objectives. Therefore, restoration efforts and measures were taken to facilitate the achievement of WFD environmental objectives.

The pressure analysis focuses on analysing the location and area of disconnected wetlands/floodplains (>500 ha or which have been identified by the Danube countries of basin-wide importance) with a definite potential for reconnection, taking into account those wetlands/floodplains which are reconnected until 2015 as part of the JPM implementation of the 1st DRBM Plan. Since for the 1st DRBM Plan partly also historical wetlands/floodplains have been reported without being considered to have a reconnection potential, the updated data set addresses now those wetlands/floodplains with a definite reconnection potential.

In total 278,871 ha of wetlands/floodplains have been identified to have a reconnection potential. Out of these and as part of the JPM implementation, 91,111 ha are totally and 40,920 ha are partly reconnected where some of the required measures were already completed but further measures are planned, having positive effects on water status and flood mitigation. The remaining wetlands/floodplains, covering an area of 146,840 ha, have a remaining potential to be re-connected to the Danube River and its tributaries in the next WFD cycles (see Figure 23 and Map 11).

The indication of no reconnection potential for wetlands/floodplains in many Danube countries (Figure 23) does not indicate that there are not wetlands/floodplains with reconnection potential or that there is no restoration taking place is these countries, since Figure 23 exclusively illustrates relevant information for the basin-wide scale for wetlands/floodplains with an area larger 500 ha.

Figure 23: Area [ha] of DRBD wetlands/floodplains (>500 ha or of basin-wide importance) which are reconnected or with reconnection potential

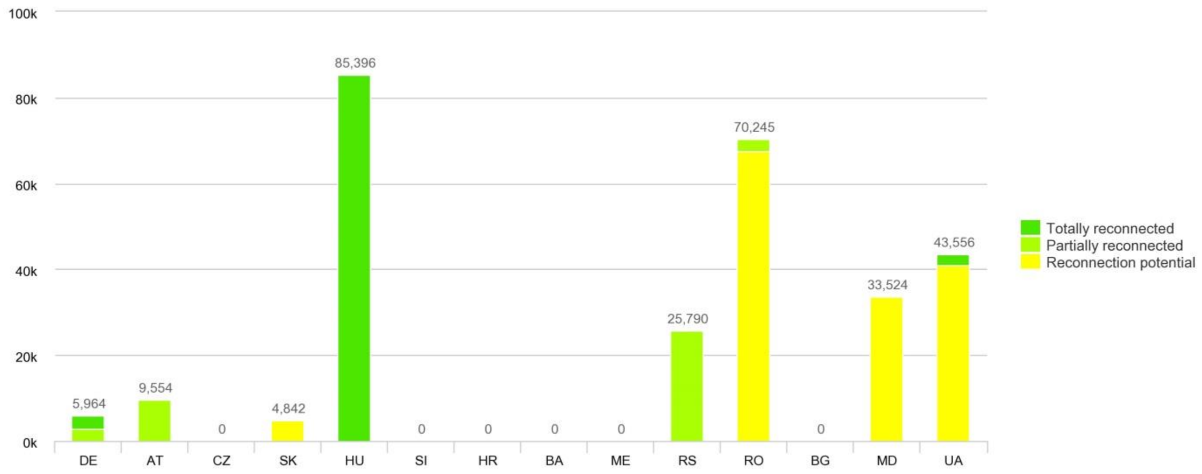


Table 9 shows the number of remaining water bodies in the DRBD (in absolute numbers and percentage) which have the potential to benefit from reconnected wetlands/floodplains or an improvement of the water regime in the future, having a positive effect on their water status. The absolute length of water bodies with restoration potential in relation to disconnected wetlands/floodplains is 3,067 km (11% of total river network).

Table 9: Number of river water bodies with wetlands/floodplains, having a reconnection potential beyond 2015 as well as relation to overall number of water bodies

	Number of WBs	WBs with reconnection potential	% with reconnection potential
Danube River	61	12	20
DRBD tributaries	699	14	2
All DRBD rivers	760	26	3

2.1.4.3 Hydrological alterations

A pressure assessment on hydrological alterations was for the first time performed for the DRBM Plan 2009. The assessment in this analysis provides updated information, taking into account the progress achieved in reducing the hydrological pressures and impacts as part from the implementation of the JPM.

The main remaining pressure types in the DRBD causing hydrological alterations are in numbers: 395 impoundments, 138 cases of water abstractions and 36 cases of hydropeaking. The provoked alterations and applied criteria used for the assessment are shown in Table 10.

Table 10: Hydrological pressure types, provoked alterations and criteria for the respective pressure/impact analysis in the DRBD

Hydrological pressure	Provoked alteration	Criteria for pressure assessment
Impoundment	Alteration/reduction in flow velocity and flow regime of the river sections caused by artificial transversal structures	Danube River: Impoundment length during low flow conditions >10 km Danube tributaries: Impoundment length during low flow conditions >1 km
Water abstraction / residual water	Alteration in quantity and dynamics of discharge/flow in water	Flow below dam <50% of mean annual minimum flow[14] in a specific time period (comparable with Q95)
Hydropeaking	Alteration of flow dynamics/discharge pattern in river and water quantity	Water level fluctuation >1 m/day or less in the case of known/observed negative effects on biology

The pressure analysis concludes that 569 hydrological alterations are located in the DRBD – 54 of them in the Danube River. Details on the distribution of hydrological alterations between the different pressure types (impoundments, water abstraction and hydropeaking) and their significance according to the ICPDR criteria (Table 10) are outlined below as well as illustrated in Map 12, 13 and 14. Table 11 shows the number of DRBD water bodies affected by hydrological alterations (in absolute numbers and percentage).

Table 11: Number of river water bodies significantly affected by hydrological alterations in relation to the overall water body number

	Total number of WBs	WBs affected by hydrological alterations	Proportion of affected WBs to total number (%)
Danube River	61	35	57
DRBD tributaries	699	201	29
All DRBD rivers	760	236	31

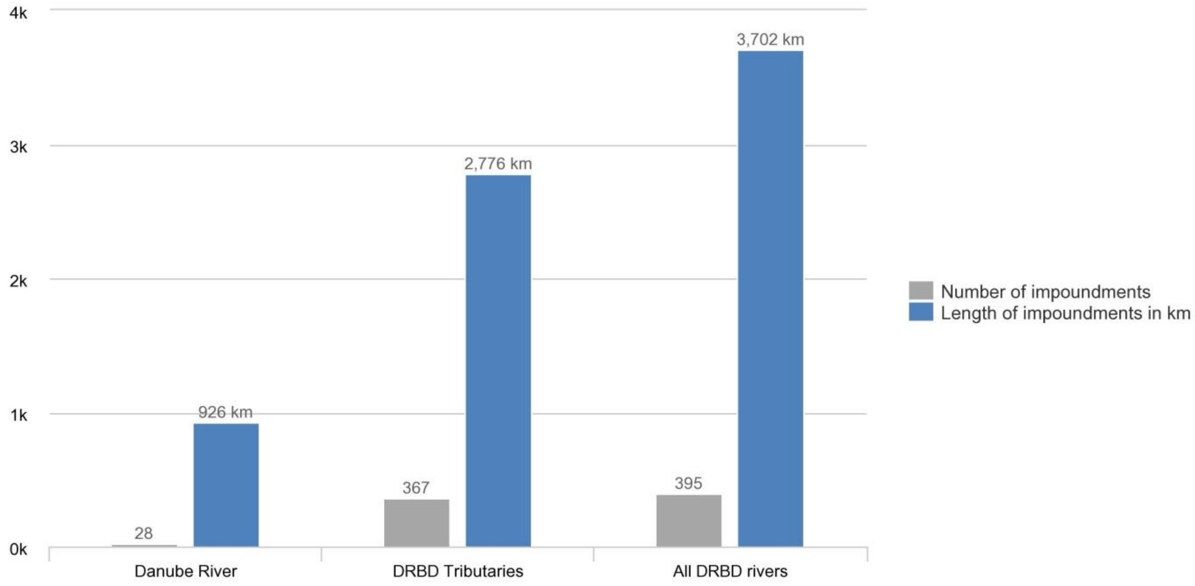
Impoundments

Impoundments are caused by barriers that - in addition to interrupting river/habitat continuity – alter the upstream flow conditions of rivers. The character of the river is changed to lake-like types due to decrease of flow velocities and eventual alteration of flow discharge. Additionally, impoundments can lead to erosion and deepening processes downstream of the impounded section, inducing a decrease of the water table and consequently, dry out of the adjacent wetlands.

The pressure analysis concludes that 395 impoundments are located in the DRBD (see Figure 24 and Map 12) affecting 222 water bodies. It can be concluded that out of 28,580 km of all rivers in the DRBD with catchment areas > 4,000 km^2, 3,702 km are affected by impoundments (13%).

[14] A pressure provoked by these uses is considered as significant when the remaining water flow below the water abstraction (e.g. below a hydropower dam) is too small to ensure the existence and development of self-sustaining aquatic populations and therefore hinders the achievement of the environmental objectives. Criteria for assessing the significance of alterations through water abstractions vary among EU countries. Respective definitions on minimum flows should be available in the national RBM Plans.

Figure 24: Number and length of impoundments in the DRBD



For the Danube River, impoundments are the key hydrological pressure type causing significant alterations. 926 km of its entire length (of 2,857 km) are impounded (representing 32% of the length) by 28 barriers. In fact, impoundments are the major hydrological pressure type for the Danube River.

The impoundment upstream of the Iron Gate 1 Dam affects the flow of the Danube River over a length of 310 km up to Novi Sad (11% of the entire length of the Danube River) and represents a significant pressure. In the middle Danube Basin, the Gabcikovo Dam impounds for more than 17 km (less than 1% of the entire length) and the AT/DE chains of hydropower plants impound a major share of the upper Danube River (approx. 269 rkm or around 9%). However, significant free-flowing stretches are located upstream of Novi Sad to the Gabcikovo Dam and downstream of the Iron Gate 2 Dam to the Black Sea.

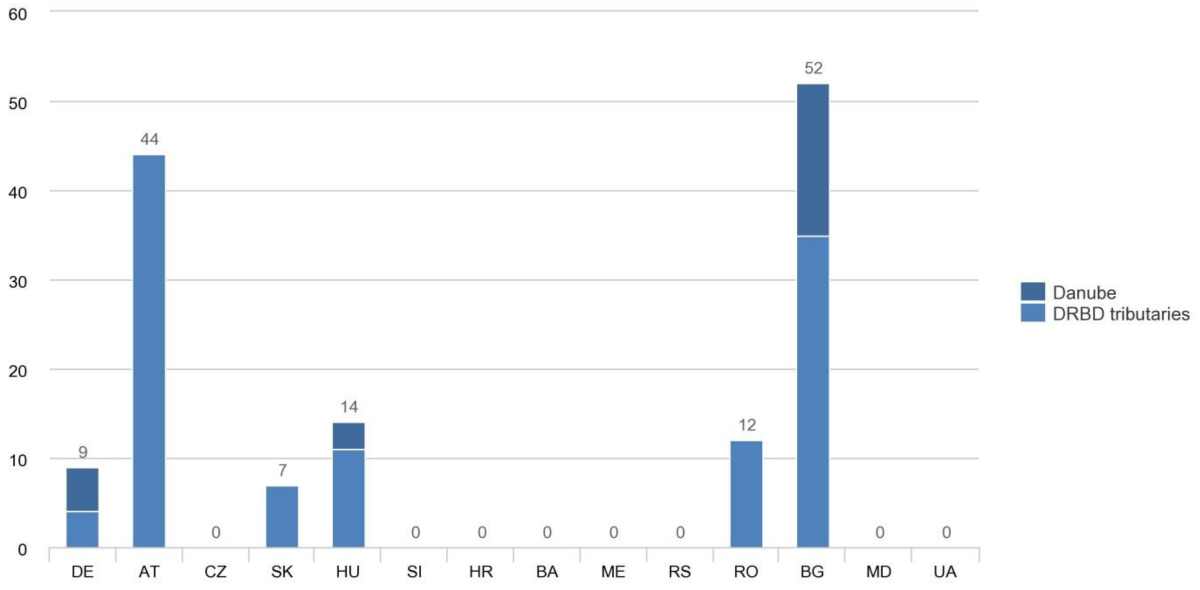
Water abstractions

Water quality and quantity are intimately related within the concept of 'good status'. Water abstractions can significantly reduce the flow and quantity of water and impact the water status in case where the minimum ecological flow of rivers is not guaranteed. Addressing this important issue, a guidance on ecological parameters/ecological flows and hydrological parameters for assessing quantitative aspects and the link to GES is under elaboration in the frame of the WFD CIS process.

In the DRBD, the key water uses causing significant alterations through water abstractions are mainly hydropower generation (57%), public water supply (3%), cooling purposes for electricity production (3%), agriculture, forestry and irrigation (14%) and others.

The pressure analysis concludes that in total 138 significant water abstractions are causing alterations in water flow in DRBD rivers (Figure 25 and Map 13). 87 water bodies are affected by these pressures. The Danube River itself is only impacted by alterations through water abstraction at Gabcikovo hydropower dam (bypass channel) and water abstractions in Germany as well as Hungary.

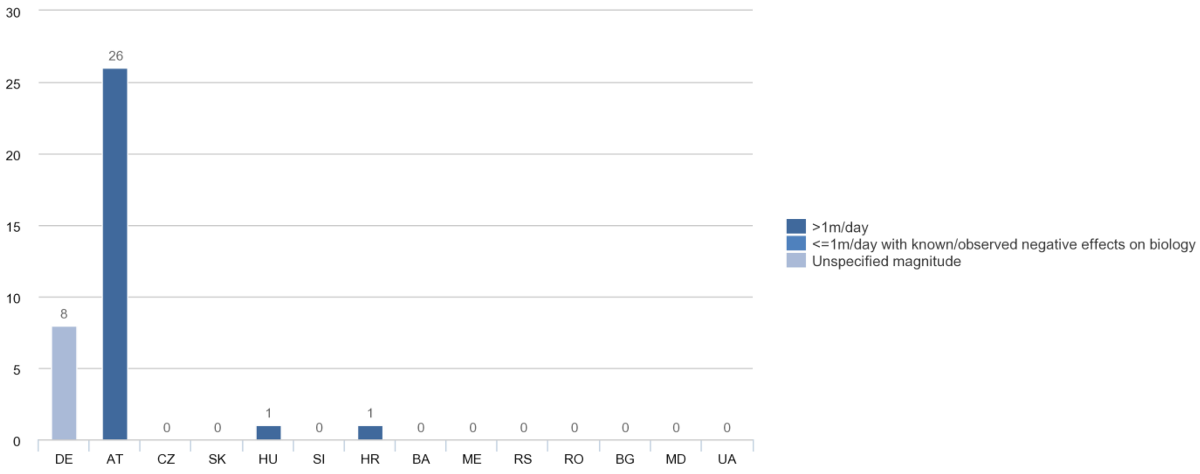
Figure 25: Number of significant water abstractions in the Danube River, DRBD tributaries and all DRBD rivers with catchment areas >4,000 km²



Hydropeaking

Hydropeaking is a pressure type that occurs in the DRBD, stemming from hydropower generation for the provision of peak electricity supply resulting in artificial water level fluctuation. Data was collected based on the ICPDR criterion (Table 10), whereas in total 36 cases of hydropeaking are causing significant water level fluctuations larger than 1 m/day below a hydropower plant or less in the case of known negative effects on biology (see Figure 26 and Map 14). Overall, 37 water bodies are affected by hydropeaking, one of them located at the Upper Danube.

Figure 26: Number of significant cases of hydropeaking in the DRBD



2.1.4.4 Future infrastructure projects

In addition to already existing hydromorphological alterations, a considerable number of future infrastructure projects (FIPs) are at different stages of planning and preparation throughout the entire DRBD. These projects, if implemented without consideration to effects on ecology, are likely to provoke impacts on water status due to hydromorphological alterations.

A list of FIPs of basin-wide importance has been compiled for the 1st DRBM Plan and was updated for this analysis for the time horizon 2021 (see Annex 5). The following criteria were applied for the data collection (Table 12):

Table 12: Criteria for the collection of future infrastructure projects for the Danube River and other DRBD rivers with catchment areas >4.000 km²

	Danube River	Other DRBD rivers with catchment areas >4.000 km²
Criteria	Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed for the project	Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed for the project
	or	**and**
	project is expected to provoke transboundary effects	project is expected to provoke transboundary effects

All FIPs (until 2021) including brief descriptions (if provided) and are compiled in Annex 5 and Map 15. The pressure analysis concludes that 35 FIPs have been reported for the DRBD. 22 of them are located in the Danube River itself. In total 20 (57%) are related to navigation; 11 (31%) to flood protection, and 4 (11%) to hydropower generation (see Map 15).

Therefore, it can be concluded that navigation and flood protection, followed by hydropower generation, are the key drivers that may provoke impacts on water bodies in the DRBD by 2021. For 4 out of all reported projects (11%), deterioration of water status is expected and therefore exemptions according to WFD Article 4.7 are required. Details are summarised in Annex 5. Information on the economic relevance of different sectors, including hydropower and inland navigation, can be obtained from the economic analysis (Chapter 7).

2.1.5 Other issues

2.1.5.1 Quality and quantity aspects of sediments

The 1st DRBM Plan outlined conclusions on the way forward regarding sediment management in the DRB and respective actions to be taken for upcoming RBM cycles.

Sediment forms a variety of habitats. Many aquatic species live in the sediment. Microbial processes cause regeneration of nutrients and important functioning of nutrient cycles for the whole water body. Sediment dynamics and gradients form favorable conditions for a large biodiversity, from the origin of the river to the coastal zone. A healthy river needs sediment as a source of life.

Sediment quantity

With regard to sediment quantity, the 1st DRBM Plan concluded that at the present the sediment balance of most large rivers within the DRB can be characterised as disturbed or severely altered. Therefore, attention should be given to ensuring the sediment continuum (improving existing barriers and avoiding additional interruptions). However, the availability of sufficient and reliable data on sediment transport is a prerequisite for any future decisions on sediment management in DRB. Hence, to propose appropriate measures for improving the situation, a sediment balance for the DRB has to be developed and additional investigations are needed to identify the significance of sediment transport on the Danube basin-wide scale. The ICPDR through the three Lead Countries Hungary, Austria and Romania is taking actions to carry out such investigation via a specific international project on sediment management. Currently, Hungary is elaborating a project proposal in cooperation with Austria, Romania and the ICPDR Secretariat which will involve the relevant sectors (i.e. hydropower, navigation) and is planned to be submitted to an appropriate call of an adequate funding program. The project will provide the missing data on the sediment transport on the basin-wide scale to produce the sediment balance and to identify the key measures to be adopted. The results of the project will be integrated in subsequent RBM cycles.

Integrated River Engineering Project on the Danube to the East of Vienna

The Austrian Danube is characterised by a chain of hydropower plants affecting the sediment regime of the Danube. One of the two free flowing sections left is between Vienna (downstream of hydropower plant Freudenau) and the Austrian-Slovakian border where the character of a mountain river is still maintained. This river section shows an ongoing erosion of the riverbed at an average rate of 2.0 to 3.5 cm per year. The decreasing water tables of the Danube and of the associated groundwater seriously affect and endanger the ecology of the floodplains in the National Park "Donau-Auen". In addition, inadequate and seasonally strongly fluctuating fairway depths in this section of the river substantially affect navigation.

The Integrated River Engineering Project on the Danube to the East of Vienna was launched to improve the hydromorphology of the river and ecology of the floodplains (in line with equivalent levels of flood protection) as well as to improve the fairway conditions in this section of the Danube. The main measures are i) the granulometric improvement of the river bed to provide long-term stabilisation of the river bed and of groundwater conditions; ii) restoring lateral connectivity and removing parts of the river bank for long-term stabilisation of the ecological conditions in the National Park "Donau-Auen"; and iii) innovative low water regulation measures which improve fairway conditions for navigation. Further information on the project is provided on the project's website: http://www.donau.bmvit.gv.at/en/

Sediment quality

The characterisation of sediment quality in the Danube was primarily based on the results of the Joint Danube Surveys (JDS1 and 2). These monitoring activities discovered that while concentrations of certain substances (organochlorinated compounds) in the solid phase were at low levels, heavy metals and polycyclic aromatic hydrocarbons were occasionally found at elevated concentrations requiring further concern.

The recent results of JDS3 showed that, in general, the contents of metals in suspended particulate matter and bottom sediments estimated during JDS3 were similar to those observed in the JDS1 and JDS2 samples. For heavy metals and arsenic in suspended particulate matter (SPM) the quality standards applied in the past for JDS were used also during JDS3 and they were not exceeded for Cd, Cr, Hg and Pb. The target value for As in SPM was not met at one site, for Cu at three sites, for Ni at 20 sites and for Zn at seven sites. In sediment the German targets for metals were with one exception met at all sites for all elements. Only copper concentration in the Timok River exceeded the quality target value of 160 mg/kg by a factor of 3.3.

For the organic compounds investigated in SPM the spatial patterns for PCDD/F and PCBs were similar in 2007 and 2013, while for BDE-209 the concentration maximum from 2007 shifted from the middle stretch more downstream. From the downstream concentration profile, there is no indication of relevant point sources. Concentrations in SPM are stable since 2007 except for BDE-209, displaying a 30% decrease in concentration. The observed concentrations of PCDD/Fs, PCBs and BDE-209 in SPM ranged between half- and more than one order of magnitude lower compared to the River Elbe. For PCDD/F and PCBs none of the existing EQS values for aquatic biota and SPM/sediments, and none of the EU food limits concerned were exceeded.

In comparison to JDS2 di(2-ethylhexyl)phthalate was found in higher concentrations in SPM and sediments showing an accumulation of this ubiquitous pollutant, but all concentrations lay far below the specific quality standard derived for the protection of benthic organisms. C10-C13-chloroalkanes were found in SPM in concentrations up to 79 µg/kg dry mass.

Most of the polycyclic aromatic hydrocarbons (PAH) were found in SPM at more than 50 % of the JDS3 sites with the maximum values between 21 – 191 µg/kg. For most of the PAH the maximum concentrations were found at Böfinger Halde. Comparison with the results of JDS2 showed comparable PAH concentrations. The maximum concentrations of PAH in sediment were between 57-489 µg/kg. For protection of the benthic community the EU Priority Substance data sheets from 2011 provide proposals for specific quality standards in sediment. Most JDS3 sites (about 90 %) show concentrations of PAH in sediment below these specific quality standards. An exceedance of these values could be observed mostly in the upper part of the Danube and the tributaries Vah and Iskar.

Dicofol and cypermethrin were analysed in SPM and sediment at all 68 JDS sampling sites, heptachlor in SPM at 47 JDS-sites and sediment at 65 JDS sampling sites. The majority of the sites show values below the limit of quantification (LOQ). Only dicofol and heptachlor in SPM show single (1-2) sites with detectable concentration, but the maximum values are in the range of the LOQ.

7 organotin compounds were analysed in SPM at 50 JDS sampling sites. Except from tetrabutyltin, all analyzed compounds were detected with concentrations above LOQ at 7 or more sites. Monobutyltin was found at more than 65 % of JDS3 sites. The highest concentration of 19µg/kg was found for triphenyltin in the Danube upstream Budapest. For dibutyltin the highest concentration of 4,1 µg/kg (Danube downstream Budapest) lay well below the national EQS of 100 µg/kg. A comparison of the SPM-concentrations with the results of JDS2 showed lower maximum values for monobutyltin, dibutyltin and tributyltin concentrations in 2013 than those measured in 2007. In JDS2 the observed maximum concentration for tributyltin in SPM was 230 µg/kg. The reduction by a factor of 20 is in line with the decline in the observed water concentrations.

7 organotin compounds were analysed in sediments (< 2 mm) at 65 JDS sampling sites. Monobutyltin, dibutyltin and triphenyltin were the most abundant compounds. The highest concentration of 28 µg/kg was found for triphenyltin in the Danube downstream Budapest. For dibutyltin the highest concentration of 19 µg/kg was found in river Vah and lay well below the national EQS of 100 µg/kg. Comparison of the organotin concentrations in sediment with the results of JDS2 showed comparable results. In 2007 the observed maximum concentration for tributyltin was 12 µg/kg, the results from 2013 showed maximum values of 13 µg/kg.

2.1.5.2 Invasive alien species

In the 1st DRBM Plan it was highlighted that the Danube River Basin is very vulnerable to invasive species given its direct linkages with other large water bodies (Southern Invasive Corridor connecting Black Sea through the Danube - Danube/Main/Rhine Canal - Rhine with the North Sea). The Danube is exposed to an intensive colonisation of invasive species and further spreading in both north-west and south-east directions throughout the basin. Results of the JDS2 showed that invasive alien species (IAS) have become a major concern for the Danube and that their further classification and analysis is essential for an effective river basin management.

To achieve a common consensus on how to assess the presence of the invasive species in the Danube and to decide whether the ecological status of the Danube is really significantly impacted by neozoa, the ICPDR is developing a "Guidance paper on Invasive Alien Species as a significant water management issue" for the Danube River Basin. The ICPDR adopted a joint position that IAS should not be considered en-bloc as having a negative impact on the ecological status unless a detailed integrative evaluation would prove this.

The ICPDR is collecting data on the distribution of non-indigenous species within the DRB with the intention to carry out the assessment of the level of invasiveness for the aquatic taxa. To ensure the comparability of results and avoid bias due to different methods used for taxonomic investigations, only the data from routine national monitoring and Danube surveys (JDS1, AquaTerra and JDS2 and JDS3) are taken into the consideration. The JDS2 data on macroinvertebrates and fish were used to assess the level of biocontamination at JDS2 sites by the BioContamination Index (SBC Index – Arbačiauskas et al. 2008) (see Maps 16 and 17). The SBC assessment is derived from data on number of non-indigenous species and their abundance in comparison to a total number of species and community abundance. The index value ranges from 0 ("no" biocontamination) to 4 ("severe" biocontamination). It should be emphasized that the assessment of biological contamination, as a reflection of the level of pressure caused by the IAS, should be observed independently from the ecological status assessment.

The assessment based on calculation of the mean value of SBC for benthic macroinvertebrates for the left and right river side showed high level of biocontamination along the Danube River. Out of 75

JDS2 sites that were assessed using the SBC Index, 52 were found to be severely contaminated (SBC=4), 11 sites were assessed as highly biocontaminated (SBC=3), seven sites were assessed as moderately biocontaminated (SBC=2), while only for 4 sites low level of biocontamination has been recorded (SBC=1). At one site (site 1, Upstream Iller) non-native species were not recorded (SBC=0). Mean values of the SBC Index ranged from 2.93 for the Lower Danube, over 3.74 for the Upper Danube to 3.86 for the Middle Danube.

In the case of fish fauna, during JDS2, at five sites alien species were not detected, while 10 sites were assessed as having low level of biocontamination (SBC=1). For 13 sites biocontamination was assessed as moderate (SBC=2), whereas 15 and 2 sites are assessed as highly (SBC=3) and severely (SBC=4) biocontaminated, respectively. Mean values of the SBC Index for fish based on JDS2 dataset ranged from 1.05 for the Lower Danube, up to 2.60 the Middle Danube and 2.73 for the Upper Danube.

The more positive situation in the Lower Danube could be explained by the fact that for the Lower Danube Ponto-Caspic species are considered as native, while for the Middle and Upper Danube, species of Ponto-Caspic distribution are non-native.

Based on the results of JDS3, the Danube River is significantly exposed to non-native species. 25 neophytes (out of 198 macrophyte taxa), 34 non-native aquatic macroinvertebrates (out of 460 benthic invertebrate taxa) and 12 non-native fish species (out of 67 fish taxa) were recorded during the JDS3.

The level of biocontamination of the Danube River was estimated as moderate to high, with higher levels for the Upper (high to severe biocontamination) and Middle Danube (moderate to high biocontamination), in comparison to the Lower Danube (low biocontamination).

Comparison with the results of previous Danube Surveys clearly showed a constant impact of invasive alien species on native biota and a considerable increase of the number of non-native aquatic macroinvertebrate species. As a specific example the allochthonous *Neogobius* fish species can be given which were found in high or even dominating abundance along the rip-rap protected banks in the upper and middle course of the Danube.

JDS3 reconfirmed that further work has to be done in the field of collecting of basic information on the distribution of invasive alien species and their influence on native biota, of developing effective tools for the assessment of the level of pressures caused by the bioinvasions, as well as of designing the appropriate mitigation measures. This work will be in line with the joint position of the ICPDR that IAS should not be considered en-bloc as having a negative impact without further analysis of pressure they impose and of their effect on the ecological status. To proceed with the assessment work a draft black list of Danube IAS will be developed by the ICPDR. The assessment will respect the provisions of the EU Regulation on the prevention and management of the introduction and spread of invasive alien species.

It is important to evaluate accurately and rationally the real pressure of each invader to native ecosystems, because of its influence on the native biota should not be considered a priori as negative.

2.2 Surface waters: lakes, transitional waters, coastal waters

In the DRBD, four lakes are identified as being of basin-wide importance: Neusiedlersee/Fertö-tó consisting of two water bodies (AT/HU), Lake Balaton (HU), Lake Yalpug (UA) also consisting of two water bodies, and Lake Razim / Razelm (RO), which was originally marine water, gradually cut off from the Black Sea and has now turned into a freshwater lake.

Table 13 summarises whether significant hydromorphological alterations and/or chemical pressures are affecting the DRBD lakes.

Table 13: Presence of significant hydromorphological alterations and chemical pressures affecting DRBD lakes

	Country	Significant hydromorphological alteration	Significant chemical pressure
Neusiedler See / Fertö-tó	AT/HU	No	No
Lake Balaton	HU	No	No
Lake Razim /Razelm	RO	No	No
Lake Yalpug	UA	Yes	No information

Transitional waters are located in Romania and Ukraine within the DRBD. Two transitional water bodies were reported by Romania – Lake Sinoe and the Black Sea waters from the Chilia mouth to Periboina. None of the two transitional water bodies located in Romania were reported to be under significant pressures. Ukraine reported 4 transitional water bodies, with one of them being under significant hydromorphological pressures.

With regard to the coastal water bodies, 4 of them are located in Romania and one in Ukraine. None was reported to be under significant pressure.

2.3 Groundwater

According to Article 2 of the EU WFD the term *groundwater* refers to all water that is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. An *aquifer* is a subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater. Finally, a *body of groundwater* means a distinct volume of groundwater within an aquifer or aquifers.

The analysis and review of groundwater bodies (GWBs) in the DRBD, as required under Article 5 and Annex II of the *WFD*, was updated in 2013 and it reconfirmed 11 transboundary GWBs or groups of GWBs of basin-wide importance (listed in Table 14 and illustrated in Map 4).

Transboundary GWBs of basin-wide importance were defined as follows:

1. Important due to the size of the groundwater body i.e. an area >4,000 km² or
2. Important due to various criteria e.g. socio-economic importance, uses, impacts, pressures interaction with aquatic eco-system. The criteria need to be agreed bilaterally.

Other GWBs, even those with an area larger than 4,000 km², that are fully situated within one country of the DRBD are dealt with at the national level.

More detailed characteristics of the 11 transboundary GWBs of basin-wide importance, as well as their status assessment, are given in Annex 6.

Table 14: Transboundary GWBs of Danube basin wide importance

GWB	Nat. part	Area [km²]	Aquifer characteristics: Aquifer Type	Aquifer characteristics: Confined	Main use	Overlying strata [m]	Criteria for importance
1	AT-1 DE-1	1,650 4,250	K	Yes	SPA, CAL	100-1000	Intensive use
2	BG-2 RO-2	12,844 11,340	F, K	Yes	DRW, AGR, IND	0-600	> 4000 km²
3	MD-3 RO-3	9,662 12,646	P	Yes	DRW, AGR, IND	0-150	> 4000 km²
4	BG-4 RO-4	3,225 2,187	K, F-P	Yes	DRW, AGR, IND	0-10	> 4000 km²
5	HU-5 RO-5	4,989 2,227	P	No Yes	DRW, IRR, IND	2-30	GW resource, DRW protection
6	HU-6 RO-6	1,035 1,459	P	No Yes	DRW, AGR, IRR	5-30	GW resource, DRW protection
7	HU-7 RO-7 RS-7	7,098 11,355 10,506	P	No Yes Yes	DRW, AGR, IND, IRR	0-125	> 4000 km², GW use, GW resource, DRW protection
8	HU-8 SK-8	1,152 2,211	P	No	DRW, IRR, AGR, IND	2-5	GW resource, DRW protection
9	HU-9 SK-9	750 1,466	P	Yes	DRW,IRR	2-10	GW resource
10	HU-10 SK-10	492 598	K K, F	No Yes	DRW, OTH	0-500	DRW protection, dependent ecosystem
11	HU-11 SK-11	3,248 563	K F, K	No Yes	DRW, SPA, CAL	0-2500	Thermal water resource

This chapter summarises the significant pressures that have been identified for the 11 transboundary GWBs of basin-wide importance. An indicative overview of these pressures is presented below, whereas detailed information on the relevant pressures for each groundwater body is given in Annex 6.

The basic principles and assessment of pollution sources for surface waters described above also provide relevant background information for groundwater due to the very close interrelation between the two water categories. Specifically, synergies between groundwater and the three SWMIs of organic, nutrient and hazardous substance pollution are of importance.

2.3.1 Groundwater quality

Diffuse sources of pollution were reported as significant pressures causing *poor* groundwater chemical status for 4 national shares which are located in 3 transboundary GWBs of basin wide importance. Eight transboundary GWBs (and in total 18 national shares) are in good chemical status and out of them 17 national shares are not subject to significant pressures on groundwater quality. For two national shares at good chemical status (MD-3 and SK-8) point and diffuse sources of pollution were reported as significant pressures and for SK-8 the significant upward trend was observed for NH_4, NO_3, Cl, As and SO_4. For one national share the status is unknown. The overall assessment of significant pressures on the chemical status identified pollution by nitrates from diffuse sources as the key factor. The major sources of the diffuse pollution are:

- agricultural activities,
- non-sewered population, and
- urban land use.

2.3.2 Groundwater quantity

The assessment of pressures on groundwater quantity of the 11 transboundary GWBs of basin-wide importance showed that over-abstraction prevented the achievement of *good* quantitative status for four national shares which are located in 3 transboundary GWBs of basin wide importance. Compared to the status assessment in 2009, four national shares which were in poor status have still the same status.

3 Protected areas in the DRBD

Protected areas are often directly linked with surface and/or groundwater bodies and their status is therefore also depending on the management practices and status of such water bodies, and vice versa. Such areas shelter valuable habitats for flora and fauna, and can provide numerous ecosystem services.

