Danube River Basin District Management Plan

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Part A – Basin-wide overview

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Disclaimer

The DRBM Plan is based on data delivered by the Danube countries by 14 September 2009. Where countries did not deliver data, other data sources have been used where available. Sources other than the competent authorities have been clearly identified in the Plan.

A more detailed level of information is presented in the national RBM Plans. Hence, the DRBM Plan should be read and interpreted in conjunction with the national RBM Plans. Where inconsistencies may have occurred, the national RBM Plans are likely to provide the more accurate information.

Due to the fact that Montenegro only joined the ICPDR in October 2008, the DRBM Plan does not include data from this country unless explicitly mentioned otherwise. Some other countries have also not been able to provide all the information needed for this report and these gaps are noted in the text. Where data has been made available, it 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

AA EQS	Annual Average Environmental Quality Standard
AEWS	Accident Emergency Warning System
AQC	Analytical Quality Control
ARS	Accidental Risk Spots
AWB	Artificial Water Body
BAP	Best Agricultural Practice
BAT	Best Available Techniques
BEP	Best Environmental Practice
BLS	Baseline Scenario
BOD_5	Biochemical Oxygen Demand
BQE	Biological Quality Element
BREF	Best Available Techniques Reference Documents (under the IPPC)
CAP	Common Agricultural Policy
CEE	Central and Eastern Europe
CEA	Cost Effectiveness Analysis
CIS	Common Implementation Strategy of the European Commission
COD	Chemical Oxygen Demand
DABLAS	Danube and Black Sea Task Force
DDT	Dichlordiphenyltrichlorethan
DEHP	di-(2-ethylhexyl)phthalate
DIN	Dissolved Inorganic Nitrogen
DBA	Danube Basin Analysis 2004
DRB	Danube River Basin
DRBD	Danube River Basin District
DRBM Plan	Danube River Basin District Management Plan
DRPC	Danube River Protection Convention
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EC GIG	Eastern Continental Geographical Intercalibration Group
EFI+	Improvement and Spatial extension of the European Fish Index (EU Framework Programme 7 project)
EG	Expert Group
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EPER	European Pollutant Emission Register
E-PRTR	European Pollutant Release and Transfer Register
EQR	Ecological Quality Ratio
EQS	Environmental Quality Standard
EU	European Union
EU MS	European Union Member State
EU WISE	European Union Information System on Water
FAOSTAT	FAO (Food and Agriculture Organisation of the United Nations) Statistical Databases & Datasets
FIP	Future Infrastructure Project
FP	Framework Programme of the European Union
Non EU MS	Non European Union Member State
EU WFD	European Union Water Framework Directive

GDP	Gross Domestic Product
GEP	Good Ecological Potential
GES	Good Ecological Status
GFP	Good Farming Practices
GIG	Geographical Intercalibration Group
GSM	Global System for Mobile Communications
GW	Groundwater
GWB	Groundwater Body
HMWB	Heavily Modified Water Body
ICPDR	International Commission for the Protection of the Danube River
IPPC	Integrated Pollution Prevention and Control
JAP	Joint Action Programme
JDS	Joint Danube Survey
JPM	Joint Programme of Measures
LDM	Long Distance Migrants
MAC EQS	Maximum Admissible Concentration Environmental Quality Standard
MDM	Medium Distance Migrants
MONERIS	Modelling Nutrient Emissions in River Systems
MS	Member State
OCP	Organochlorinated Pesticides
PAH	Polyaromatic hydrocarbons
PBDEs	Polybrominated diphenylethers
PCB	Polychlorinated biphenyls
PCDD/Fs	Polychlorinated dibenzo-p-dioxins and dibenzofurans
PE	Population Equivalent
PI	Prioritisation Index
PIAC	Principal International Alert Centers
PRTR	Pollutant Release and Transfer Register
QA/QC	Quality Assurance/Quality Control
RBM	River Basin Management
REACH	EU regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals
SEA	Strategic Environmental Assessment
SPM	Suspended Particulate Material
SWMI	Significant Water Management Issue
TNMN	Transnational Monitoring Network
TOC	Total Organic Carbon
UWWTP	Urban Waste Water Treatment Plant
UWWTD	Urban Waste Water Treatment Directive
WB	Water Body
WWTP	Waste Water Treatment Plant

List of Tables

List of Figures

List of Maps

List of Annexes

1. Introduction and background

1.1. Introduction

The EU Water Framework Directive (WFD)[1] establishes a legal framework to protect and enhance the status of all waters and protected areas including water depending ecosystems, prevent their deterioration and ensure long-term, sustainable use of water resources. The Directive provides for an innovative approach for water management based on river basins, the natural geographical and hydrological units, and sets specific deadlines for EU Member States to produce Programmes of Measures and River Basin Management Plans. The WFD addresses inland surface waters (rivers and lakes), transitional waters, coastal waters, groundwater and, under specific conditions, water dependent terrestrial ecosystems and wetlands. It establishes several integrative principles for water management, including public participation in planning and the integration of economic approaches, and also aims for the integration of water management into other policy areas. The WFD calls for the creation of international districts for river basins that cover the territory of more than one EU Member State and for coordination of work in these districts. EU Member States should aim to achieve *good status* in all bodies of surface water and groundwater by 2015, respectively by 2027 at the latest.

The Danube and its tributaries, transitional waters, lakes, coastal waters and groundwater form the Danube River Basin District (DRBD – see Map 1). For the purpose of this Danube River Basin District Management Plan (DRBM Plan)[2], the DRBD has been defined as covering 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. All Danube countries with territories >2,000 km² in the DRB are Contracting Parties to the Danube River Protection Convention[3] (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 Community – EC - is a Contracting Party. Currently not all countries are EU Member States and therefore not obliged to fulfil the WFD. Six countries (BA, HR, MD, ME, RS and UA) are Non EU Member States (Non EU MS). Out of these Non EU MS, one country (HR) carries the status of an EU Accession Country.

When the WFD was adopted in October 2000, all countries cooperating under the DRPC decided to make all efforts to implement the Directive throughout the whole basin. The Non EU Member States committed themselves to implement the WFD within the frame of the DRPC. In the case of an international river basin district extending beyond the boundaries of the Community, WFD Article 13 (3) requires that "Member States shall endeavour to produce a single river basin management plan". In accordance with this Article, the Danube countries have developed the DRBM Plan entailing measures of basin-wide[4] importance as well as setting the framework for more detailed plans at the sub-basin and/or national level.

The DRPC represents the legal, as well as political, framework for cooperation and transboundary water management in the DRB. The International Commission for the Protection of the Danube River (ICPDR) served as the coordinating platform to compile multilateral and basin-wide issues at the "Roof level"[5] of the DRB and facilitated the compilation of this DRBM Plan (Part A) – see Figure 1.

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[1] 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.

[2] DRBM Plan stands for Danube River Basin **District** Management Plan.

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

[4] A definition on the term *'basin-wide'* can be found in the ICPDR document IC 132 on Significant Water Management Issues in the DRB; page 4, Chapter 3.3.

[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.

1.2. The development of the DRBM Plan and the EU Water Framework Directive

This DRBM Plan has been elaborated within the framework of the first River Basin Management (RBM) Cycle according to the EU WFD, which lasts until 2015. The first cycle will be followed-up by two more RBM Cycles that will be finalised by 2021 and 2027, respectively.

According to the WFD, the first RBM Cycle follows four phases, each with defined tasks:

PHASE I: Definition of river basin districts; definition of the institutional framework and mechanisms for coordination (until end of 2003).

PHASE II: Analyses of river basin characteristics, pressures and impacts and economic analysis; establishment of the register of protected areas (until end of 2004).

PHASE III: Development of monitoring networks and programmes (until end of 2006).

PHASE IV: Development of the River Basin Management Plan including the Joint Programme of Measures (JPM) (until end of 2009).

The DRB is the “most international” river basin in the world covering territories of 19 countries. Those 14 countries with territories greater than 2,000 km² in the DRB cooperate in the framework of the ICPDR. With an area of 807,827 km², the DRBD is the second largest in Europe. Some of its basic characteristics are given in the following Table 1.

Table 1: Basic characteristics of the Danube River Basin District.

DRBD area	807,827 km²
DRB area	801,463 km²
Danube countries with catchment areas >2,000 km²	**EU Member States** (8): Austria, Bulgaria, Czech Republic, Germany, Hungary, Slovak Republic, Slovenia, Romania. **EU Accession Country** (1)**:** Croatia **Non EU Member States** (5): Bosnia & Herzegovina, Moldova, Montenegro, Serbia and Ukraine.
Danube countries with catchment areas <2,000 km²	**EU Member States** (2): Italy, Poland. **Non EU Member States** (3): Albania, FYR Macedonia, Switzerland.
Inhabitants	approx. 80,5 million
Length of Danube River	2,857 km
Average discharge	approx. 6,500 m³/s (at the Danube mouth)
Key tributaries with catchment areas >4,000 km²	Lech, Naab, Isar, Inn, Traun, Enns, March/Morava, Svratka, Thaya/Dyje, Raab/Rába, Vah, Hron, Ipel/Ipoly, Siò, Drau/Drava, Tysa/Tisza/Tisa, Sava, Timis/Tamiš, Velika Morava, Timok, Jiu, Iskar, Olt, Yantra, Arges, Ialomita, Siret, Prut.
Important lakes >100 km²	Neusiedler See/Fertö-tó, Lake Balaton, Yalpug-Kugurlui Lake System, Razim-Sinoe Lake System (Lacul Razim and Lacul Sinoe, which is also a transitional water body)
Important groundwater bodies	11 transboundary groundwater bodies of basin-wide importance are identified in the DRBD.
Important water uses and services	Water abstraction (industry, irrigation, household supply), drinking water supply, wastewater discharge (municipalities, industry), hydropower generation, navigation, dredging and gravel exploitation, recreation, various ecosystem services.

The DRBD is not only characterised by its size and large number of countries but also by its diverse landscapes and the major socio-economic differences that exist between the upstream and downstream countries.