Objectives for protected areas are also determined by the WFD in Article 4, requiring to “achieve compliance with any standards and objectives at the latest 15 years after the date of entry into force of this directive unless otherwise specified in the Community legislation under which the individual protected areas have been established”.

The protected areas to be considered are listed in WFD Annex IV. Furthermore, the WFD requires to establish a “register or registers of all areas lying within each river basin district which have been designated as requiring special protection under specific Community legislation for the protection of their surface water and groundwater or for the conservation of habitats and species directly depending on water” (WFD Article 6).

At the Danube basin-wide scale, protected areas for the protection of habitats and species, nutrient sensitive areas, including areas designated as nitrates vulnerable zones, and other protected areas in Non EU MS have been compiled and are updated. Other types of protected areas according to WFD Article 6, Annex IV (e.g. areas designated for the abstraction of water intended for human consumption under Article 7 WFD, areas designated for the protection of economically significant aquatic species, or bodies of water designated as recreational waters, including areas designated as bathing waters under Directive 76/160/EEC, repealed by Directive 2006/7/EC) are not addressed at the basin-wide level but are subject to national registers.

Table 15 provides an overview on the registers of protected areas required by WFD Article 6 and Annex IV to be kept under review and up to date. The table furthermore provides information whether the register was established and is regularly reviewed at the Danube basin-wide and/or national level.

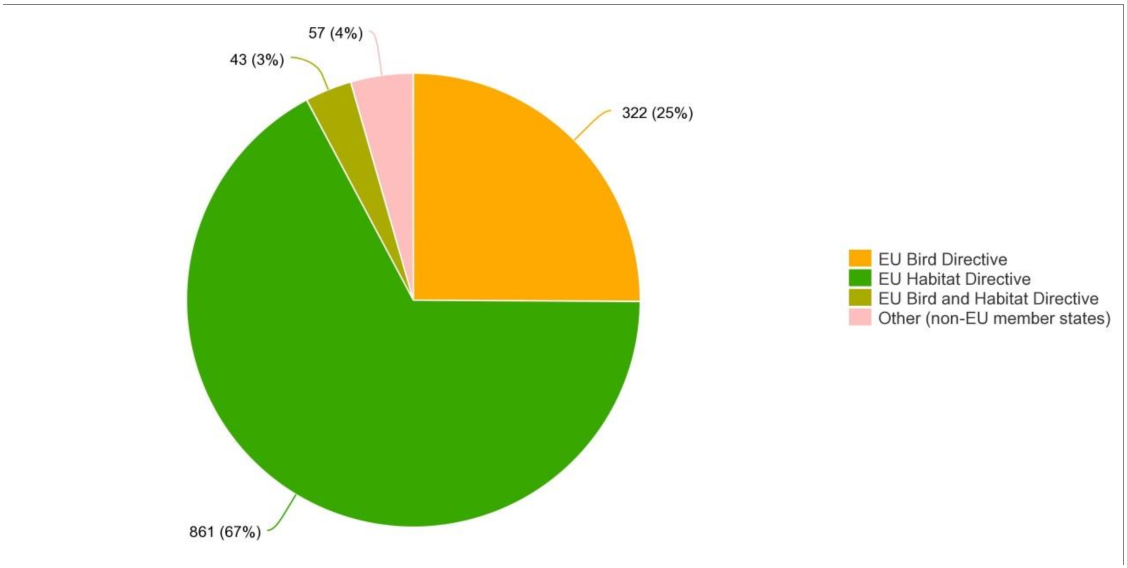
Table 15: Overview on established registers for protected areas

Type of protected area	Corresponding legislation	Register established and regularly reviewed at		Comment
		Danube basin-wide level (Part A)	National level (Part B)	
Areas designated for the abstraction of water intended for human consumption	EU Drinking Water Directive 80/778/EEC as amended by Directive 98/83/EC	-	x	-
Areas designated for the protection of economically significant aquatic species	EU Shellfish Directive 79/923/EEC and Freshwater Fish Directive 78/659/EEC	-	-	Repealed by EU WFD 2000/60/EC with effect from December 2013
Bodies of water designated as recreational waters, including areas designated as bathing waters	EU Bathing Waters Directive 76/160/EEC	-	x	Repealed by Directive 2006/7/EC
Nitrates vulnerable zones	EU Nitrates Directive 91/676/EEC	x	x	Included in 1st DRBM Plan and to be updated for 2nd DRBM Plan
Nutrient sensitive areas	EU UWWT Directive 91/271/EEC	x	x	Entire DRB is considered as a catchment area for the sensitive area under Article 5(5) of Directive 91/271/EEC
Areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection	EU Habitats Directive 92/43/EEC and EU Birds Directive 79/409/EEC	x	x	Water-relevant Natura 2000 sites
Other protected areas in Non EU Member States (e.g. Nature and Biosphere Reserves)	-	x	x	Relevant for Non EU Member States

Map 18 illustrates water-related protected areas >500 ha designated for the protection of habitats or species where maintenance or improvement of the water status is an important factor in their protection (including Natura 2000 sites)[15]. Furthermore, the map visualises protected areas in the Non EU MS. Annex 8 includes a detailed inventory of the protected areas as illustrated in Map 18.

Figure 27 provides an overview of these protected area types for the DRBD. Out of a total of 1,267 protected areas, 861 (67%) have been designated following the EU Habitats Directive and 322 (25%) are bird protected areas (EU Birds Directive). 43 (3%) areas are protected under both the Habitat as well as Birds Directive. All of them are Natura 2000 sites designated in EU MS according to the EU WFD. 57 (4%) are protected area types reported by Non EU MS and are mainly nature reserves and Biosphere Reserves. A significant share of designated Natura 2000 sites is located along the Danube River.

Figure 27: Overview on number of WFD water relevant protected areas under the EU Habitats Directive and EU Birds Directive including reported areas for Non EU MS



[15] Natura 2000 designation under the EU Directive 92/43/EEC and Directive 79/409/EEC.

4 Monitoring networks and status assessment

4.1 Surface waters

According to the EU WFD, good ecological and chemical status has to be ensured and achieved for all surface water bodies. For those identified as heavily modified or artificial, good ecological potential and chemical status has to be achieved and ensured.

Monitoring results according to the EU WFD serve the validation of the pressure analysis and an overview of the impacts on water status is required in order to initiate measures.

Ecological status / ecological potential

Ecological status results from assessment of the biological status of all WFD biological quality elements (fish, benthic invertebrates, phytoplankton, phytobenthos and macrophytes) and the supportive physico-chemical parameters (general and specific ones).

Ecological potential includes the same biological and physico-chemical components and reflects given hydromorphological changes. It is assessed for heavily modified as well as artificial water bodies and aims for alternative environmental objectives than ecological status.

Both ecological status and ecological potential for surface water bodies are assessed on the basis of specific typologies and reference conditions, which have been defined by EU MS according to WFD Annex V.

Chemical status

Chemical status has to meet the requirements of environmental objectives for surface waters outlined in EU WFD Article 4(1). To meet the good chemical status, the environmental quality standards established in line with the WFD Article 16(7) by EU Directive 2008/105/EC on environmental quality standards in the field of water policy, amended by Directive 2013/39/EU, must not be exceeded.

The overall results of the status assessment can be found in Chapter 4.1.5. These results build mainly upon the outcomes of the TNMN (4.1.1) and the JDS3 (4.1.2).

4.1.1 Surface water monitoring network under the TNMN

In line with the provisions of the DRPC, the TNMN in the DRB has been in operation since 1996 (see Map 19). The major objective of the TNMN is to provide an overview of the overall status and long-term changes of surface water and, where necessary, groundwater status in a basin-wide context (with particular attention paid to the transboundary pollution load). In view of the link between the nutrient loads of the Danube and the eutrophication of the Black Sea, the monitoring of sources and pathways of nutrients in the DRB and the effects of measures taken to reduce the nutrient loads into the Black Sea are an important component of the scheme.

The TNMN laboratories have a free choice of standardized analytical method, providing they are able to demonstrate that the method in use meets the required performance criteria. To ensure the quality of collected data, a basin-wide Analytical Quality Control (AQC) programme is regularly organized by the ICPDR.

To meet the requirements of both the WFD and the DRPC, the TNMN for surface waters consists of the following elements:

- Surveillance monitoring I: Monitoring of surface water status;
- Surveillance monitoring II: Monitoring of specific pressures;
- Operational monitoring;
- Investigative monitoring.

Surveillance monitoring II is a joint monitoring activity of all ICPDR Contracting Parties, which produces data on concentrations and loads of selected parameters in the Danube and major tributaries. Surveillance monitoring I and operational monitoring is based on collection of data on the status of surface water and groundwater bodies in the DRBD, to be published in the DRBM Plan. Investigative monitoring is primarily a national task. However, on the basin-wide level, the JDS serve the investigative monitoring as required e.g. for harmonisation of existing monitoring methodologies; filling information gaps in monitoring networks; testing new methods; or checking the impact of "new" chemical substances in different matrices. JDSs are carried out every 6 years.

4.1.2 Joint Danube Survey 3

During JDS3 altogether 68 sites were sampled along a 2,581 km stretch of the Danube, 15 of which were located in the mouths of tributaries or side arms. Sampling at the JDS3 stations included five different sample types – surface water, biological quality elements, sediment, suspended particulate matter (SPM) and biota for chemical analysis (fish and mussels) - each with a different determinant list.

The findings of JDS3 are supportive to the implementation of EU WFD as they provide an extensive homogeneous dataset production of which was mainly based on WFD compliant methods commonly used by the Danube experts. Even though these data have no ambition of replacing the national data used for the assessment of the ecological and chemical status they are an excellent reference database serving for future efforts of method harmonization in the Danube River Basin, especially concerning the development of a concerted type-specific approach to the status assessment of large rivers.

4.1.2.1 Hydromorphology

The JDS2 in 2007 delivered results on hydromorphological alterations for the Danube River (from Kelheim (rkm 2,416) to the Danube Delta) for the very first time. JDS3, which was performed in 2013, allowed for updated investigations based on an updated methodology developed for JDS3 (for details see Chapter 2.1.4 and the JDS3 report).

4.1.2.2 Biology

<u>Macrozoobenthos</u>

During JDS3 three different sampling methods were applied: Multi Habitat Sampling and Kick and Sweep for wadeable and riparian areas and Deep Water Sampling with a dredge (DWS) for deeper areas of the river. Altogether 460 macroinvertebrate taxa were identified. Insects, with 319 taxa, were the dominant component of the communities. Higher abundances of EPT- Taxa (Ephemeroptera, Plecoptera and Trichoptera) were restricted to the upper stretch, whereas Trichoptera showed the highest abundances within these sensitive groups.

Saprobic Indices and the respective water quality status class per site are comparable to the JDS2 data: 73 % of 55 sampled sites in 2013 can be classified as "indication of good ecological status", 15 % of the sites as "indication of moderate ecological status" and 4 % actually as "high ecological status" according to the WFD. Bad status based on the Saprobic Index was identified upstream Novi-Sad, poor status was indicated in Jochenstein due to river impoundment, upstream Drava, downstream Velika Morava and at Vrbica/Simjan in the Irongate reservoir.

On the basis of the Slovak assessment method for general degradation (Multimetric Index) for large rivers, the morphologically high degraded sites (channelized or impounded, with rip-rap dominating at the shore zones) in the Upper Danube reach indicate moderate status, while hydromorphologically more natural sites at the Upper and Middle Danube reach indicate generally good status. However the compatibility of this method in the Lower Danube reach has to be further tested as substrate composition differs considerably from the Middle Danube, for which the method was designed.

<u>Phytobenthos</u>

The Danube phytobenthos was mainly composed of diatoms and cyanobacteria, with the former prevailing in the Upper Danube. The algal biomass showed to increase in the Upper and Lower

Danube and was most significantly influenced by phosphates and suspended solids. Altogether 68 non-diatom taxa and 318 diatom taxa were identified during JDS3. Both species composition of diatoms and non-diatoms as well as the diatom metrics changed gradually downstream the Danube. The algal assemblages in the upper reaches were most significantly influenced by velocity, slope oxygen content, pH and nitrates. The assemblages in the middle and lower Danube reacted mainly on phosphates, potassium, DOC and suspended solids indicating the increasing pressures on aquatic environment. All diatom indices tested decreased gradually and significantly downstream the Danube reflecting the increase of general degradation of aquatic environment and natural longitudinal changes. The IPS-based indication of the ecological status assessment of the Danube showed that the ecological status of the Upper Danube (sites down to Gabčíkovo reservoir at 1,852 rkm) varied between high to good. Sites downstream Budapest (after the 1,852 rkm) appeared consistently below the good/moderate boundary. It must be however pointed out that the assessment method applied (even though having been intercalibrated) did not fully take into account the Danube typology and the results should be therefore considered only as indicative.

Macrophytes

A total of 198 macrophyte taxa were identified during JDS3 belonging to bryophytes (35 taxa), ferns (4 taxa), angiosperms (150 taxa), charophytes (1 taxon) and other macroalgae (8 taxa). The Slovak and Austrian assessment systems applicable for large rivers were used for data evaluation and indicated a decrease in ecological status from the source to the mouth of the Danube. These findings however could not be justified by the typical pressure data macrophytes are regarded to be indicative for. Neither the nutrient concentrations nor hydromorphological impairments showed a significant increase along the Danube stretch. Thus these results demonstrate clearly that the indicative value of species, especially concerning trophic conditions, changed within different regions and river-types and underline the necessity for developing and applying type-specific assessment systems.

Phytoplankton

The distribution of phytoplankton chlorophyll-a and biomass along the river corridor was different from previous JDS investigations. From the findings during JDS1 and JDS2 three river sections were defined: An upstream section with low values, a middle section where values increased to a maximum and a downstream section with generally low values. During the 2013 survey, this distinct sections were somewhat replaced by alternating sections of low and high concentrations. As previously, the highest chlorophyll and biomass concentrations occurred in the middle section of the river between km 1,481 (Baja) and 1,159 (downstream Sava). Different from earlier observations however, chlorophyll-a and biomass concentrations exceeded threshold values between Klosterneuburg (km 1,942) and upstream of Budapest (km 1660). These high values most likely were a reflection of the heat wave preceding the investigation period and low discharge associated with.

According to the TNMN quality classification most chlorophyll-a concentrations in the Danube belonged to water quality class I. The type specific WFD criteria for large rivers using the metrics total phosphorus (TP) and chlorophyll-a (chl-a) for trophy assessment were also applied and chl-a indicated high to good status (water quality class 1-2) in most of the upper and the lower reach of the Danube. Moderate status was assigned to the river section from rkm 1384, upstream Drava to rkm 1216, upstream Tisa. The 15 investigated tributaries were in high to good status except Morava in bad state and Vah in poor status.

Fish

In total 139.866 individuals representing 67 fish taxa were caught during JDS3. The electrified benthic frame trawl proved to be a great additional sampling method, detecting species not caught by littoral sampling. The Danube fish fauna is heavily influenced by non-native species which can be found in all habitats, even close to the river bottom and partly in remarkable densities. It appears that the dominance of *Neogobius* species in the Upper Danube has dramatically increased since JDS2, especially in altered littoral structures such as rip rap.

In the upper course of the Danube the fish fauna mainly reflects hydromorphological alterations and damming as most important human impacts, but also the lack of connectivity along the whole river stretch. The excessive use of hydropower in the upper Danube, which consequently leads to an impoverishment of aquatic habitats can be detected easily by the absence of sensitive species and certain age classes and is clearly indicated by the applied national WFD assessment indices FIA and FIS. The lower course of the Danube seems to be influenced by professional & recreational fishery and poaching.

The three applied national WFD assessment indices of JDS3 indicate a call for action as 50 % of the sites according to FIA, 72,1 % (EFI) and 94,7 % (FIS) respectively show a value worse than "good" and do not meet the requirements of the WFD.

Zooplankton

Zooplankton is not included among the biological quality elements determining the ecological status but the opportunity of Joint Danube Surveys is used to go beyond the legislative requirements to obtain a comprehensive view on the Danube biology. 149 zooplankton taxa have been discovered, out of which 107 Rotifera, 33 Cladocera and 9 Copepoda have been registered. There are tychoplanktonic elements among the planktonic community, coming from aquatic plant stocks, the sediment, dead arms and side arms. The composition of the dominant species was the same as in former investigations but the density of zooplankton was in general higher than in 2007 (JDS2).

4.1.2.3 Chemistry

Water temperature measured in the Danube River and in selected major tributaries followed the typical pattern for the timing of the survey (August – September), with larger variation range in tributaries than in the Danube. The longitudinal distribution of conductivity in the Danube River showed a strong decrease in the upper stretch, followed by a constant profile towards the middle and lower stretches. The dilution effect along the Danube was demonstrated by the significant correlation coefficient of conductivity with water discharge values.

pH and dissolved oxygen content demonstrated a good balance between primary production and decomposition of organic matter, with most of the oxygen saturation levels situated around the equilibrium value. Several local depletions were found in specific areas (dammed Rackeve-Soroksar side arm, the Iron Gates reservoir) and two tributaries (Tisa and Velika Morava).

Total Nitrogen presented a strong decreasing profile from upper to lower stretch of the Danube, and it was significantly negatively correlated with water discharge. The typical lower profile was noticed in the Iron Gates reservoir, due to the denitrification process from this area. Most of the tributaries presented levels similar to those in the Danube, but elevated concentrations were found in the Timok, Russenski Lom and Arges. No systematic trend in Total Phosphorous concentrations along the Danube River was found; still, a slight decreasing line appeared in the lower stretch, more pronounced in the Iron Gates reservoir area, due to the retention of the suspended material on which this nutrient form is adsorbed. The Total Nitrogen and Phosphorous levels measured in the three arms of the Danube Delta come in good agreement to previous findings which showed that the contribution of the Danube Delta in nutrients retention is negligible, because most of the Danube water passes directly to the Black Sea, almost not reaching the Delta itself. N-ammonium and N-nitrites showed levels below the limit of quantification in most of the sampling sites. Compared with JDS1 and JDS2 results, Total Nitrogen and Total Phosphorous concentrations measured in the Danube River during JDS3 were lower.

The ecological indication given by the general physico-chemical quality elements was assessed using the environmental quality standards/guiding values reported by the Danube countries. The general view is that most of the sampling sites located on the Danube River belongs to either ”high” or ”good” class, except for the dammed side arm Rackeve-Soroksar and the Iron Gates reservoir area, which fall in ”moderate” class due to the oxygen depletion. ”Moderate” class is also present in several tributaries (Morava, Tisa, Velika Morava, Jantra, Russenski Lom and Arges), caused by low oxygen saturation and dissolved nutrients forms.

Metals

In general, the concentrations of heavy metals and arsenic in water estimated during JDS3 were similar to those observed in the JDS1 and JDS2 samples. Comparison of results in water with WFD environmental quality standards showed occasional and scattered non-conformity primarily for Ni and Pb. For mercury and arsenic there were no violations of limits at all.

Organic compounds

The challenge for the JDS3 was not only to review the occurrence of the priority substances which were found relevant during previous surveys but also to focus on the new priority substances and on the emerging pollutants which are not covered by legislation but are frequently detected in European rivers. Priority substances with known concentrations well below the current EQS (e.g. DDT) from other Danube surveys were not analysed. Thanks to cooperation of a numerous European laboratories the largest search ever on the Danube for the unknown pollutants has been carried out.

It must be stressed that EQS in water for priority substances are defined by the WFD for an average value of 12 measurements within one year, while the JDS3 only provided a single sample from August/September.

Reviewing the results obtained the required limits of quantification (1/3 of the AA-EQS according to Directive 2009/90/EC) were met for most of the investigated substances.

DEHP in water was present in all samples significantly below the AA-EQS of 1.3 µg/l whereas during JDS2 in 44% of the water samples DEHP concentrations were above the AA-EQS. For the first time C10-C13-chloroalkanes could be analysed. All measured concentrations in water were below the AA-EQS of 0.4 µg/l. Concentrations of PFOS exceeded the AA-EQS of 0.00065 µg/l at 94% of the sampling sites. For PAH and tributyl-tin the AA-EQS for water was exceeded only at few sampling sites. Only low concentrations of analysed pesticides were detected due to the fact that sampling was carried out in August/September which is not the main season for pesticide application. The positive data observed for terbutryn show its predominant use as a biocide. AMPA (metabolite of the widely used herbicide glyphosate) was found in all water samples in concentrations around 0.25 µg/l in the Danube and higher in some tributaries. The biocide cybutryne was analysed in all water samples for the first time detecting only very low concentrations well below the AA-EQS. For HBCDD all biota sampling sites showed values below the EQS. Dicofol and heptachlor/heptachlorepoxide could not be found in biota samples.

Among the investigated organophosphorus compounds (OPCs) in water, the flame retardant TCPP clearly dominates, both in the Danube and in the tributaries. However, considering toxicities of OPCs, their concentrations found in the Danube were several orders of magnitude below their effect levels for aquatic biota.

Multi-component target-analysis of water using different sample preparation techniques in combination with LC-MS/MS methods performed by different laboratories provided data for some hundreds of anthropogenic trace compounds. These emerging polar organic substances were usually found in very small concentrations. The pharmaceuticals occurred mostly in concentrations below 40 ng/L. Pollutants with generally higher concentration levels were the metamizol metabolites FAA and AAA, the artificial sweeteners acesulfame, cyclamate and sucralose, metformin, enalapril, triphenylphosphinoxide, 2-benzothiazolesulfonic acid, benzotriazoles, iodinated X-ray contrast media and the stimulant caffeine. Overall, concentration levels of most of these substances slightly decreased downstream the Danube to the Black Sea.

As regards the hot-spots there was an impact detected of municipal wastewater released from major cities. However due to the relatively very small discharge of most tributaries receiving the contaminated wastewaters the Danube itself hardly showed higher concentrations after their inflow. Occurrence of elevated concentrations of rather easily biodegradable compounds like caffeine, cyclamate and saccharine in surface water could also indicate a release of significant portions of untreated wastewater into the surface waters.

In general, the concentrations for most of the emerging contaminants were lower in 2013 compared to JDS2 in 2007.

During JDS3 several new analytical techniques and strategies were applied:

- To explore the presence of non-regulated organic substances in the Danube a newly developed mobile large-volume extraction device was used to concentrate water samples of up to 1000 litres on-site during the JDS3. The extracts were then analysed for 264 water phase relevant organic compounds using liquid chromatography coupled to high resolution mass spectrometry (LC-HRMS) followed by the effect-based screening with a set of different in vitro and in vivo bioassays.

- Non-target screening was performed at a basin-wide scale based on the state-of-the-art UHPLC-QTOF-MS and LC-HR-MS techniques with the major goal to search for as many compounds as possible. Initial results from non-target screening by UHPLC-QTOF-MS revealed presence of more than 3370 different organic compounds. The follow up evaluations resulted in identification of 56 substances dominated by pesticides, pharmaceuticals and personal care products. The rest of tentatively identified suspect compounds still need to be investigated in the future.
- An alternative sampling approach to detect the trace concentrations of organic substances was tested during JDS3. The passive samplers were exposed to the Danube water for a period of up to two days to adsorb the dissolved pollutants. Despite the low or sub- $ng.l^{-1}$ concentrations of most organic pollutants present in the free dissolved phase, passive sampling enabled to clearly identify spatial gradients of a broad range of organic pollutants in the water column, including PCBs, organochlorine compounds, PAHs, alkylphenols, selected polar pesticides and pharmaceuticals. In many cases, the integrative character of passive sampling allowed measurement of compounds down to $pg.l^{-1}$ levels.

For the first time the link between contamination of surface water and groundwater was explored. A number of emerging substances were detected during JDS3 in the abstraction wells at bank filtration sites. This phenomenon can be expected for substances like amidotrizoic acid, iopamidol, acesulfame, benzotriazole or carbamazepine which are known to be quite persistent in the aquatic environment and which are mostly not completely retained by bank filtration. However, due to the relatively low concentration levels in the Danube, concentrations in the abstraction wells were mostly below 0.1 µg/L for most substances. An exception was the artificial sweetener acesulfame which occurred in concentrations up to 1.1 µg/L in the Danube and was detected in most of the abstraction wells with a maximum concentration of 0.45 µg/L. Acesulfame is used as a food additive and the observed concentrations are not considered to be harmful for humans. However, acesulfame can act as an example for a more or less persistent and very mobile substance which is consumed in large quantities.

The analysis of a large amount of organic substances during JDS3 enabled to provide suggestions for the update of the Danube river basin-wide list of specific pollutants. The prioritization methodology which was based on the approach developed by the prioritization working group of the NORMAN network produced a list of 20 substances suggested as relevant for the Danube river basin based on the results of the JDS3 target screening of 654 substances in the Danube water samples by 13 laboratories. PNEC values were available for 189 out of 277 JDS3 substances actually determined in the samples. The cut off criteria to include a compound in the list was its exceedance of the ecotoxicological threshold value (PNEC or EQS) at minimum of one JDS3 site. The list contains five WFD priority substances (three PAHs, fluorathene and PFOS) and two EU Watch List candidate compounds (17beta-estradiol, diclofenac). The 'top ten' substances are dominated by (i) the pesticides 2,4-dinitrophenol (exceeding the limit value at all sites), chloroxuron, bromacil, dimefuron, diazinon and transformation products of widely used atrazine and terbuthylazine, (ii) polyfluorinated substance PFOS,(iii) the plasticiser bisphenol A and polyaromatic hydrocarbon benzo(g,h,i)perylene.

More information about the results of JDS3 can be found in the final report of JDS3.

4.1.3 Confidence in the status assessment

Actual confidence levels achieved for all data collected for a RBM plan should enable meaningful assessments of status in time and space. According to WFD Annex V, estimates of the level of confidence and precision of results provided by monitoring programmes shall be given in the plan. For this purpose, a three-level confidence assessment system was agreed for surface water bodies (regarding both ecological and chemical status in the DRBD). General indication/guidance on confidence levels for ecological and chemical status are described in Figure 28 and Figure 29 and will be illustrated in maps.

Figure 28: 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.	

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).	

Figure 29: 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).	

4.1.4 Designation of heavily modified and artificial water bodies

Economic development and social needs have substantially physically changed rivers and other waters e.g. for flood control, navigation, hydropower generation, water supply and other purposes. Surface waters have been used as an economic resource and canals and reservoirs have been created where no water bodies previously existed.

One of the key objectives of the WFD is to ensure that water bodies meet 'good ecological status'. However, aquatic ecosystems which are part of modified water bodies may not be able to meet this standard considering the uses connected with such water bodies. This is why the WFD allows to designate some of their surface waters as heavily modified water bodies or artificial water bodies whereby specific environmental objectives are applied. They will need to meet the 'good ecological potential' criterion for these ecosystems and 'good chemical status'. However, artificial and heavily modified water bodies will still need to achieve the same low level of chemical contamination as other water bodies. A series of conditions have to be met to designate water bodies in these categories.

4.1.4.1 Approach for the designation of Heavily Modified Water Bodies

WFD Articles 4.3, 5 and Annex II allows inter alia for the identification and designation of artificial and heavily modified water bodies. A surface water body is considered as artificial when created by human activity. Heavily modified water body (HMWB) means a body of surface water which as a result of physical alterations by human activity is substantially changed in character, as designated by the Member State in accordance with the provisions of Annex II.

According to those provisions, EU MS may designate a body of surface water as artificial or heavily modified, when:

- its hydromorphological characteristics have substantially changed so that good ecological status cannot be achieved and ensured;
- the changes needed to the hydromorphological characteristics to achieve good ecological status would have a significant adverse effect on the wider environment or specific uses;
- the beneficial objectives served by the artificial or modified characteristics of the water body cannot, for reasons of technical feasibility or disproportionate costs, reasonably be achieved by other means, which are a significantly better environmental option.

The designation of a water body as heavily modified or artificial means that instead of ecological status, an alternative environmental objective, namely ecological potential, has to be achieved for those water bodies, as well as good chemical status.

The DBA 2004 first provisionally identified HMWBs, and artificial water bodies (AWBs) were presented on the basis of specific basin-wide criteria. For the DRBM Plan 2009, the Danube countries reported the nationally identified artificial and heavily modified water bodies. Updated information on the designation of AWBs and HMWBs was reported by the Danube countries for the 2013 DBA.

4.1.4.1.1 Surface waters: rivers

The 1st DRBM Plan included the final HMWB designation for EU MS. The Non EU MS performed a provisional identification based on criteria outlined in the DBA 2004, whereas all water bodies have been fully considered for the designation.

For the 1st DRBM Plan (Part A), the designation of HMWBs for rivers and transitional waters was performed for:

a. The Danube River;
b. Tributaries in the DRBD >4,000 km^2.

For the Danube River, the Danube countries agreed on a harmonised procedure for the final HMWB designation (the designation for HR, RS and UA was provisional) and on specific criteria for a step by step approach.

The HMWB designations for the tributaries are based on national methods and respective reported information. However, the preconditions for the basin-wide final HMWB designation (regarding both the Danube River and tributaries >4,000 km^2) are to follow the EC HMWB CIS[16] guidance document.

4.1.4.1.2 Surface waters: lakes, transitional waters and coastal waters

The HMWB/AWB designations for coastal and lake water bodies are based on national methods and the respective reported information is summarised below.

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

4.1.4.2.1 Surface waters: rivers

Table 16 and Figure 30 provide information on the designation of DRBD rivers into Natural Water Bodies, HMWB and AWB. Out of overall 760 river water bodies in the entire DRBD (Danube River and DRBD Tributaries) a total number of 264 are designated heavily modified (244 final and 20 provisional HMWBs). These are 35% of the water bodies. This means that 11,888 rkm out of a total 28,580 rkm are heavily modified (38% final HMWBs and 4 % provisional HMWBs) due to significant physical alterations. Further, 25 water bodies are AWBs. The results are also illustrated in Map 20.

The most significant canals, largely intended for navigation, are the Main-Danube Canal in DE, the Danube-Tisza-Danube Canal System in RS and the Danube-Black Sea Canal in RO.

Table 16: Designated HMWBs and AWBs in the DRBD (expressed in rkm, number of water bodies and percentage)

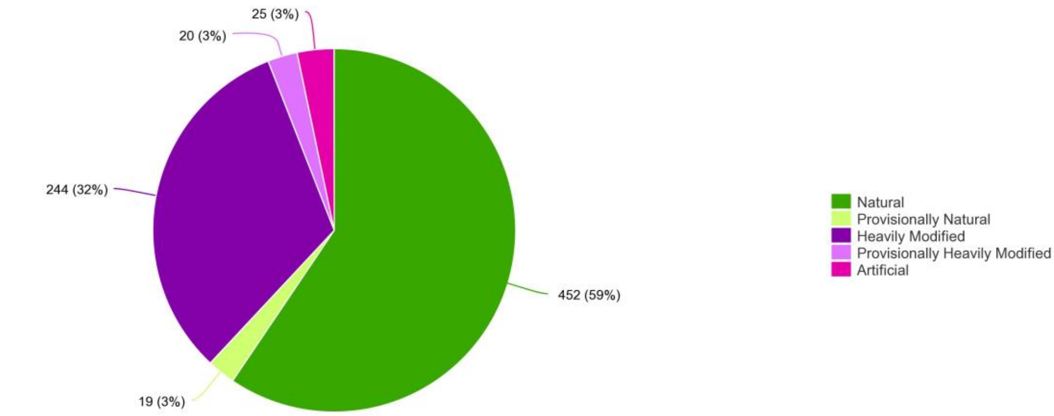
Rivers – Danube River Basin District (DRBD)		
Total number of WBs: 760	Total number of HMWBs: 264 (244 final and 20 provisional HMWB)	Proportion HMWB (number): 35%
Total WB length (km)[17]: 28,580	Total HMWB length (km): 11,888 (10,814 final and 1,074 provisional HMWB)	Proportion HMWB (length): 42%
The Danube River		
Total number of WBs: 61	Total number of HMWBs: 38 (33 final and 5 provisional HMWB)	Proportion HMWB (number): 62%
Total length (km): 2,857	Total HMWB length (km)[18]: 1,810 (1,764 final and 46 provisional HMWB)	Proportion HMWB (length): 63%

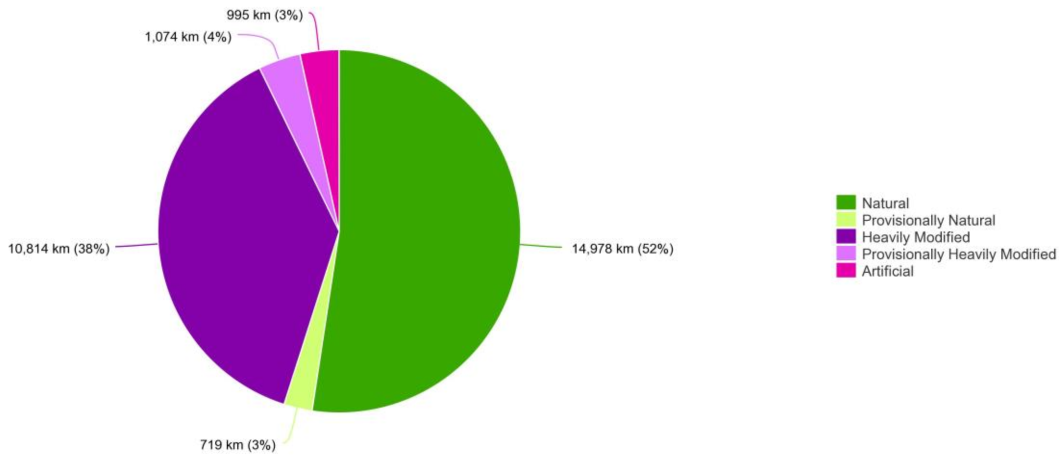
[16] EC HMWB CIS: European Commission's Common Implementation Strategy for HMWB.

[17] Including double-counting for transboundary water bodies.

[18] Double-counting of the length of transboundary water bodies was avoided for the Danube.

Figure 30: HMWBs, AWBs and natural water bodies in the DRBD, indicated in number of river water bodies and length (River km)





HMWB designation for the Danube River

Out of a total of 61 Danube River water bodies, 38 water bodies were designated as heavily modified. 5 were designated as provisionally heavily modified by the Non EU MS (see Table 16). Therefore, 1,810 rkm of the entire Danube River length (63%) have been designated as HMWB. No artificial water body has been designated for the Danube River itself. The results are illustrated in Map 20.

4.1.4.2.2 Surface waters: lakes, transitional waters and coastal waters

Out of 6 lake water bodies, 4 were not designated as heavily modified or as artificial water body. From the two lake water bodies in Ukraine, one was designated as heavily modified and one as provisionally heavily modified.

Out of the 6 transitional water bodies, one was designated as heavily modified. Out of the 5 coastal water bodies, 2 were designated as heavily modified and none was identified as artificial.

4.1.5 Ecological status/potential and chemical status

In this chapter, the results of the monitoring programmes concerning the ecological and chemical status of rivers, transitional waters and coastal waters are presented. More detailed results of the classification of all assessed surface water bodies according to particular biological, hydromorphological and chemical quality elements is provided in Annex 7.

4.1.5.1 Rivers

Figure 31 and Figure 33 illustrate the water status regarding *ecological status*, *ecological potential* and *chemical status* for the length (rkm) of river water bodies as well as the share of existing data gaps. Out of a 28,580 rkm network in the DRBD, *good ecological status* or *ecological potential* is achieved for 6,524 rkm (22%) and *good chemical status* for 16,997 rkm (59%). Details on the confidence levels are provided in Map 21, Map 22 and Annex 7.

Figure 31: Ecological status and ecological potential for river water bodies in the DRBD (indicated in length in km)

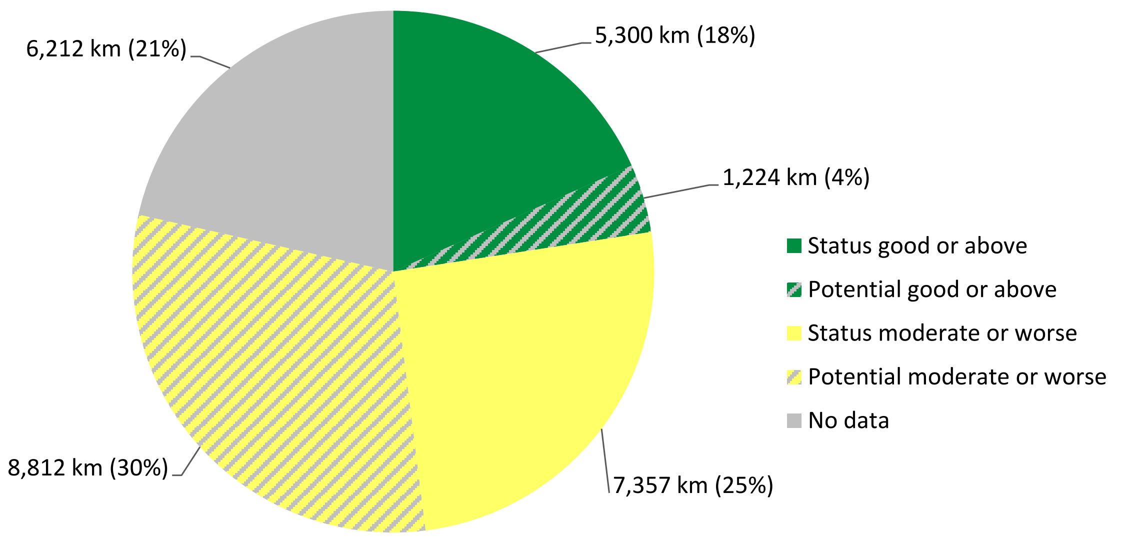
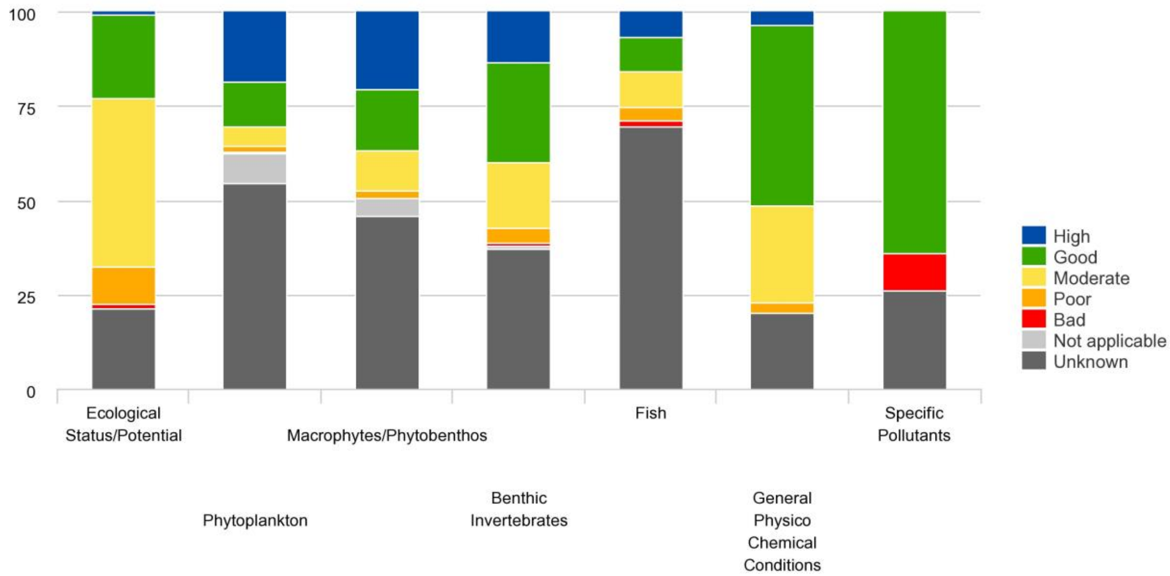
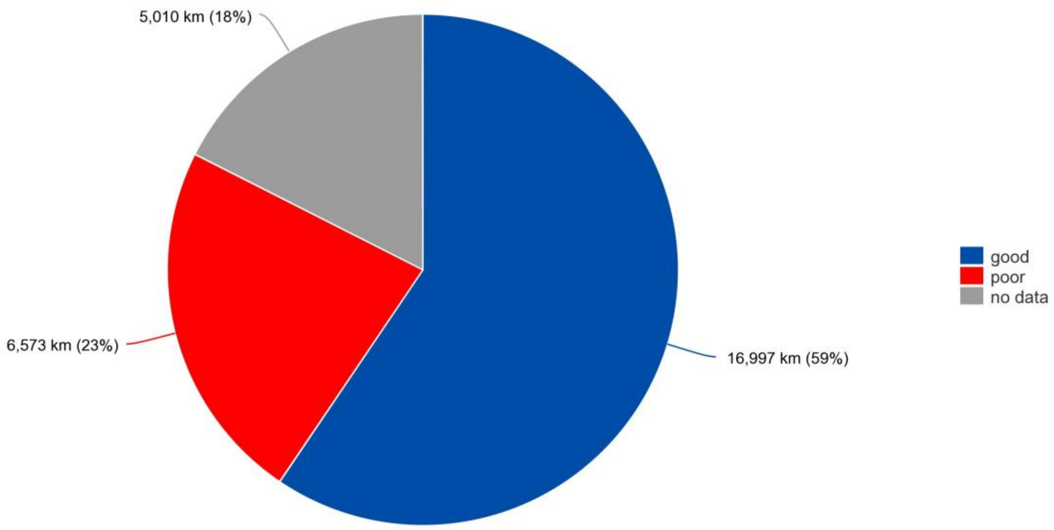


Figure 32: Ecological status: classification of biological quality elements and physico-chemical conditions (indicated as % of the total length)[19]



[19] In case of specific pollutants red colour means exceedance of environmental quality standard.

Figure 33: Chemical status for river water bodies in the DRBD (indicated in length in km)



4.1.5.2 Lakes and transitional waters

Results of assessments will be added as soon as data becomes available

Four lakes - consisting of six lake water bodies - were evaluated. Out of these, two achieved *good ecological status* and two *good chemical status*. Out of six transitional water bodies evaluated xx achieved *good ecological status* and xx achieved *good chemical status*.

4.1.5.3 Coastal waters

Altogether five coastal water bodies were evaluated, none was reported to achieve *good ecological status* but four achieved *good chemical status*.

4.1.6 Gaps and uncertainties

To be added after evaluation of status data

4.2 Groundwater

4.2.1 Groundwater monitoring network under TNMN

The transnational groundwater management activities in the DRBD were initiated in 2002 and were triggered by the implementation of the WFD. Monitoring of the 11 transboundary GWBs of basin-wide importance has been integrated into the TNMN of the ICPDR. For groundwater monitoring under the TNMN (GW TNMN) a 6-year reporting cycle has been set, which is in line with reporting requirements under the WFD. GW TNMN includes both quantitative and chemical (quality) monitoring. It shall provide the necessary information to: assess groundwater status; identify trends in pollutant concentrations; support GWB characterisation and the validation of the risk assessment; assess whether drinking water protected area objectives are achieved and support the establishment and assessment of the programmes of measures and the effective targeting of economic resources. To select the monitoring sites, a set of criteria has been applied by the countries, such as aquifer type and characteristics (porous, karst and fissured, confined and unconfined groundwater) and depth of the GWB (for deep GWBs, the flexibility in the design of the monitoring network is very limited). The flow direction was also taken into consideration by some countries, as well as the existence of associated drinking water protected areas or ecosystems (aquatic and/or terrestrial).

The qualitative monitoring determinants of GW TNMN, which are set as mandatory by the WFD, include dissolved oxygen, pH-value, electrical conductivity, nitrates and ammonium. The measurement of temperature and set of major (trace) ions is recommended as they can be helpful to validate the Article 5 risk assessment carried out in 2013 and conceptual models. Selective determinants (e.g. heavy metals and relevant basic radionuclides) would be needed for assessing natural background concentrations. It is also recommended to monitor the water level at all chemical monitoring points in order to describe (and interpret) the physical status of the site and to help in interpreting (seasonal) variations or trends in chemical composition of groundwater. In addition to the core parameters, selective determinants will need to be monitored at specific locations, or across GWBs, where the risk assessments indicate a risk of failing to achieve WFD objectives. Transboundary water bodies shall also be monitored for those parameters that are relevant for the protection of all uses supported by groundwater.

As regards quantitative monitoring, WFD requires only the measurement of groundwater levels but the ICPDR has also recommended monitoring of spring flows; flow characteristics and/or stage levels of surface water courses during drought periods; stage levels in significant groundwater dependent wetlands and lakes and water abstraction as optional parameters.

Information on the groundwater monitoring network density is provided on Map 4.

4.2.2 Status assessment approach and the aggregation confidence level

The results of the status assessment of the 11 transboundary GWBs of basin-wide importance are provided for the whole national part of a particular ICPDR GWB (so called: aggregated GWB). If a national part of an ICPDR GWB consists of several individual national-level GWBs, then *poor status* in one national-level GWB is decisive in characterising the whole national part of an ICPDR GWB as having *poor status*.

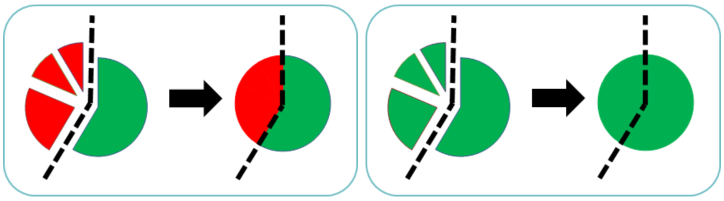
To indicate the diversity of different status results of individual GWBs within aggregated groundwater bodies a concept of the aggregation confidence levels was developed by the ICPDR. The reason of introducing these specific confidence levels for DRBMP (see Figure 34) was the need to distinguish between the cases when all individual GWBs in an aggregated GWB have the same status (high confidence) or not (medium confidence) or the assessment is based on the risk assessment data (low confidence). Information about the WFD-related confidence levels of status assessment for the individual national (non-aggregated) GWBs can be found in the national plans and in WISE. The aggregation confidence for the whole national part of an ICPDR GWB is illustrated in maps. More detailed description of the technicalities of the GW TNMN and groundwater status assessment are given in the ICPDR Groundwater Guidance[60].

[60] ICPDR document: IC 141 ICPDR Groundwater Guidance (version 2010).

Figure 34: Aggregation confidence levels for groundwater

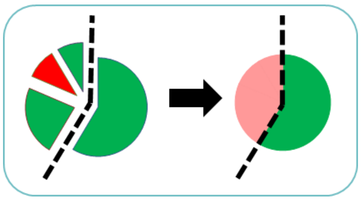
High confidence

1.) Status assessment is based on WFD compliant monitoring data.
2.) If the national part of an ICPDR GWB (the aggregated GWB) is formed by more than one GWB or groups of GWBs, **all** have the same status.



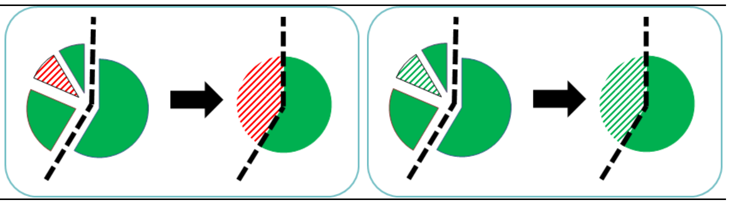
Medium confidence

1.) Status assessment is based on WFD compliant monitoring data.
2.) If the national part of an ICPDR GWB is formed by more than one GWB or groups of GWBs, **not all** have the same status.



Low confidence

- The status assessment of at least one individual GWB is based on risk assessment data.



Poor Status Good Status Poor/Good Status based on Risk Assessment

4.2.3 Status of GWBs of basin-wide importance

A summary overview of the chemical and quantitative status for the 11 transboundary GWBs is presented in Table 17. This table also provides an overview of the results of the risk assessment carried out in 2004 and 2013, of the status assessment made in 2009 for the 1st DRBM Plan and of the significant pressures in 2009 and 2015 as well as the future significant pressures expected by 2021.

Table 17: Risk and Status Information of the ICPDR GW-bodies over a period of 2009 to 2021

Nat. part	QUALITY: Status 2009	Status Pressure Types 2009	Risk 2004 →2015	Exemp-tions from 2015	Status 2015	Status Pressure Types 2015	Significant upward trend (parameter)	Trend reversal (parameter)	Risk 2013 →2021	Risk Pressure Types →2021	Exemptions from 2021 (Date of achievement)	QUANTITY: Status 2009	Status Pressure Types 2009	Risk 2004 →2015	Exemp-tions from 2015	Status 2015	Status Pressure Types 2015	Risk 2013 →2021	Risk Pressure Types →2021	Exemptions from 2021 (Date of achievement)
AT-1	Good	-	-	-	Good	-	-	-	-	-	-	Good	-	-	-	Good	-	-	-	-
DE-1																				
BG-2	Good	-	-	-	Good	-	-	-	-	-	-	Good	-	-	-	Good	-	-	-	-
RO-2							-	-												
MD-3	Good	-	Risk	-	Good	-			Risk	PS, DS, WA	-	Good	-	-	-	Good	-	-	-	-
RO-3			-						-	-										
BG-4	Good	-	-	-	Good	-	-	-	-	-	-	Good	-	-	-	Good	-	-	-	-
RO-4							-	-												
HU-5	Poor	DS	Risk	Yes	Poor	DS			Risk	DS	2027	Good	-	Risk	-	Good	-	-	-	-
RO-5							NH_4				2027			-						
HU-6	Good	-	Risk	-	Good	-			-	-	-	Good	-	-	-	Good	-	-	-	-
RO-6			-				-	-			-									
HU-7	Poor	DS	Risk	Yes	Poor	DS			Risk	DS	2027	Poor	WA	Risk	Yes	Poor	WA	Risk	WA	2027
RO-7	Good	-	-	-	Good	-	-	-	-	-	-	Good	-	-	-	Good	-	-	-	-
RS-7	Good*	-	Risk	Yes	Good*	-			-	-	-	Poor*	WA	Risk	Yes	Poor*	WA	Risk	WA	-**
HU-8	Poor	DS	Risk	Yes	Poor	DS			Risk	DS	2027	Poor	WA	Risk	Yes	Poor	WA	-	-	-
SK-8	Good		Risk	-	Good	-	NH_4, NO_3, Cl, As, SO_4	-		PS, DS	-	Good	-	-	-	Good	-			
HU-9	Good	-	Risk	-	Good	-			-	-	-	Good	-	-	-	Good	-	-	-	-
SK-9			-				-	-												
HU-10	Good	-	-	-	Good	-			-	-	-	Good	-	-	-	Good		-	-	-
SK-10							-	-												
HU-11	Good	-	Risk	-	Good	-			-	-	-	Poor	WA	Risk	Yes	Poor	WA	Risk	WA	2027
SK-11					Unknown		Unknown*	-				Good			-	Unknown				-

** The status information is of low confidence as it is based on risk assessment;*

Explanation to Table 17

GWB	ICPDR GWB code which is a unique identifier.
Nat. part	Code of national shares of ICPDR GWBs
QUALITY / QUANTITY	
Status 2009	**Good / Poor**
Status Pressure Types 2009	Indicates the significant pressures causing poor status in 2009. **AR =** artificial recharge**, DS** = diffuse sources**, PS** = point sources**, OP** = other significant pressures**, WA** = water abstractions
Risk 2004→2015	**Risk** / - (which means 'no risk')
Exemptions from 2015	Indicates whether there are exemptions for the GWB from achieving good status by 2015 at the latest.
Status 2015	**Good / Poor**
Status Pressure Types 2015	Indicates the significant pressures causing poor status in 2015. **AR =** artificial recharge**, DS** = diffuse sources**, PS** = point sources**, OP** = other significant pressures**, WA** = water abstractions
Significant upward trend (parameter)	Indicates for which parameter a significant sustained upward trend has been identified.
Trend reversal (parameter)	Indicates for which parameter a trend reversal could have been achieved.
Risk 2013→2021	**Risk** / - (which means 'no risk')
Risk Pressure Types →2021	Indicates the significant pressures causing risk of failing to achieve good status in 2021. **AR =** artificial recharge**, DS** = diffuse sources**, PS** = point sources**, OP** = other significant pressures**, WA** = water abstractions
Exemptions from 2021	Indicates the year by when good status is expected to be achieved.

4.2.3.1 Groundwater quality

Processing the data from the TNMN groundwater monitoring programmes, the results on chemical *status* of the transboundary GWBs of basin-wide importance were collected and are shown on the map 24. The characterisation of the GWBs, a description of the methodologies how chemical status was assessed, information on threshold values including their relationship to natural background values and environmental quality objectives, and finally a description of the methodologies for trend and trend reversal assessment is provided in the Annex 6.

Out of 11 transboundary GWBs of basin-wide importance (23 national parts evaluated), *good chemical status* was observed in all national parts of seven transboundary GWBs. In two transboundary GWBs, *poor chemical status* was observed in one national part. In only one GWB all national parts are in *poor status*. In one GWB one national share had good chemical status and one share had an unknown status.

Altogether, *poor chemical status* was identified in four out of 23 of the evaluated national parts of the 11 transboundary GWBs. These national shares were already in a poor status in 2009 and they are expected to achieve good chemical status in 2027 due to exemptions applied for.

Nitrates are the cause of the *poor* classification in every case. In addition to that the failed achievement of WFD Article 4 objectives for associated surface waters was the reason for the *poor* classification of one GWB (HU-7).

The overview of reasons for failing good groundwater chemical status is displayed in Table 18

Table 18: Reasons for failing good groundwater CHEMICAL status in 2015 for the ICPDR GW-bodies

GWB	Name	National part	Year of status assessment	Chemical Status	Which parameters cause poor status	Failed general assessment of GWB as a whole	Saline or other intrusions	Failed achievement of WFD Article 4 objectives for associated surface waters	Significant damage to GW dependent terrestrial ecosystem	WFD Art 7 drinking water protected area affected	Increasing trend exceeding starting points of trend reversal
				good / poor	*parameter*	*Yes / No / Unknown (parameter)*	*Yes / No / Unknown (parameter)*	*Yes / No / Unknown (parameter)*	*Yes / No / Unknown (parameter)*	*Yes / No / Unknown (parameter)*	*Yes / No / Unknown (parameter)*
GWB-1	Deep GWB – Thermal Water	AT-1	2014	Good	-	-	-	-	-	-	-
		DE-1	2014	Good	-	-	-	-	-	-	-
GWB-2	Upper Jurassic – Lower Cretaceous GWB	BG-2	2014	Good	-	-	-	-	-	-	-
		RO-2	2014	Good	-	-	-	-	-	-	-
GWB-3	Middle Sarmatian - Pontian GWB	MD-3	2014	Good	-	-	-	-	-	-	-
		RO-3	2014	Good	-	-	-	-	-	-	-
GWB-4	Sarmatian GWB	BG-4	2014	Good	-	-	-	-	-	-	-
		RO-4	2014	Good	-	-	-	-	-	-	-
GWB-5	Mures / Maros	HU-5	2014	Poor	nitrates	Yes	-	-	-	-	-
		RO-5	2014	Poor	nitrates	Yes	-	-	-	-	-
GWB-6	Somes / Szamos	HU-6	2014	Good	-	-	-	-	-	-	-
		RO-6	2014	Good	-	-	-	-	-	-	-
GWB-7	Upper Pannonian – Lower Pleistocene / Vojvodina / Duna-Tisza köze deli r.	HU-7	2014	Poor	nitrates	Yes	-	Yes	-	-	-
		RO-7	2014	Good	-	-	-	-	-	-	-
		RS-7	2013	Good*	-	-	-	-	-	-	-
GWB-8	Podunajska Basin, Zitny Ostrov / Szigetköz, Hanság-Rábca	HU-8	2014	Poor	nitrates	Yes	-	-	-	-	-
		SK-8	2014	Good		-	-	Unknown	Unknown	-	(NH4,NO3 – agri) (Cl, As, SO4, TOC – industry)
GWB-9	Bodrog	HU-9	2014	Good	-	-	-	-	-	-	-
		SK-9	2014	Good	-	-	-	Unknown	Unknown	-	-
GWB-10	Slovensky kras / Aggtelek-hgs.	HU-10	2014	Good	-	-	-	-	-	-	-
		SK-10	2014	Good	-	-	-	Unknown	Unknown	-	-
GWB-11	Komarnanska Vysoka Kryha / Dunántúli-khgs. északi r.	HU-11	2014	Good	-	-	-	-	-	-	-
		SK-11	2014	Unknown	-	-	-	-	-	-	Unknown

4.2.3.2 Groundwater quantity

The results for the quantitative status of the transboundary GWBs of basin-wide importance are presented on map 23.

Out of 11 transboundary GWBs (23 national parts evaluated), *good quantitative status* was observed in all national parts of 8 transboundary GWBs. In two transboundary GWBs, *good quantitative status* was observed in only one national part. *Poor* groundwater chemical status was observed in four national shares which are located in three transboundary GWBs of basin wide importance. In one national part the status was unknown. Compared to the status assessment in 2009, four national shares which were in poor status have still the same status and three of them are also at risk of failing good chemical status by 2021. For two of these GWBs the date of achievement of *good quantitative status* is prolonged until 2027 based on the application for exemption.

The *poor quantitative status* is caused in three cases by the exceeding of available groundwater resources; in three cases by significant damage to groundwater dependent terrestrial ecosystems and in one case by the failed achievement of WFD Article 4 objectives for associated surface waters. Herewith it should be stated that *poor status* can be caused by more than one reason.

The overview of reasons for failing good groundwater chemical status is displayed in Table 19.

Table 19: Reasons of failing good groundwater QUANTITATIVE status in 2015 for the ICPDR GW-bodies

GWB	Name	National part	Year of status assessment	Quantitative status	Exceedance of available GW resource	Failed achievement of WFD Article 4 objectives for associated surface waters	Significant damage to GW dependent terrestrial ecosystem	Uses affected (drinking water use, irrigation etc.)	Intrusions detected or likely to happen due to alterations of flow directions resulting from level changes
				good / poor	*Yes / No / Unknown*	*Yes / No / Unknown*	*Yes / No / Unknown*	*Yes / No / Unknown If yes, which?*	*Yes / No / Unknown*
GWB-1	Deep GWB – Thermal Water	AT-1	2014	Good	-	-	-	-	-
		DE-1	2014	Good	-	-	-	-	-
GWB-2	Upper Jurassic – Lower Cretaceous GWB	BG-2	2014	Good	-	-	-	-	-
		RO-2	2014	Good	-	-	-	-	-
GWB-3	Middle Sarmatian - Pontian GWB	MD-3	2014	Good	-	-	-	-	-
		RO-3	2014	Good	-	-	-	-	-
GWB-4	Sarmatian GWB	BG-4	2014	Good	-	-	-	-	-
		RO-4	2014	Good	-	-	-	-	-
GWB-5	Mures / Maros	HU-5	2014	Good	-	-	-	-	-
		RO-5	2014	Good	-	-	-	-	-
GWB-6	Somes / Szamos	HU-6	2014	Good	-	-	-	-	-
		RO-6	2014	Good	-	-	-	-	-
GWB-7	Upper Pannonian – Lower Pleistocene / Vojvodina / Duna-Tisza köze deli r.	HU-7	2014	Poor	Yes	-	Yes	-	-
		RO-7	2014	Good	-	-	-	-	-
		RS-7	2013	Poor*	Yes	Unknown	Unknown	Unknown	Unknown
GWB-8	Podunajska Basin, Zitny Ostrov / Szigetköz, Hanság-Rábca	HU-8	2014	Poor	-	-	Yes	-	-
		SK-8	2014	Good	-	-	-	-	-
GWB-9	Bodrog	HU-9	2014	Good	-	-	-		-
		SK-9	2014	Good	-	-	-	-	-
GWB-10	Slovensky kras / Aggtelek-hgs.	HU-10	2014	Good	-	-	-		-
		SK-10	2014	Good	-	-	-	-	-
GWB-11	Komarnanska Vysoka Kryha / Dunántúli-khgs. északi r.	HU-11	2014	Poor	Yes	Yes	Yes		-
		SK-11	2014	Unknown	-	-	-	-	-

4.2.3.3 Gaps and uncertainties

The Danube countries used a broad spectrum of different methodologies for the delineation and characterisation of GWBs; the assessment of the chemical and quantitative *status*; the establishment of threshold values, trend and trend reversal assessment. Despite there being overall coordination facilitated by the ICPDR Groundwater Task Group, further harmonisation of the national methodologies is still needed. Data gaps and inconsistencies are still available in the collected data, resulting in uncertainties in the of data interpretation.

To achieve a harmonisation of data sets for transboundary GWBs, there is a need for intensive bi- and multilateral cooperation. In addition, the interaction of groundwater with surface water or directly dependent ecosystems need further attention for which technical guidance is currently elaborated at European level.

5 Environmental objectives and exemptions

5.1 Management objectives for the DRBD and WFD environmental objectives

The WFD requires achievement of the following environmental objectives:

a. good ecological/chemical status of surface water bodies;
b. good ecological potential and chemical status of HMWBs and AWBs;
c. good chemical/quantitative status of groundwater bodies.

The DRBM Plan – Update 2015 provides an updated overview of the status assessment results of both surface water bodies and groundwater bodies for the entire DRBD and risk assessment classifications for the Non EU MS (see Chapter 4). However, regarding the basin-wide scale, the DRBM Plan (Part A) may differ from the national RBM Plans (Part B), the respective objectives and respective complexity related to each SWMI and groundwater. 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 SWMIs and groundwater. They guide the Danube 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 DRBD with a long-term perspective.

The respective management objectives describe the steps towards the 2021 environmental objectives in an explicit way - they are less detailed than at the national level and more detailed than expressed in the DRPC and Danube Declaration. The DRBD basin-wide management objectives:

a. describe the measures that need to be taken to reduce/eliminate existing significant pressures for each SWMI and groundwater on the basin-wide scale and
b. help to bridge the gap between measures on the national level and their agreed coordination on the 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 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 SWMI and groundwater in Chapter 8 (The Joint Programme of Measures), which includes the relevant conclusions regarding the level of achievement of the management objectives.

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

The application of WFD Article 4(4) indicates that respective measures will not be implemented by 2021, but rather by 2027, whereas less stringent environmental objectives will be aimed for in water bodies subject to WFD Article 4(5). Future Infrastructure Projects (FIP) may need an exemption according to WFD Article 4(7) in the case that they would provoke deterioration in water status – the application of these exemptions is also summarised. Details on the application of the three Articles on exemptions are part of the national Part B reports.

For the 760 river water bodies of the DRBD, it can be summarised that Article 4(4) is applied for 164 water bodies (22%) and Article 4(5) for 37 water bodies (5%). Article 4(7) is implemented in 3 water bodies. No exemptions according to WFD Article 4(4) and 4(5) were reported for lakes and coastal water bodies. Further details on exemptions according to WFD Articles 4(4) and 4(5) for all three components of hydromorphological alterations (river and habitat continuity interruption, reconnection of wetlands/floodplains and hydrological alterations) are part of Chapter 8.1.4. Which specific measures will be undertaken by 2021, which after 2021, or not at all due to exemptions according to Articles 4(4) and 4(5) is illustrated in Map 25. Information on FIPs, which may be subject to apply

WFD Article 4(7) during the planning process is provided in Chapter 8.1.4.4, Annex 5 as well as in Map 15[20]. More information on approaches for exemptions can also be obtained from Chapter 7.5.

For the 11 important transboundary groundwater bodies of the DRBD, Article 4(4) is applied for quality for four national parts of GWBs and for quantity for two national parts of GWBs. Details are illustrated in Map 26.

[20] It can be the case for some countries that the number of exemptions reflect the exemptions for hydromorphological alterations.

6 Integration issues

6.1 Interlinkage between river basin management and flood risk management

Aware of the basin-wide relevance of flood issues, the ICPDR decided to develop its flood protection policy, which was formalised by adoption of the ICPDR Action Programme on Sustainable Flood Protection in the DRB in 2004. The Action Programme has been designed in line with the principles of the EU Flood Risk Management Directive 2007/60/EC (FRMD)[21], which aims to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The FRMD is based on the river basin approach and a six year cycle of planning likewise this is the case for the WFD.

The FRMD is to be implemented in three phases. During the first phase, a Preliminary Flood Risk Assessment (PFRA)[22] has been carried out for the DRB by December 2011 in order to identify areas of existing or foreseeable future potentially significant flood risk. During the second phase, flood hazard maps and flood risk maps are prepared by December 2013. These should identify areas prone to flooding during events with a high, medium and low probability of occurrence, including those where occurrences of floods would be considered an extreme event. The third phase requires to produce catchment-based Flood Risk Management Plans (FRMPs) by December 2015, focusing on prevention, protection and preparedness, as well as setting objectives for managing the flood risk and setting out a prioritised set of measures for achieving those objectives.

The integration between the WFD and the FRMD offers the opportunity to optimize the mutual synergies and minimise conflicts between them. This is articulated in Article 9 of the FRMD, requiring that "*Member States shall take appropriate steps to coordinate the application of this Directive and that of Directive 2000/60/EC (WFD) focusing on opportunities for improving efficiency, information exchange and for achieving common synergies and benefits having regard to the environmental objectives laid down in Article 4 of Directive 2000/60/EC*".

In practical terms, there are a number of reasons why coordination is beneficial. These include:

- The interaction of legal and planning instruments in many countries;
- Planning and management under both Directives generally use the same geographical unit (i.e. the DRBD);
- Aiding the efficiency of the implementation of measures and increasing the efficient use of resources.

In order to address the different coordination requirements, the ICPDR developed in 2011 a first list of issues for a coordinated implementation of the WFD and FRMD in the DRBD, facilitating the exchange between experts on relevant issues. Following, the EU Water Directors adopted in December 2013 a Resource Document[23] on the links between both Directives.

Opportunities towards gaining synergies and key issues requiring coordination are clearly seen for the programmes of measures of the DRBM Plan – Update 2015 and the 1st DFRM Plan 2015. River and floodplain restoration and the creation of new retention and detention capacities, especially those based on the natural water retention, are likely to provide the most significant direct contribution to both FRMD and WFD objectives. More information about natural water retention measures can be found in the 1st Danube Flood Risk Management Plan. The other measures, addressing potential negative impacts of technical flood protection measures on water status, regulation of spatial and land use planning, prevention of accidental pollution during floods etc., have to be considered as well.

[21] Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

[22] http://www.icpdr.org/main/activities-projects/implementation-eu-floods-directive

[23] EU Resource Document - Links between the Floods Directive (FD 2007/60/EC) and Water Framework Directive (WFD 2000/60/EC)

Therefore, the relevant measures foreseen in the JPM of the DRBM Plan are taken into consideration as well for the elaboration of the DFRM Plan. The achievement of synergies in practice needs to be ensured mainly at the national level as the implementation of measures is a national task.

In order to ensure a coordinated application of both directives as well with regard to public consultation, a coordinated public consultation and communication plan[24] for both, the WFD and FRMD has been put in place by the ICPDR to assist with the development of the DRBM Plan – Update 2015 and the 1st DFRM Plan for the DRBD. The document serves as a blue-print for participation, outlining integrated consultation measures to be carried out, including inter alia a joint Stakeholder Conference.

6.2 Interlinkage between river basin management and the marine environment

The aim of the European Union's Marine Strategy Framework Directive 2008/56/EC (MSFD)[25], adopted in June 2008, is to protect more effectively the marine environment across Europe. It aims to achieve good environmental status (GES) of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend.

The key milestones of the MSFD, reviewed and updated every 6 years, include inter alia the following:

a. By 15 July 2012: Initial assessment of the current environmental status of national marine waters and the environmental impact and socio-economic analysis of human activities in these waters; Determination of what GES means for national marine waters; Establishment of environmental targets and associated indicators to achieve GES by 2020.
b. By 15 July 2014: Establishment of a monitoring programme for the ongoing assessment and the regular update of targets.
c. By 2015: Development of a programme of measures designed to achieve or maintain GES by 2020.

The MSFD outlines in Art. 6 regional cooperation requirements, extending the need for coordination and cooperation, where appropriate, to all Member States in the catchment area of a marine region or subregion, including land-locked countries.

Since the Danube is linked with marine waters by discharging into the Black Sea, the ICPDR adopted in 2012 a resolution declaring "the willingness of the ICPDR to serve as platform facilitating the coordination with land-locked countries required under Article 6 (2) MSFD and to contribute hereby to a close coordination of the implementation of the WFD in the Danube River Basin and the MSFD in the Black Sea Region".

The ICPDR and the International Commission for the Protection of the Black Sea (ICPBS) signed a Memorandum of Understanding (MoU) on common strategic goals as early as 2001. A Joint Technical Working Group of the two commissions is in place since 1997. Its work is focused on better understanding the impact of the Danube discharge (including sediments, pollution, etc.) on the ecosystem of the Black Sea. ICPDR will continue its efforts in supporting this work.

Romania and Bulgaria, the EU MS of the Danube basin sharing the Black Sea waters, are currently working on the implementation of the MSFD, i.a. by elaborating different criteria, targets and indicators of descriptors defining GES, which include e.g. biodiversity, non–ingenious species, fisheries, eutrophication or the concentration of contaminants. Both countries take all efforts to promote the MSFD in the ICPBS and to coordinate with the land-locked countries via the ICPDR.

[24] http://www.icpdr.org/main/sites/default/files/nodes/documents/ic_wd_517_-_pp_drbmp_2015-public.pdf

[25] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

There are various issues requiring coordination between the WFD and the MSFD. The management of nutrients and hazardous substances foreseen in the DRBM Plan is of particular importance for the Black Sea. Other issues include e.g. the migration of anadromous migratory fish species like sturgeons from the Black Sea to the Danube.