The DRBM Plan is based on three levels of coordination:

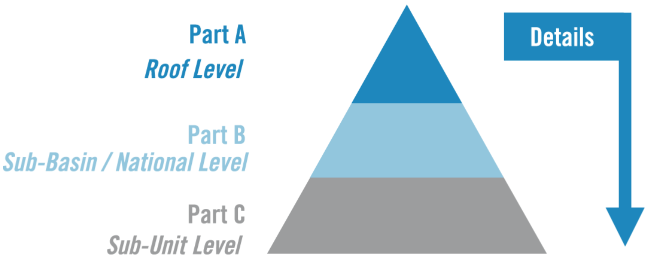
⇨ Part A: the international, basin-wide level - the Roof level;

⇨ Part B: the national level (managed through competent authorities[6]) and/or the internationally coordinated sub-basin level for selected sub-basins (Tisza, Sava, Prut and Danube Delta);

⇨ Part C: the sub-unit level, defined as management units in the national territory.

The information increases in detail from Part A to Parts B and C (see Figure 1).

Figure 1: Overall structure of the DRBM Plan showing the increase of details from Part A to Parts B and C.



The investigations, analysis and findings of this DRBM Plan for the basin-wide scale (Roof level) focus on (see Map 1):

- rivers with catchment areas >4,000 km^2; [7]
- lakes >100 km^2;
- transitional and coastal waters;
- transboundary groundwater bodies of basin-wide importance.

Waters with smaller catchment and surface areas are part of the national RBM Plans.

The content of the DRBM Plan at the Roof level is strongly based on findings and actions at the national/sub-basin level. The national RBM Plans and Programme of Measures can be downloaded from the respective websites indicated in Annex 1. So far, the Danube countries have agreed to develop sub-basin management plans for the Danube Delta, the Tisza, the Sava and the Prut Basin, which are to be elaborated in a higher resolution than that used at the Roof level. The Tisza RBM Plan is currently being elaborated by the Tisza countries (UA, SK, HU, RO and RS) under coordination with the activities in the ICPDR and will be finalised in 2010. The International Sava River Basin Commission has finalised a Sava River Basin Analysis in 2009. RBM activities are currently initiated for the Danube Delta, whereas for the Prut River Basin activities still need to be developed.

In addition to the DRPC, many bilateral/multilateral agreements between individual countries are in place and enable transboundary cooperation below the Roof level. At the Roof level, the ICPDR serves as the facilitating and coordinating platform between the different DRPC Contracting Parties. Where the boundaries of the DRBD extend beyond the national borders of the countries cooperating under the DRPC (e.g. into Italy or Poland) it is the responsibility of the respective DRPC Contracting Parties to find an appropriate form of coordination with the relevant neighbours.

1.3. The Danube Basin Analysis 2004 – analytic basis for the DRBM Plan

The Danube Basin Analysis 2004 (DBA) reported the requirements under WFD Article 5 (Annexes II and III) and Article 6 (Annex IV) and was submitted to the European Commission in March 2005. The DRBM Plan fills the gaps and updates the findings of the DBA 2004.

Main tasks, conclusions and updates of the Danube Basin Analysis

The DBA included the first characterisation of surface waters and groundwater of the DRBD, an inventory of protected areas, an economic analysis and information on public participation as well as key conclusions and an outlook. As a first step of the DBA, **surface waters** of the DRBD were

[6] A list of competent authorities can be found in Annex 1.
[7] The scale for measures related to point source pollution is smaller and therefore more detailed.

generally characterised by ecoregions (see Map 2), a river typology and by defining reference conditions for the EU WFD biological quality elements (WFD Annex V). The typology for surface waters (rivers, transitional waters, lakes and coastal waters) has been updated for this DRBM Plan. 160 river types have been identified for the entire DRB and 10 types for the Danube River. Details on the revised typology of DRB surface waters form part of Annex 2.

Further, the DBA water body delineation, which is based on the respective EC WFD Common Implementation Strategy Guidance, 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 MD and ME - have performed water body delineations for surface waters (see Map 3) and groundwater (see Map 4.) For the DRBD rivers with catchment areas >4,000 km^2, 681 river water bodies (25,117 rkm) have been delineated in the DRBD. The Danube River itself is characterised by 45 water bodies. Further, seven lakes water bodies – one being transitional – have been delineated. The two UA lake water bodies Yalpug and Kugurlui result together in a lake system with a surface area larger 100 km^2. Overall 7 transitional and 5 coastal water bodies have been identified. For each Danube country, Table 2 provides an overview of river water body (WB) totals; their relation to the overall DRBD WB total; their average length and the length of the national river network.

Table 2: Share of DRBD per country; percentage of state within the DRBD; DRBD population; water body delineation for all DRBD rivers with catchment areas >4000 km^2 and the Danube River.

Country	Share of DRBD (%)	Percentage of state within the DRBD (%)	Population in DRBD (in millions)	Length of national DRB river network	Number of water bodies		Share of all DRBD WBs (%)	Average national WB length (rkm)	
					All	Danube		All	Danube
DE	7.0	16.0	9.7	1,503	53[8]	15	7.1	28.4	37.7
AT	10.0	96.1	7.9	2,392	190	13	25.6	12.6	27.0
CZ	2.7	27.3	2.8	598	32	0	4.3	18.7	-
SK	5.8	96.0	5.2	1,811	45	4	6.1	40.2	43.4
HU	11.5	100.0	10.2	3,189	57	4	7.7	55.9	128.1
SI	2.0	81.1	1.8	834	25	0	3.4	33.4	-
HR	4.3	61,9	3.1	1,470	33	2	4.4	44.6	70.3
BA	4.7	74.9	2.9	1,602	35	0	4.7	45.8	-
ME	0.9	55.0	0.2	no information					
RS	10.1	92.8	7.5[9]	3,277	63[10]	10	8.5	52.0	77.0
RO	29.6	100.0	21.6	9,474	182[11]	7	24.5	52.1	370.8
BG	5.8	42.6	3.4	1,291	15	1	2.0	86.1	471.6
MD	1.5	36.2	1.1	837	no information				
UA	4.5	6.0	2.6	1,056	13	1	1.7	81.3	245.2
Total	**100[12]**		**80.5[13]**	**25,117[14]**	**681[15]**	**45[14]**	**100**	**38.4**	**85.8**

Danube River	WB number	Total length (rkm)
	45	2,857[15]

[8] This value includes 2 artificial canal water bodies (Main-Danube Canal).
[9] This value does not include the population of Kosovo - a territory defined by the United Nations resolution 1244 (1999) as an autonomous province of the Republic of Serbia administered by the UN.
[10] This value includes 11 artificial canal water bodies (Danube-Tisa-Danube Canal System).
[11] This value includes 2 artificial canal water bodies (Danube-Black Sea Canal).
[12] This value includes the area of CH, IT, PL, AL and MK.
[13] This value includes the DRBD population share of CH, IT, PL, AL and MK.
[14] This value does exclude doublecounts regarding country shared river stretches and is therefore not the sum of individual river network lengths respectively number of water bodies per country in the table.
[15] This value does not include the length of thet Chilia and St. Gheorge Danube Delta branches.

The overall aim of the DBA's pressure/impact analysis was the identification/estimation of surface water bodies *at risk*, *possibly at risk* or *not at risk* of failing the WFD environmental objectives in 2015. Water bodies have been classified *possibly at risk* in the case of insufficient information or knowledge. During the pressure/impact analysis of the DBA, the results from WFD compliant monitoring networks and WFD compliant classification systems were not available. Therefore, the approach followed an interim procedure of risk estimation using pressure and impact criteria/thresholds for all anthropogenic pressures.

The 2004 analysis focused on anthropogenic pressures resulting from point and diffuse source pollution as well as from hydromorphological alterations. Other pressures/impacts were not identified in detail on the basin wide level but may be important on the more detailed national level.

Regarding the entire DRBD and its surface water bodies, the analysis showed an increase of water bodies *at risk* from upstream to downstream countries due to the pressure ***organic emissions***. Figure 2 illustrates this for the Danube River. The major cause was insufficient wastewater treatment – wastewater treatment either missing or inadequate – in the middle and lower DRB. The countries within the upper basin have already undertaken significant measures related to wastewater treatment during recent decades and have therefore succeeded in reducing negative impacts due to organic pollution on surface water status. Measures to be implemented by 2015 for the entire DRBD to reduce organic pollution are outlined in Chapter 7.

Regarding the pressure ***nutrient emissions***, the DBA showed a similar picture as for organic pollution i.e. the number of water bodies *at risk,* affected by significant pressures and eutrophication, increased from upstream to downstream countries for the Danube River (see Figure 2). The DBA presented modelling results for nutrient emissions in the DRB using the model MONERIS (Modelling Nutrient Emissions into River Systems[16]). Overall, nutrient loads in the DRB have significantly decreased over the past 20 years, although they are still well above the levels of the 1960s.

The pressures resulting from ***hazardous substance emissions*** also predominantly impacted water bodies within the middle and lower Danube River (see Figure 2). Pollution from hazardous substances was analysed as significant although the full extent could not be evaluated.

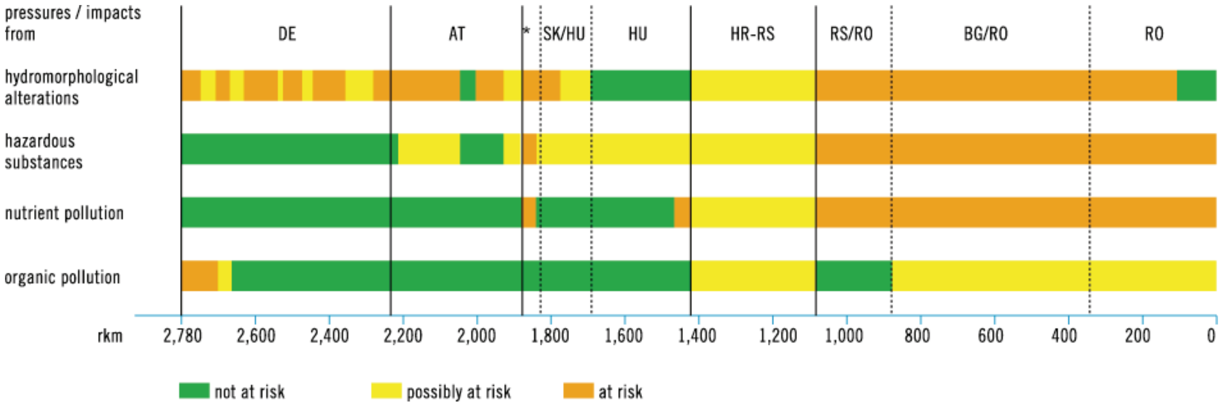
Hydromorphological pressures[17] were identified as impacting the majority of water bodies within the entire DRB. Water bodies within the upper, middle and lower basin were dominantly *at risk* or *possibly at risk* because of these pressures. The most important pressures were related to hydropower generation, flood protection and navigation. As a consequence, the number of water bodies identified provisionally as *heavily modified* was very high throughout the entire basin.

Figure 2 illustrates the results of the DBA according to the categorised pressures for the entire length of the Danube River itself. 58% of the Danube River length was categorised *at risk* due to organic pollution, 65% due to nutrient pollution and 74% due to hazardous substances. 93% of the Danube River was *at risk* or *possibly at risk* of failing the WFD environmental objectives because of hydromorphological alterations. In conclusion, large parts of the Danube River are subject to multiple pressures. For the entire DRBD, the distribution of pressures is similar.

[16] Modelling Nutrient Emissions into River Systems, Behrendt (2000).

[17] Hydromorphological pressures are human alterations to the natural form, shape or pattern of surface waters such as modification of bank structures, sediment/habitat composition, flow regime and slope and river continuity. The consequence of these pressures can impact aquatic ecological flora and fauna and can hence significantly impact the water status.

Figure 2: Results of the risk analysis for the entire Danube River length (DBA, 2004).[18] (*: SK territory).



Four of the 11 important transboundary **groundwater bodies** of the DRBD have been identified *not at risk* concerning chemical status. The remaining 7 groundwater bodies were *possibly at risk*. Related to groundwater quantity, it has been concluded that 6 of the transboundary groundwater bodies were *not at risk* and five *possibly at risk.*

The DBA enabled the identification of four Significant Water Management Issues (SWMI)[19] that can directly or indirectly affect the status of both surface water and transboundary groundwater[20]:

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

1.4. Role of the Significant Water Management Issues

The DRBM Plan and the JPM 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. However, investigations have also been and will be undertaken to identify other relevant issues and their significance on the basin-wide scale. These include climate change, flood/drought events, sediment transport and invasive species.

For each SWMI and groundwater, visions and operational management objectives have been developed to guide the Danube countries and the DRBM Plan (see Chapter 7). 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 an explicit way - they are less detailed than at the national water body level and more detailed than expressed in the DRPC and Danube Declaration[21].

Overall, the visions and management objectives reflect the joint approach among all Danube countries and support the achievement of the WFD objectives in a very large, unique and heterogeneous European river basin.

[18] This figure is based on findings of the DBA 2004 and may include differences to final findings at the national level and/or to this DRBM Plan.

[19] ICPDR document IC 132 (2007): Significant Water Management Issues in the Danube River Basin District.

[20] Groundwater quality and quantity of important transboundary groundwater bodies.

[21] ICPDR document IC 089 (2004): The Danube Basin – Rivers in the Heart of Europe (Danube Declaration).

1.5. Structure and logic of the DRBM Plan

The nine chapters of this management plan follow the logic and requirements of the EU WFD. Further, their structure is determined through the SWMIs of the DRB. Chapter 2 and Chapter 7 are specifically dedicated to the SWMIs and their analyses. While Chapter 2 describes existing pressures for each SWMI, important transboundary groundwater bodies and other issues (i.e. sediment quality/quantity, invasive species), Chapter 7 responds with respective measures to be implemented on the basin-wide scale for each SWMI. The latter chapter also includes key conclusions regarding the Joint Programme of Measures, which are important for future river basin management in the DRB. The monitoring networks of the DRB are described in Chapter 4, which also includes the outcomes of the basin-wide water status assessment and the final designation of Heavily Modified Water Bodies and Artificial Water Bodies. The exemptions outlined in Chapter 5 and applied according to WFD Articles 4(4), 4(5) and 4(7) add up to the monitoring assessment results. In combination these chapters clearly indicate actions needed to be taken to improve water status in the DRB. Further, the DRBM Plan includes an inventory of protected areas (Chapter 3 and Annex 10), an economic analysis of water uses (Chapter 6) as it reflects on flood risk management and climate changes in the DRB (Chapter 8) as well as on public information/consultation (Chapter 9).

The DRBM Plan illustrates the findings in 29 thematic maps and detailed information is part of 21 Annexes.

2. Significant pressures identified in the Danube River Basin District

As outlined in the previous chapter, the Danube Basin Analysis 2004 (WFD Article 5) enabled the identification of Significant Water Management Issues in the DRBD. This chapter addresses each of the SWMIs concerning surface waters, addresses groundwater issues and includes revised information since the DBA. The current overview outlines existing pressures in the DRBD. The Joint Programme of Measures responds to all these pressures in order to achieve the environmental objectives on the basin-wide scale.

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, and is addressed in this DRBM Plan.

Further, the country specific emissions regarding organic, nutrient and hazardous substance pollution presented in this chapter should in general be seen in relation to the respective countries share of the DRBD.

2.1. Surface waters: rivers

2.1.1. Organic pollution

Organic pollution is mainly caused by the emission of partially treated or untreated wastewater from agglomerations[22], industry and agriculture. Many agglomerations in the DRB have no, or insufficient, wastewater treatment and are therefore key contributors to organic pollution. Direct, as well as indirect, discharges of industrial wastewaters are also important. Very often industrial wastewaters are insufficiently treated or are not treated at all before being discharged into surface waters (direct emission) or public sewer systems (indirect emission).

[22] Emissions from agglomerations: all releases of substances originating from the agglomeration reaching the environment (soil, water, air).

Organic pollution can cause significant changes in the oxygen balance of surface waters. As a consequence it can impact upon the composition of aquatic species/populations and therefore water status. Organic emissions and their impact can be measured and expressed with parameters like COD (chemical oxygen demand), BOD_5 (biological oxygen demand) and TOC (total organic carbon).

Analysis of pressures causing organic, nutrient and hazardous pollution

For the DBA, the significance of pressures – in the sense of being of basin-wide importance – was identified and characterised using specific criteria based on the size of the pressure and/or the performance of treatment applied. Unfortunately there were limitations in this approach, especially with respect to data completeness, and so modification of the methodology was required.

To that extent, data collections are primarily based on existing binding EU reporting processes or on existing international conventions. For urban wastewater discharges, the evaluation is based on the methodology of the EU Urban Waste Water Treatment Directive (UWWTD) and uses the data model and information that are also reported to the European Commission. The UWWTD covers all agglomerations with ≥2,000 PE[23]. The UWWTD concept is centered around the term "agglomeration" which means "an area where the population and/or economic activities are sufficiently concentrated for urban wastewater to be collected and conducted to an urban wastewater treatment plant or to a final discharge point".

For industrial emissions, the data and methodology of the "European Pollutant Emission Register" (EPER) was used. In future, the "Pollutant Release and Transfer Register" (PRTR), which supersedes the EPER, and which is currently being implemented in all ICPDR countries, will be used.

Data from Non EU Member States were collected in the same structure so that a basin-wide assessment is possible.

The new data collections and evaluations give a more complete picture on pollutant sources and emissions. The direct comparison with the data of the DBA is not possible.

2.1.1.1. Organic pollution from urban wastewater

In order to address organic pollution pressures in the DRB, collection and assessment of data on urban, industrial and agricultural wastewater have been increasingly improved in the framework of the ICPDR. Significant effort has gone into creating a complete, flexible and pragmatic reporting system that makes the best use of mandatory EU reporting requirements, while keeping the workload for the Contracting Parties as low as possible. Further, respective data have been collected from the Non EU Member States. Details on the methodology and data assessment can be found in Annex 3.

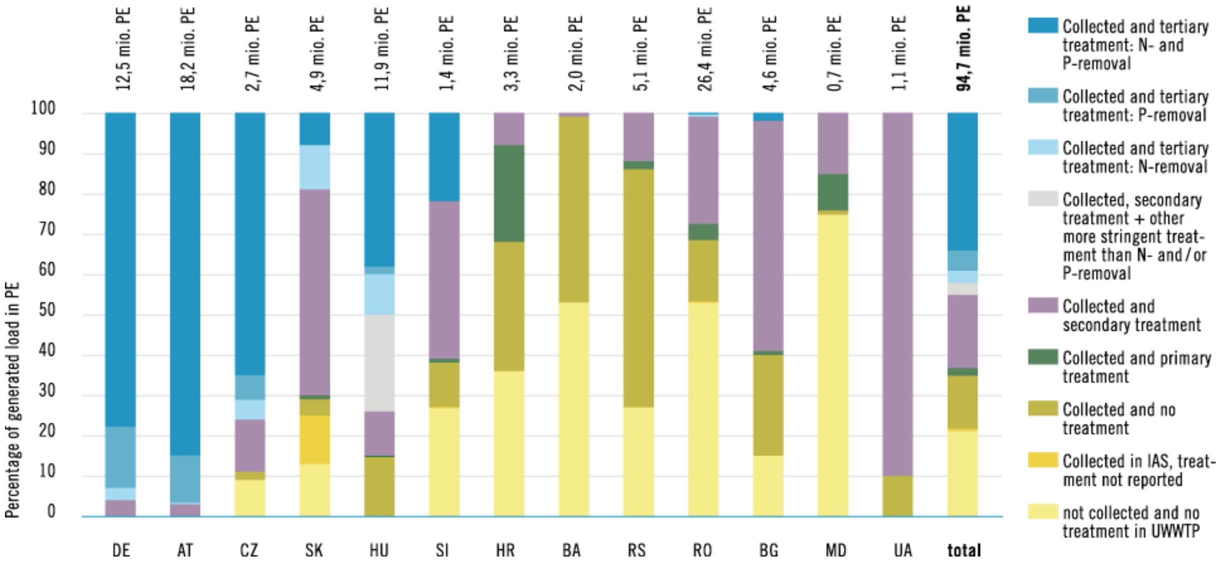
A total of 6,224 agglomerations ≥2,000 PE are located in the DRBD. Out of those, 4,969 agglomerations (21 million PE) are in the class 2,000 -10,000 PE and 1,255 agglomerations can be classified with a PE >10,000 (73.6 million PE) – see Map 18 (Reference Situation UWWT). These figures clearly demonstrate the importance of addressing the organic pollution from this relatively small number of large communities (>10,000 PE), which contain the majority of the population.