6.3 Interlinkage between river basin management and nature protection

With its integrated approach and aim to achieve inter alia a healthy aquatic ecosystem and 'good status' for all waters, the WFD is closely related to nature protection legislation and policies. This is in particular the case for the EU Habitats Directive 92/43/EEC and EU Birds Directive 79/409/EEC, but also the EU Green Infrastructure Strategy[26] and the EU 2020 Biodiversity Strategy[27], beside national nature protection legislation. By acknowledging these connections, synergies can be developed that help saving resources and reaching multiple goals since a significant number of protected areas is located along the Danube and its tributaries (see Map 18).

As far as water bodies in water-dependent protected areas are concerned, measures under the WFD and the Birds and Habitats Directives need to be coordinated between the responsible authorities for nature conservation and water management, and included in the WFD Programme of Measures. To start dialogue at the national level on the WFD programmes of measures at an early stage can help to avoid conflicts that could arise from different objectives of WFD and the EU Birds and Habitats Directives, or to miss opportunities to achieve joint benefits .

Infrastructure projects which are fully or partly located in protected freshwater habitats and which are likely to have a significant effect must be carefully planned and assessed in order to avoid conflicts. Article 6.3 of the EU Habitats Directive provides for an appropriate assessment of the impacts of such plans or projects. Only if no reasonable scientific doubt remains as to the absence of adverse effects on the integrity of the site, the competent authorities can give their consent. In case of doubt, the precautionary and preventive principles need to be applied and the plan or project cannot go ahead, unless EU Habitats Directive Art. 6.4 requirements are met[28], which are in principle similar in character to Art 4.7 of the WFD. Therefore, the best way of avoiding impacts on protected areas and thus conflicts is integrated planning with stakeholder involvement from the start. Some navigation projects have already shown the benefits of such an approach.

In May 2013, the European Commission adopted the Green Infrastructure Strategy. Green Infrastructure is a strategically planned network of natural and semi-natural areas managed to deliver a wide range of ecosystem services. A typical example are floodplains that should be managed to provide multiple services such as retaining floods, nurturing young fish, or providing biomass. Target 2 of the EU Biodiversity Strategy foresees the deployment of such Green Infrastructure as well as restoration. Floodplain restoration but also restoring river continuity are therefore measures that contribute to Strategy implementation.

Hence, good integration of WFD and these nature protection policies and directives do not only increase efficiency, but can also diversify the range of funding sources for measures, both from public funding programmes or through innovative finance schemes.

[26] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Green Infrastructure (GI) — Enhancing Europe's Natural Capital - SWD(2013) 155 final

[27] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Our life insurance, our natural capital: an EU biodiversity strategy to 2020 - SEC(2011) 540 final / SEC(2011) 541 final

[28] Links between the Water Framework Directive (WFD 2000/60/EC) and Nature Directives (Birds Directive 2009/147/EC and Habitats Directive 92/43/EEC) - Frequently Asked Questions

6.4 Inland navigation and the environment

Inland navigation can contribute to making transport more environmentally sustainable, particularly where it can act as a substitute for road transport. It can, however, also have significant influence on river ecosystems, jeopardizing the goals of the WFD.

Recognising this potential conflict, the ICPDR initiated in cooperation with the Danube Commission (on Navigation) and the International Commission for the Protection of the Sava River Basin a cross-sectoral discussion process involving all relevant stakeholders and NGOs. This led to the "Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin"[29], which was concluded in October 2007 and subsequently agreed by the Commissions involved.

The Joint Statement summarises principles and criteria for environmentally sustainable inland navigation on the Danube and its tributaries, including the maintenance of existing waterways and the development of future waterway infrastructure. These include inter alia the following:

- Establishment of interdisciplinary planning teams, involving key stakeholders, experts from different organisations (governmental and non-governmental) and independent (international) experts to ensure a transparent planning process
- Defining joint planning objectives and goals of IWT as well as river/floodplain ecology
- Ensure flexible funding conditions, enabling integrated planning (including the involvement of all stakeholder groups) and adaptive implementation as well as monitoring
- Monitor the effects of measures and – if relevant – adapt them

In the frame of yearly meetings, exchange on the experiences with the application of the Joint Statement is shared amongst administrations, stakeholders and environmental groups.

Furthermore, a "Manual on Good Practices in Sustainable Waterway Planning"[30] was developed in the frame of the EU PLATINA project, which started in 2008 and concluded in early 2012. The manual further outlines practical steps for integrated planning approaches towards sustainable solutions taking into account both, the needs of inland navigation and the environment.

A number of concrete navigation projects are in development or under implementation. Progress has been made in setting up integrated planning approaches throughout the basin and for the practical implementation of the Joint Statement principles.

Table to be added, including brief information on steps taken in the frame of different navigation projects to practically apply the Joint Statement principles

6.5 Sustainable hydropower

The increased production and use of energy from renewable sources, together with energy savings and increased energy efficiency, constitute important steps towards meeting the need of reduced greenhouse gas emissions to comply with international climate protection agreements. The development of further renewable energy in line with the implementation of the EU Renewable Energy Directive 2009/28/EC[31] represents a significant driver for the development of hydropower generation in the countries of the DRB. At the same time, Danube countries are committed to the implementation of water, climate, nature and other environmental legislation.

Aware of the fact that hydropower plants offer an additional reduction potential for greenhouse gases but recognizing as well their negative impacts on the riverine ecology, the Ministers of the Danube

[29] http://www.icpdr.org/main/activities-projects/joint-statement-navigation-environment

[30] http://www.icpdr.org/main/sites/default/files/Platina_IWT%20Planning%20Manual.FINAL.Aug10.c.pdf

[31] DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

countries asked in 2010 for the development of Guiding Principles on integrating environmental aspects in the use of hydropower in order to ensure a balanced and integrated development, dealing with the potential conflict of interest from the beginning.

In the frame of a broad participative process launched in 2011, with the involvement of representatives from administrations (energy and environment), the hydropower sector, NGOs and the scientific community, first an “Assessment Report on Hydropower Generation in the Danube Basin” has been elaborated. The report provides information on a variety of issues, including information on the current situation regarding existing hydropower plants in the DRB, which are illustrated in Map 27 according to their generation capacity. Following, the “Guiding Principles on Sustainable Hydropower Development in the Danube Basin”[32] have been elaborated. Besides outlining background information on the relevant legal framework and statistical data, the Guiding Principles are addressing the following key elements for the sustainability of hydropower:

1) General principles and considerations (the principle of sustainability, holistic approach in the field of energy policies, weighing of public interests, etc.);
2) Technical upgrading of existing hydropower plants and ecological restoration measures;
3) Strategic planning approach for new hydropower development, and;
4) Mitigation measures.

The Guiding Principles were adopted by the ICPDR in June 2013 and recommended for application by the Danube countries, what is planned to be further facilitated via an exchange of experiences on the application in the frame of a follow-up process.

As an important step facilitating dissemination, the Guiding Principles were translated by countries into Croatian, Czech, German and Slovak languages. In general, the process of practical application is still at an early stage, also because the issue is of different relevance depending on the respective framework conditions in each of the countries. However, some experiences are already in place e.g. with regard to technical upgrading of existing plants linked with ecological restoration measures, strategic planning approaches for new hydropower development and setting up of national stakeholder processes, or with regard to the application of mitigation measures.

In order to ensure the sustainability of hydropower and for obtaining a better shared understanding on the topic, it will be a key issue for the coming years to build on this knowledge and to further exchange practical experiences in the frame of regular meetings. This will in particular help to facilitate communication between water managers and relevant actors from the energy sector, in order to ensure the coherence between energy policies and river basin management planning.

6.6 Sturgeons in the Danube River Basin District

Sturgeons represent a natural heritage for the Danube River Basin and the Black Sea. Considered as “flagship species”, sturgeons constitute as “living fossils” a unique value for biodiversity but can also be of significant importance from a socio-economic point of view since healthy and properly managed stocks can sustain the income of fishermen communities and hatchery owners.

However, sturgeon stocks declined dramatically during the last century. From the six native Danube sturgeon species, four migrated from the Black Sea, partly upstream as far as Regensburg on the Upper Danube. One is already extinct, while the others are on the verge of extinction according to current information (see Table 20). Main pressures include the disruption of migration routes due to infrastructure projects, the loss of habitats and spawning grounds, pollution as well as overfishing of already diminishing stocks also for caviar trade.

[32] http://www.icpdr.org/main/activities-projects/hydropower

Table 20: Overview Danube sturgeon species and their status and trend according to IUCN

Species	Also known as	Status	Trend
		According to IUCN[33]	
Acipenser gueldenstaedti	Danube sturgeon or Russian sturgeon	Critically endangered	Decreasing
Acipenser nudiventris	Ship sturgeon or Fringebarbel sturgeon	Critically endangered	Decreasing
Acipenser ruthenus	Sterlet	Vulnerable	Decreasing
Acipenser stellatus	Stellate sturgeon	Critically endangered	Decreasing
Acipenser sturio	Common sturgeon, European sturgeon, Atlantic sturgeon	Critically endangered (extinct in DRB)	Decreasing
Huso huso	Beluga sturgeon or Great sturgeon	Critically endangered	Decreasing

Although not in their natural distribution, different sturgeon species are still present within the whole Danube River Basin (in particular in the lower DRB, but with regard to the sterlet and ship sturgeon also in the middle DRB, and with regard to the sterlet in the upper DRB). Therefore, sturgeons are an issue of basin-wide concern and actions are required on the basin-wide scale.

Sturgeon conservation in the Danube River-Black Sea system requires a basin-wide and interdisciplinary approach. A first decisive step was made in 2005 with the development of the "Action Plan for the conservation of Danube River sturgeons"[34] under the Bern Convention. Further, in 2009 the 1st DRBM Plan was adopted, which specified important key measures in the field of the ICPDR (i.e. measures for pollution reduction and the improvement of hydromorphological conditions). In addition, further measures were taken on the national level to prevent sturgeons from extinction, i.e. catchment bans in Bulgaria, Romania and Serbia, and more recently in Austria on provincial level.

The issue lately gained broad political attention in the frame of the EUSDR, with the agreed target "*To secure viable populations of Danube sturgeon species and other indigenous fish species by 2020*". Working towards the achievement of this target, the "Danube Sturgeon Task Force" (DSTF) was created in January 2012 in the frame of EUSDR Priority Area 6 (Biodiversity), where different organisations from the Danube basin (e.g. WWF, IAD, ICPDR, representatives from national research institutions, Ministries and the World Sturgeon Conservation Society) joined to work towards the issue. The DSTF aims to coordinate and foster conservation efforts in the DRB and the Black Sea by promoting actions which are outlined in the strategy and programme "Sturgeon 2020", developed by the DSTF based on the Danube Sturgeon Action Plan from 2005.

The ICPDR dedicated Danube Day 2013 to the motto "Get active for the sturgeons" in support of the ongoing process, leading to various public information and awareness raising events organised by the Danube countries throughout the basin. Furthermore, the following urgent priority actions were identified by the ICPDR:

1) Investigations on the potential feasibility to establish fish migration at the Iron Gate dams, including migration through the reservoir of Iron Gate I;
2) Monitoring and mapping of existing and historic[35] sturgeon habitats in the DRB, and;
3) Ex-situ conservation measures in support of a self-sustaining sturgeon reproduction and the natural life cycle.

[33] Source: http://www.iucnredlist.org/search (Accessed: 28 April 2013)

[34] http://www.iad.gs/docs/reports/SAP.pdf

[35] All available historic data sources are useful for the mapping of historic habitats, including specifically also data from the time period before the main river regulation works and economic development activities have been conducted.

A first compilation of important regions with sturgeon habitats, including currently known spawning sites, wintering sites and feeding sites, and for the middle Danube historic potential spawning sites, was compiled by sturgeon experts in the frame of the DSTF and is illustrated in Figure 35. Different methods were applied for this compilation, including literature review, information from fishermen on catches, presence and absence data on Young of the Year fish, bathymetric and granulometric surveys, as well as telemetry data for mature fish. However, further monitoring and mapping activities are required to obtain a comprehensive picture on the situation, allowing for more targeted conservation activities.

The three priority actions identified by the ICPDR above are in need to be moved forward in the future, in particular via specific ongoing and future projects, and in close coordination with relevant Priority Areas of the EU Danube Strategy.

Figure 35: Potential critical habitat for A. gueldenstaedtii, A. nudiventris, A. ruthenus, A. stellatus and H. huso as identified by various methods[36]

6.7 Water scarcity and drought

Attention to water scarcity and drought events in Europe has increased in the recent decade, particularly following the widespread droughts in 2003 that affected over 100 million people, a third of EU territory, and cost approximately € 8.7 billion in damage to the European economy[37].

Additional water scarcity and drought events have since affected portions of Northern, Southern, and Western Europe in 2007, 2011, and 2012 (see Figure 36)[38]. These recent trends highlight the

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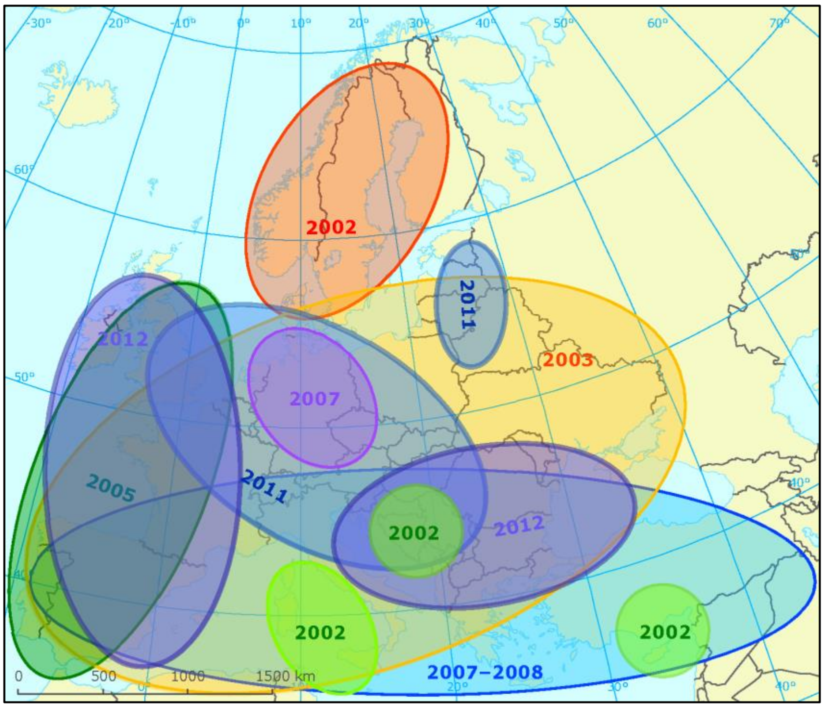
[36] Compiled from Friedrich 2012, Guti 2006 & 2012, Lenhardt 2012, Ludwig et al. 2009, Pekarik 2012, Suciu 2012, Suciu & Guti 2012 and Vassilev 2003, partially unpublished information

[37] Communication from the Commission to the Council and the European Parliament – Addressing the challenge of water scarcity and droughts, COM(2007) 414, 18 July 2007.

[38] Communication from the Commission to the Council and the European Parliament – Report on the Review of the European Water Scarcity and Droughts Policy, COM(2012) 672 final, 14 November 2012.

significance of growing imbalances in water supply and availability in Europe, specifically in the context of climate change.

Figure 36: Water scarcity and drought events in Europe in the period 2002 – 2011 (Source: ETC/ICM 2012[39])



In line with the 2007 Communication by the European Commission on Water Scarcity and Droughts, and as agreed upon by the EU Member States[40], the concepts of water scarcity and drought were developed as:

- **Water scarcity** is a man-made phenomenon. A recurrent imbalance that arises from an overuse of water resources caused by consumption being significantly higher that the natural renewable availability. Water scarcity can be aggravated by water pollution (reducing the suitability for different water uses), and during drought episodes.
- **Drought** is a natural phenomenon. A temporary, negative, and severe deviation along a significant time period and over a large region from average precipitation values (deficit in rainfall), which might lead to meteorological, agricultural, hydrological, and socioeconomic drought, based on its severity and duration.

Though there are clear similarities and differences between water scarcity and drought, the 2012 EU Gap Analysis of Water Scarcity and Droughts Policy in the EU[41] highlights the following differences:

1) Drought causes economic damage mostly in the peak spring or summer season when the irrigation demand is highest, the effects of winter drought often being less notable;

[39] European Topic Centre on Inland, Coastal and Marine Waters. Available: http://www.eea.europa.eu/data-and-maps/figures/main-drought-events-in-europe

[40] INTECSA-INARSA, S.A., based on previous draft by TYPSA (2012). Working definitions for Water Scarcity and Drought Report to the European Commission.

[41] ACTeon (2012). Gap Analysis of the Water Scarcity and Droughts Policy in the EU. Available: http://ec.europa.eu/environment/water/quantity/pdf/WSDGapAnalysis.pdf

2) Water scarcity poses a permanent limit to the economic development of a region or to the ecological status of ecosystems, whereas drought poses only a time-limited (potentially significant) water shortage; and
3) Drought may occur in different water-scarce conditions, droughts under high water scarcity require specific treatment from a risk-management perspective.

Therefore, formulating clear distinctions between these events can aid in the development of more effective River Basin Management Plans and in strengthening future water management practices.

Sound quantitative management of water resources is a pre-requisite for addressing water scarcity and drought events but also for the achievement of WFD objectives, as illustrated by the need to ensure the quantitative status of groundwater bodies and to achieve good ecological surface water status (including in terms of supporting river flows) as specified by the WFD. A CIS Guidance Document is under elaboration with the main objective to support the development and use of water balances at the river basin and/or catchment scales, as pre-requisite to sound and sustainable (quantitative) management of water resources. The application of water balances is expected to support integrated water resources management and decision-making at the local scale, improve water allocation schemas and the drafting and adoption of targeted measures.

Water scarcity and drought in the Danube River Basin

The role of water scarcity and drought in river basin management is expected to become more relevant over time also within the DRB, particularly with increased attention to climate change. Therefore, the ICPDR became active in elaborating on the relevance of the issue of water scarcity and drought, which was previously not systematically addressed on the basin-wide scale and what is in line with the following specific target agreed in the frame of the EUSDR: "*To address the challenges of water scarcity and drought based on the 2013 update of the Danube Basin Analysis and the ongoing work in the field of climate adaptation, in the Danube River Basin Management Plan to be adopted by 2015*"[42].

Based on feedback provided by the Danube countries via a specific questionnaire, it can be summarised that water scarcity and drought is not considered as a SWMI for the majority of the countries, but a number of countries consider them as a SWMI in River Basin Management Plans on national level. The main sectors which were reported to be affected by water scarcity and drought include agriculture, water supply, biodiversity, other energy production, hydropower, navigation and public health.

Water scarcity and drought was reported to be addressed by a number of Danube countries in their national River Basin Management Plans, whereas specific measures are planned or already under implementation (e.g. increase of irrigation efficiency, reduction of leakages in water distribution networks, drought mapping and forecasting, education of public on water-saving measures, market-based instruments, wastewater recycling and rain water harvesting).

Summary and outlook

It can be concluded that water scarcity and drought is not considered as an issue requiring coordination and management on the basin-wide level at this stage. This is also due to the fact that the relevance of the issue and the situation is differing between the countries and regions within the DRB. However, maintaining an exchange on the topic is considered to be beneficial, also in relation to the ongoing discussions on climate change adaptation, what should be facilitate via the exchange of best practice examples. Such activities area already ongoing within the Danube basin, e.g. facilitated by Global Water Partnership (GWP) Central and Eastern Europe with the objective to commit to an Integrated Drought Management Programme (IDMP). Important activities are also performed by the Drought Management Centre for Southeastern Europe (DMCSEE). The mission is to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in South-

[42] EUSDR Report June 2012. Priority Area 5 - To manage Environmental Risk.

Eastern Europe with the goal of improving drought preparedness and reducing drought impacts. Scientific support for the Danube region is provided by the Joint Research Centre (JRC) with the Danube Water Nexus project, aiming to help decision-makers and other stakeholders to identify policy needs and actions needed.

6.8 Adaptation to climate change

Despite ambitious international climate protection objectives and activities, adaptation to climate change impacts is urgently needed. Water, together with temperature, is in the centre of the expected changes. Due to the fact that water is a cross-cutting issue with major relevance for different sectors, water is the key for taking the required adaptation steps. In the DRB, climate change is likely to cause significant impacts on water resources and can develop into a significant threat if the reduction of greenhouse gas emissions is not complemented by climate adaptation measures.

In order to take the required steps on adaptation, the ICPDR was asked in the 2010 Danube Declaration[43] to develop a Climate Adaptation Strategy for the DRB. In December 2012, the ICPDR Strategy on Adaptation to Climate Change[44] was finalised and adopted. The Strategy provides an outline of the climate change scenarios for the DRB and the expected water-related impacts. Furthermore, an overview on potential adaptation measures is provided and the required steps towards integrating adaptation into ICPDR activities and the next planning cycles are described. Apart from activities on the basin-wide level, it has to be pointed out that important actions on climate change adaptation are undertaken at national (see Figure 37) and/or sub-basin level based on national and/or sub-basin climate adaptation strategies or adaptation plans, which were elaborated by Danube countries as well as for the Sava and Danube Delta sub-basins.

Figure 37: Overview of the current status of National Adaptation Strategies in the DRBD

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[43] Danube Declaration: http://www.icpdr.org/main/sites/default/files/Ministerial%20Declaration%20FINAL.pdf

[44] ICPDR Strategy on Adaptation to Climate Change: http://www.icpdr.org/main/activities-projects/climate-adaptation

Since adaptation to climate change is a cross-cutting issue, all relevant ICPDR Expert Groups and Task Groups were mandated to fully integrate adaptation to climate change in the planning process for the implementation of the WFD and FRMD in the Danube River Basin. Steps for ensuring this integration during the elaboration of the DRBM Plan – Update 2015 included the facilitation of an exchange between the experts via a questionnaire, addressing key elements of the ICPDR Strategy on Adaptation to Climate Change, in particular on the planned measures of the JPM in the context of climate change. Some of the outcomes are summarised in Chapter 8.4.

First adaptation activities will be implemented already in the second RBM cycle (2015-2021), in particular „no-regret-measures“[45] and „win-win-measures“[46] have been considered as part of the JPM and the national PoMs (see Chapter 8.4). One of the key challenges for future climate adaptation activities will be the further closing of knowledge gaps as outlined in the ICPDR Strategy on Adaptation to Climate Change (for details see Chapter 8.2 of the Strategy).

Taking these considerations into account, it is proposed to further facilitate exchange in the Danube basin on climate change adaptation and to check the need for an update of the ICPDR Strategy on Adaptation to Climate Change in 2018, linking it with the six-years planning cycles according to the WFD and FRMD.

7 Economic analysis

7.1 WFD economics

The WFD with its clear environmental focus requires that river basins are also described in economic terms. This "economic analysis" forms a foundation to base the following steps upon. This means that the planning of measures, for example, should combine all three aspects of sustainability (considering environmental, economic and social concerns), in order not to put the possible burden of measures disproportionally high on a single user group.

Economic principles are addressed in the WFD mainly in Article 5 (and Annex III) and Article 9. The WFD requires in Article 5 to perform an economic analysis of water uses, that shall be reviewed, and if necessary updated, at the latest 13 years after the date of entry into force of the WFD and every six years thereafter. Furthermore, Article 9 requires that by 2010, EU Member States had to take account of the principle of cost-recovery (CR), including environmental and resource costs (ERC). In addition to this direct requirement, the WFD refers implicitly to economic principles in many of its Articles.

A first economic analysis of water uses (based upon the requirements of Article 5 WFD) was carried out in the Danube river basin in 2004, in the framework of the first Danube Basin Analysis (DBA). A summary of this economic analysis was included in the 1st DRBM Plan 2009 as required by WFD Article 13 and Annex VII, referring to Article 5 and Annex III. The required updated of the economic analysis was performed for the 2013 Update of the DBA, which has now been updated for inclusion into the DRBM Plan – Update 2015.

7.2 Description of relevant economic water uses and economic meaning

According to Article 5 and Annex III of the WFD, an economic analysis of water uses had to be carried out (and has to be updated regularly) with the aim of assessing the importance of water use for the economy and assessing the socio-economic development of the river basin; this economic analysis is herewith updated at the Danube River Basin level.

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[45] Cost-effective adaptation measures that are worthwhile (i.e. they bring net socio-economic benefits) whatever the extent of future climate change is; they include measures which are justified (cost-effective) under current climate conditions (including those addressing its variability and extremes) and are also consistent with addressing risks associated with projected climate changes.

[46] Cost-effective adaptation measures that minimize climate risks or increase adaptive capacity, and which also have other social, environmental or economic benefits; win-win options are often associated with those measures or activities that address climate impacts and also contribute to climate change mitigation or meet other social and environmental objectives.

Table 21 presents basic socio-economic data covering all fourteen countries cooperating in the frame of the ICPDR. As can be observed, a considerable difference in the GDP per capita figures exists among the Danube basin countries, demonstrating a significant disparity in wealth. This big gap among the countries is reduced slightly when GDP per capita figures are expressed in Purchase Power Parities (PPP), as can be seen in Figure 38.

Table 21: General socio-economic indicators of Danube countries

Country	Population within the DRBD	Share of population within the Danube Basin[47]	National GDP 2013[48]	GDP 2013 per capita[48]	GDP 2012 per capita[49]
	in Mio.	*in % of total population*	*in Mio. US$*	*in US$ per capita*	*in PPP/International $ per capita*
Austria	8.1 (2013)	95,4% (2013)	428.321	50.546	45.492
Bosnia and Herzegovina	3.2	84.75% (2013)	17.851	4.661	9.535
Bulgaria	3.5	48,5% (in 2011)	54.479	7.498	15.731
Croatia (2011)	2.9	67.8% (in 2011)	57.868	13.607	21.365
Czech Republic	2.7	25.4% (in 2012)	208.796	19.844	28.769
Germany[50]	9.7	41.6% (in 2010)	3.730.260	46.268	44.469
Hungary	10.0	100%	133.423	13.480	23.482
Moldova	1.1	32% (in 2011)	7.969	2.239	4.670
Montenegro	0.2	28.7%	4.416	7.106	14.131
Romania	20.2	97.4% (estimated)	185.626	8.728	18.991
Serbia[51]	7.5	99.8%	45.519	6.354	13.020
Slovak Republic	5.2	96.2% (2013)	97.707	18.046	26.642
Slovenia	1.8	88% (2013)	47.987	23.289	28.995
Ukraine	2.7	-	177.430	3.900	8.790

[47] National contributions.

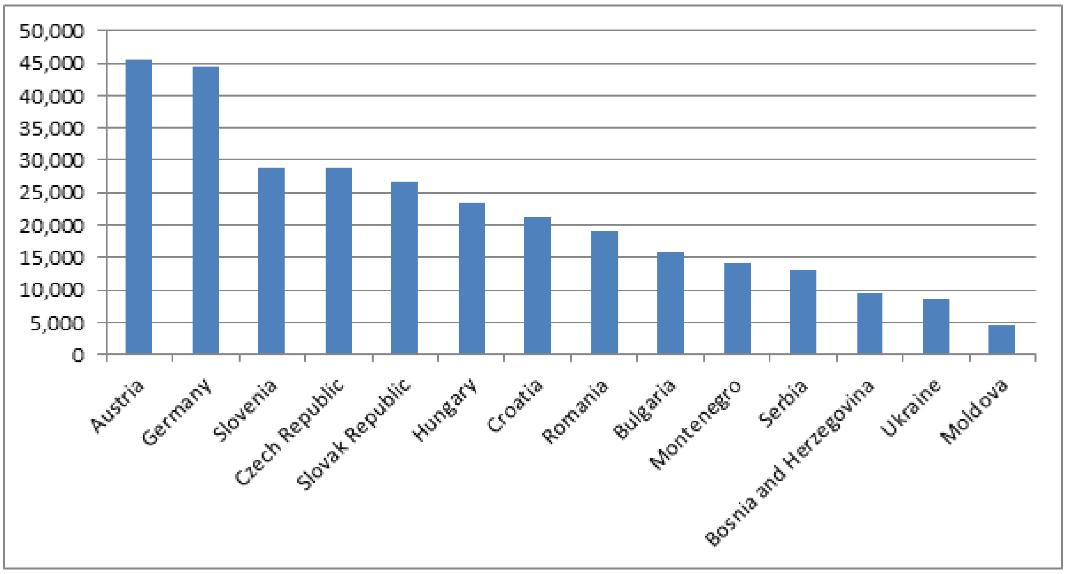
[48] Source: World Bank.

[49] GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. The data is depicted in current international dollars based on the 2011 ICP round.

[50] Data from 2010, which represents the most recent comparable national data available on the level of river basins.

[51] The data from Serbia do not include any data from the Autonomous Province of Kosovo and Metohija.

Figure 38: GDP per capita (PPP/International $) of Danube countries (2013)



7.2.1 Characteristics of water services

"Water services" means all services which provide, for households, public institutions or any economic activity (WFD Article 2 (38)):

- Abstraction, impoundment, storage, treatment & distribution of surface water or groundwater;
- Wastewater collection and treatment facilities which subsequently discharge into surface water.

Five Danube countries - Austria, Germany, Moldova, Serbia and Croatia - defined water services as encompassing no other services than water supply and wastewater collection/treatment.

Seven other countries interpreted the WFD definition to encompass more than these two services. In the Czech Republic, for example, further water services (beside water supply and wastewater collection/treatment) are a) rivers and river basin management, surface water abstraction, groundwater abstraction, discharge of wastewater into surface water, discharge of wastewater into the groundwater, impoundment for the energy production, and navigation (only recreation; on Baťův kanál). Slovakia defined three additional water services ("use of hydro-energy potential of watercourse, abstraction of energy water from watercourse, abstraction of surface water from watercourse"), and included these into CR calculations already in the first cycle. Hungary defined "irrigation" as water service (Hungary also includes "other agricultural water service", such as fishponds and “own thermal use” in the definition), whereas Romania, Slovenia and Bosnia and Herzegovina each defined a great number of water services (23 further water services in the case of Slovenia, 13 in Bosnia and Herzegovina, 8 in the case of Romania). Both Slovenia and Bosnia and Herzegovina, however, did not include these in their cost recovery assessments.

Bulgaria subdivided the water services according to the economic sectors, i.e. public water supply, public collection of waste water, public treatment of waste water, individual water supply in industry, individual water supply in agriculture for irrigation, individual water supply for stock-breeding, producing of electric power by hydropower plant, protection of harmful impact of water, conservation of water, navigation and other activities connected with navigation, and individual drinking water supply are each defined as individual water services. Bulgaria states that all of these are included in the calculation of CR (for more detailed information on water services, see Annex 9).

Basic information regarding water services and connection rates of the population to public water supply, public sewerage systems and wastewater treatment plants are presented in Table 22 below. The table shows for a number of countries high connection rates above 90% to public water supply (Austria, Bulgaria, Czech Republic, Germany, Hungary and Montenegro). With regard to connection rates to public sewerage systems and wastewater treatment plants, the connection rates are generally still lower compared to public water supply.

Table 22: Water production, wastewater services and connection rates in the Danube River Basin countries (if not indicated otherwise, the data refers to the national level)

Country	Water supply production (industry, agriculture and households from public systems)	Supply to households	Population connected to public water supply	Population connected to public sewerage system	Population connected to wastewater treatment plant
	in Mio. m³	*in Mio. m³*	*in %*	*in %*	*in %*
Austria	791	ca. 525	91.6	94.9	94.9
Bosnia and Herzegovina	320	109	60-65	46	3
Bulgaria (in 2013)	188.85 (Danube), 387.82 (national level)	129.68 (Danube), 260.69 (national level)	99.8 (Danube), 99.3 (national level)	74.9 (Danube), 74.7 (national level)	61.9 (Danube), 56.4 (national level)
Croatia (in 2012)	286 (Danube), 513 (national level)	124 (Danube), 184 (national level)	80 (Danube), 84 (national level)	45 (Danube), 47 (national level)	32 (Danube), 35 (national level)
Czech Republic	327.8 (Danube)	147.2 (Danube)	94.9 (Danube)	86 (Danube)	83.5 (Danube)
Germany[52]	683.9 (Danube)	453.2 (Danube)	98.9 (Danube)	96.2 (Danube)	97.0 (Danube)
Hungary (in 2012)	598.5	341.7	94.2	74	99 (public sewerage system)
Moldova	851 (130 from GW)	118	75 (urban); 13 (rural)	75 (urban); 13 (rural)	50 (urban); 2 (rural)
Montenegro	47	0.2	97.4	64 (no of households with sewerage services)	10
Romania	2,701	507	62.9	49.1	47.1
Serbia[53] (2013)	658	324	86.6	57.8	9.4
Slovak Republic (2013)	2,488.5	291.4	84.1	61.2	59.9
Slovenia (2011)	100 (Danube)	73 (Danube)	88.6	67.9	59.8
Ukraine	-	-	-	-	-

Source: contributions from Danube countries. Note: National-level data is depicted in all cases except otherwise noted.

In several Danube countries, the water supply networks are in poor condition due to faulty design and construction, and lack of maintenance and ineffective operation in some places. Leakage is generally high - in many cases 30–50% of the water is lost. The extent of piped drinking water supplies to households varies between urban and rural areas, with rural populations in some countries less well provided. The share of the population connected to public sewer system varies from under 13% in rural Moldova to over 96% in Germany.

The following two tables demonstrate the difference in the overall dimension of wastewater collection and sewage treatment that exists in the Danube river basin.

As can be seen in Table 23, in Germany and Austria the percentage of agglomerations in which wastewater is collected and treated reaches 100%; other countries in the Western part of the basin have quotas that are similarly high (the Czech Republic, Slovakia, Hungary). Further East, towards the youngest EU Member States and non-EU Member States which still have a transition period, the share of the agglomerations in which wastewater is collected and treated gets smaller. In Moldova, for example, in 17 out of 169 agglomerations, the wastewater is collected and treated. In the whole basin, almost 14 million population equivalents of wastewater is neither collected nor treated.

[52] Data from 2010, which represents the most recent comparable national data available on the level of river basins.