There is still a high number of agglomerations ≥2,000 PE that are neither connected to a sewage collecting system nor to a wastewater treatment plant. In total, wastewaters are not collected at all in more than 2,900 agglomerations (12.6% of the total generated load). Approximately 1,000 further agglomerations have collection systems that require more stringent treatment. The construction of sewerage collecting systems for agglomerations ≥2,000 PE will reduce the pollutants emitted directly and infiltrated to the ground; but at the same time this could also lead to a significant increase in organic pollutants if proper treatment is not applied before being discharged to surface waters.

Figure 3 provides an overview of existing wastewater treatment plants, existing treatment levels and degree of connection to wastewater treatment throughout the entire DRB per country.

[23] PE (Population Equivalent) describes the average untreated biological load generated by one person per day and equals 60g of BOD_5/d.

Figure 3: Wastewater treatment of the generated load from agglomerations ≥ 2,000 PE – reference year 2005/2006 (existing wastewater treatment plants; existing treatment levels and degree of connection to wastewater treatment for the entire DRB by country).[24&25]
(IAS: Individual and appropriate systems e.g. cesspools, septic tanks, domestic wastewater treatment plants).



The updated assessment of this Plan shows that the COD & BOD_5 emission from large agglomerations (>10,000 PE) in the DRB are respectively 922 kt/a and 412 kt/a. Further, the assessments have been improved by calculating emissions from agglomerations ≥2,000 PE. The total emission contribution from these sources is 1,511 kt/a for COD and 737 kt/a for BOD_5 (see Table 3).

Table 3: COD and BOD_5 emissions from agglomerations ≥2,000 PE for each Danube country and the entire DRBD emitted through all pathways (reference year 2005/2006).

	DE	AT	CZ	SK	HU	SI	HR	BA	RS	RO	BG	MD	UA	Total
Emission COD (kt/a)	31.7	30.5	17.0	74.0	87.6	26.3	144.6	87.5	191.3	727.1	62.3	22.0	8.8	**1,511**
Emissions BOD_5 (kt/a)	5.9	6.2	7.1	34.6	45.8	12.7	68.0	47.8	95.4	366.6	31.1	11.5	4.7	**737**

2.1.1.2. Organic pollution from industry

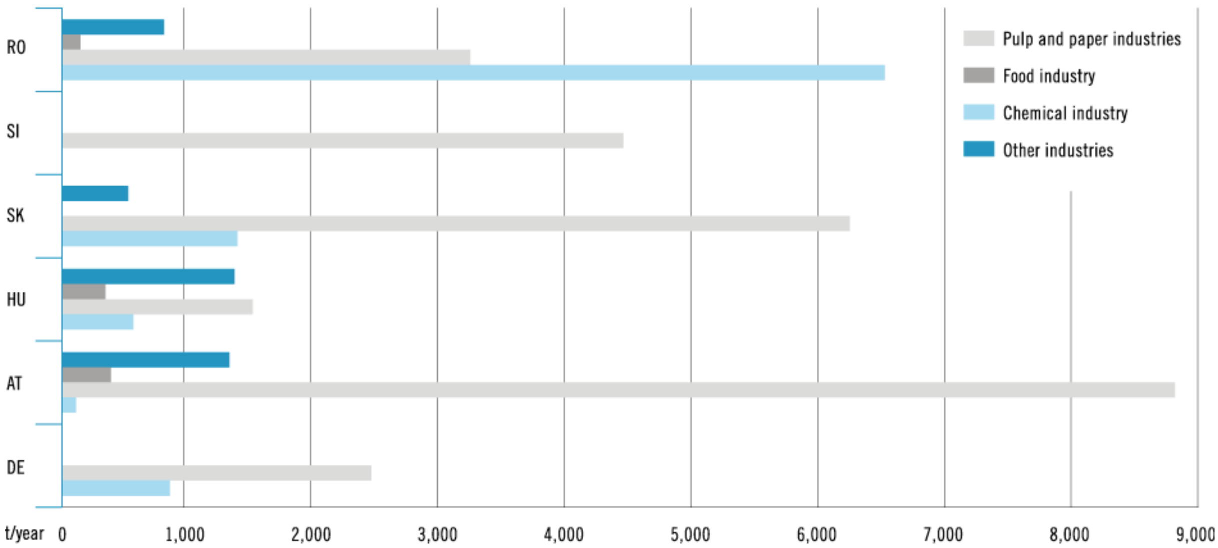
Over the past twenty years the closure of many heavily polluting industrial activities in the middle and lower Danube countries has contributed to a decrease in organic pollution. A large portion of industrial wastewaters is still being discharged without any, or with insufficient, pre-treatment into the public sewerage network. The pressure analysis shows that emissions from industry are still lower than those from agglomerations but nonetheless important.

A preliminary analysis on industrial and food industrial sources of organic pollution identifies a total number of 173 facilities emitting directly into the DRBD and 189 facilities with indirect emissions to water through urban sewers.[26] Detailed information on the data collection forms part of Annex 5.

[24] For some countries a collection rate of less than 100% does not indicate that the remaining percentage is not treated at all.
[25] Discrepancies in the pressure analysis results between national level and DRB level can be attributed to the differences in the level of aggregation between national and basin wide level, to different reference years (the DRBM Plan considered 2005/2006), and/or to different methodologies used at national levels (i.e. differentiation between emissions to water bodies and emissions into soil).
[26] The analysis is incomplete due to the ongoing PRTR protocol implementation.

The degree of industrial development and amount of pollution caused by the industrial sector varies among the countries. In general, almost all industrial sectors are producing organic pollution. However, the pulp and paper industry is the largest emitter, with significant emission contributions from the chemical, textile and various branches of the food industry. Figure 4 provides an overview of those key industries emitting directly into the waters of the DRB and indicates respective generated load for EU Member States. The Total Organic Carbon (TOC) emissions by the EU MS for the reference year 2004/2005 show a direct[27] industrial TOC load of 41,3 t/a. The TOC emissions of Non EU MS in t/a are currently unknown.

Figure 4: Direct emissions of TOC per relevant types of industries in EU MS (2004).[28]



2.1.1.3. Organic pollution from agriculture

Animal breeding and manure disposal are key agricultural point sources of organic pollution. Related EPER data were collected on facilities for animal breeding for EU MS. However, data gaps still exist regarding the Non EU MS and need to be closed in the future in order to perform a comprehensive and more detailed analysis. The contribution of organic pollution from agricultural sources is well below the historical estimates of approximately 30% of the overall total emissions. Among agricultural point sources of pollution, the pig and poultry farms are clearly the most relevant point sources of organic pollution. Although many of these facilities have in recent years reduced the numbers of animals they maintain or made other improvements, this remains a pressure.

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[27] The EPER data also provided information on "indirect emissions" i.e. industrial emissions into public sewerage systems and subsequent urban wastewater treatment. Depending on the technical performance of the subsequent treatment, the actual emissions into the environment are significantly smaller (often <10%). The dominant activities for indirect emissions of TOC to water are "Pulp from timber or other fibrous materials and paper or board" and "Slaughterhouses, plants for the production of milk, other animal raw materials or vegetable raw materials". The reference year for Romania is 2005.

[28] BG, CZ: Data not reported for EPER 2004, therefore no illustration included in Figure 4. RO: data from 2005.

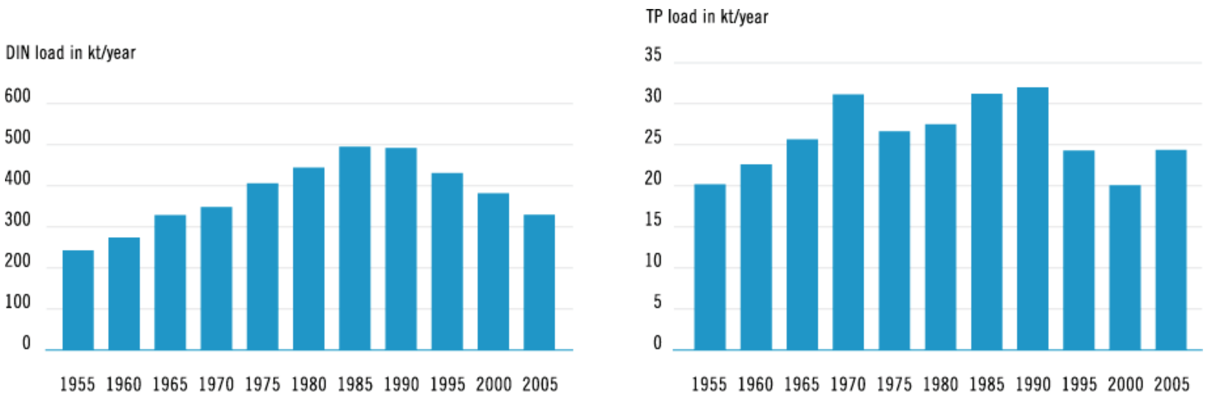
2.1.2 Nutrient pollution

Nutrient pollution – particularly by Nitrogen (N) and Phosphorus (P) - can cause eutrophication[29] of surface waters. Further, their emission and discharge into coastal areas and the marine environment can significantly impact upon the status of those ecosystems. Nutrient pollution is a priority challenge, interlinking the freshwater with the marine environment.

N and P emissions cause eutrophication in many DRBD surface waters and contribute to eutrophication in the Black Sea North Western shelf. For the period 1988-2005, the Danube, as one of the major rivers discharging into the Black Sea, was estimated to introduce on average about 35,000 tonnes of P and 400,000 tonnes of inorganic N into the Black Sea each year.

The present level of the total nutrient load in the Danube River system is considerable higher than in the 1960s, but lower than in the late 1980s. The decrease from the 1990s to the present situation is due to the political as well as economic changes in the middle and lower DRB resulting in (i) the closure of nutrient discharging industries, (ii) a significant decrease of the application of mineral fertilisers and (iii) the closure of large animal farms (agricultural point sources). Furthermore, the application of economic mechanisms in water management (e.g. the *polluter pays principle* also applied in the middle and downstream DRB countries) and the improvement of wastewater treatment (especially in upstream countries) contributed to this decrease.

Figure 5: Long-term discharges of dissolved inorganic nitrogen (DIN) and total phosphorus (TP) (1955-2005).



The present level of the total Phosphorus load that would be discharged to the Black Sea (including the P storage that occurs today in the Iron Gate impoundments[30]) would be about 20% higher than in the early 1960s (based on modelling results from daNUbs and MONERIS). The Iron Gate Dams (which were built between 1970 and 1986) are a significant factor in reducing the amount of Phosphorous from countries upstream the dams, in the Danube River that eventually reaches the Black Sea. The reason for this is that large amounts of sediment - containing P attached to the sediment particles - settle out in the reservoir behind the dams. Although this P is at present stored in the Iron Gates reservoir it may in future be a significant source of pollution in the case of flood events causing chemical P release. This P release and eventual mobilisation could be a pressure factor for the downstream countries but also for the impoundment section upstream of the Iron Gate Dams.

The recent investigations also show that the ecological situation in the North Western Black Sea coastal area has improved significantly since the early nineties due to the lower discharges of N and P to the Black Sea. However, economic recovery in the future, which would potentially result in increasing nutrient loads to the Black Sea (industry, agriculture and increased connection to sewerage),

[29] Definition of *eutrophication*: The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned [Directive 91/271/EEC].

[30] The Iron Gate influences the retention of phosphorus via the sedimentation process and has been taken into account within the MONERIS calculations.

would put the achievement of environmental objectives at risk if not combined with a set of effective measures, especially as required by EU legislation.

Interlinkage between organic and nutrient pollution

Nutrient pollution is – as with organic pollution – mainly caused by emissions from the agglomeration, industrial and agricultural sectors (see Annex 4). Furthermore, for agglomerations, the P emissions via household detergents play a significant role. Regarding nutrient emissions, respective pressures on water bodies can result from (i) point sources (in particular untreated/partially treated wastewaters), and/or (ii) diffuse sources (especially agriculture). The pressure assessment related to nutrient pollution took the synergies between organic and nutrient pollution fully into account. The same basic assumptions and facts regarding wastewater treatment for urban and industrial emissions for organic pollutions are also valid for nutrients (see Chapter 2.1.1.1). The findings of point source analysis have been combined with those related to diffuse sources. The MONERIS model integrates these components and reflects the overall nutrient input in the DRB in total and per Danube country.[31]

2.1.2.1. Nutrient point source pollution

Nutrient pollution from urban wastewater

Nutrient pollution from point sources is mainly caused by emissions from insufficiently or untreated wastewater into surface waters (from agglomerations, industry and agriculture). It should be mentioned that the operation of secondary and tertiary treatment levels at wastewater treatment plants (WWTPs) is of particular importance for the respective elimination/reduction of nitrates/phosphates. An overview of treatment levels is provided in Chapter 2.1.1.1 (Figure 3).

Nutrient emissions and the eventual impact from point sources can be measured and expressed with parameters such as inorganic nitrogen, total nitrogen (N_{tot}), ammonia (NH_4), nitrate (NO_3), nitrite (NO_2) or total phosphorus (P_{tot}) and phosphates (PO_4)

Organic point source pollution from agglomerations is outlined in Chapter 2.1.1.1 and is also illustrated for nutrients in Map 18. Table 4 shows N_{tot} and P_{tot} generated load emitted from agglomerations ≥2,000 PE for each Danube country and the DRB total generated load emissions (point and diffuse) for reference year 2005/2006).

Table 4: N_{tot} and P_{tot} emissions from agglomerations ≥2,000 PE for each Danube country and the entire DRBD emitted through all pathways (reference year 2005/2006).

	DE	AT	CZ	SK	HU	SI	HR	BA	RS	RO	BG	MD	UA	Total
Emissions N_{tot} (kt/a)	12.3	9.5	2.8	11.4	14.7	3.2	10.9	7.3	16.0	69.3	6.5	1.9	2.1	**168.0**
Emissions P_{tot} (kt/a)	1.0	0.8	0.4	1.7	2.8	0.7	2.8	1.6	2.9	11.5	1.3	0.4	0.7	**28.6**

[31] The MONERIS Model integrates the findings of point source analysis with those related to diffuse sources and reflects the overall nutrient input in the DRB in total and per Danube country. SI is using a method based on the OECD method: *Environmental indicators for agriculture. Methods and Results (2006)*.

Industry

Many industrial facilities are significant sources of nutrient pollution. The chemical sector is the most important contributor. Figure 6 and Figure 7 show direct emissions of N_{tot} and P_{tot} for EU MS for the different types of industries in 2004. The N_{tot} and P_{tot} emissions in t/a for Non EU MS are currently unknown.

Figure 6: Industrial direct emissions of nitrogen per relevant types of industries and EU MS (2004; RO: 2005).

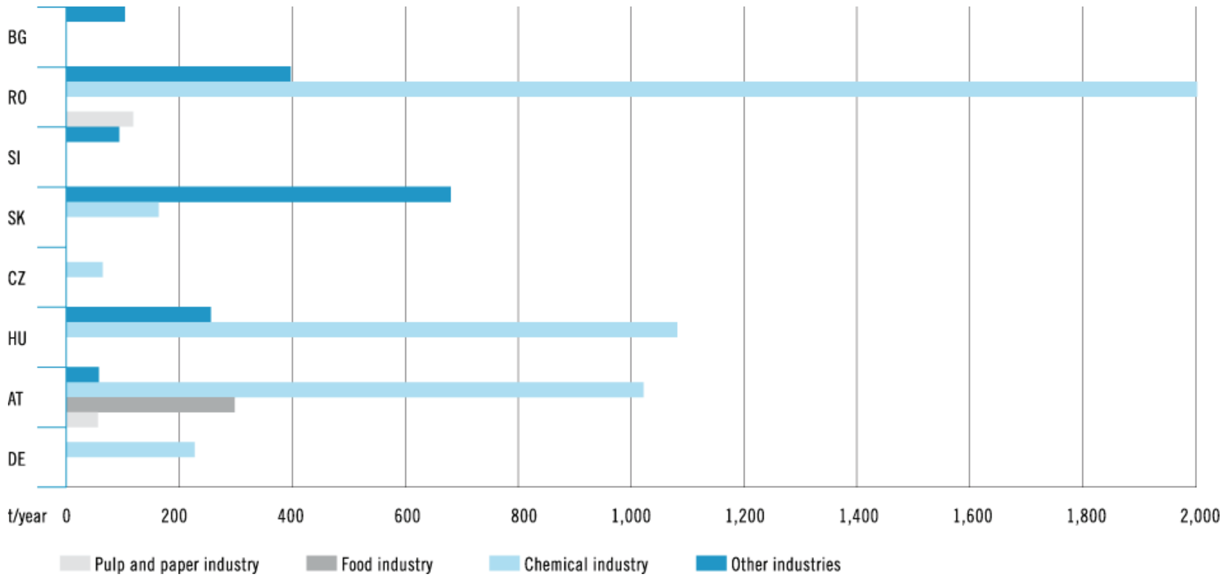
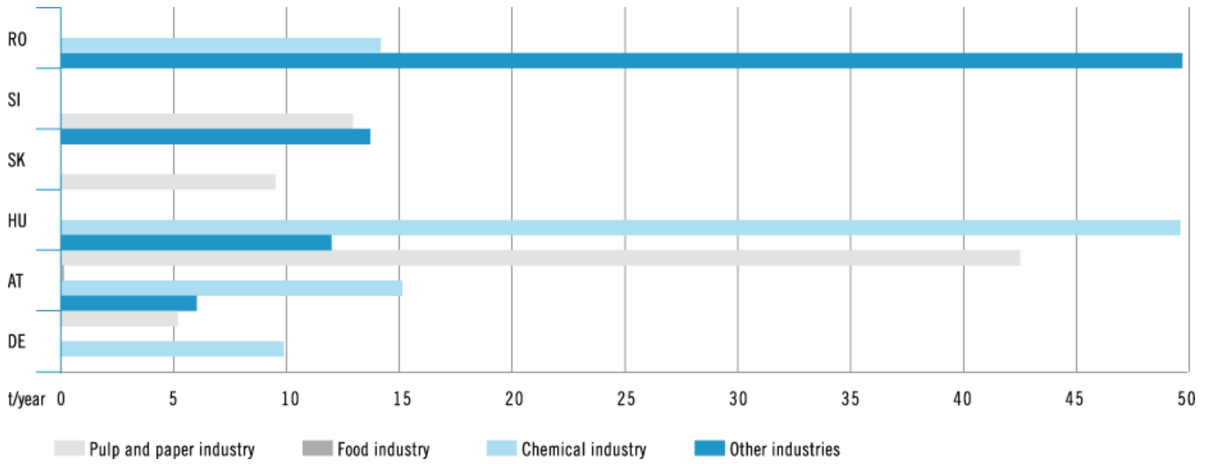


Figure 7: Industrial direct emissions of phosphorus per relevant types of industries and EU MS (2004; RO: 2005).[32]



Nutrient point source pollution from agriculture

For agricultural point source pollution, data gaps (that mainly exist for Non EU MS as EPER data are available for EU MS) need to be closed in the future in order to perform a comprehensive and more detailed analysis. However, agricultural emissions from diffuse sources are of even greater importance and are analysed by MONERIS (see below).

[32] BG, CZ: Data not reported for EPER 2004, therefore no illustration is included in Figure 7.