[53] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

Table 23: Wastewater Collection in the Danube River Basin[54]

Country	Number of agglomerations[55]					Population equivalent				
	Total	Collected and treated	Addressed through IAS	Collected but not treated	Not collected and not treated	Total	Collected and treated	Addressed through IAS	Collected but not treated	Not collected and not treated
Austria	608	608	0	0	0	13,137,976	13,043,568	94,408	0	0
Bosnia and Herzegovina	241	6	0	79	156	2,045,920	299,475	0	590,254	1,156,191
Bulgaria	138	29	2	50	57	4,049,697	2,540,998	7,630	522,343	978,726
Croatia	152	27	0	61	64	2,916,445	1,432,588	0	479,485	1,004,372
Czech Republic	185	181	4	0	0	2,395,708	2,261,870	118,431	14,907	499
Germany	718	718	0	0	0	13,629,528	13,611,069	18,459	0	0
Hungary	511	508	3	0	0	11,698,020	9,957,010	1,741,010	0	0
Moldova	169	17	3	22	127	899,189	173,283	38,075	29,017	658,814
Montenegro	-	-	-	-	-	-	-	-	-	-
Romania	1852	403	102	142	1205	21,411,700	10,554,488	179,939	1,913,212	8,764,060
Serbia[56]	241	36	205	0	0	4,581,832	697,132	737,987	3,119,028	27,685
Slovak Republic	344	274	70	0	0	4,874,448	4,151,739	648,449	52,120	22,140
Slovenia	138	97	16	17	8	1,313,346	873,980	111,831	173,827	153,708
Ukraine	315	32	0	7	276	1,952,299	708,743	0	28,346	1,215,209
DRBD	**5,612**	**2,506**	**337**	**297**	**2,472**	**84,906,108**	**60,305,943**	**3,696,220**	**6,922,538**	**13,981,407**

The following Table 24 demonstrates the level of the treatment, and again shows the difference in the level of wastewater treatment in the Danube basin. As can be seen, treatment plants with only primary treatment were phased out in a number of countries. At the same time, treatment plants with tertiary treatment and nutrient removal became more commons.

Table 24: Sewage Treatment in the Danube River Basin[57]

Country	Number of agglomerations[58]			Population equivalent		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
Austria	0	5	603	0	9,037	13,034,531
Bosnia and Herzegovina	1	5	0	268,800	30,675	0
Bulgaria	7	12	10	39,924	607,266	1,893,807
Croatia	11	13	3	116,606	1,214,192	101,790
Czech Republic	0	31	150	0	132,782	2,129,088
Germany	0	138	580	0	470,533	13,140,536
Hungary	8	198	302	68,845	2,441,449	7,446,716
Moldova	11	6	0	89,123	84,160	0
Montenegro	-	-	-	-	-	-
Romania	58	313	32	547,577	5,688,213	4,318,698
Serbia[59]	5	30	1	117,998	510,921	68,213
Slovak Republic	4	151	119	10,029	2,110,840	2,030,870
Slovenia	0	72	25	0	605,077	268,903
Ukraine	3	29	0	42,805	665,939	0
DRBD	**108**	**1003**	**1825**	**1,301,706**	**14,571,084**	**44,433,153**

[54] Source: Danube countries, data collection via ICPDR PM EG; reference year 2009, for BA 2006.

[55] Categorization is based on the highest technology level available.

[56] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

[57] Source: Danube countries, data collection via ICPDR PM EG; reference year 2011/2012.

[58] Categorization is based on the highest technology level available.

[59] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

7.2.2 Characteristics of water uses

The WFD requires the identification of water uses: abstraction for drinking water supply, irrigation, leisure uses, industry, etc., and a characterization of the economic importance of these uses. Water use means water services together with any other activity having a significant impact on the status of water. Some countries defined more water uses as water services than others.

The following tables provide an overview of the economic importance of water uses in the Danube basin. As can be seen, agriculture still represents an important economic sectors in several Danube countries, such as Serbia, Moldova and Ukraine (around and above 10%). On the contrary, in other Danube countries, mostly in the Western part of the basin, the share of agriculture in national GDP is very low, compared to these levels - in the Czech Republic, Slovenia and Slovakia, the share is only around 2%. Industry is significant in all Danube countries, contributing a significant share to the national GDP. Electricity generation does not exceed the 5% mark in any of the Danube countries, except for Bosnia and Herzegovina. Generally it has to be noted that the service sector, although not listed here, can contribute significantly to GDP in spite of potential low water consumption.

Table 25: Production of main economic sectors (national level)

Country	Agriculture	Industry	Electricity Generation
	Share of GDP (in %)	Share of GDP (in %)	Share of GDP (in %)
Austria	0.97 (average 2011-2013)	26.4 (2012)	2.5 (2012)
Bosnia and Herzegovina (2013)	14.24	5.75	16.36
Bulgaria (in 2011)	4.7	26.4	n. a.
Croatia (in 2010)	4.9	15.93	2..25
Czech Republic (in 2010)[60]	2.8	35	n. a.
Germany[61]	0.8 (DRB)	30.3 (DRB)	n. a.
Hungary (2012)	4.7	23	2.7
Moldova (2010)	28	39	3.4
Montenegro		No information	
Romania	4.2	20	1.2
Serbia[62] (2013)	7.9	16.1	4.1
Slovak Republic (in 2013)	2.83	22.57	2.86
Slovenia (2012)	2.34	18.5	2.47
Ukraine	9.82[63]	-	-

Other sources: contributions from Danube countries.

[60] http://www.mzv.cz/newdelhi/en/economy_and_trade/czech_economy_development_and_prospects.html

[61] Data from 2010, which represents the most recent comparable national data available on the level of river basins.

[62] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

[63] ICPDR 2011: Facts and Figures Brochure.

Table 26: Hydropower generation in the Danube River Basin

Country	Installed hydropower capacity in 2010[64]	Electricity production from hydropower in 2010[65]	Share of hydropower generation[66]
	in MW	*in GWh/year*	*in % of total electricity generation*
Austria	12,469 (2008)	37,958 (2008)	56.8
Bosnia and Herzegovina	90 (2011)	1,667	18
Bulgaria	3,108	5,523	11.9
Croatia	339	1,495	31.8
Czech Republic	2,203	2,790	3.2
Germany	4,050 (2009)	19,059 (2009)	3.3
Hungary	55	188	0.5
Moldova	none	n. a. (79.1 including pumped storage)	None (6% if pumped storage is included)
Montenegro	n. a.	n. a.	n. a.
Romania	6,453	19,857.2	33.2
Serbia[67]	2,859 (2009)	10,636 (2009)	24.2
Slovak Republic	2,515 (2012)	5,125 (2013)	18.4 (2013)
Slovenia	1,188 (2011)	4,198	29.6
Ukraine	36.2	0.16	n. a.

Austria has the largest percentage of generated electricity based on hydropower (almost two thirds of total electricity generated). The share of hydropower is also relatively high in Croatia, Slovenia, Romania and Serbia (around 30%), and more modest in Germany[68] (although the absolute amount of electricity produced from hydropower is high, compared to other countries in the DRB), the Slovak Republic, and the Czech Republic, where hydropower still plays an important role in the electricity system. However, in most Danube countries (with the exception of DE, HU and MD), hydropower currently represents the most important component of total renewable energy production (for more concrete information, see the Assessment Report on Hydropower Generation in the Danube Basin).

[64] Assessment Report on Hydropower Generation in the Danube Basin. AT, BG, CZ, DE, HU, MD, RS, SI and SK: data for the whole country. RO data are relevant both for the Romanian part of the Danube River Basin as well as the whole country. BA, HR and UA: data valid for the national part of the Danube River Basin only.

[65] Assessment Report on Hydropower Generation in the Danube Basin . Excluding pumped storage. AT, BG, CZ, DE, HU, MD, RS, SI and SK: data for the whole country. RO data are relevant both for the Romanian part of the Danube River Basin as well as the whole country. BA reported data for the current amount of electricity production for the national part of the Danube River Basin, while the figures for the expected amount of electricity production in the year 2020 refer to the whole country. HR and UA: data valid for the national part of the Danube River Basin only. It has to be stated that in RO, the year 2010 was an exceptional year as regards hydro-energy production, being the second highest year in the hydro- energy production history of RO.

[66] Assessment Report on Hydropower Generation in the Danube Basin and national contributions. Own calculation. Excluding pumped storage.

[67] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

[68] Because of geographical differences, the distribution of hydropower plants in Germany varies considerably. About 87.7 % of installed power in Germany is located in the federal states Baden-Württemberg and Bavaria, which make up the German share of the DRB. In Bavaria the overall contribution of hydropower to gross power generation is 13.3 %, in Baden-Württemberg it is 8.6 %, whereas in Germany it is 3.2 % (source: Agentur für Erneuerbare Energien - www.foederal-erneuerbar.de/, reference year for data given here: 2012).

Table 27: The importance of inland navigation in the Danube River Basin

Country	Freight transport on the entire Danube[69]	Number of major ports
	Million tons	*Number*
Austria	11.11	8
Bosnia and Herzegovina	0.04	2
Bulgaria	6.49	11
Croatia	5.80	2
Czech Republic	none	none
Germany	6.59	6
Hungary	8.33	12
Moldova	0.18	1
Montenegro	n. a.	n. a.
Romania	17.63*	12
Serbia[70]	12.11	14
Slovak Republic	8.02	3
Slovenia	none	n. a.
Ukraine	3.66	4

*This figure includes the data related to the Danube – Black Sea channel.

The above table shows that inland navigation does not play a major role in every Danube country - it is relevant only for some Danube countries as there is no commercial inland navigation in the countries on the edges of the Danube River Basin. The countries with the highest tonnage transported on the Danube are Romania, followed by Austria and Serbia (all three countries move more than 10 million tons of cargo annually). Nevertheless, most other riparian countries also transport significant amounts.

7.3 Cost recovery

This chapter summarizes information on CR approaches and methodologies used in the Danube countries based on national contributions (for more detailed information see Annex 9).

Cost recovery for specific water services is defined as the ratio between the revenues paid for a specific service and the costs of providing the service. The WFD calls for accounting related to the recovery of costs of water services and information on who pays, how much and what for.

Analysing CR approaches in general, but especially in transboundary basins with a variety of national approaches, faces several challenges. First, the application of economic and environmental principles into price setting and the degree of application of CR vary from one to another Danube country according to the specific legal and socio-economic conditions. Second, the approaches to CR and pricing vary inside the Danube countries as well, as often local authorities have the responsibility for setting the price and therefore determining the degree of cost recovery of certain water services. Third, the topic touches several challenging questions regarding methodologies and the understanding of, for example, ERC and "adequate cost recovery". Furthermore, a number of influencing factors are to be considered when analysing water prices, costs, or level of cost recovery in different countries with varying socio-economic structures (such as general price levels, local favourable or unfavourable conditions for water supply etc.).

Generally, all Danube countries have defined water services. The interpretation of what is to be considered a water service varies (see Chapter 7.2.1 above), as well as the consequences for CR calculations. For example, the definition of a certain activity as water service does not necessarily mean that this water service is included in cost recovery calculations (this, for example, is the case in

[69] via donau – Österreichische Wasserstraßen-Gesellschaft mbH 2013: Danube Navigation in Austria (data for 2012); national contributions

[70] The data from Serbia do not include data from the Autonomous Province of Kosovo and Metohija.

several Danube countries: a wide definition of water services is used, but these are then not included in the CR assessment; see Chapter 7.2.1 above, or Annex 9).

Also, the methods and underlying definitions that are relevant for calculating CR differ between Danube countries. Here, a variety of approaches can be observed: in some countries, CR is not calculated, or the information - which is sometimes difficult to obtain - is missing or unclear; often, only financial and/or operation and maintenance (O&M) costs are considered; some countries also included ERC into cost recovery calculations, although in these cases, a clear definition of ERC is missing (i.e. an underlying methodology to determine the ERC). Overall, seven countries clearly state the percental level of CR of water services in a quantitative manner, two countries partly.

Regarding ERC, the current understanding and approach to defining and/or calculating them varies among the Danube countries. A full and comprehensive methodology for calculating ERC is not reported by any Danube country, due to methodological difficulties and lack of information/data. Nevertheless, a pattern can be observed that is followed by the majority of Danube countries in a slightly different way. First of all, it has to be noted that "resource costs" are often understood not as "opportunity costs" (i.e. the costs of foregone opportunity), but as the costs of the resource itself, i.e. as a form of "abstraction price/cost". Environmental costs, on the contrary, are often defined as the costs that are associated with the discharge of wastewater into water bodies, and the costs for wastewater collection and treatment (and captured and internalized through the respective charges and fees - i.e. the underlying assumption seems to be that the wastewater charges/fees adequately cover the associated environmental damages; based on this assumption, the charges/fees are then equated with the environmental costs; see below for more details).

Consequently, all Danube countries state that the principle of ERC cost recovery is applied by various forms of charges/fees, or taxes. Six countries state that in addition to charges/fees, permits which include restrictions/limitations in a way that ERC do not occur fulfil this role as well. Mitigation and/or supplementary measures seem to play a smaller role (three countries stating that mitigation/supplementary measures contribute to ERC cost recovery, although on which basis such costs are calculated is not clear).

7.4 Projection trends in key economic indicators and drivers up to 2021

In order to assess key economic drivers likely to influence pressures and thus water status up to 2015, a Baseline Scenario (BLS) has been developed in the DRBM Plan 2009. Hereby, the trend projections followed the DPSIR approach, i.e. focused on the most relevant drivers and pressures of socio-economic development and accompanying effects on water status (quality and quantity).

The main trends of key economic drivers are updated and projected further into the future (until 2020/2021) in the DRBM Plan – Update 2015. In the following, a short summary of the general trends is provided, and a table in Annex 9 presents the data that was available in the Danube countries in early 2015.

Estimating overall trends in socio-economic development is already challenge in a single country, as such developments are dependent on many factors that cannot be influenced by states (such as global commodity prices, exceptional events etc.). These challenges are aggravated in a region that consists of a multitude of different countries using different methodologies and approaches in their statistics and national forecasts.

Nevertheless, some general trends can clearly be recognized. First, overall population in the Danube River Basin can be expected to decline, as only three countries are expected to have an increase in population until 2021 (AT, CZ and SL). All other Danube countries are expected to have a smaller population than today, in some cases reaching -6 or -7% . At the same time, the economies are mostly expected to grow (as far as information is available). This, however, applies not only to economic growth in agriculture and industry, but especially to electricity production from hydropower and biomass. In these sectors, almost all countries expect significant growth, which could have significant consequences for both quality and quantity related aspects of water management (information on future water demand is scarce, Germany reports an expected slight decrease, the Slovak Republic a slight increase).

More detailed information can be found in form of a table and brief summaries for different countries in Annex 9.

7.5 Economic assessment of measures

Cost-effectiveness analysis

A cost-effectiveness analysis (CEA) can be a support to decision making regarding the selection of the most cost-effective combinations of measures for inclusion in the Programme of Measures as described in Article 11 of the WFD. However, Article 5 and Annex III WFD do not stipulate CEA as method for cost-effectiveness assessment.

Conducting a full CEA, however, faces significant challenges, most of them linked to data requirements and availability, e.g. on the costs of measures, or on the quantified impact in terms of reaching WFD objectives. These challenges apply to both the national (and sub-national), as well as the transboundary levels.

In a transboundary context, the application of CEA can be a useful tool in assessing the effectiveness of supplementary, not for basic measures. Achieving the nutrient reduction targets cost-effectively, for example, requires analysis of the costs and effects of potential measures. National approaches for incorporating cost-effectiveness assessments in modelling tools for planning nutrient reduction measures (e.g. in MoRE/MONERIS in Germany) are being developed and their applicability and practicability is being examined. However, performing a CEA on a transnational level faces several difficulties in addition to the challenges existing on national level, as outlined above, for instance, when comparing costs of measures in countries with very different socio-economic backgrounds, or when definitions of measures differ in various countries. Furthermore, measures which are under implementation in particular for pollution reduction are to a large extent still basic measures according to the WFD.

In the second WFD management cycle, CEA is therefore an issue addressed at national level and no basin-wide CEA was performed for the DRBM Plan – Update 2015. However, the planning period until 2021 could be used to “pave the way” for a possible use of CEA in the third management cycle, when, as can be expected, supplementary measures will gain importance for reaching WFD objectives for certain SWMIs (such as nutrient pollution).

The aim could be to tackle the following issues as a step towards a potential application of CEA in the third cycle:

- Framework of analysis: defining the methodology and scope of a future CEA.
- Data availability: costs of measures (catalogue of measures with harmonized average costs per, for example, km or ha).
- Better understanding of effectiveness of measures towards reduction of pressures.

Cost-benefit analysis

The tool of the cost-benefit analysis (CBA) is of specific relevance for assessing the disproportionality of costs compared to benefits in the context of WFD Art. 4 exemptions, which is an issue dealt with at national level. The assessment of disproportionality / a cost-benefit analysis has therefore not been performed at the basin-wide scale. It needs to be noted that Article 4 WFD doesn’t stipulate the use of CBA for the assessment of disproportionate costs. However, proportionate selection of different analytical approaches (cost-benefit analysis, benefits assessment, assessment of the consequences of non-action, distribution of costs, social and sectoral impacts, affordability, cost-effectiveness etc.) can be useful to inform decision making[71].

Approaches towards Disproportionality of Costs

[71] As stated by the Water Directors and in the CIS Guidance Document No. 20 on Exemptions to the Environmental Objectives.

According to the WFD, disproportionality of costs can be an argument for justifying exemptions from WFD objectives (Article 4.4: time derogations/Article 4.5: less stringent environmental objectives). It was employed by five Danube countries (for justifying time derogations; three countries also used it for justifying less stringent environmental objectives). Three countries did not employ disproportionality of costs.

A range of approaches and methodologies are used to determine if costs are disproportionate: four of the five countries use cost-effectiveness analyses, three "affordability" and two cost-benefit analyses in addition. In the German share of the DRB disproportionality of costs, identified by assessment and evaluation of costs and benefits, is only applied in context of Article 4.4 WFD.

More detailed information on the application of Article 4.4 and 4.5 WFD in the DRB can be obtained from Annex 9.

7.6 Summary and key findings

A considerable difference in the GDP per capita figures still exists among the Danube countries that shows a significant disparity in wealth in the DRB. This fact is also reflected in terms of the heterogeneity in levels of investments which were possible in the past on basic water services like water supply and wastewater treatment, leading to different levels of infrastructure development (e.g. regarding the levels of UWWT). Apart from the lack of available funds, shortcomings in capacities to absorb existing funds remain as well as an important issue.

Closing this gap remains one of the key challenges for the Danube River Basin and the WFD planning period 2015 – 2021. Cost-recovery is inter alia seen as a key tool for ensuring the financial sustainability of utilities, whereas socio-economic circumstances and affordability issues have to be taken into consideration. This can in particular be an issue for regions which are less advanced with regard to economic development, what is also reflected by significant differences in the figures on GDP contributions of different economic sectors like agriculture, industry or energy.

With regard to trends, overall population in the Danube River Basin can be expected to slightly decline, while economies are mostly expected to grow. This is the case for water-related sectors like agriculture and industries, but especially for hydropower and biomass, what could have significant consequences for water quality and quantity related aspects.

Efforts will be required in order to close still existing knowledge gaps and further work remains regarding methodologies and possibly harmonized approaches e.g. on tools like cost recovery, including environmental and resource costs, in order to make best use of economic instruments offered by the WFD for water management planning at national level as well as in a transboundary context. Cost-effectiveness or cost-benefits analyses and affordability are approaches for determining disproportionality of costs and justifying exemptions, and Danube countries could benefit from harmonized approaches.

8 Joint Programme of Measures (JPM)

The JPM builds upon the results of the pressure analysis (Chapter 2), the water status assessment (Chapter 4) and includes, as a consequence, measures of basin-wide importance oriented towards the agreed visions and management objectives for 2021. It is based on the national programmes of measures, which shall be made operational by December 2018, and describes the expected improvements in water status by 2021. Priorities for the effective implementation of national measures on the basin-wide scale are highlighted and are the basis of further international coordination. Some additional joint initiatives and measures on the basin-wide level that show transboundary character are presented as well. They are undertaken through the framework of the ICPDR.

The JPM is structured according to the Significant Water Management Issues (organic, nutrient and hazardous substances pollution and hydromorphological alterations) as well as groundwater bodies of basin-wide importance. It follows the basin-wide management objectives for each SWMI and groundwater in order to achieve the WFD environmental objectives by 2021. An important step towards the achievement of these objectives is the implementation of the JPM from the 1st DRBM Plan 2009, implemented between 2009 and 2015. For each of the SWMIs information is provided on state of play with regard to the implementation of these measures (according to WFD Annex VII B. 3. and 4.). For the assessment largely the information from the 2012 Interim Report was used at this stage and partly updated where later information was made available. More detailed information can be obtained from the national RBM Plans.

The JPM represents more than a list of national measures as the effect of national measures on the Danube basin-wide scale is also estimated and presented. Key findings and conclusions on identified measures and their basin-wide importance, as well as priorities regarding their implementation on the basin-wide scale, are summarised as part of the JPM. The implementation of the measures of basin-wide importance is ensured through their respective integration into the national programme of measures of each Danube country. A continuous feedback mechanism from the international to the national and sub-basin level and vice versa will be crucial for the achievement of the basin-wide objectives, in order to improve the ecological and chemical status of water bodies.

The three SWMIs of organic, nutrient and hazardous substances pollution have been approached taking into account the specific inter-linkages between them. The basic principles of those inter-linkages are described. Regarding the conclusions on these three SWMIs but also hydromorphological alterations, as an important follow-up the improvement of understanding with regards to the linkages between respective DRBD river loads and the ecologic response in the DRBD rivers and the Black Sea will remain. This improvement should be based upon additional monitoring results that will be available in the coming years.

The JPM does not address basic and supplementary measures (WFD Article 11(3) & (4)) separately. However, as the supplementary measures are of importance on the national level, they have been taken fully into account and are therefore indirectly reflected.

8.1 Surface waters: rivers

8.1.1 Organic pollution

8.1.1.1.1 Vision and management objectives

The ICPDR's basin-wide vision for organic pollution is zero emission of untreated wastewaters into the waters of the Danube River Basin District.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU and Non EU Member States:

- ⇨ Further reduction of the organic pollution of the surface waters via urban waste water within the DRB by implementing the Urban Waste Water Treatment Directive (EU MS) and by constructing a specified number of wastewater collecting systems and municipal wastewater treatment plants (Non-EU MS).
- ⇨ Further reduction of the organic pollution of the surface waters from the major industrial and agricultural installations by implementing the Industrial Emissions Directive (EU MS) and introducing Best Available Techniques at a specified number of industrial facilities (Non-EU MS).

8.1.1.1.2 Progress in implementation of measures from 1st DRBM Plan

The Danube countries committed themselves in the DRPC, inter alia, to implement measures to reduce the pollution loads entering the Black Sea from sources in the Danube River Basin. The 1st DRBM Plan included major efforts for the improvement of the urban waste water and industrial sector by upgrading or constructing sewer systems and waste water treatment plants as well as introducing Best Available Techniques (BAT) at the main industrial facilities. In the first management cycle significant investments have been made in the field of organic pollution control in the Danube River Basin District (DRBD) resulting in considerable reduction of organic pollution (see Annex 10 on measures in urban waste water and industrial sectors). This progress also contributes to achieve the UN Millennium Development Goals in the field of sanitation in the Danube region by providing access to sanitation for the respective population. The number of agglomerations for which waste water treatment plants are being/will be constructed, upgraded or extended, is indicated in Annex 10. Almost 900 UWWTPs have already been completed by 2015. Additional 1000 plants are under construction/rehabilitation or planning, half of them are currently under construction.

However, additional measures should be taken in the future. According to the presented assessments and the recent 7th Implementation Report of the UWWTD, the new EU MS have a considerable delay in the implementation of the UWWTD mainly due to financial limitations. Another issue of concern is the lack of compliance in a significant number of big agglomerations. The objectives of the 1st DRBM Plan were related to the accession treaty obligations of the new EU MS which were rather optimistic. Thus, the progress achieved is slower than it was originally planned and the objectives will probably be accomplished with a delay as the implementation of the respective measures is lagging behind in many countries. The transition period obtained by some EU MS for the implementation of the UWWTD requirements was considered as a funding prioritisation criterion (e.g.. Romania: most agglomerations between 2,000 and 10,000 PE will be in line with the UWWTD provisions after 2015, with a transition period until 2018, and therefore the agglomerations with more than 10,000 PE have a higher priority). Therefore, continuation of the developments in the urban waste water sector is necessary.

For the 2nd management cycle, further measures to achieve the ICPDR's basin-wide vision for organic pollution should be identified and implemented. Ensuring integration of the implementation of the WFD, UWWTD and IED in EU MS and supporting Non EU MS to achieve progress is a challenge in the Danube River Basin and it should be further observed and managed. For Non EU MS, further efforts should be made to continuously implement and update BAT in the chemical, food, chemical pulping and papermaking industrial facilities or to develop new ones. Realistic planning of investments is needed in line with the WFD/DRBM Plan requirements and funding availability. Efforts are needed to reinforce the capacity of the countries to identify and prepare environmental investment projects, and to improve access to good practice studies with the aim of facilitating the development of investment projects.

8.1.1.1.3 Summary of measures of basin-wide importance

Further development of the urban waste water sector is needed in the next management cycle. Management activities are legally determined for the EU Member States (EU MS) through several EU directives. The Urban Waste Water Treatment Directive (UWWTD) specifically focuses on the sewer system and waste water system development. EU MS are obliged to establish sewer systems and treatment plants at least with secondary (biological) treatment or equivalent other treatment at all agglomerations with a load higher than 2,000 PE (also for agglomerations smaller than 2,000 PE appropriate treatment must be ensured). This must have been finished till 2005 in the EU MS, even though the new EU MS have a longer transition period to fulfil the requirements (e.g. Romania till 2018). EU MS must report their activities in the waste water sector to the Commission that makes them transparent to the public through the Waterbase information system. Non-EU MS also intend to make efforts to achieve significant improvements. They are going to construct a specific number of sewer systems and waste water treatment plants till 2021 that is realistically executable.

Organic pollution stemming from industrial facilities and large farms should also be further addressed by the Danube countries. For EU MS the Industrial Emissions Directive (IED, repealing inter alia the Integrated Pollution Prevention and Control Directive (IPPCD) by the 7th of January 2014) dictates that authorities need to ensure that pollution prevention and control measures at the major industrial units are up-to-date with the latest Best Available Techniques (BAT) developments. The industrial plants covered by the Directive must have a permit with emission limit values for polluting substances to ensure that certain environmental conditions are met. Application of BAT in the large industrial and agro-industrial facilities was mandatory in EU MS till the end of 2007, with a gradual transition period for some new EU MS. It is expected that all relevant facilities in the EU MS will meet the IED requirements according to the legal deadlines. Reporting is also obligatory, information on these industrial facilities must be available for the public. For this purpose, emission data of facilities from different industrial sectors and over a certain capacity threshold have to be uploaded to the European Pollutant Release and Transfer Register (E-PRTR). Application of BAT is recommended for Non-EU MS, especially for some special industrial sectors, like chemical, food, chemical pulping and papermaking industry. For these sectors ICPDR elaborated supplying documents that recommend appropriate BAT. Implementation of other Directives like Nitrate Directive (ND) and Sewage Sludge Directive (SSD) that respectively concern the fate of nutrients and hazardous substances have also benefits for organic pollution reduction. Regulation of the manure and sewage sludge application at the agricultural fields positively affects the diffuse organic pollution as well reducing organic matter available at the fields for run-off and sediment transport. Similar regulatory actions are recommended for the Non-EU MS.

8.1.1.1.4 Future development scenarios

- Urban waste water sector

  Baseline scenario by 2021

  EU MS: The baseline scenario assumes the establishment of public sewer systems at all agglomerations with population equivalents more than 2,000 and connection of these agglomerations to urban wastewater treatment plants with appropriate technology through the implementation of the Urban Waste Water Treatment Directive (UWWTD) in line with the agreed national objectives. Taking into account that the Black Sea coastal waters are considered as sensitive area under Article 5 of this Directive the appropriate technology is defined as secondary treatment for agglomerations below 10,000 PE and more stringent treatment for agglomerations above 10,000 PE. Alternatively, the latter provision has not to be necessarily applied for each individual plant if the overall load reduction of the EU MS is at least 75% for both, total N and total P. Introduction of appropriate treatment at agglomerations with PE less than 2,000 according to the UWWTD requirements (small agglomerations with existing sewer systems). It is expected that except Croatia (transition period for the implementation is end of 2023) all EU MS will comply with the obligations of the UWWTD by 2021.

  Non EU MS: Construction/upgrading of a specific number of wastewater collecting systems and municipal wastewater treatment plants (with specified treatment technology) is assumed in line with the national prioritisation which can realistically be accomplished (Table 28).

Table 28: Number of agglomerations where waste water collecting systems and treatment plants will be constructed or upgraded

	Primary treatment	Secondary treatment	Tertiary treatment
Agglomerations	13	46	8
PE concerned	34,742	706,769	440,209

Midterm Scenario
In addition to the baseline scenario this scenario assumes full implementation of the UWWTD in all EU MS (including Coatia) and P removal for all agglomerations above 10,000 PE in the Non EU MS.
Vision Scenario
This scenario goes beyond the midterm scenario. It is based on the assumption that the full technical potential of wastewater treatment regarding the removal of organic material and nutrients is exploited for both, the EU and Non EU MS. The scenario assumes that agglomerations above 10,000 PE are equipped with N and P removal, whereas all agglomerations below 10,000 PE are equipped with secondary treatment.

- Industrial sector

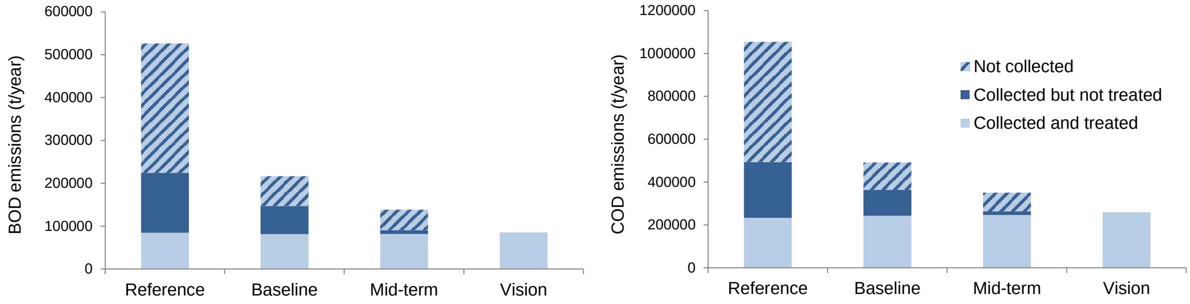
  Baseline scenario by 2021
  Introduction of Best Available Techniques (BAT) is expected at the main industrial facilities. This concerns all facilities under the scope of the Industrial Emissions Directive (IED) in the EU MS. In Non EU MS technology improvement is expected at a specific number of industrial plants by applying BAT.

8.1.1.1.5 Estimated effect of measures on the basin-wide scale

Maps on the above described scenarios for urban waste water sector are presented in Map 28-30 showing the envisaged future infrastructural developments in sewerage and waste water treatment technology. Estimated impacts of the baseline scenario on BOD and COD emissions are presented in Figure 39. Besides discharges directly entering surface waters (220,000 tons BOD per year, 490,000 tons COD per year) the emissions released to soil and groundwater via not collected waste water are also remarkable for the reference status (300,000 tons BOD per year, 560,000 tons COD year). The baseline scenario by 2021 estimates that emissions via uncollected waste water will significantly decrease due to the construction of sewer systems. This would raise the inputs of surface waters through connection to treatment plants and the subsequent concentrated discharges. However, as the treatment levels will be more enhanced resulting in higher removal rates, the overall surface water emissions will also decline. Some 35% (BOD) and 25% (COD) decrease in the surface water discharges is expected. Total emissions via urban waste water discharges will drop by about 59% and 53% respectively. Despite the significant progress expected the baseline scenario will probably not ensure the full achievement of the WFD environmental objectives by 2021 as a number of agglomerations will not have appropriate collection and treatment system established.

According to the other future scenarios the not collected and not treated fluxes will gradually decrease towards the vision (no uncollected and untreated waste water) due to the further developments. However, due to the high connection rates to and the enhanced elimination efficiency of treatment plants for organic substances the surface water emissions will also drop by 60% (BOD) and 50% (COD) in comparison to the reference status. Total BOD and COD emissions released to the environment are foreseen to be reduced by the vision scenario by about 85% and 75%, respectively.

Figure 39: BOD and COD emissions via urban waste water according to future scenarios



8.1.2 Nutrient pollution

8.1.2.1.1 Vision and management objectives

The ICPDR's basin-wide vision for nutrient pollution is the balanced management of nutrient emissions via point and diffuse sources in the entire Danube River Basin District that neither the waters of the DRBD nor the Black Sea are threatened or impacted by eutrophication.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU and Non EU Member States:

- ⇨ Further reduction of the total amount of nutrients entering the Danube and its tributaries and the nutrient loads transported into the Black Sea.
- ⇨ Further reduction of the nutrient point source emissions by the implementation of the management objectives described for organic pollution as they address the nutrient pollution as well.
- ⇨ Further reduction of the nitrogen pollution of the ground and surface waters by the implementation of the EU Nitrates Directive according to the developed action programs within the designated vulnerable zones or the whole territory of the country (EU MS).
- ⇨ Ensuring sustainable agricultural production and soil nutrient balances and further reduction of the diffuse nutrient pollution by implementation of basic and cost-efficient supplementary agri-environmental measures linked to the EU Common Agricultural Policy (EU MS) and by implementation of best management practices in the agriculture considering cost-efficiency (Non-EU MS).
- ⇨ Further decrease of the phosphorus point source pollution by implementation of the EU Regulation on the phosphate-free detergents (EU MS) and by reduction of phosphates in detergent products (Non-EU MS).