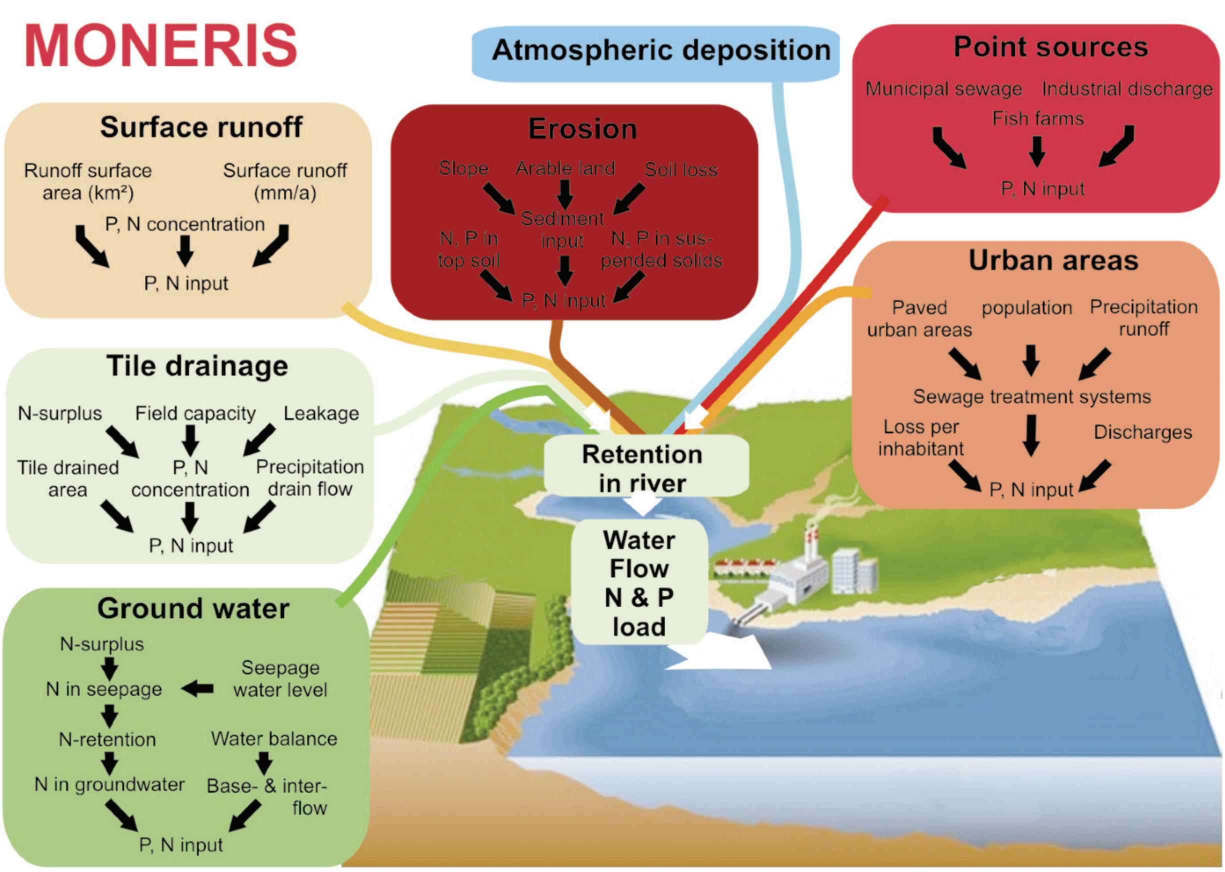
2.1.2.2. Nutrient diffuse source pollution

Diffuse source pollution is caused by widespread activities such as agriculture and other sources (see Figure 8). The levels of diffuse pollution are not only dependent on anthropogenic factors such as land use, and land use intensity, but also on natural factors such as climate, flow conditions and soil properties. These factors influence pathways that are significantly different. For N, the major pathway of diffuse pollution is groundwater while for P it is erosion.

MONERIS – a model for point source and diffuse source emissions calculations

The emission of substances from diffuse sources cannot be easily measured. The emissions estimation of diffuse source pollution for large river catchments such as the Danube is only possible by mathematical modelling. In the framework of the DBA and DRBM Plan, nutrient emissions into the river system through individual pathways were calculated/estimated using MONERIS (MOdelling Nutrient Emissions in RIver Systems) model.[33] MONERIS considers point source emissions and combines them with emissions resulting from different diffuse source pathways (see Figure 8). Furthermore, MONERIS integrates various statistical information for different administrative levels, land use, hydrological, soil and hydrogeological data and works for Geographical Information System (GIS) illustration.

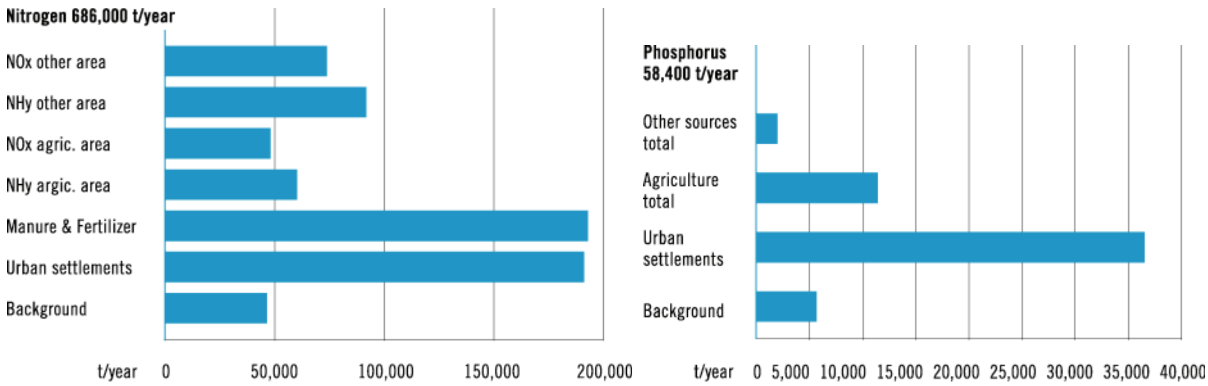
Figure 8: Schematic picture of main processes in relation to sources and pathways of nutrient inputs, including retention, into surface waters (MONERIS model).



[33] Behrendt et al. (2007): The Model System MONERIS (2007) – User Manual; Leibniz Institute for Freshwater Ecology and Inland Fisheries in the Forschungsverbund Berlin e.V., Müggelseedamm 310, D-12587 Berlin, Germany.

Figure 9 shows the MONERIS results decribing that altogether 686 kt of N and 58 kt of P in total are annually emitted into the DRB. The background conditions presented in MONERIS (7% for N; 9% for P) represent the pre-industrial situation with very limited airborne emissions of reactive N and erosion of soils not yet saturated with P. Consequently, these values are small in comparison with the current DRB emissions. The main contributors for both N and P emission are agglomerations not served by sewerage collection and wastewater treatment. For N pollution, the input from agriculture (fertilisers, manure, NO_x and NH_x) is the most important (totalling 43% of total emissions). For P, emissions from agriculture (area under cultivation, erosion, intensity of production, specific crops and livestock densities) are the second largest source after input from urban settlements. The share of agricultural emissions differs significantly between countries (for details see Chapter 7).

Figure 9: Sources of nitrogen and phosphorus emissions (EU MS and Non EU MS) in the DRBD as of 2005 (MONERIS results).



Phosphate input via detergents

The emission of phosphates via household detergents is significant in the DRB and it is included in the agglomerations contribution to total emissions. In case of no wastewater treatment or treatment without a tertiary treatment the respective P loads find a direct way into the aquatic environment. Currently, only some countries in the DRB have introduced a phosphate ban for laundry detergents, although others intend to follow. P emissions due to laundry and dishwasher detergents in the DRB are estimated at 9,190 t/a. This is 15,7% of the total P emissions.

Nutrient input via mineral fertilisers and livestock manure

The use of mineral fertilisers significantly contributes to nutrient pollution in the DRB and it is included in the agglomerations contribution to total emissions. The two most important plant nutrients applied as mineral fertilisers are N and P.

The use of fertilisers dropped significantly after the economic collapse in the early 1990s in almost all Danube countries. This led to a significant reduction in agricultural productivity in the region, including a decline in the use of mineral fertilisers. Data available from the FAOSTAT database[34] (2004) shows that the use of N fertilisers (kg N/ha) by farmers in the middle and lower DRB countries is far below the EU average and that of upstream Danube countries. In addition, the density of livestock per hectare on farms in lower Danube countries is below the Danube average. It can be expected that the number of livestock will increase in due course leading to an increase in nutrient emissions[35] if it is not done in a sustainable way.

34 FAOSTAT database: Data from the FAOSTAT database of the UN Food and Agriculture Organisation Pesticide Consumption in CEE countries and the EU15.

35 Detailed information can be taken from the ICPDR Technical Report on MONERIS published end 2009.

The dynamic situation related to agriculture and respective re-thinking in the region could in future significantly affect the extent of nutrient pressure from agriculture on water resources.

Summarising the situation regarding nutrient inputs from the agricultural sector, emissions from diffuse sources (such as those from mineral and organic fertilisers and manure) are significant.

Nutrient input via atmospheric deposition

In the DRB, the share of nutrient pollution from atmospheric deposition is also significant. It is diverse in different regions of the DRB and stems partly from sources outside the DRB. The share for N is significant (39%) but less so for P (13%). Contributions to atmospheric nutrient pollution stem from human activities including transport, combustion of oil and derivates, agriculture (livestock farming) and industry.

2.1.3. Hazardous substances pollution

Hazardous substances pollution can seriously damage riverine ecology and consequently impact upon water status and affect the health of the human population. Types of hazardous substances include: man-made chemicals, naturally occurring metals, oil and its compounds, endocrine disruptors and pharmaceuticals.

Sources of hazardous substances are: industrial effluents, storm water overflow, pesticides and other chemicals applied in agriculture as well as discharges from mining operations and accidental pollution. For some substances atmospheric deposition may also be of significance.

Article 16 of the WFD has put in place a mechanism through which a list of 33 *priority pollutants* has been created[36]. Their inclusion on the list was based on environmental quality standards and emission control measures (established in the mid 1990s) and ranked effects according to their measured or estimated concentrations in water or sediments. From this list of 33 priority substances, a group of 11 *priority hazardous substances* has been identified, which are to be subject to cessation or phasing out of discharges, emissions and losses according to a timetable that shall not exceed 20 years.

A list of substances/parameters of relevance in the DRB was prepared by the ICPDR[37] consisting of two separate annexes:

- Annex A: 33 priority substances, in accordance with the Annex X of the EU WFD;
- Annex B: 8 additional substances (of which four are hazardous), divided into two groups:
  - B1: General Parameters (COD, NH_4-N-ammonia, Total N, Total P) ;
  - B2: Danube Specific Substances (arsenic, copper, zinc, chromium).

Existing knowledge gaps

For the DBA, the ICPDR Emission Inventory and results from the JDS 1 provided the basis for the pressure analysis regarding hazardous substances. At this stage of analysis, out of the 33 priority substances identified, only 7 were included in the parameters assessed in the Transnational Monitoring Network (TNMN). Very limited basin-wide information was available for the other 26 substances. For this DRBM Plan, the respective lack of data on hazardous substances continues, although new reporting schemes, improved analytical capabilities and results from the JDS 2 (that took place in 2007 - see Chapter 4) have created some improvement. The continued deficiency of adequate analytical instrumentation in some downstream countries; the lack of legal instruments for obligatory measurements and inadequate wastewater treatment remain major problems. In recent years, endocrine substances and pharmaceuticals have been increasingly analysed in effluents from wastewater treatment plants or water intakes. For pesticides, effluents from cleaning equipment are usually considered of local significance. However, the significant uncertainty in our current knowledge of

[36] According to WFD Article 2(30), priority substances mean substances identified in accordance with Article 16(2) and listed in Annex X. Among these substances there are *priority hazardous substances,* which are defined as substances identified in accordance with Article 16(3) and (6) for which measures have to be taken in accordance with Article 16(1) and (8).

[37] ICPDR document: List of Priority Substances 2001/2002 (see www.icpdr.org).

pressures due to hazardous substances, as well as their impact on water status, is ongoing and needs to be improved in the future.

EU regulations on hazardous substances

Marketing and use of chemicals is subject to EU-wide regulations in EU countries. These regulations consist of:

a. Regulation of plant protection products: Directive 91/414/EEC is the key document for defining the strict rules for authorisation of plant protection products (PPPs). The Directive requires extensive risk assessments for effects on health and environment to be carried out, before a PPP can be placed on the market and used. An amendment to these regulations is currently in the final stage of the European legislative process.
b. Regulation of biocidal products: The Biocidal Product Directive (Directive 98/8/EC) aims to harmonise the European market for biocidal products and their active substances. At the same time it aims to provide a high level of protection for humans, animals and the environment.
c. Regulation of chemicals: REACH is a new European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the registration, evaluation, authorisation and restriction of chemical substances. The new law entered into force on 1 June 2007.

Hazardous substances pollution -– industrial sources

Manufacturing industries are responsible for the large emission loads of a number of hazardous substances. Heavy metals and organic micro-pollutants in particular are of concern, in addition to traditional pollutants. The EPER covers 26 water pollutants. Information provided by the EU MS in EPER reporting shows an increase of the reported load values of arsenic, cadmium, chromium, copper, mercury, nickel, lead and zinc in 2004 (compared with 2001 values). In 2004, the amount of lead directly discharged was 138 t/a, and for zinc, 171 t/a. In the forthcoming PRTR, a total of 71 pollutants (including all priority and priority hazardous substances) will be covered.

Use of agricultural pesticides in the DRB

Another major source of hazardous substances is pesticides used in agriculture. Information on use within the Danube countries prepared for the DBA[38] showed that 29 relevant active ingredients were used in pesticide products. Of these, only three pesticides are authorized for use in all of the DRB countries, while 7 are not authorized in any of the countries, despite the fact that they have been found in testing of water and sediments (see also results from JDS 1 and 2).

Compared with Western Europe and including the upstream Danube countries, the level of pesticide use in central and lower DRB countries is still relatively low. Data from the FAOSTAT database show a strong decline in pesticide use in the CEE countries to approx. 40% of 1989 levels (compared to a relatively small decrease in EU MS during the same period - 1960-2000). There are indications, however, of increasing use in those countries where the economic circumstances for agriculture are improving most rapidly.

Although pesticide use is currently relatively low in the middle and lower DRB countries, the risks of pesticide pollution remain present and are clearly an important pressure on water resources:

- Pesticides are frequently detected in surface water and groundwater in the DRB and pose a serious hazard to the environment and human health.
- 7 pesticides are not authorized in the Danube countries; some of them continue to be of concern because of the existence of old stockpiles and residues in soils and sediments.
- The uncontrolled and illegal trade of pesticide products lead to the use of banned pesticides (e.g. DDT) by farmers.

[38] UNDP GEF Danube Regional Project: Inventory of Agricultural Pesticide Use in the DRB Countries.

Accidental pollution and the inventory of accident risk spots in the DRB

Within the DRB, there have been accidental spills of hazardous substances that have severely affected the aquatic environment and water quality. Accidents are concentrated in time and space and often have severe immediate as well as localized ecological consequences. Prevention is often possible and relatively easy if precautionary measures are taken. The ICPDR has elaborated a basin-wide inventory of potential accident risk spots (ARS Inventory). An estimation of the real risk at a particular site was prepared and a set of checklists elaborated for prevention of accident risk.[39]

In addition to accidental pollution from operating industrial facilities, pollution from sites contaminated by former industrial activities or waste disposal has been identified as significant. It is of specific importance for sites contaminated by hazardous substances to identify those substances that can be mobilised and enter water bodies in the event of a flood. The updated inventories should provide a clear picture on potential risk sites, as well as possible targets for reducing and controlling accidental pollution[40].

A survey in 2002 identified 261 such sites in the DRB. As a consequence, a methodology (M1) was developed to screen their risk potential[41]. It was agreed by the Danube countries that sites with a high risk potential should be investigated further in order to create a more concrete risk estimation and ranking.

In total, approx. 650 risk spots have been recorded and 620 evaluated based on further investigations. As a result, a hazardous equivalent of about 6.6 million tonnes has been identified as a potential danger in the Danube catchment area.

2.1.4. Hydromorphological alterations

Hydromorphological alterations and their effects on water status have gained vital significance in Europe's water management activities due to the requirements of the EU WFD (in addition to traditional issues related to chemical pollution pressures on water quality).

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 populations. The alteration of natural hydromorphological structures can have negative effects on aquatic populations and therefore result in the deterioration of the water status of surface waters.

Hydropower generation, navigation and flood protection are the key water uses that cause hydromorphological alterations. 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.

Three key hydromorphological pressure components of basin-wide importance have been identified:

a. Interruption of river and habitat continuity;
b. Disconnection of adjacent wetlands/floodplains;
c. Hydrological alterations.[42]

Potential pressures that may result from future infrastructure projects are also dealt with.

This chapter reflects in part findings on hydromorphological alterations and their significance from the DBA 2004, the Joint Danube Survey 2 (JDS 2) and from the most recent national data.

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[39] For the classification of potential risk spots, a common procedure was elaborated considering the findings of the International Commission for the Protection of the Elbe, the EU Seveso II Directive and the UN/ECE Convention on the Transboundary Effects of Industrial Accidents.

[40] Based on that estimation it is possible to elaborate a list of necessary immediate measures to enhance the safety level of a site. The selected M1 methodology for risk identification considers the properties of substances used or stored at a site and the quantity of the given substances. The properties of the substances determine the Water Risk Class (WRC), which – in combination with the amount of used/stored substances – determines the Water Risk Index (WRI), the quantitative indicator of the risk.

[41] UNDP GEF DRP: M1 & M2 Methodology on Risk Assessment for Contaminated Sites (2006) – www.icpdr.org.

[42] Hydrological alterations provoke changes in the quantity and conditions of flow.

The DBA examined the extent of river continuity interruptions (major hydraulic structures) and the disconnection of floodplains/wetlands for the Danube River and selected tributaries. Hydrological alterations were not analysed as part of the DBA. Future infrastructure projects were addressed with a list of planned hydro-engineering projects that has been updated for this Plan and supplemented with additional information. Overall morphological alterations are considered as an important pressure component for surface waters. However, details on their analysis are part of the national RBM Plans and are not yet addressed on the basin-wide scale. In the DBA, expert judgement served as a basis for the analysis of hydromorphological alterations. This analysis approach has been further elaborated as part of this chapter.

In cases where countries share river stretches it is likely that some hydromophological components (river and habitat continuity interruption, hydrological alterations) include double-counts. This is because the information has been reported separately by the Danube countries and is not bilaterally harmonised. However, the discrepancy between the results of the analysis and the factual values without double-counts is estimated to be only between 1 and 4% of the total. For the cases where countries reported separately for shared river stretches the information needs to be harmonised in the future.

Hydromorphological alterations in the Danube River – Joint Danube Survey 2

The JDS 2 in 2007 delivered results on hydromorphological alterations for the entire length of the Danube River (from Kehlheim (rkm 2416) to the Danube Delta) for the very first time. A special method for hydromorphological survey and assessment was developed for the JDS 2. A 5-class evaluation for three categories (1. channel; 2. banks; 3. floodplains) formed the basis for the overall hydromorphological assessment. The 5 classes were calculated as a mean of the three categories. The overall hydromorphological assessment of the JDS 2 concluded that more than one third (39%) of the Danube River from Kehlheim to the Black Sea can be classified as class 2. However, 30% of the Danube River's length is characterised as class 3, 28% as class 4 and 3% as class 5 (Figure 10 and Figure 11).

The analysis for the upper, middle and lower Danube indicates that the upper reach in Germany and Austria is the most affected by significant hydromorphological alterations (68 barriers – see Figure 11). There are only a few river stretches in the upper Danube that are not impacted by impoundments and can be classed as free-flowing stretches (e.g. natural flow velocity) e.g. Straubing-Vilshofen (DE) or Wachau (AT) and downstream of Vienna (AT). The middle and lower courses of the Danube River still sustain significant free flowing stretches: upstream of Novi Sad to Gabcikovo Dam (SK) and downstream of the Iron Gate Dams (RO/RS) to the Black Sea.