8.1.2.1.2 Progress in implementation of measures from 1st DRBM Plan

The 1st DRBM Plan summarizes, on the basin-wide level, the basic measures in the urban waste water, industrial and agricultural sectors and the implementation of the ICPDR Best Agricultural Practice (BAP) recommendations as the main measures to address nutrient emissions. Measures to control point source emissions include nutrient removal at urban waste water treatment plants (all treatment plants under construction or planned at agglomerations above 10,000 PE in the EU Member States contain tertiary treatment technology), enhanced treatment technologies at industrial facilities and application of P-free detergents in consumer laundry sector (see Annex 10 on measures in urban waste water and industrial sectors). In the agricultural sector, action programs are under implementation within the designated Nitrate Vulnerable Zones (NVZ, see Map 31) or over the whole national territory in the EU MS. In addition, measures under the Codes of Good Agricultural Practice are voluntarily implemented outside the zones. Moreover, a set of BAPs are applied on agricultural farms linked to the EU Common Agricultural Policy (CAP) and other national programmes (see Annex 11 on measures in agricultural sector). The measures under implementation are substantially contributing to the reduction of nutrient inputs into surface waters and groundwater in the DRBD but further efforts are still needed. Similarly to the organic pollution, the enhancement of the urban waste water treatment and application of BAT should continue. According to the assessments of the recent Implementation Report of the Nitrates Directive additional actions are needed to reduce and prevent pollution of the ground waters and in terms of extending NVZ designation and reinforcing action programmes in order to avoid eutrophication of the coastal waters. Countries should intensify their efforts to accelerate the identification and implementation of measures to reduce nutrient pollution particularly via diffuse pathways from agriculture. To further reduce nutrient loads of rivers, coastal waters and seas necessary to meet the environmental objectives of the WFD and DRPC should be further considered through basin-wide nutrient emission estimations and scenario assessment (using tools such as the MONERIS model). Efforts are needed to ensure necessary financial investments and clarification is required on how to finance agricultural measures. Past experience with the implementation of the ND and application of agri-environmental measures have clearly demonstrated the need for financial support out of the CAP. Nevertheless, countries should make use of the CAP-Reform. Between 2014 and 2020, over 100 billion EUR will be invested to help farmers meet the challenges of soil and water quality, biodiversity and climate change by funding environmentally friendly farming practices and agri-environmental measures from both direct payment and rural development pillars. Efforts to extend the introduction of phosphate-free detergents to all Danube countries are also likely to be needed. One of the challenging future tasks of this field is to better understand and realistically predict the possible future economic drivers, the agricultural development and changes and their anticipated impacts.

The measures implemented in the urban waste water sector might have short-term negative impacts if establishment of public sewer systems is not accompanied with appropriate nutrient removal technology before discharging into the recipients. Simple collection and concentrated discharge of waste water without sufficient tertiary treatment usually causes higher nutrient pollution of surface water bodies than dispersed smaller waste water discharges from septic tanks that percolate into groundwater and reach surface waters via base flow. Due to the longer time necessary for an effective management of diffuse nutrient pollution (longer residence time of groundwater, stored nutrients in bottom sediment of reservoirs) the water quality impacts of any changes in agriculture induced by the implementation of the ND or BAP recommendations will probably not be instantly visible but after several years or even decades only.

8.1.2.1.3 Summary of measures of basin-wide importance

Continuation of measures implementation in urban waste water, industrial, production and agricultural sectors is necessary in the next management period. As the point source pollution for nutrients and organic substances are highly interlinked their regulation is partially ensured by the same measures to be implemented. In the EU MS, the UWWTD requires more stringent removal technology than secondary treatment if the recipient water body is sensitive to eutrophication or the catchment in which a particular urban waste water treatment plant is located belongs to a sensitive water body. Since the Black Sea was significantly suffering from eutrophication and the receiving coastal areas have been designated as a sensitive area under the UWWTD, more stringent treatment technology than secondary treatment is needed at least at the medium-sized and large treatment plants. According to the UWWTD treatment plants with a load higher than 10,000 PE in the EU MS of the DRBD have to be subject to tertiary treatment (nutrient removal) or a reduction of at least 75% in the overall load of total phosphorus and nitrogen entering all urban waste water treatment plants has to be achieved. Old EU MS had to establish nutrient removal technology till 1999, new EU MS obtained longer implementation period. More stringent technology is strongly suggested for the Non-EU MS as well in order to ensure a consistent development strategy in waste water sector. The implementation of the IED in the EU MS and BAT recommendations in Non-EU MS can significantly reduce industrial and agricultural point source nutrient pollution.

Application of phosphate-free detergents in laundry is a great example for source control by reducing phosphorus inputs from laundry waste water. Introduction of phosphate-free detergents is considered to be a fast and efficient measure to reduce phosphorus emissions into surface waters. For the large number of settlements smaller than 10,000 PE the UWWTD does not legally require phosphorus removal. Reduction of phosphate in detergents could have a significant influence on decreasing phosphorus loads in the Danube, particularly in the short term before all countries have built a complete network of sewers and waste water treatment plants. The ICPDR has been highly supporting the introduction of the phosphate-free detergents in the Danube countries which committed themselves at ministerial level to initiate the introduction of a maximum limit for the phosphate content of the consumer detergents. The EU Regulation 259/2012 regarding the use of phosphate-free detergents has recently been put into force for consumer laundry and will be for automatic dishwashing on the 1st of January 2017 that prescribes limitations on the phosphate contents of a detergent dose in a laundry/dishwashing cycle. The Regulation has to be implemented in all EU MS and similar efforts are either already in progress or recommended to be made in Non-EU MS.

Diffuse pathways have a dominant share in the total nutrient emissions, therefore implementation of measures addressing land management has high importance. A key set of measures to reduce nutrient inputs and losses related to farming practices and land management has been identified as appropriate management tools to be applied in agricultural areas. Agricultural nitrogen pollution of ground and surface water is regulated by the ND in the EU MS. It requires designation of vulnerable zones (NVZ) that are hydraulically connected to waters polluted by nitrate or sensitive for nitrate pollution or alternatively, to apply the whole territory approach. In the zones (or over the whole territory) the amount of nitrate that is applied on agricultural fields in fertilizer or manure is limited and the application is strictly regulated through action programmes with basic mandatory measures. A code of good agricultural practices is also recommended outside the NVZs on voluntary basis to ensure low nitrogen emissions entering the river network. A set of measures related to the concept of Best Agricultural Practices (BAP) is also suggested to be adopted in the entire Danube Basin. The concept has been applied to different extent among the countries to manage inter alia diffuse nutrient emissions that is partly covered by the ND for nitrate pollution in the EU MS. It concerns appropriate land management activities (source and transport control measures) that are able to prevent, control and minimize the input, mobilization and transport of nutrients from fields towards water bodies. The management usually leans on both compulsory actions and voluntary measures that are acceptable for the farming community and subsidized or compensated via regional/state funds (e.g. cross-compliance and "greening" under the direct payment pillar and agri-environmental measures in rural development programmes of the CAP). The critical area concept is an emerging approach in several countries that aims to find technically and economically feasible measures. It considers that management activities should focus on those areas where the highest emissions come from and where the highest fluxes from land to water probably are transported. Targeting management actions to these critical fields can provide cost-efficiency (high river load reduction at minimal implementation costs and area demand).

The agricultural sector should be particularly addressed as significant amounts of nutrients stem from agricultural fields. The ICPDR intends to organize in close cooperation with the agricultural sector and all relevant stakeholders a broad discussion process with the aim of developing a guidance document on good agricultural practices in the DRB. It would aim at recommending good agricultural practices and policy instruments to ensure the effective protection of both, the surface and ground water bodies of the DRB and the Black Sea coastal waters and sustainable agricultural production and nutrient balance in the Danube countries. The document would provide with a sound knowledge base on the agricultural sector and the connections to water environment, highlight the existing relevant European legislative framework and financial mechanisms, summarize cross-compliance as well as supplementary measures related to the CAP and other financial programs and recommend policy tools and cost-effective measures supported by case studies in order to facilitate the introduction of good agricultural practices within the DRB.

8.1.2.1.4 Future development scenarios

- Urban waste water sector

  Baseline scenario by 2021

  It concerns the implementation of the UWWTD in the EU MS (except Croatia) and implementation of the related commitments in the Non EU MS.

  Midterm Scenario

This scenario describes implementation of the UWWTD in EU MS (including Croatia) and P-elimination for agglomerations above 10,000 PE in Non EU MS.

Vision Scenario

It assumes establishment of N and P removal technology for all agglomerations above 10,000 PE and secondary treatment for all agglomerations below 10,000 PE in all countries.

- Industrial sector

Baseline scenario by 2021

Implementation of the IED in the EU MS and introduction of BAT to improve industrial technologies in Non EU MS are expected.

- Agricultural sector

Baseline scenario by 2021

A set of basic measures and best agricultural practices are expected based on the most realistic estimates of the countries for future agricultural development in the agricultural sector and implementation of measures foreseen by the countries. In EU MS the measures are in compliance with the ND, the Good Agricultural and Environmental Conditions (GAECs) and "greening" required under the first pillar of CAP and also include agri-environmental measures supported by the CAP rural development programmes. In Non EU MS a bunch of best agricultural practices is expected to be implemented.

Intensification Scenario

This scenario describes an intensive agricultural development for the middle and lower DRB, whereas agricultural nutrient surpluses are projected. It assumes that surpluses in the new EU MS and non-EU MS will reach the level of the EU15 countries around the year 2010 (55 kg N per hectare and year). The implemented measures are identical to the Baseline scenario.

Vision Scenario

This scenario describes sustainable agricultural development and balanced nutrient management based on agricultural predictions of the OECD and the CAPRI model. The implemented measures are identical to the Baseline scenario assuming high utilisation of the agri-environmental measures of the CAP rural development pillar in the EU MS. Similar BAP measures are assumed to be taken in the Non EU MS.

- Detergents sector

Baseline scenario by 2021

Full implementation of the Regulation on phosphate-free detergents in EU MS (laundry and dishwasher) is expected. Introduction of the P-free laundry detergents is assumed in Non-EU MS.

Mid-term/Vision Scenario

Introduction of phosphate-ban in laundry and dishwasher detergents is expected in all countries.

- All sectors

Baseline scenario by 2021

This scenario represents a combined baseline scenario of the various sectors described above.

Vision Scenario

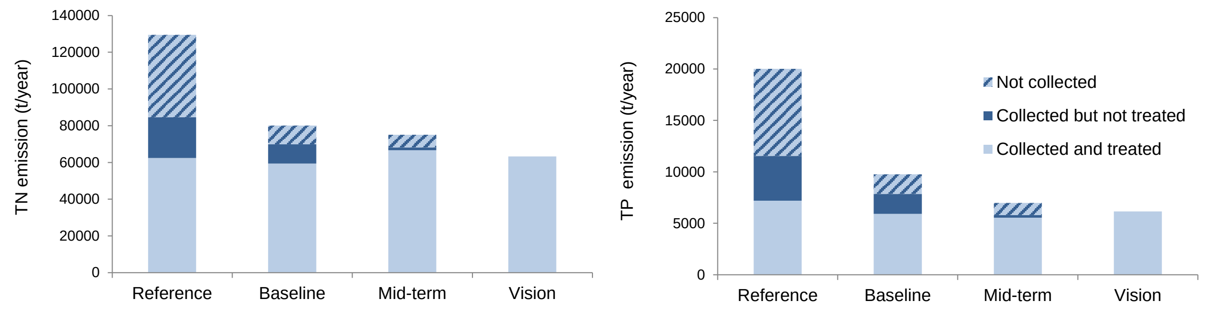
This scenario represents a combined vision scenario of the various sectors described above.

8.1.2.1.5 Estimated effect of measures on the basin-wide scale

Similarly to the organic pollution, higher connection rates and introduction of higher level technologies at treatment plants will result in decreasing nutrient emissions via urban waste water (Figure 40). Regarding nitrogen, not collected and not treated emissions will be substantially lower by 2021, however, only a smaller decrease is expected for the surface water emissions (about 17%). For phosphorus, surface water emissions will drop by 30% due to the high removal rate available for P and the application of P-free detergents. The latter still has a great reduction potential as half of the expected decrease (15%) is due to the assumed basin-wide application of P-free laundry detergents. Total emissions released to the environment via urban waste water discharges are expected to be declined by 40% (TN) and 50% (TP). Despite the significant progress expected the baseline scenario will probably not ensure the full achievement of the WFD environmental objectives by 2021 as a number of agglomerations above 10,000 PE will not have more stringent treatment technology put in place.

Additional future scenarios represent further reduction of emissions as the measures will address higher proportion of agglomerations. For the vision scenario 25% (TN) and 45% (TP) decrease is estimated for the surface water emissions, whilst total emissions will be reduced by 50% and 70%, respectively.

Figure 40: TN and TP emissions via urban waste water according to future scenarios



- Analysis of expected effects of measures according to the scenarios in agriculture at the basin-wide scale (graphs, tables and maps on emissions)

8.1.3 Hazardous substances pollution

8.1.3.1.1 Vision and management objectives

The ICPDR's basin-wide vision for hazardous substances pollution is no risk or threat to human health and the aquatic ecosystem of the waters in the Danube River Basin District and Black Sea waters impacted by the Danube River discharge.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU and Non EU Member States:

- ⇨ Closing knowledge gaps on the hazardous substances of Danube basin relevance.
- ⇨ Further elimination/reduction of the amount of hazardous substances entering the Danube and its tributaries (EU MS: by implementing the EQS Directive).
- ⇨ Further reduction of the point source emissions by the implementation of the management objectives described for organic pollution as they address the hazardous pollution as well.
- ⇨ Further reduction of the diffuse pollution of agricultural chemicals by implementation of supplementary measures linked to EU Common Agricultural Policy, implementing the Sewage Sludge Directive and the Pesticides Directive (EU MS) and by implementation of best management practices in the agriculture (Non-EU MS).

- ⇨ Ensuring the safe application of chemicals (EU MS: by implementing inter alia the Plant Protection Products Directive, the REACH Regulation and the Biocides Regulation).
- ⇨ Minimisation of the risk of accidental pollution events by using enhanced technologies and putting in place appropriate safety measures (EU MS: by implementing the Seveso, Mining Waste and Industrial Emission Directives, Non-EU MS: by fulfilling the obligations/adopting recommendations of the UNECE Convention on the transboundary effects of industrial accidents).

8.1.3.1.2 Progress in implementation of measures from 1st DRBM Plan

The 1st DRBM Plan highlights the measures of basin-wide importance in the waste water, industrial and agricultural sectors to be implemented in order to reduce and/or eliminate the hazardous substances discharges into the surface water bodies. Enhancing waste water treatment and industrial technologies, phasing out certain substances from the market products and promoting sustainable use of sewage sludge and pesticides in the agriculture are the most important measures recently being implemented (see Annex 10 on measures in urban waste water and industrial sectors and Annex 11 on measures in agricultural sector). In addition, Danube countries have taken significant steps in order to close information gap on hazardous substances pollution. Prioritisation of the emerging pollutants, data collection on the major point sources releasing hazardous substances and accident risk analysis of the industrial and contaminated sites are those on-going activities which can provide more detailed information on the existence, sources and fate of hazardous substances in the Danube Basin.

Despite the substantial progress achieved in many aspects of the hazardous substances pollution the state of the art knowledge needs to be improved and the implementation of measures should be proceeded in the future to appropriately manage the problem. Further efforts are needed to identify which priority substances and other emerging chemicals are of basin-wide relevance. Moreover, limited information is recently available on the emission sources contributing to hazardous substances contamination of the surface waters. This information gap should be narrowed. Implementation of the measures should be continued in compliance with the existing legislative framework in order to reduce hazardous substances pollution releases. Regular update of a basin-wide catalogue of hazardous industrial, abandoned and mining sites and providing with recommendations for preventive measures in the key industrial sectors are important future tasks to be accomplished as well.

8.1.3.1.3 Summary of measures of basin-wide importance

Measures to address hazardous substances releases should be further implemented in various fields. Appropriate treatment of urban waste water and application of BAT in the industrial plants and large agricultural farms are elementary measures and can significantly contribute to the mitigation of hazardous contaminations. Implementation of the UWWTD and IED in EU MS is also highly beneficial for the reduction of hazardous substances pollution. In Non-EU MS the considerable efforts to be made in order to develop and improve the waste water sector and industrial technologies will have also positive effects on water quality related to hazardous substances pollution. Other EU legal documents like the Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), the Plant Protection Products Regulation, the Biocidal Products Regulation, or the Pesticides Directive aim to minimize the release of chemicals in order to protect human health and environment. For instance, they lay down rules for the authorisation of products containing dangerous chemicals and regulating their placing on the market, enforce substitution or exclusion of certain substances, ensure the safe application of products containing dangerous chemicals and prescribe emission limits for the hazardous substances. The EQSD interconnected with the WFD intends to regulate water pollution of priority substances by setting up EQS values for the priority substances and mandating to phase out priority hazardous substance emissions for the dischargers. Reporting on emissions, discharges and losses of these substances is also obligatory.

The progressive development of the urban waste water sector increases the quantities of sewage sludge that requires disposal. The SSD (currently being assessed whether a revision is needed) seeks to encourage the use of sewage sludge in agriculture and simultaneously regulates its use in such a way as to prevent harmful effects on soil, vegetation, animals and human beings. Detailed recording is required on the circumstances of sewage sludge application in agriculture and a set of limit values for concentrations of heavy metals in sewage sludge intended for agricultural use and in sludge-treated soils is assigned. Therefore, implementation of the SSD helps to avoid hazardous substances pollution by restricting the application of contaminated sludge to agricultural fields. Management actions similar to those of the EU MS are recommended for the Non-EU MS. Sustainable pesticide usage in the agriculture can also be managed by some BAP measures that are on-going activities in both EU and Non-EU MS.

To avoid major accidental pollution events, EU MS are obliged to implement the Seveso and the Mining Waste Directives. Operators of the facilities/mines under the umbrella of the Directives have to develop a safety management system, provide safety reports and information for the public and elaborate emergency plans for both, the internal and surrounding areas of the establishments. Moreover, Parties of the UNECE Convention on the transboundary effects of industrial accidents have to fulfil the obligations of the Convention. It aims to prevent accidents and to mitigate their effects if required and also promotes active international cooperation regarding accident risk mitigation.

Further efforts are needed to compile the basin-wide inventory on discharges, emissions and losses in a comparable and coordinated way and develop a strategy to improve and harmonize the approach for the elaboration of the inventory. In particular the lack of high quality monitoring data on priority substance discharges from waste water effluents has to be addressed by e.g. specific sampling campaigns prior to the update of the inventories. This will ensure to have a consistent picture on the point sources of the relevant hazardous substances. Application of regionalised modelling tools that are able examine sources and pathways for certain substances and in-stream transport and water quality models (e.g. models developed by SOLUTIONS and JRC) can additionally help to fill knowledge gaps. To support these activities further information on in-stream concentrations and river loads via improved regular monitoring (enhanced devices and higher sampling frequency) is needed. The information to be further gained from JDS3 and its follow-up activities will strongly facilitate the prioritisation of the hazardous substances that could potentially be relevant in the Danube basin. Furthermore, if the same approach is applied for the tributaries of the Danube River, additional data can be collected offering a more complete picture on the DRB.

Appropriate control of accidental pollutions is essential in order to mitigate adverse effects of hazardous substances spills. The Danube countries have made efforts in order to ensure effective and quick responses to transboundary emergency cases. The Accident Emergency Warning System (AEWS) was developed to timely recognise emergency situations. It is activated if a risk of transboundary water pollution exists and alerts downstream countries with warning messages in order to help national authorities to put safety measures timely into action. The AEWS has been operated, maintained and enhanced by the ICPDR Secretariat. In addition, activities on accident risk prevention should be continued in the priority industrial sectors in order to appropriately mitigate accidental pollution risk. Besides identifying the most important potential accident hot-spots the ICPDR should ensure that a proper platform for information exchange and know-how transfer is provided for the countries to facilitate risk management in the identified key industrial fields and recommend particular preventive measures to be implemented. This can be supported by flagship projects and workshops with an active involvement of the ICPDR.

8.1.3.1.4 Estimated effect of measures on the basin-wide scale

Due to the lack of reliable information on the sources of hazardous substances pollution a detailed assessment on the effects of measures to be implemented cannot be performed. Achievement of the WFD environmental objectives and the respective basin-wide management objectives might not be possible by 2021 due to the existing knowledge gaps although measures to be implemented in the next management cycle will improve the situation.

8.1.4 Hydromorphological alterations

The pressure analysis shows that surface waters of the DRBD are impacted by hydromorphological alterations to a significant degree. Interruption of river continuity and morphological alterations, disconnected adjacent wetlands/floodplains, hydrological alterations and future infrastructure may impact water status and are therefore addressed as part of the JPM.

On the European level, measures related to the improvement of hydromorphological alterations are exclusively foreseen and required by the EU WFD and not by any other, specific European Directive. Therefore the respective DRBD management objectives have an important role in guiding the joint improvement of ecological water status.

Measures addressing different hydromorphological alterations, planned to be implemented by 2015, were included in the JPM of the 1st DRBM Plan 2009. The following chapters inter alia outline progress in the implementation of these measures. The starting point for the assessments are the measures which were indicated in the JPM of the 1st DRBM Plan, updated with information on the finally agreed measures in the national programs of measures and progress in measures implementation. Information on the implementation status is based on the assessments of the 2012 Interim Report which was updated with latest information for the reference year 2015. In case delays in the implementation are observed, different reasons were indicated, including the lack of financial resources, difficulties in solving issues related to ownership questions, next to the need for further assessments. Further detailed information for each country can be obtained from Annex 12. The ongoing implementation of measures provides the opportunity to monitor the effectiveness of measures (e.g. the performance of fish migration aids) as well as the effects on water status (e.g. of re-connecting wetlands and floodplains). Exchange of experiences will be useful towards reaching more cost-effective programs of measures in the future.

Furthermore, measures which are planned to be implemented on the basin-wide scale by 2021 are summarised for each hydromorphological component. In cases where countries share river stretches it is likely that some hydromorphological components (river and habitat continuity interruption, hydrological alterations) include double-counts. This is because the information has been reported separately by the Danube countries which might in some cases not be bilaterally harmonised. However, as already outlined in the 1st DRBM Plan the discrepancy between the results of the analysis and the factual values without double-counts is estimated to be low. For cases where countries reported separately for shared river stretches further harmonisation efforts are needed in the future.

8.1.4.1 Interruption of river continuity and morphological alterations

8.1.4.1.1 Vision and management objectives

The ICPDR's basin-wide vision for hydromorphological alterations is the balanced management of past, ongoing and future structural changes of the riverine environment, that the aquatic ecosystem in the entire DRB functions in a holistic way and is represented with all native species.

This means in particular, that anthropogenic barriers and habitat deficits do not hinder fish migration and spawning anymore – sturgeon species and specified other migratory species are able to access the Danube River and relevant tributaries. Sturgeon species and specified other migratory species are represented with self-sustaining populations in the DRBD according to their historical distribution.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ Construction of fish migration aids and other measures at existing migration barriers to achieve/improve river continuity in the Danube River and in respective tributaries to ensure self-sustaining[72] sturgeon populations and specified other migratory fish populations

[72] Populations that are maintaining a group size, age structure and genetic heterogeneity through natural reproduction and recruitment that is sufficient to ensure the long-term stability of the population without external support measures.

- Specification of number and location of fish migration aids and other measures to achieve / improve river continuity, which will be implemented by 2021 by each country.

⇒ New barriers for fish migration imposed by new infrastructure projects will be avoided; unavoidable new barriers will incorporate the necessary mitigation measures like fish migration aids or other suitable measures already in the project design according to BEP and BAT.

⇒ Restoration, conservation and improvements of river morphology, habitats and their connectivity for self-sustaining sturgeon populations and other type-specific fish populations in the Danube River and the respective tributaries, also contributing to the improvement of other aquatic biological quality elements.

- Specification of location and extent of measure for the improvement of river morphology, which will be implemented by 2021 by each country.

⇒ Closing the knowledge gaps on the possibility for sturgeon and specified other migratory species to migrate upstream and downstream through the Iron Gate I & II dams including habitat surveys, based on progress achieved on this issue. If the results of these investigations will be positive the respective measures should be implemented and step by step a similar feasibility study will be performed for the Gabcikovo Dam and in case of positive results also for the Upper Danube.

8.1.4.1.2 Progress in implementation of measures from 1st DRBM Plan

The measures on river continuity for fish migration which were planned to be implemented between 2009 and 2015 are indicated in Table 29. In total, 108 measures were indicated in the 1st DRBM Plan 2009, whereas in total 168 measures were finally agreed on national level to be implemented by 2015.

The implementation status in Table 29 is largely referring to the end of 2012, whereas updated information was partly provided. 79 measures have been completed and 44 are in the construction phase. For 38 measures the planning process is on-going, while for 7 measures the implementation process was not started.

Table 29: Progress in implementation of measures on restoration of river continuity for fish migration

Number of measures to be implemented by 2015		Implementation status (in reference to finally agreed measures)			
Indicated in the 1st DRBM Plan	Finally agreed measures at national level	Not started	Planning on-going	Construction on-going	Completed
108	168	7 (4%)	36 (21%)	45 (27%)	80 (48%)

In support for implementing fish migration measures, the ICPDR organised in 2012 a workshop on river and habitat continuity. The workshop allowed for exchange between fish migration experts and for the elaboration of the ICPDR Technical Paper “Measures for ensuring fish migration at transversal structures”[73], summarising the latest knowledge on fish migration aids.

Information on progress regarding the step-by-step approach to jointly ensure the achievement of the management objectives related to the restoration of river and habitat continuity in the DRB and the elaboration of the Iron Gates feasibility study can be obtained further below.

8.1.4.1.3 Summary of measures of basin-wide importance

8.1.4.1.3.1 Interruption of river continuity for fish migration

The DRB rivers with catchment areas >4,000 km^2 are large to medium sized and include crucial living and spawning habitats, vital to the life cycles of fish species. These rivers are the key routes and

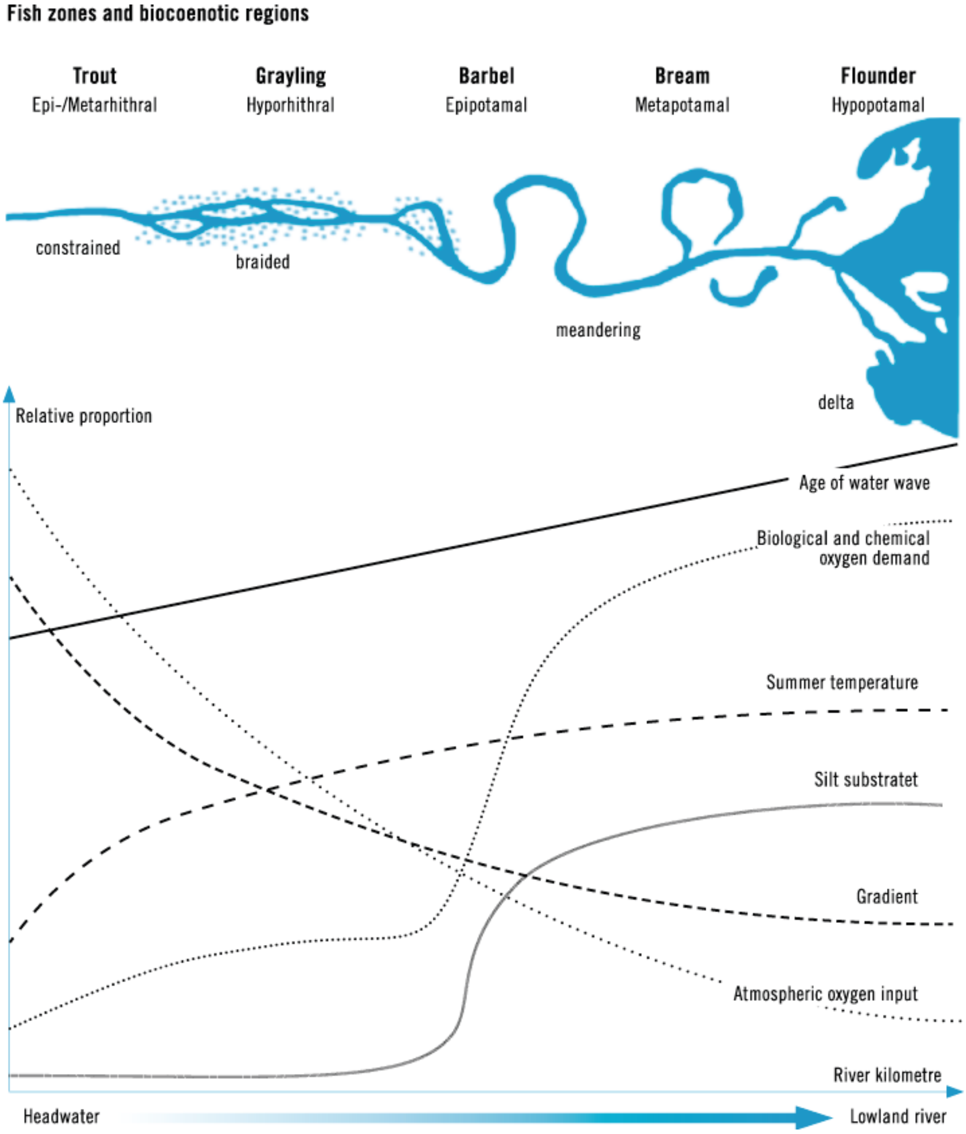
[73] Schmutz S., Mielach C.; Measures for ensuring fish migration at transversal structures – ICPDR Technical Paper; ICPDR (2013).

starting points of fish migration for long and medium distance migratory fish species. The Danube River, for example, is not only a key migration route itself, it is also of special importance for those species migrating from the Black Sea and connects all tributaries in the basin for migration.

The overall goal of river continuity restoration is free migration routes for the DRBD rivers with catchment areas >4,000 km^2, as this will be crucial for achieving and maintaining good ecological status/potential for the future. However, due to the results of the objective setting undertaken at the national level (related to the application of WFD Article 4(5)), some restoration measures might not be implemented.

In general, all fish species of the DRB are migratory, however, the importance of migration for the viability of fish populations varies considerably among them. Differences exist in terms of migration distances, direction (upstream, downstream, lateral), spawning habitats, seasons and the life stage for which migration takes place. DRB migration requirements are more relevant in lowland rivers than in headwater fish communities. (The definition of headwater and lowland rivers and their relation to the rhithral and potamal sections, as well as the different fish regions of rivers, are illustrated in Figure 41).

Figure 41: Fish zones, abiotic conditions and rhithral (headwater)/potamal (lowland river) sections (adapted from Jungwirth et al. 2003)[74]



Long distance migrants (LDM), such as the Beluga sturgeon (Huso huso), formerly migrated from the Black Sea up to (what is termed) the Barbel region of the DRB. Medium distance migrants (MDM, so called potamodromous fish species) such as Nase (Chondrostoma nasus) and Barbel (Barbus barbus) migrate within the river over distances between 30 to 200 km within the Barbel and Grayling regions of the DRB[75]. In contrast, headwater fish species migrate over comparable short distances because their living an spawning habitats are closer to each other. Nevertheless, under a long term perspective all fish species need open river continuity.

Table 30 lists examples for both the long distance migrants of the DRB as well as nine DRB medium distance migrants that are represented with the highest numbers in the Danube River and adjacent lowland rivers, and which are therefore of key importance regarding continuity restoration. The key MDMs have been selected out of overall 58 fish species that have been classified in the European FP7

[74] Jungwirth, M., Haidvogl, G., Moog, O., Muhar, S., Schmutz, S. (2003): Angewandte Fischökologie an Fließgewässern. p552; Facultas Universitätsverlag,Wien; ISBN 3-8252-2113-X.

[75] Waidbacher, H. & G. Haidvogl (1998): Fish migration and fish passage facilities in the Danube: Past and present. In: Jungwirth, M., Schmutz, S. & Weiss, S. (eds.): Fish Migration and Fish Bypasses. Oxford, Fishing News Books: pp 85-98.

Project EFI+. The technical report on the ecological prioritisation approach from the 1st DRBM Plan includes more details on LDMs and MDMs.

Table 30: Examples for long and medium distance migrants in the DRB (based on EFI+ guild classification)

DRB Long Distance Migrants (LDM)			
	Nr.	Scientific name	English name
	1	*Huso huso*	Great sturgeon, beluga
	2	*Acipenser guldenstaedti*	Russian sturgeon
	3	*Acipenser nudiventris*	Ship sturgeon
	4	*Acipenser stellatus*	Stellate sturgeon
	5	*Alosa caspia*	Caspian shad
	6	*Alosa immaculate (pontica)*	Pontic shad
DRB Medium Distance Migrants (MDM)			
	1	*Abramis brama*	Common bream
	2	*Abramis sapa*	Danubian bream
	3	*Acipenser ruthenus*	Sterlet
	4	*Aspius aspius*	Asp
	5	*Barbus barbus*	Barbel
	6	*Chondrostoma nasus.*	Nase
	7	*Hucho hucho*	Danube salmon
	8	*Lota lota*	Burbot
	9	*Vimba vimba*	Vimba

Ecological prioritisation approach for continuity restoration in the DRB

One focus for measures in the DRBD is on establishing free migration for long and medium distance migrants of the Danube River and the connected lowland rivers that are addressed at the Roof level.

In order to enable a sound estimation of where to target measures most effectively at the basin-wide scale, an ecological prioritisation of measures to restore river and habitat continuity in the DRBD was carried out for the 1st DRBM Plan. The elaborated approach provided indications on the step-wise and efficient implementation of restoration measures at the basin-wide scale. It provided useful information on the estimated effects of national measures in relation to their ecological effectiveness at the basin-wide scale and served as a supportive tool for a number of countries in the implementation of measures. Therefore, it also supports feedback from international to national level and vice versa.

In the Danube Declaration 2010 the Danube countries reconfirmed their commitment to further develop and make full use of the ecological prioritisation approach for measures to restore river and habitat continuity in order to ensure that they are ecologically most efficient. Therefore, the ecological prioritisation approach has been further developed and updated for the DRBM Plan – Update 2015.

Key migration routes for long and medium distance migrants of the DRB are addressed. The illustrated distribution of LDMs is based on historical information going back centuries. The historical information serves the definition and use as reference conditions corresponding to entirely or almost entirely undisturbed natural conditions. The distribution of MDMs is based on modelled data that has been calibrated with current information. Further details of the prioritisation approach can be obtained from Annex 13.

In general, the updated approach is based on the first version including various criteria focusing on the migratory behaviour (migration distances and key migration routes) of LDMs as well as MDMs in the DRB. Again, apart from other criteria like the distance from the river mouths, reconnected habitat lengths or protected sites, the prioritisation principle follows the idea that LDM within the Danube receive the highest priority followed by LDM within the tributaries and MDM which receive less priority. For the updated approach, additional criteria (the number of pressures in the respective water body) were added, whereby barriers in un-impacted water bodies are prioritized to focus in the restoration activities on the connection to high quality habitats. The output of the approach is a calculated Prioritisation Index (PI = migratory habitat x (1 + first obstacles upstream + distance from mouth + reconnected habitat + protected site + number of pressures). This allows an estimation of where measures would be most effective from the ecological point of view for implementation on the basin-wide scale. A maximum possible PI value of 44 indicates the utmost priority for LDM, whereas a PI of 0 indicates a low priority for a measure. The PI was grouped into classes of ecological priority (utmost priority for LDM: PI >30, utmost priority: PI 21-30, very high priority: PI 16-20, high priority: PI 11-15, medium priority: PI 6-10, low priority: PI 1-5 and not relevant in case a fish migration aid is in place).

Since LDM are currently hindered from passing the Iron Gates further upstream, barriers with existing fish migration aids were considered as not relevant in the updated calculation at this stage of the elaboration of the draft DRBM Plan – Update 2015. However, as described in more detail later on in this chapter, a step-wise approach is followed to ensure free fish migration in the Danube River as a key migration route connecting all tributaries. Therefore, in the future, in case the Iron Gates can be made passable, the barriers have to be assessed again considering also the passability for LDM-species.

The key findings of the ecological prioritisation approach are illustrated in Map 33. The results show that according to the defined prioritisation criteria continuity interruptions in the lower Danube (Iron Gates, two barriers) receive the highest priority with PI values of 44. Those barriers are considered of utmost priority for LDM species. Also in the middle (Gabcikovo Dam) and upper Danube barriers with utmost priority are located – in total four with PI values of 24. Furthermore, 6 barriers are considered of very high priority, 13 of high priority, 125 of medium and 341 of low priority. The remaining 193 barriers are located in the headwaters (i.e. outside of LDM-/MDM-habitats) and therefore received no priority respectively 16 barriers are outside of the fish region and LDM-/MDM-habitats.

Generally it can be stated that the importance to restore upstream/headwater interruptions increases as soon as downstream continuity interruptions are restored. However, low restoration priority indicated on the basin-wide level does not imply that no measures should be undertaken on the national level, as all fish species need open river continuity. Therefore, results of the proposed prioritisation are recommended to be used as a guideline for implementing ecological efficient measures. However, it has to be pointed out that ecological prioritisation is only one aspect in deciding which measures to implement. Several other important aspects (e.g. technical, economic and/or administrative issues) exist alongside ecological prioritisation, which have to be taken into account when deciding at national level where priority measures will be implemented by 2021 and beyond.

The Danube River and the restoration of river and habitat continuity

The status of migratory fish, such as sturgeon (declared as a species of basin-wide importance in the framework of the ICPDR), is a parameter of the ecological condition and important indicator of the entire DRB.

The Danube River itself is a key migration route and connects all tributaries for migration. The Iron Gate Dams I & II, in part the Gabcikovo Dam, and the chains of hydropower plants in AT and DE represent significant migration barriers for fish. Migratory fish, such as sturgeon and medium distance migrators, are particularly affected, being unable to move up or downstream between their spawning grounds and areas used at other times in their life cycle.

As already pointed out in the 1st DRBM Plan 2009, in particular, the impact of the Iron Gate Dams I and II has resulted in sharp declines in most Danube sturgeon species, with significant regional economic impacts on the productivity of fisheries. As a result, the ICPDR has developed a step-by-step approach to jointly ensure the achievement of the management objectives related to the restoration of river and habitat continuity in the DRB. A first step foresees the performance of a feasibility study to analyse the possibility to re-open the Iron Gate Dams for free fish migration, with a focus on sturgeon species. Information on the feasibility study's key objectives can be obtained from the 1st DRBM Plan.

The technical and ecological problems to be investigated and overcome are complex. However, steps were made towards the investigation of the issue as part of the overall feasibility study to be performed. In 2011, a scoping mission to the Iron Gates complex was organised by the ICPDR together with Romania, Serbia, and with support from FAO and international fish migration experts. The mission allowed to undertake first considerations of potential technical solutions[76].

Following, under Dutch – Romanian partnership and with ICPDR and further international support, the project "Towards a Healthy Danube – Fish Migration Iron Gates I & II"[77] was initiated in 2013 and completed in October 2014. The project allowed for further investigations on potential technical solutions and for the elaboration of a road map, providing guidance for a project process that leads to a feasibility analysis of the implementation of fish migration measures at both Iron Gates I and II. The following next steps are inter alia proposed in the roadmap for addressing the Iron Gates issue:

1. Preparation (2014-2015): Test monitoring techniques, analyse fish monitoring data, genetic analysis sturgeons;
2. Alternatives and preliminary design (2015-2017): Monitoring at IG I & II (fish behaviour, to be continued also during phase 3 and phase 4), monitoring sturgeon in reservoir, fish test damage turbine at IG I & II (downstream migration), analysis hydrological model, alternatives study and preliminary design for different facilities at IG I & II;
3. Technical design (2018): Technical design fish migration facilities, tender document;
4. Construction (2019 →): Implementation

Results of the investigations as outlined above and therefore the full feasibility study can be expected during the second WFD cycle only in case the required funding can be ensured.

In case the results from the feasibility study are positive, the next steps for the ICPDR approach include the implementation of measures for the Iron Gate Dams and a similar feasibility study regarding Gabcikovo Dam. Once the decision is made to assist sturgeon species in bypassing the Gabcikovo Dam, respective actions need to be discussed and considered in the upper DRB.

The Danube countries have reported on the measures that will be undertaken by 2021 to ensure fish migration (where still needed) e.g. by the construction of fish migration aids. Measures that will be taken are intended to ensure both up and downstream migration of fish[78] and will also help to improve the migration of other fauna.

[76] For details see: Comoglio, C. (2011): FAO Scoping mission at Iron Gates I and II dams (Romania and Serbia). Preliminary assessment of the feasibility for providing free passage to migratory fish species. Mission report May 2011.

[77] For details see: W. Bruijne, et.al., Towards a Healthy Danube – Fish Migration at Iron Gates I & II; October 2014.

[78] The restoration of downstream connectivity is still less advanced than it is for upstream fish passage. This is due to the fact that the re-establishment of connectivity started with upstream migration and that downstream migration problems have only been recognised and addressed more recently. Further details and information on possible solutions can be obtained from the ICPDR Technical Paper "Measures for ensuring fish migration at transversal structures".

Figure 42 and Map 32 illustrate that, as of 2015, 660 interruptions of river and habitat continuity are located in the DRBD (52 of which are located in the Danube River). By 2021, 118 fish migration aids are planned to be constructed in the DRBD that should ensure the migration of all fish species and age classes according to best available techniques. 330 measures to restore river continuity interruptions are planned to be implemented after 2021 (WFD Article 4(4)) and 36 measures are not planned to be implemented (WFD Article 4(5)).

No measures are planned for 70 continuity interruptions since the respective water bodies are reported to be already in good status/potential and no measures are yet indicated for 122 continuity interruptions, meaning that at present no measures are foreseen and neither WFD Article 4(4) nor 4(5) is applied. More detailed information for each country can be obtained from Table 31 and Map 32.

Figure 42: Measures on river continuity for fish migration by 2021 and exemptions

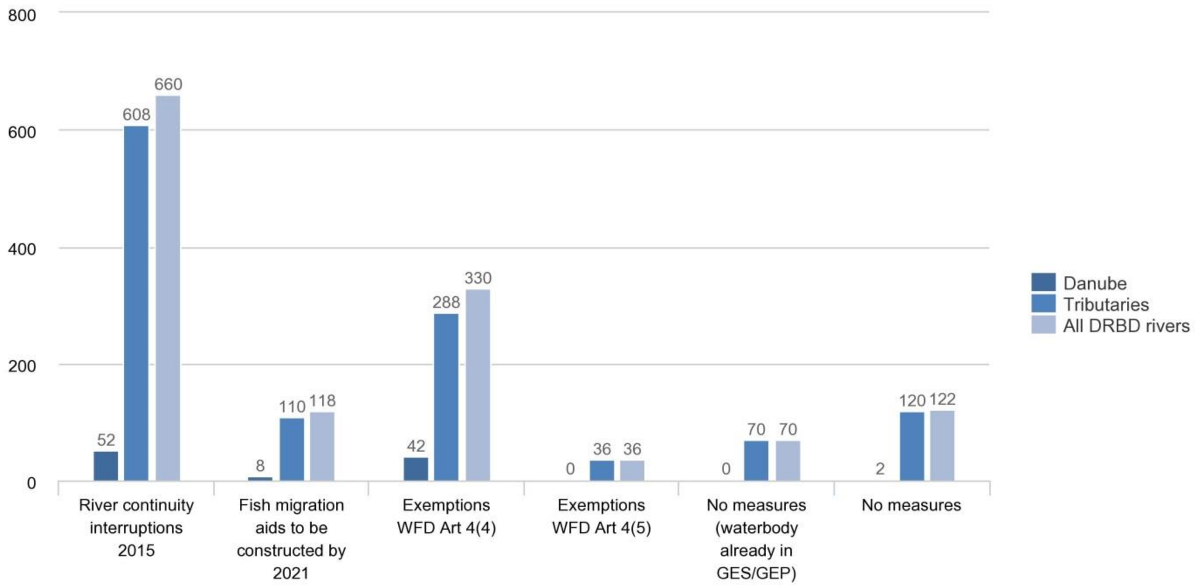


Table 31: Measures on river continuity for fish migration by 2021 and exemptions for each country

Country	River continuity interruptions 2015	Fish migration aids to be constructed by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures planned since water body already in GES/GEP	No measures yet indicated
DE	148	9	139	-	-	-
AT	197	76	121	-	-	-
CZ	72	2	-	-	-	70
SK	83	19	62	-	-	2
HU	11	-	-	-	-	11
SI	14	-	-	-	-	14
HR	2	-	-	-	-	2
BA	3	-	-	-	-	3
ME	-	-	-	-	-	-
RS	15	1	-	-	-	14
RO	75	1	4	16	70	-
BG	40	10	4	20	-	6
MD	-	-	-	-	-	-
UA	-	-	-	-	-	-
Total	**660**	**118**	**330**	**36**	**70**	**122**

Table 32 indicates that in total river continuity will restored in 69 water bodies until 2021, with 224 which will remain affected out of a total number of 760 water bodies.

Table 32: Number of river water bodies affected and restored for fish migration by 2021

	Total number of WBs	WBs affected by continuity interruptions by 2021	Water bodies restored for continuity by 2021
Danube River	61	23	5
DRBD tributaries	699	201	57
All DRBD rivers	760	224	62

8.1.4.1.3.2 Alteration of river morphology

Deterioration of the natural river morphology influences habitats of the aquatic flora and fauna and can therefore impact water ecology. Morphological alterations can inter alia be caused by bed and bank reinforcement for erosion control, the straightening and deepening of the river channel or by river substrate manipulation like the removal of silt and gravel. Aggregated information on water body level on the measures planned to be implemented until 2021 for the improvement of river morphology is summarised as follows.

As illustrated in Figure 43 and on Map 34, out of the total 760 river water bodies, morphology was restored in 2015 for 33 water bodies and for 163 water bodies no measures are necessary for the achievement of GES/GEP. Morphological measures are planned to be implemented for 70 water bodies until 2021. Exemptions according to Art. 4(4) are applied for 139 water bodies and therefore measures are planned to be taken at a later stage. For 6 water bodies no measures are applied (Art. 4(5)), respectively no measures were yet indicated for 87 water bodies. Further details on the planned measures and exemptions on the country level can be obtained from Table 33.

For 262 water bodies it is still unknown whether measures are necessary or will be implemented. Obtaining a clear picture on the possibilities for morphological measures implementation until 2021 is considered as a challenge. This since success in measures implementation often depends on the results of negotiations between authorities, land owners and communities. Morphological measures can also be taken on a voluntary basis or combined with flood protection measures. The exact location for the measures or concrete possibilities for implementation are therefore often still unknown at this stage.

Figure 43: Number of water bodies with measures for the improvement of river morphology by 2021 and exemptions

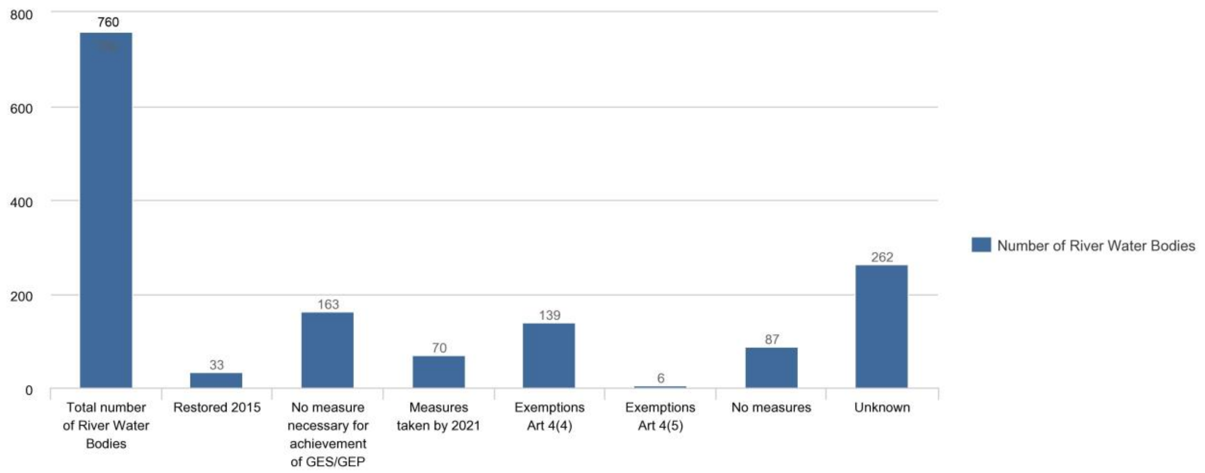


Table 33: Number of water bodies with measures for the improvement of river morphology by 2021 and exemptions for each country

Country	Number of River Water Bodies	Morphology restored by 2015	No measures necessary for achievement of GES/GEP	Measure taken by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures	Unknown
DE	57	2	6	39	8	-	-	2
AT	197	10	-	24	101	-	-	62
CZ	26	11	-	-	-	-	-	15
SK	40	-	13	-	27	-	-	-
HU	57	-	20	-	-	-	-	37
SI	25	-	-	-	-	-	-	25
HR	37	-	37	-	-	-	-	-
BA	33	-	-	-	-	-	-	33
ME	-	-	-	-	-	-	-	-
RS	58	-	-	-	-	-	46	12
RO	146	10	70	4	-	-	-	62
BG	29	-	17	3	3	6	-	-
MD	14	-	-	-	-	-	-	14
UA	41	-	-	-	-	-	41	-
Total	760	33	163	70	139	6	87	262

8.1.4.1.4 Estimated effect of measures on the basin-wide scale

Chapter to be further elaborated as follows once data on measures is available

- Indication of possible effects of measures for the basin-wide scale

8.1.4.2 Disconnected adjacent wetlands/floodplains

8.1.4.2.1 Vision and management objectives

The ICPDR's basin-wide vision is that floodplains/wetlands in the entire DRBD are reconnected and restored. The integrated function of these riverine systems ensure the development of self-sustaining aquatic populations, flood protection and reduction of pollution in the DRBD.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ Protection, conservation and restoration of wetlands/floodplains to ensure biodiversity, the good status in the connected river, flood protection, pollution reduction and climate adaptation by 2021.
  - Specification of number, location and area of wetlands/floodplains that will be reconnected and restored by 2021 by each country.
  - Ensuring exchange with relevant experts on the implications of the measures for sustainable flood risk management.

⇒ An inventory, priority ranking and steps for implementation will be developed for the restoration and reconnection of lost floodplains and wetlands along the Danube River and its tributaries, taking the effects on biodiversity, flood risk management, nutrient reduction, water retention and climate adaptation into account.

⇒ Implementation of the "*no net-loss principle*"[79]

8.1.4.2.2 Progress in implementation of measures from 1st DRBM Plan

The measures on the reconnection of adjacent wetlands/floodplains which were planned to be implemented between 2009 and 2015 are indicated in Table 34. In total, 11 adjacent

[79] No net loss principle = avoidance of converting floodplains and wetlands whenever possible - if conversion to other uses is not prohibited by law or unavoidable, the total wetland resource base has to be offset through restoration of comparable other wetlands.

wetlands/floodplains, covering an area of 62,300 ha, were indicated in the 1st DRBM Plan to be addressed by measures by 2015.

The implementation status in Table 34 is referring to the end of 2012, whereas updated information was partly provided. The measures for reconnection are completed for 4 adjacent wetlands/floodplains, covering an area of 5,531 ha, and some of the planned measures have already been implemented but not the whole range of required measures for reconnection fully completed for 6 adjacent wetlands/floodplains, covering an area of 46,544 ha. Construction works were ongoing for two wetlands/floodplain with an area of 10,225 ha.

Table 34: Progress in implementation of measures on reconnecting adjacent wetlands/floodplains

Measures to be implemented by 2015	Implementation status				
Indicated in the 1st DRBM Plan	Not started	Planning on-going	Construction on-going	Completed	
				Partially re-connected	Totally re-connected
Number of adjacent wetlands/floodplains					
11	0 (0%)	0 (0%)	2 (18%)	6 (55%)	3 (27%)
Area of adjacent wetlands/floodplains					
62,300 ha	0 ha (0%)	0 ha (0%)	10,225 ha (16%)	46,544 ha (75%)	5,531 ha (9%)

8.1.4.2.3 Summary of measures of basin-wide importance

Wetlands/floodplains play an important part of the ecological integrity of riverine ecosystems and are of significant importance when it comes to ensuring/achieving good ecological status of adjacent water bodies (see Chapter 2.1.4 for details). As 80% of the former wetlands in the DRBD are considered to be disconnected[80], ongoing restoration efforts and measures are needed in order to further improve the reconnection of wetlands/floodplains in the entire DRBD, although restoration projects have been undertaken by the Danube countries in recent years.

The approach chosen for the JPM to protect, conserve and restore wetlands is a pragmatic one, taking into account a background of 80% wetland loss. The Danube countries provide information on:

- national wetlands/floodplains >500 ha with a potential to be reconnected to the adjacent river;
- respective reconnection measures to be undertaken by 2021 or beyond regarding WFD Art.4(4).

The analysis shows the area of floodplains/wetlands to be reconnected by 2021 for both the Danube River and its tributaries. The inter-linkage with national RBM Plans is vital for wetland reconnection as significant areas are expected to be reconnected to rivers with catchment areas < 4,000 km^2 and with surface areas <500 ha having nevertheless positive effects on the water status of larger rivers.

Activities on the implementation of the FRMD and the elaboration of the Flood Risk Management Plans are significantly contributing to the compilation of inventories of connected and disconnected wetlands/floodplains and therefore increase the knowledge on reconnection potential. This is considered as important also due to the multiple benefits of wetlands/floodplains reconnection for flood and drought mitigation, groundwater recharge and climate adaptation[81].

[80] Danube Basin Analysis 2004: Danube Pollution Reduction Programme report: Evaluation of Wetland and Floodplain Areas in the DRB (1999).

[81] More information can be obtained from the EU Policy Document on Natural Water Retention Measures available at https://circabc.europa.eu/sd/a/2457165b-3f12-4935-819a-c40324d22ad3/Policy%20Document%20on%20Natural%20Water%20Retention%20Measures_Final.pdf

Figure 44 and Map 11 illustrate that from the 278,871 ha of wetland areas which were identified with potential for reconnection, 91,111 ha are already reconnected in 2015 also as a results of measures implementation from the 1st DRBM Plan. An area of 15,130 ha is planned to be reconnected by 2021. For 80,814 ha no measures were yet indicated and for 35,499 ha it is still unknown whether measures will be implemented. Table 35 further below provides more detailed information for each Danube country.

Figure 44: Measures for the reconnection of wetlands/floodplains by 2021 and exemptions

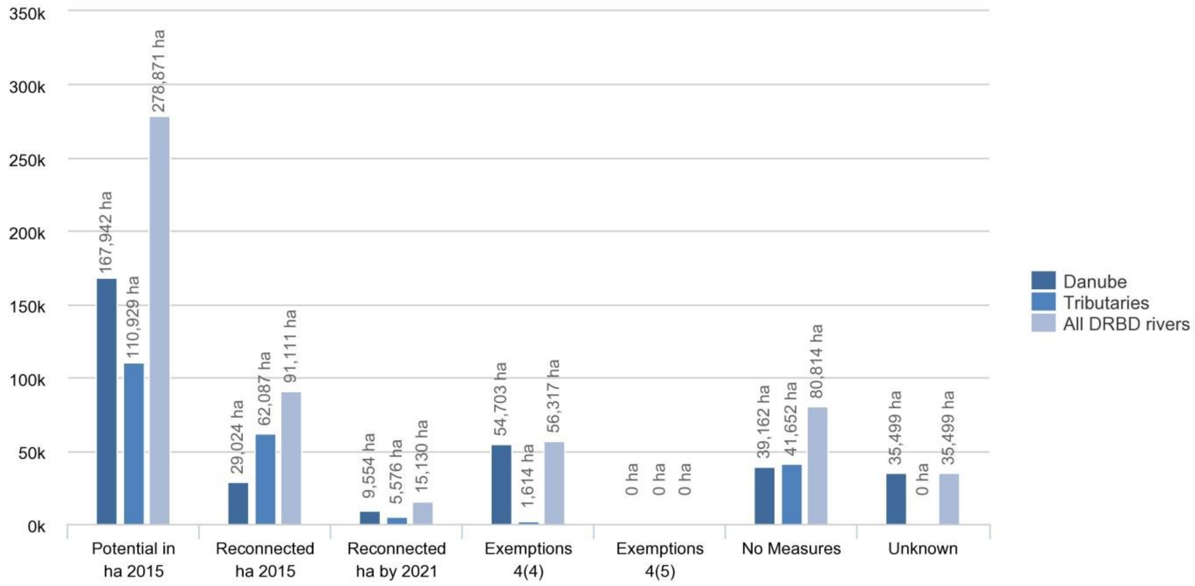


Table 35: Measures on the reconnection of wetlands/floodplains by 2021 and exemptions for each country

Country	Wetlands/flood plains with reconnection potential 2015	Wetlands/flood plains totally reconnected in 2015	Wetlands/flood plains totally reconnected by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures yet indicated	Unknown
DE	5,964	3,038	2,926	-	-	-	-
AT	9,554	-	9,554	-	-	-	-
CZ	-	-	-	-	-	-	-
SK	4,842	7	-	4,835	-	-	-
HU	85,396	85,396	-	-	-	-	-
SI	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-
RS	25,790	-	-	-	-	6,404	19,386
RO	70,245	-	2,650	51,482	-	-	16,113
BG	-	-	-	-	-	-	-
MD	33,524	-	-	-	-	33,524	-
UA	43,556	2,670	-	-	-	40,886	-
Total	**278,871**	**91,111**	**15,130**	**56,317**	**-**	**80,814**	**35,499**

8.1.4.2.4 Estimated effect of measures on the basin-wide scale

Chapter to be further elaborated as follows once data on measures is available

- Indication of possible effects of measures for the basin-wide scale (e.g. improvement of status, transboundary effects for flood mitigation, biodiversity, etc.)

8.1.4.3 Hydrological alterations

8.1.4.3.1 Vision and management objectives

The ICPDR's basin-wide vision for hydrological alterations is that they are managed in such a way, that the aquatic ecosystem is not influenced in its natural development and distribution.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ ***Impoundments:*** Most of the impounded water bodies are designated to be heavily modified and the good ecological potential (GEP) has to be achieved. Due to this fact the management objective foresees additional measures on the national level to improve the hydromorphological situation in order to achieve and ensure the GEP, e.g. improvement of river morphology in the head sections of the reservoir.

⇒ ***Water abstractions:*** Discharge of an ecological flow, ensuring that the biological quality elements are in good ecological status respectively good ecological potential, and the flow requirements for protected species and habitats are met.

⇒ ***Hydropeaking:*** Most of the water bodies affected by hydropeaking are designated to be heavily modified and the good ecological potential (GEP) has to be achieved. Therefore, the management objective foresees measures on the national level to improve the situation to achieve and ensure the GEP. Hydropeaking and its effect on water status is a very complex issue. Therefore, further respective investigations and scientific studies are needed.

⇒ Specification of measures addressing hydrological alterations that will be implemented by 2021 by each country.

8.1.4.3.2 Progress in implementation of measures from 1st DRBM Plan

Overall, in the 1st DRBM Plan 139 measures addressing hydrological alteration (impoundments, water abstractions, hydropeaking) were indicated to be implemented by 2015. The measures which were planned to be implemented between 2009 and 2015 are individually indicated below. The implementation status is largely referring to the end of 2012, partly updated with latest information in case it could be made available.

Impoundments

In total, 52 impoundments were reported to be improved by 2015, whereas for 24 of the agreed measures the implementation was already completed and 3 are in the construction phase. 27 or 50% are in the planning phase and for none of the measures implementation was not started yet (see Table 36).

Table 36: Progress in implementation of measures on impoundments

Number of measures to be implemented by 2015	Implementation status			
Indicated in the 1st DRBM Plan	Not started	Planning on-going	Construction on-going	Completed
52	0 (0%)	27 (52%)	2 (4%)	25 (48%)

Water abstractions

In total, 42 measures were indicated in the 1st DRBM Plan to be implemented by 2015, whereas 37 were finally agreed at the national level. 26 of the measures are completed and 3 are in the construction phase. Planning is ongoing for 8 measures and for none of the measures the implementation phase was not yet started (see Table 37).

For measures where planning was on-going, studies on ecological flow requirements at existing water uses were undertaken. The results of these assessments fed into the negotiations on residual flows downstream of existing water abstractions.

Table 37: Progress in implementation of measures on water abstractions

Number of measures to be implemented by 2015		Implementation status			
Indicated in the 1st DRBM Plan	Finally agreed measures at national level	Not started	Planning on-going	Construction on-going	Completed
42	37	0 (0%)	8 (22%)	2 (5%)	27 (73%)

Hydropeaking

3 measures addressing hydropeaking were reported by Austria in the JPM to be implemented by 2015.

Water bodies affected by hydropeaking in Austria are mostly fulfilling the requirements according to WFD Article 4(3) and are therefore designated as heavily modified water bodies (HMWB). Usually there is a lack of space in the alpine valleys to build a balance reservoir to achieve good status in the respective river stretch. There are some project ideas to build new hydropower stations which - as an additional effect to electricity generation - also contribute to decrease the existing hydropeaking effects on ecology considerably.

As the knowledge about restoration measures which increase the ecological situation significantly is generally low (including Austria), several scientific studies were commissioned as a first step where the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management co-operated with the hydropower sector. The studies investigated the effects of hydropeaking on fish, benthic invertebrates and the hydraulic/hydrological conditions in detail by field experiments; based on the results mitigation measures were tested and proposed (i.e. morphological measures, operational measures like the reduction of velocity in the down-surge-phase)[82]. The effects of these mitigation measures are analysed also with regard to costs to find the most cost-effective measures combination and for the definition of “good ecological potential” for water bodies affected by hydropeaking.

8.1.4.3.3 Summary of measures of basin-wide importance

As shown by the pressure analysis and status assessment, hydrological alterations impact the status of water bodies (see Chapter 2 and Chapter 4). Impoundments, water abstraction and hydropeaking remain key pressures that require measures on the basin-wide scale. In the following, the planned measures for each category of hydrological alteration are outlined. The information is also illustrated on Map 35 in aggregated form on water body level. The map shows in which water bodies measures addressing hydrological alterations are planned. This can be a combination of different measures addressing different hydrological pressure types. More detailed information on each measure can be obtained from Annex 14.

Impoundments

In total, 395 impoundments are located in the DRBD rivers, 28 of them in the Danube River itself. For 20 impoundments, restoration measures have already been implemented for the achievement of GES/GEP by 2015. For 40 impoundments restoration measures are planned to be implemented by 2021 and for 218 after 2021 as part of the third RBM cycle (Art. 4(4)). For 3 impoundments no measures will be applied (Art. 4(5)), respectively no measures were yet indicated for 23 impoundments. For 27 impoundments it is still unknown whether measures will be implemented (see Figure 45). Table 38 further below provides more detailed information for each Danube country.

[82] See http://www.bmlfuw.gv.at/wasser/wasser-oesterreich/plan_gewaesser_ngp/umsetzung_wasserrahmenrichtlinie/schwallstudie.html

Figure 45: Measures for the improvement of impoundments by 2021 and exemptions

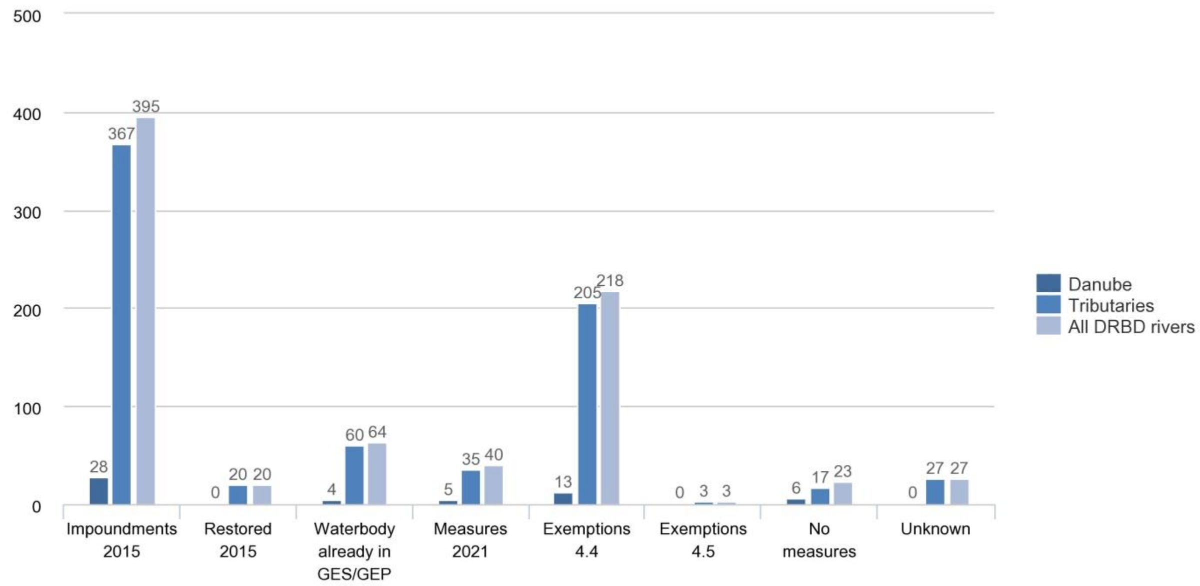


Table 38: Measures on impoundments by 2021 and exemptions for each country

Country	Impoundments 2015	Impoundments restored by 2015	No measures necessary for achievement of GES/GEP	Measure taken by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures	Unknown
DE	25	-	3	1	21	-	-	-
AT	203	9	-	36	158	-	-	-
CZ	6	-	-	-	-	-	-	6
SK	34	-	-	-	34	-	-	-
HU	25	8	8	-	-	-	-	9
SI	12	-	-	-	-	-	-	12
HR	4	-	4	-	-	-	-	-
BA	-	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-	-
RS	19	-	-	-	-	-	19	-
RO	54	3	48	3	-	-	-	-
BG	12	-	-	-	5	3	4	-
MD	1	-	1	-	-	-	-	-
UA	-	-	-	-	-	-	-	-
Total	**395**	**20**	**64**	**40**	**118**	**3**	**23**	**27**

Water abstractions

138 cases of significant water abstractions were identified in the DRBD. For 15 abstractions, ecological flow requirements for the achievement of GES/GEP have already been achieved in 2015. For 23 water abstractions, restoration measures are planned to be implemented by 2021 and for 21 after 2021 as part of the third RBM cycle (Art. 4(4)). For 1 case of water abstraction it is still unknown whether measures will be applied (see Figure 46). Table 39 further below provides more detailed information for each Danube country.

A recently published EU Guidance Document[83] on ecological flows provides support towards gaining a better shared understanding on ecological flows and ways to use them in river basin management planning.

[83] EU Guidance Document No. 31 on “Ecological flows in the implementation of the Water Framework Directive”.

Figure 46: Measures on water abstractions by 2021 and exemptions

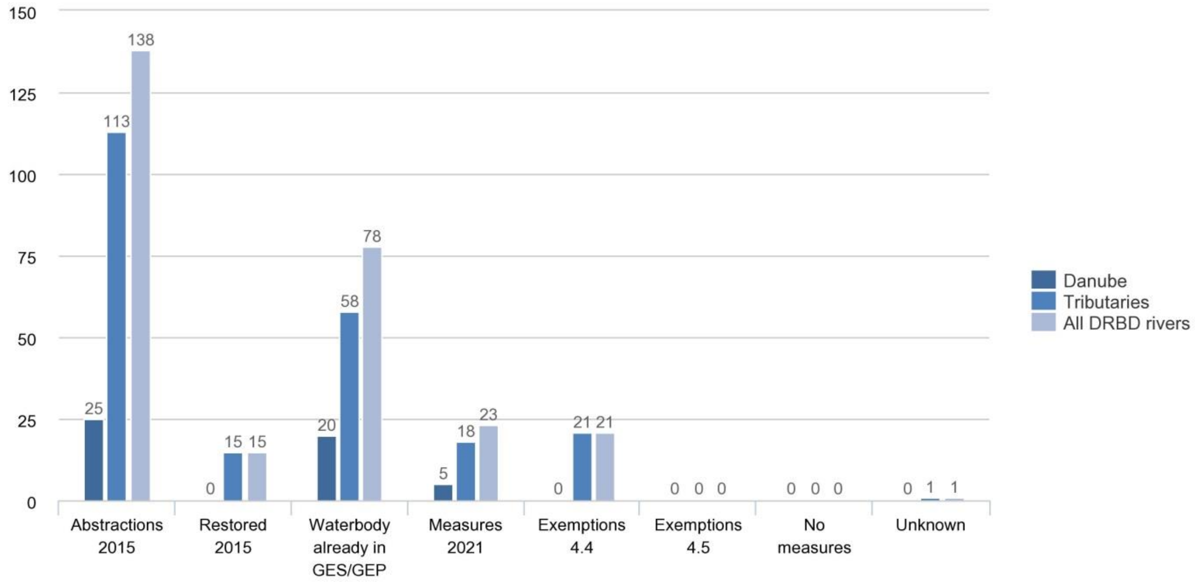


Table 39: Measures on water abstractions by 2021 and exemptions for each country

Country	Abstractions 2015	Abstractions restored by 2015	No measures necessary for achievement of GES/GEP	Measure taken by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures	Unknown
DE	9	-	1	8	-	-	-	-
AT	44	14	-	15	15	-	-	-
CZ	-	-	-	-	-	-	-	-
SK	7	-	7	-	-	-	-	-
HU	14	-	13	-	-	-	-	1
SI	-	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-	-
RO	12	1	11	-	-	-	-	-
BG	52	-	46	-	6	-	-	-
MD	-	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-	-
Total	**138**	**15**	**78**	**23**	**21**	**-**	**-**	**1**

Hydropeaking

36 significant cases of hydropeaking were identified in the DRBD, one of them in the Danube. For 1 case, mitigation measures have already been implemented in 2015 for the achievement of GES/GEP. For 4 cases of hydropeaking restoration measures are planned to be implemented by 2021 and for 30 after 2021 as part of the third RBM cycle (Art. 4(4)) (see Figure 47). Table 40 further below provides more detailed information for each Danube country.

Figure 47: Measures on hydropeaking by 2021 and exemptions

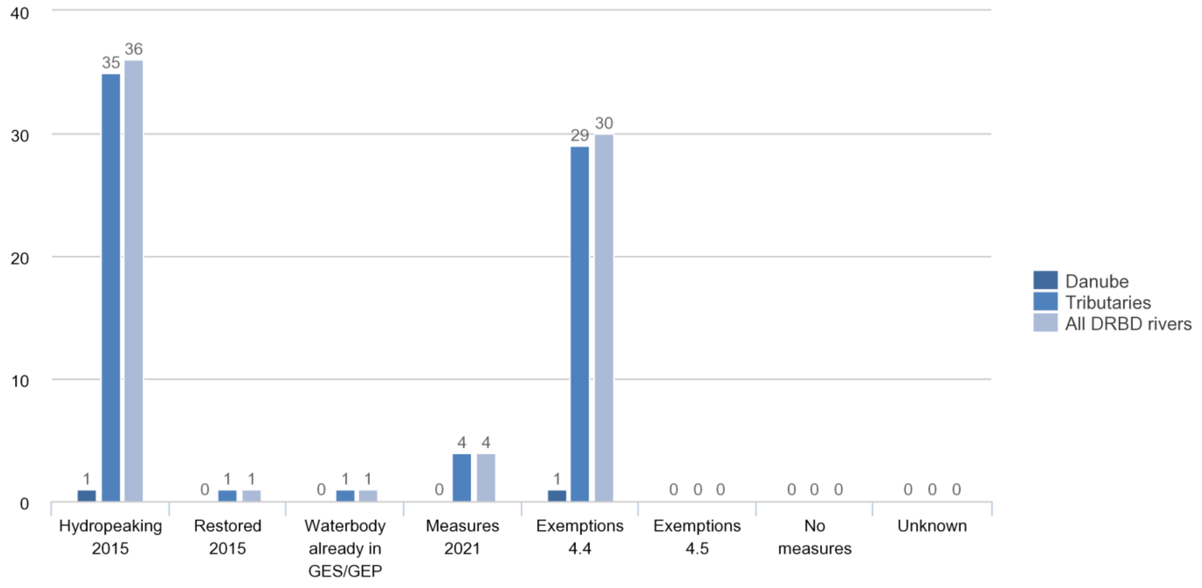


Table 40: Measures on hydropeaking by 2021 and exemptions for each country

Country	Cases of hydropeaking 2015	Hydropeaking restored by 2015	No measures necessary for achievement of GES/GEP	Measure taken by 2021	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures	Unknown
DE	8	-	-	4	4	-	-	-
AT	26	-	-	-	26	-	-	-
CZ	-	-	-	-	-	-	-	-
SK	-	-	-	-	-	-	-	-
HU	1	-	1	-	-	-	-	-
SI	-	-	-	-	-	-	-	-
HR	1	1	-	-	-	-	-	-
BA	-	-	-	-	-	-	-	-
ME	-	-	-	-	-	-	-	-
RS	-	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-	-
BG	-	-	-	-	-	-	-	-
MD	-	-	-	-	-	-	-	-
UA	-	-	-	-	-	-	-	-
Total	**36**	**1**	**1**	**4**	**30**	**-**	**-**	**-**

8.1.4.3.4 Estimated effect of measures on the basin-wide scale

Chapter to be elaborated once data on measures is available

- Indication of possible effects of measures for the basin-wide scale

8.1.4.4 Future infrastructure projects

8.1.4.4.1 Vision and management objectives

The ICPDR's basin-wide vision for future infrastructure projects is that they are conducted in a transparent way using best environmental practices and best available techniques in the entire DRBD – impacts on or deterioration of the good status and negative transboundary effects are fully prevented, mitigated or compensated.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ Conduction of a Strategic Environment Assessment and/or Environmental Impact Assessments in conjunction with the EU Water Framework Directive requirements.

⇒ New infrastructure projects should be planned and conducted to ensure that water status is not deteriorated. Deterioration should only be allowed in exceptional cases and following the requirements as set in WFD Article 4(7).

⇒ Pre-planning procedures should be conducted with stakeholder participation to ensure that impacts are avoided and the best environmental option is chosen for new infrastructure projects.

⇒ Application of recommendations for the implementation of best environmental practices and best available techniques which were developed for inland navigation and sustainable hydropower.

⇒ Improvement of ecological status in case of new flood risk management measures, and improvement of ecological situation in case of required refurbishment/maintenance/reconstruction of existing structures by making best use of synergies.

8.1.4.4.2 Progress in implementation of measures from 1st DRBM Plan

In order to prevent and reduce basin-wide and transboundary effects from future infrastructure projects in the DRBD, the development and application of BAT and BEP is crucial. For new infrastructure projects, it is of particular importance that environmental requirements are considered as an integral part of the planning and implementation process, beside the involvement of stakeholders right from the beginning.

In the 1st DRBM Plan the intention was indicated of further developing respective processes and guidance documents in this regard. Such a process was already started for the navigation sector (Joint Statement) in 2007 but similar approaches were launched in the frame of the ICPDR in the meantime and as part of the implementation of the JPM. In 2011 the elaboration of "Guiding Principles on Sustainable Hydropower Development in the Danube Basin" started. The document was finalised and adopted by the ICPDR in June 2013. Furthermore, exchange on sustainable flood risk management is ongoing in the frame of the coordinated implementation of the WFD and FRMD. Details on those processes can be obtained from Chapter 6 on integration issues.

8.1.4.4.3 Summary of measures of basin-wide importance

As analysed in Chapter 2, a significant number of FIPs (navigation, flood protection, hydropower) may have negative impacts on water status by 2021 and need to be addressed accordingly. 35 FIPs have been reported for the DRBD according to the criteria as outlined in Table 12 and are illustrated on Map 15). 22 of them are located in the Danube River itself.

For 9 FIPs, SEAs have been performed during the planning process. Further, EIAs have already been performed for 20 FIPs and are intended for another 4 FIPs. 15 FIPs are expected to have a negative transboundary effect on other water bodies and 4 FIPs are expected to provoke deterioration of water status, for which exemptions according to WFD Article 4(7) are applied (see Annex 5 for details).

The management objectives include precautionary measures (best environmental practices and best available techniques) that should be implemented to reduce and/or prevent impacts on water status.

For new infrastructure projects, it is of particular importance that environmental requirements are considered as an integral part of planning and implementation right from the beginning of the process. In the framework of the ICPDR, respective guidance has been developed in this regard for inland navigation (Joint Statement) and hydropower (Guiding Principles). Both documents describe respective processes in detail and the organisation of regular meetings to facilitate the follow-up discussions will help the exchange of experiences for practical application. The management objectives also indicate precautionary measures with regard to sustainable flood risk management.

8.1.4.4.4 Estimated effect of measures on the basin-wide scale

Chapter to be elaborated once measures are further specified

- Indication of possible effects of measures for the basin-wide scale

8.2 Surface waters: lakes, transitional waters and coastal waters

The Razim Lake in Romania has been evaluated as being in good ecological status and therefore no measures for hydromorphological alterations are necessary.

Regarding the two coastal water bodies in Romania, affected by significant hydromorphological alterations, the projects and their related mitigation measures will be promoted taking into consideration the philosophy of the Joint Statement on Guiding Principles for the Development of Inland Navigation and Environment in the DRB.

8.3 Groundwater

This chapter summarizes the measures for the 11 GWBs of basin-wide importance in the DRB. An indicative overview of the measures is shown in Table 41. Detailed information on the relevant measures for each GWB is given in the Annex 6.

Table 41: GWBs at poor status and implemented measures

DRBD-GWB		5-RO-HU		7-RO-RS-HU			8-SK-HU	11-SK-HU
National part / Status		**5-RO / Quality**	**5-HU / Quality**	**7-HU / Quality**	**7-RS / Quantity**	**7-HU / Quantity**	**8-HU / Quality**	**11-HU / Quantity**
Basic Measures (BM) – Article 11(3)(a)								
BM-01	BathingWater							
BM-02	Birds							
BM-03	DrinkingWater	CO						
BM-04	Seveso							
BM-05	EnvironmentalImpact							
BM-06	SewageSludge							
BM-07	UrbanWasteWater	MC, CO	MO	MO			MO	
BM-08	PlantProtectionProducts							
BM-09	Nitrates	MC, MO	MO	MO			MO	
BM-10	Habitats							
BM-11	IPPC	MC						
Other Basic Measures (OBM) – Article 11(3)(b-l)								
OBM-20	CostRecoveryWaterServices							
OBM-21	EfficientWaterUse							
OBM-22	ProtectionWaterAbstractions							
OBM-23	ControlsWaterAbstraction					MO		
OBM-24	RechargeAugmentationGroundwater							
OBM-25	PointSourceDischarge							
OBM-26	PollutantsDiffuse							
OBM-27	AdverseImpact							
OBM-28	PollutantDirectGroundwater							
OBM-29	SurfacePrioritySubstances							
OBM-30	AccidentalPollution							
Supplementary Measures (SM) – Article 11(4)&(5)		MP			MO	MO, MC		

MC…Measure implementation completed, **MO**…Measure implementation on-going, **MP**…Measure implementation planned, **PO**…Construction planning, **CO**…Construction on-going after 2012

8.3.1 Groundwater quality

8.3.1.1 Vision and management objectives

The ICPDR's basin-wide vision is that the emissions of polluting substances do not cause any deterioration of groundwater quality in the Danube River Basin District. Where groundwater is already polluted, restoration to good quality will be the ambition.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ Elimination/reduction of the amount of hazardous substances and nitrates entering the groundwater bodies in the DRBD to prevent deterioration of groundwater quality and to prevent any significant and sustained upward trends in the concentrations of pollutants in groundwater.

⇒ Implementation of the management objectives described for organic, and nutrient pollution as well as for pollution by hazardous substances of surface waters (see above).

⇒ Increase of the wastewater collection and treatment efficiency and level thereafter.

⇒ Implementation of Best Available Techniques and Best Agricultural Practices.

⇒ Reduction of pesticide/biocides emission in the DRBD.

⇒ Close knowledge gaps concerning the presence of emerging substances in groundwater

In addition, for EU Member States:

⇒ Implementation of the principle concerning prevention/limitation of pollutants inputs to groundwater according to the EU Groundwater Directive (GWD, 2006/118/EC).

⇒ Implementation of the EU Nitrates Directive (91/676/EEC).

⇒ Implementation of the Sustainable Use of Pesticides Directive (2009/128/EC), the Plant Protection Directive (91/414/EEC) and the Biocides Directive (98/8/EC).

⇒ Implementation of Urban Wastewater Treatment Directive (91/271/EEC).

⇒ Implementation of the Integrated Pollution Prevention Control Directive (96/61/EC), which also relates to the Dangerous Substances Directive 2006/11/EC.

⇒ Implementation of the Industrial Emissions Directive (2010/75/EU)

8.3.1.2 Progress in implementation of measures from 1st DRBM Plan

A number of UWWTD and IPPC related measures were reported by Romania to be already completed such as the construction of new sewer systems respectively the reduction of pollution of the groundwater body No. 5. Considerably larger investments (~ 32 Mio Euro) in Romania, where the construction planning and the construction are still on-going after 2012, comprise the planning and construction or extension of sewer systems serving about 106,000 inhabitants. As regards the IPPC measures in Romania, these were completed by end of 2012. Hungary reported to increase the rate of connection to sewer systems in the South Great Plain Region from 52.4% of the settlements in 2008 to 82.4% by 2015 and in the West Trans-Danubian Region from 75.8% to 89.8%. In 2014 the investments in Hungary were ongoing according to the UWWTD implementation plan which was assisted by EU Cohesion Fund 2007-2013.

The Nitrate Directive related measures in Romania implemented and under implementation after 2012 comprise the application of the code of good agricultural practice (e.g. construction of manure storage) and the application of specific action programmes at certain localities with estimated costs of about 22 Mio Euro. Since 2013, Romania has applied whole territory approach, meaning that the code of good agricultural practices and the action programs are applied at the national level. The revision of designation of Nitrate vulnerable zones in Hungary was finished in 2013 and Hungary has new designated areas for all groundwater bodies of basin-wide importance failing good chemical status.

Romania reported the elaboration of a research study as a supplementary measure tackling nitrate pollution in the related groundwater body.

It has to be pointed out that the progress in implementation of the JPM reported in the chapters on pollution by organic substances, nutrients and hazardous substances for surface water bodies, has consequently a positive effect on the improvement of the chemical status of groundwaters.

8.3.1.3 Summary of measures of basin-wide importance – groundwater quality

Taking into account that contamination by nitrates is a key factor against achieving *good chemical status* of a significant portion of the GWBs of basin-wide importance, and in line with the management objectives, it is essential to eliminate or reduce the amount of nitrates entering groundwater bodies in the DRBD. Prevention of deterioration of groundwater quality and any significant and sustained upward trend in concentrations of nitrates in groundwater has to be achieved primarily through the implementation of the EU Nitrates Directive and also the EU UWWTD.

To avoid the presence of hazardous substances in groundwater aquifers, additional measures need to be taken as required under the following Directives:

a. Drinking Water Directive (80/778/EEC) as amended by Directive (98/83/EC);
b. Plant Protection Products Directive (91/414/EEC);
c. Sustainable Use of Pesticides Directive (2009/128/EC),
d. Habitats Directive (92/43/EEC);
e. Integrated Pollution Prevention Control Directive (96/61/EC) as amended by IED 2010/75/EU.

To prevent pollution of GWBs by hazardous substances from point source discharges liable to cause pollution, the following measures are needed: an effective regulatory framework ensuring prohibition of direct discharge of pollutants into groundwater; the setting of all necessary measures required to prevent significant losses of pollutants from technical installations; the prevention and/or reduction of the impact of accidental pollution incidents.

More detailed information on scenarios and specific actions to be taken to reduce or eliminate the presence of polluting substances in surface water bodies, which has a clear effect on the status of groundwaters, is given in other sections in Chapter 8.

It can be concluded that in agreement with the ICPDR's basin-wide vision, emissions of nitrates and relevant hazardous substances need to be sufficiently controlled so not to cause any deterioration of groundwater quality in the DRBD. Where groundwater is already polluted, restoration to good quality by a thorough implementation of the respective EU legislation is essential.

8.3.2 Groundwater quantity

8.3.2.1 Vision and management objectives

The ICPDR's basin-wide vision is that the water use is appropriately balanced and does not exceed the available groundwater resource in the Danube River Basin District, considering future impacts of climate change.

The following management objectives will be implemented by 2021 as steps towards the vision:

EU Member States, Candidate Countries and Non EU Member States:

⇒ Over-abstraction of GW-bodies within DRBD is avoided by sound groundwater management.

In addition, for EU Member States:

⇒ Implementation of WFD (2000/60/EC) requirements that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.

8.3.2.2 Progress in implementation of measures from 1st DRBM Plan

Groundwater bodies of basin-wide importance failing good quantitative status were reported from Hungary and Serbia.

Poor quantitative status has been tackled by Hungary through the revision of relevant legislation by 2013 concerning the licensing of domestic wells, construction and rehabilitation projects, demand management measures and inter alia, promotion of adapted agricultural production such as low water requiring crops in areas affected by droughts. According to the high level inter-ministerial committee decision and due to the structural changes within the water authorities the legislation on licensing of domestic wells remained unchanged. The municipalities remain responsible for licensing this type of wells. The planned level of construction and rehabilitation projects are completed. Under the European Agricultural Fund for Rural Development - EAFRD 2007-2013 the environmentally friendly investments in the field of agricultural water management can be supported (e. g. water-saving irrigation techniques) so this measure is still on-going. The draft of the 2014 - 2020 Rural Development Plan in Hungary contains promotion of adapted agricultural production as one of the possibilities of the agri-environmental measures.

Serbia focuses its measures on research, development and demonstration projects and construction designs for new GW sources.

8.3.2.3 Summary of measures of basin-wide importance – groundwater quantity

The ICPDR vision for groundwater quantity stipulates that water use in the DRBD has to be appropriately balanced taking into account the conceptual models for particular GWBs and should not exceed the available groundwater resource in the DRBD. In line with this vision, the over-abstraction of GWBs within the DRBD should be avoided by effective groundwater and surface water management. Therefore, appropriate controls regarding abstraction of fresh surface water and groundwater and impoundment of fresh surface waters (including a register or registers of water abstractions) must be put in place as well as the requirements for prior authorisation of such abstraction and impoundment. In line with the WFD, it must be ensured that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.

The concept of registers of groundwater abstractions is well developed throughout the DRBD. The Ministry of Environment and Water in Bulgaria maintains a national register of abstraction permits. A central register of groundwater abstractions based on the National Water Law is updated annually in Slovakia. In Hungary, a Groundwater Abstractions register is published yearly and it contains data on the withdrawals of the operating, monitoring and reserve wells. In Bavaria, water suppliers are obliged to report annual data to local authorities on overall water abstraction and specific abstractions from spring sources. Bavaria and Austria cooperate on the annual preparation of a register of abstractions from the thermal water of the Lower Bavarian - Upper Austrian molasses basin (GWB-1). In Romania, the National Administration “Romanian Waters” maintains the national register of abstraction permits according to the National Water Law.

To prevent deterioration of groundwater quantity as well as the deterioration of dependent terrestrial ecosystems, solutions for the rehabilitation have to be explored. These should include restoration of wetland areas which are in direct contact with aquifers.

8.4 Joint Programme of Measures under Climate Change

Climate change impacts on water resources should be considered together with other pressures when planning adaptation measures. As a result, adaptation measures with respect to climate change should build on planned or already implemented water management measures.

The design of the JPM is generally based on the pressures and status assessment, whereas at this stage difficulties are still encountered to assess and distinguish influences of climate change from other pressures created due to human activities. Due to this reason it is instrumental that surface and groundwater surveillance monitoring sites are generally maintained for long time series, allowing to better track and distinguish pressures due to climate change in the future.

For the DRBM Plan – Update 2015, the proposed measures of the JPM went through a "climate check" of the ICPDR Expert and Task Groups. Although statements on climate change bear a certain degree of uncertainty, adaptation has to start now with a priority on win-win, no-regret and low-regret measures which are flexible enough for various conditions. Therefore, the JPM at this stage generally does not include specific measures which are solely dealing with the effects stemming from climate change. In contrary, it clearly reveals that the JPM which is targeted towards the improvement of water status and sustainable water management generally helps to increase the resilience against climate change effects. This is for instance the case for measures addressing the reduction of pollution from point and diffuse sources. Increased capacities of sewer system storages or measures to control soil erosion are in particular relevant for potential increased heavy rainfall events. The reduction of pollution also helps to ensure and maintain low concentration levels of contaminants during extended drought and low flow conditions.

With regard to water quantity issues, the JPM includes measures to achieve and maintain good quantitative status of groundwater bodies. This is a pre-requisite to ensure a balanced management of abstraction and groundwater recharge, what is a key requirement for sustainable water management as well as a response to climate change. In some countries, specific efforts are taken at the national level to protect future possible locations of water accumulation reservoirs for irrigation purposes in order to increase the resilience of the agricultural sector.

Hydromorphological measures like fish migration aids or the re-connection of wetlands and floodplains are increasing the resilience of the ecosystem. With regard to the latter multiple benefits also in terms of increased water retention capacities and therefore flood mitigation are encountered, leading to potential win-win solutions for WFD and FRMD implementation.

In general, due to effects of climate change on multiple water-related sectors, there is a need to further gain clarity on climate impacts across sectors and to further integrate this knowledge into inter-sectoral cooperation activities, e.g. in the exchange with flood risk management, inland navigation, hydropower or agriculture. This will help to better shape programs of measures in order to facilitate win-win solutions or to achieve adequate trade-offs. Furthermore, it will allow to better target activities on emerging and new issues which might be in need to be addressed at the basin-wide level, like this is already the case for the issue of water scarcity and drought (see Chapter 6.7).

The WFD, as a framework to achieve climate change adaptation in the field of water management, follows an adaptive approach which provides flexibility – programs of measures, including adaptation measures, are updated within the 6-years planning cycles once new information and understanding on climate change and related impacts becomes available, with the objective to increase resilience and to decrease vulnerability for the whole Danube basin.

8.5 Financing the JPM

For successfully implementing the Joint Programme of Measures and reaching 'good status' in the Danube River basin, it is necessary to mobilize adequate ways of financing the planned measures. This, although some measures in the DRBM Plan/JPM might be implemented without major investment of financial resources. The WFD implementation is a national responsibility and as such, the financing of measures is the responsibility of each national government (or private owners and operators of facilities which influence water quality).

A number of EU-supported funding programs are available for some of the measures. This is particularly important for new EU Member States (MS) which will clearly rely upon EU funding for measures with regard to wastewater treatment, agriculture or hydromorphological alterations. As far as possible, funds available for other programs (CAP, LIFE, etc.) have in the past, and can be in the future, utilized by EU MS to address a number of specific problems and to implement necessary measures.

The DRB is composed of both EU MS and non-EU countries. In general, the funding of measures in non-EU countries is more difficult than for those countries which have the legal obligation to fulfil the WFD. This is particularly the case because the general level of economic well-being in Danube countries varies significantly from west to east. In addition, non-EU countries do not have Cohesion

Funds which they can draw upon to finance wastewater treatment or other necessary measures. Applying for and securing funds for financing the JPM also faces multiple challenges, especially in terms of skills and capacity for the sometimes complex application procedures and preparation of bankable project proposals.

The challenges, problems and approaches for securing financing for the implementation of the JPM have been addressed in the frame of the ICPDR for the preparation of the DRBM Plan – Update 2015, also considering the question how the financing of necessary measures in non-EU countries could be supported. In the following, an overview is provided on the different SWMIs, related key measures and possible financing sources and funding instruments (see Table 42), with the intention for being useful for the countries in securing financing opportunities for WFD implementation. More detailed information can be obtained from the table in Annex 15, which is organized by financing source/program.

The key funding instruments include the following:

- The European Regional Development Fund (ERDF) is aimed at economic, social and territorial cohesion in the EU.
- The European Social Fund (ESF) represents the main EU financial instrument for investing in employment opportunities, better education, improvement of the situation of the most vulnerable people and capacity building in the environment.
- The Cohesion Fund (CF) supports investments in TEN-T transport networks and the environment in EU Member States whose Gross National Income (GNI) per inhabitant is less than 90 % of the EU average, what can in particular be relevant for new EU Member States.
- The European Maritime and Fisheries Fund (EMFF) supports marine and fisheries policies in the EU.
- The European Agricultural Fund for Rural Development (EAFRD) ist the main instrument to finance the Rural Development and Agri-Environmental Programs of the EU Common Agricultural Policy.
- LIFE is the EU's financing program entirely devoted to environmental objectives.
- INTERREG V/European Territorial Cooperation (ETC) focus on cooperation between regions and countries.
- The European Neighbourhood Instrument (ENI) provides direct support for the EU´s external policies, including environmental protection.
- The Instrument for Pre-Accession Assistance (IPA II) provides (in the Danube RB) assistance for transition and institution building and funds cross-border cooperation.

ERDF, ESF, CF, EAFRD and EMFF together form the EU’s five structural and investment funds ESIF). For the European programming period 2014-2020, the European Commission issued a legally binding (in the form of a Commission Regulation[84]) set of standards to improve consultation, participation and dialogue with partners during the planning, implementation, monitoring and evaluation of projects financed by ESIF, the "European Code of Conduct on the Partnership Principle". The Code of Conduct sets out objectives and criteria to ensure that Member States implement the "partnership principle". More details can be obtained from the Commission Regulation.

[84] Regulation to be found at: ec.europa.eu/social/BlobServlet?docId=11350&langId=en.

Table 42: Overview SWMIs, measures and potential funding sources

Type of pressure	Measures	Possible financing source/program (EU)	Possible financing source/program (non-EU)
Organic Pollution	UWWTP	ERDF, CF	ENI, IPA II
	Industrial point sources (direct discharges)	ERDF, CF, ESF (capacity building)	ENI, IPA II
	Animal feeding/breeding lots	EAFRD	ENI, IPA II
Nutrient Pollution	Diffuse sources: agriculture	ERDF, EAFRD, LIFE, ESF (capacity building)	ENI, IPA II
	Diffuse sources: atmospheric deposition	EAFRD (concerning agricultural atmospheric emissions)	ENI, IPA II
	Diffuse sources: urban run-off	CF, potentially LIFE	Potentially LIFE, ENI, IPA II
	UWWTP	ERDF, CF	ENI, IPA II
	Industrial point sources (direct discharges)	ERDF, CF, ESF (capacity building)	ENI, IPA II
	Animal feeding/breeding lots	EAFRD	ENI, IPA II
Hazardous Substances Pollution	Industrial point sources (direct discharges)	ERDF, CF, ESF (capacity building)	ENI, IPA II
	UWWTP	ERDF, CF	ENI, IPA II
	Diffuse sources: urban run-off	ERDF (integrated sustainable urban development measures), CF, potentially LIFE	Potentially LIFE, ENI, IPA II
	Diffuse sources: agriculture	EAFRD, LIFE, ESF (capacity building)	LIFE, ENI, IPA II
	Diffuses sources: landfills, mining sites etc.	Possibly LIFE	Possibly LIFE, ENI, IPA II
Hydromorphological Alterations	Interruption of river continuity and morphological alterations	CF, LIFE	LIFE
	Reconnection of wetlands/floodplains	ERDF, CF (ecosystem-based measures regarding CC adaptation), LIFE, possibly EAFRD (Art. 30 NATURA2000/WFD payments)	LIFE, ENI, IPA II
	Hydrological alterations (quantity and conditions of flow)	CF, LIFE	LIFE, ENI, IPA II

Furthermore, several additional instruments/organization exist that are potentially relevant for acquiring financing in the context of WFD implementation for all pressures in the Danube RB, Instead of listing them in the table for each pressure individually, they are listed here instead:

- HORIZON 2020, the EU research framework from 2014-2020, funds research in EU Member States and non-EU countries.
- The World Bank (IBRD/IDA) and the Global Environment Facility (GEF) provide mostly loans, but also grants, to developed and developing countries, also in the field of environmental protection and climate change adaptation (GEF, of course, has the focus on the environment).

- Other European and international banks (the European Investment Bank/EIB and the European Bank for Reconstruction and Development/EBRD) provide loans, mostly to the private sector (but possibly at reduced interest rates), supporting development, climate change adaptation and, mostly indirectly, environmental protection.

EU Strategy for the Danube Region (EUSDR)

The EUSDR, a macro-regional strategy endorsed by the European Council in 2011, has inter alia the objective to facilitate and strengthen cooperative frameworks, which should utilise and support existing institutions, help Member States to implement EU legislation and should in particular support Member States and candidate countries in programming and effective use of EU funds and other financial mechanisms.

EUSDR's Priority Areas 4 and 5 are supporting measures implementation inter alia through projects development, facilitating direct financing support as well as via alignment of funding through Operative Programmes. With regard to the latter an exchange between EUSDR PA4/5 and the ICPDR was conducted[85] in order to influence the setting of objectives and priorities, in particular for the operational programs of the European Structural and Investment Funds, but also for other financing frameworks.

8.6 Linkage between the international Danube basin-wide level and the national level

As outlined in Chapter 1.2, the management of the DRBD is based on three levels of coordination – Part A (international, basin-wide level), Part B (national level and/or the international coordinated sub-basin level for selected sub-basins), and Part C (Sub-unit level, defined as management units within the national territory). All plans together provide the full set of information.

The ICPDR serves as the coordinating platform between the countries to compile multilateral and basin-wide issues at Part A of the DRBD. Therefore, ensuring the linkage between Part A and the national level (Part B) of RBM Plans is of particular relevance for ensuring coherence. This, inter alia because the implementation of the measures in the JPM is primarily a national task and performed via national RBM and water management plans. Table 43 provides (hyper-)links to national RBM and water management plans, aiming to further improve the linkage between the international Danube basin-wide level and the national level.

Table 43: Information on national RBM and water management plans

Country	Where can the national RBM and water management plans be found?
Austria	http://wisa.bmlfuw.gv.at/
Bosnia and Herzegovina	-
Bulgaria	http://www.bd-dunav.org/content/upravlenie-na-vodite/plan-za-upravlenie-na-rechniia-baseyn/
Croatia	http://www.voda.hr/puvp/
Czech Republic	http://eagri.cz/public/web/mze/voda/planovani-v-oblasti-vod/priprava-planu-povodi-pro-2-obdobi/zverejnene-informace/
Germany	www.wrrl.bayern.de
Hungary	www.euvki.hu; www.vizeink.hu
Moldova	-
Montenegro	-

[85] For more information: EUSDR/EC 2014: Alignment of Funding – Operative programmes for EUSDR (Priority Area 4 "To restore and maintain the quality of waters" (PA4)) (Version: v.5 draft) and EUSDR/EC 2014: Alignment of Funding - Operative programmes for EUSDR (Priority Area 5 "Environmental Risks" (PA5) with additional information of Priority Area 4 "To restore and maintain the quality of waters" (PA4))(v.1draft).

Romania	http://www.rowater.ro/SCAR/Planul%20de%20management.aspx
Serbia	http://www.mpzzs.gov.rs
Slovak Republic	www.enviro.gov.sk; www.vuvh.sk/rsv2
Slovenia	http://www.mop.gov.si/si/delovna_podrocja/voda/nacrt_upravljanja_voda/
Ukraine	-

In line with the river basin approach of the WFD and in order to further improve the coherence of the Part A and the Parts B of the DRBM Plan it is necessary to ensure that the national plans (Part B) make reference to the main findings of the Part A of the DRBM Plan. Therefore the national plans (Part B) should reflect the four Significant Water Management Issues (SWMIs) identified on the basin-wide level and indicate how far they are relevant as well on the national level.

In addition there are a number of key products of the ICPDR which were highlighted in the ICPDR Ministerial Declaration 2010, in particular the

- Joint Statement Navigation,
- Guiding Principles on Sustainable Hydropower Development in the Danube Basin,
- ICPDR Strategy on Adaptation to Climate Change and
- Ecological prioritisation approach for measures to restore river and habitat continuity.

These ICPDR products, though not legally binding, are intended to serve as a common roadmap guiding national activities and supporting harmonization of actions at the basin-wide scale. Therefore the national plans (Part B) should make reference to them and take them into consideration when developing national activities in the relevant fields.

8.7 Conducting the DPSIR approach for the DRBM Plan – Update 2015

To be drafted once further discussed and additional data (status assessment, JPM) becomes available

- Critical analysis how far the logic of the DPSIR approach could be followed in the DRBM Plan – Update 2015
- Indication of requirements to strengthen practical application of DPSIR approach

8.8 Key conclusions

To be drafted once the JPM is further elaborated and data becomes available

- Key conclusions based on information from the previous chapters

9 Public information and consultation

This chapter is a draft that will require updates with results and findings from the public consultation activities outlined below, as well as reporting on how these results influenced the development of the final DRBMP.

Objectives and legal framework for Public Participation

The ICPDR is committed to active public participation in its decision making. The commission believes that this facilitates broader support for policies and leads to increased efficiency in the implementation of measures. The ICPDR pursues the consultation of stakeholders in the entire cycle of ICPDR activities: from conceptualising policies, to implementing measures, to evaluating impacts. A legal framework for this is provided by Article 14 of the EU Water Framework Directive.

In practice, the ICPDR pursues public participation primarily through two avenues: (1) through the involvement of observer organisations in its ongoing work; and (2) through specific activities that are dedicated to public participation and information. Although not purely aimed at public participation, a third line of relevant activities are ad-hoc stakeholder dialogues. These are conducted in areas that require inter-sectoral approaches, in particular inland navigation, climate change adaptation, hydropower and agriculture.

Observers to the ICPDR

Observers of the ICPDR can actively participate in all meetings of ICPDR expert groups and task groups, as well as plenary meetings (Standing Working Group and Ordinary Meetings). Observers represent a broad spectrum of water stakeholders in the Danube River Basin, covering social, cultural, economic and environmental interest groups. As of 2015, there were 23 organisations approved as observers, all of which had the opportunity to contribute to the development of the DRBM Plan – Update 2015. Observers are accepted upon approval of the ICPDR and have to meet a defined set of criteria.

Public participation, communication and outreach

Under the umbrella of public participation, the ICPDR pursues a range of specific activities. These include (1) public information such as the development of technical public documents and general publications (e.g. the quarterly magazine Danube Watch); (2) environmental education, awareness raising and outreach (e.g. the annual river festival Danube Day or the teacher's kit Danube Box); and (3) public consultation activities directly linked to the development of river basin management plans.

Public Consultation for the DRBM Plan – Update 2015 in line with Article 14 WFD

To accompany the development of the DRBM Plan – Update 2015, public consultation is done in three main stages: comments from the public are collected (1) on a timetable and work programme including public consultation measures; (2) on significant water management issues (SWMIs) in the river basin; and (3) the draft management plan.

Public consultation for each of these steps spans a period of at least six months, in which the opportunity to provide comments is actively promoted through the ICPDR network. The timetable and work programme was published for comments from 22 December 2012 to 22 June 2013; the SWMI document was published 22 December 2013 to 22 June 2014; the draft DRBM Plan – Update 2015 entered the public consultation phase on 22 December 2014 and will convene on 22 July 2015. The opportunity to participate in each of these steps was promoted through the ICPDR network of contracting parties and observers; the ICPDR website icpdr.org; and the magazine Danube Watch.

For the consultation on the draft DRBM Plan – Update 2015, a number of additional activities will also be pursued to actively involve stakeholders and the interested public. These include a questionnaire to collect opinions on all major chapters of the management plan; a stakeholder workshop to discuss the management plan in detail on 2/3 July 2015; and a social media campaign. These consultation activities will be supported by information materials on the DRBM Plan – Update

2015, such as a short information video. The findings from all four sets of public consultation activities (comments given directly on the draft plan; questionnaires; workshop; social media) will provide the basis for a final report.

Links to public consultation on the national level

The DRBMP provides a basin-wide umbrella supported by national and sub-basin management plans. These management plans are developed with national endeavours in the field of public consultation. To support information exchange between the responsible authorities and link national public consultation activities with the basin-wide level, information on national SWMIs documents was collected and centrally published on icpdr.org and the ICPDR SWMI document was (vice versa) published on national consultation sites. This is also pursued for the draft RBMPs (Part A and B). Meetings of the ICPDR and its Expert Group for Public Participation further supported a basin-wide exchange on the national consultation work.

Links to public consultation for the 1st Danube Flood Risk Management Plan

All activities related to public consultation described here were aligned as much as possible with the steps towards the finalisation of the 1st DFRM Plan. This applies in particular to the publication of the timetable and work programme including public consultation measures in 2013; and the public consultation measures for the draft management plan, which was linked to the draft flood risk management plan. For example, the stakeholder consultation workshop is a joint activity to highlight the inter-linkages between both plans and also to enable an attendance back to back; questionnaires were developed jointly and referred to each other.