Figure 10: Overall hydromorphological assessment in five classes in %
(mean of channel, banks and floodplain evaluations).

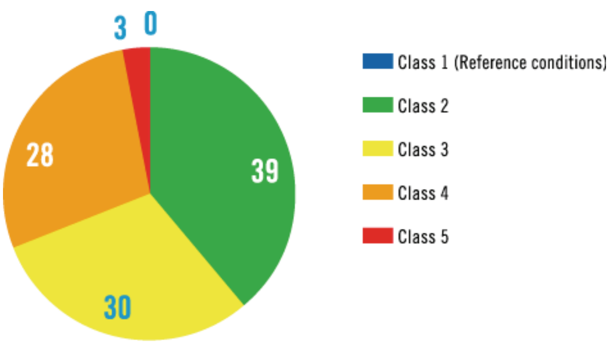
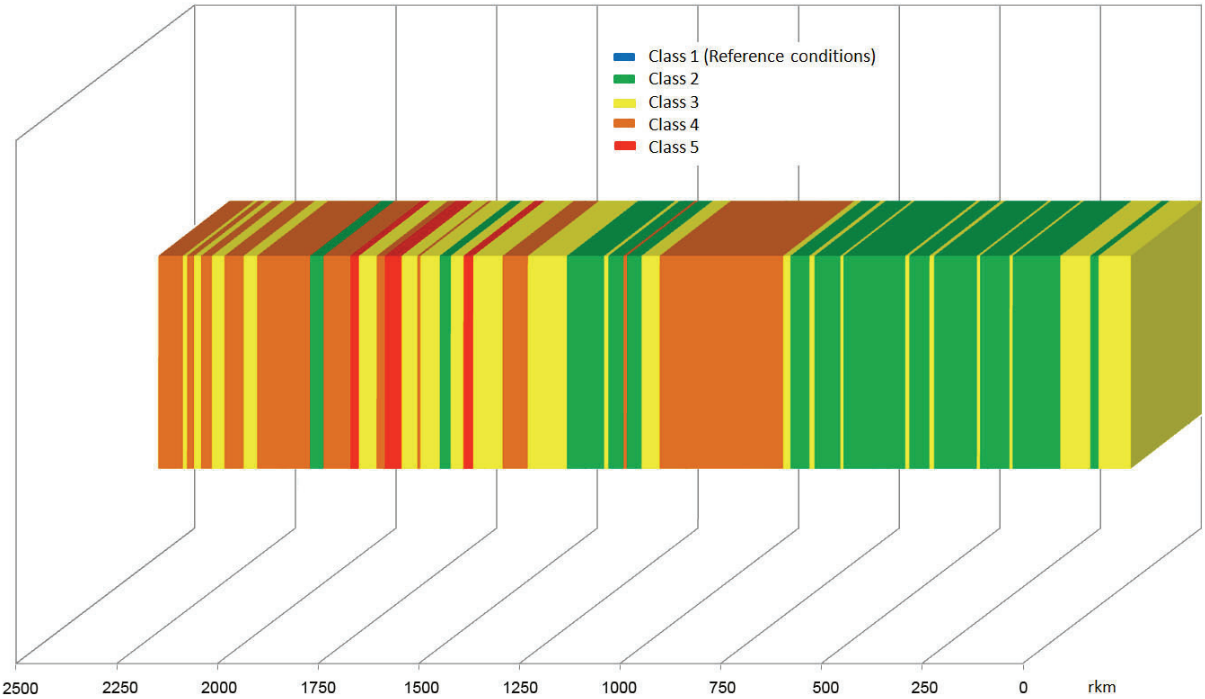


Figure 11: Overall hydromorphological assessment of the Danube River in five classes as longitudinal colour-ribbon visualisation.[43]



Overall, only very short stretches of the Danube can be characterised as reference condition (class 1) in connection with the naturalness of banks and floodplains. Near-natural banks occurred along the steep slopes of the Serbian, Bulgarian and Romanian Danube and longer stretches were observed in the lower Danube. With respect to floodplains, large natural stretches occurred in the protected sites of Kopački Rit (HR) and Gornje Podunavlje (RS) and on the right bank of Small Braila Island (RO). Details of the hydromorphological approach and results can be found in the final scientific report of the JDS[44].

2.1.4.1. River and habitat continuity interruption as a significant pressure

The key driving forces causing eventual river and habitat continuity interruptions in the DRBD are mainly flood protection (45%), hydropower generation (45%) and water supply (10%). 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).

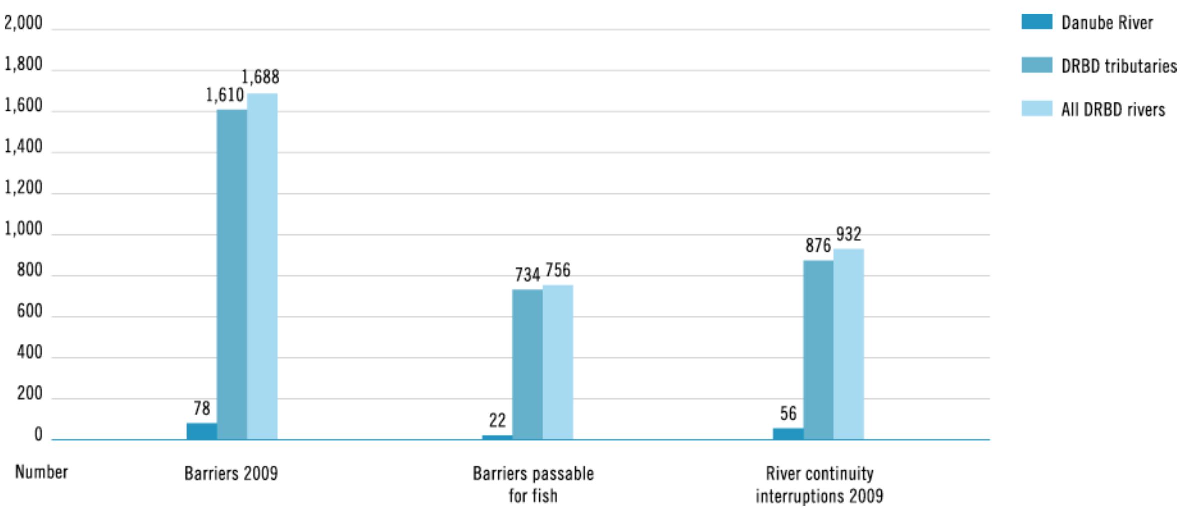
1,688 barriers are located in DRBD rivers with catchment areas >4,000 km^2 (Figure 12 and Map 5). 600 of the 1,688 continuity interruptions are dams/weirs, 729 are ramps/sills and 359 are classed as other types of interruptions. 756 are currently indicated to be equipped with functional fish migration aids. **Therefore, 932 continuity interruptions (55%) remain a hindrance for fish migration as of 2009 and are currently classified as significant pressures** (see Figure 12 and Map 5)**.**

296 water bodies in the DRBD are significantly altered by continuity interruptions un-passable for fish species. This is 44% of the total number of DRBD water bodies (681).

[43] The approach applied by JDS2 for the assessment of the hydromorphological alterations does not replace a WFD compliant status assessment and therefore the JDS2 results do no 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.

[44] ICPDR (2008): Joint Danube Survey 2 – Final Scientific Report; Eds: Liska et al; ICPDR Secretariat, VIC/D0412, P.O. Box 500, 1400 Vienna, Austria.

Figure 12: Current situation on interruption of river and habitat continuity in the Danube River, the DRBD tributaries and all DRBD rivers.



For the Danube River itself, 78 barriers can be identified, 22 of which are passable for fish as of 2009. The Austrian/German chain of barriers (75 in total), the Gabcikovo Dam (SK) and the Iron Gate Dams 1 & 2 (RO/RS) are significant river and habitat continuity interruptions for the Danube River. For details see Chapter 7.1.4.1.2 (blue box).

2.1.4.2. Disconnection of adjacent wetlands/floodplains

Among many ecosystem services, wetlands/floodplains and their connection to adjacent river water bodies play an important role in the functioning of aquatic ecosystems by providing important habitats for fish as well as other fauna and have a positive effect on their water status. According to the EU WFD, pressures on wetlands are to be considered as significant and need to be addressed by measures where they are impacting negatively on the water status of adjacent water bodies. 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.

The DBA concluded that the main causes of wetland destruction have been the expansion of agricultural uses and river engineering works concerning mainly flood control, navigation and power generation. Drainage and irrigation are also responsible for alterations in water levels and the loss of wetlands and floodplains. Compared with the 19th Century, less than 19% of the former floodplain area (7,845 km² out of a once 41,605 km²) remains in the entire DRB. Since the 1950s, engineering works have accounted for a total of 15-20,000 km² of Danube floodplains being cut off from the rivers.

The basis of the pressure analysis for this DRBM Plan was the consideration that disconnected wetlands/floodplains are potential pressures to aquatic ecosystems on the basin-wide level and that the highest possible area should be re-connected to the adjacent rivers in the DRBD in order to support the achievement the environmental objectives by 2015 and beyond. The pressure analysis therefore focused 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 by 2015 and beyond.

To date, 95 wetlands/floodplains (covering 612,745 ha) with potential to be re-connected to the Danube River and its tributaries have been identified (see Figure 13 and Map 6). The 31,932 ha of wetlands/floodplains reported by RS are already partly connected to the adjacent river and this will be further improved in the future (see Chapter 7.1.4.2). The location and size of the evaluated wetlands/floodplain are illustrated in Map 6.

The indication of no reconnection potential for wetlands/floodplains in many Danube countries (Figure 13) does not indicate that there is no restoration taking place. Figure 13 illustrates exclusively the reconnection for the basin-wide DRBD scale, whereas many restoration activities are taking place at the national level. Further information on the restoration of wetlands/floodplains are outlined in the national RBM Plans (see Annex 1 for national web links).

Figure 13: Current situation regarding the area (ha) and number of DRBD wetlands/floodplains (>500 ha or which have been identified by the Danube countries of basin-wide importance) identified as having a potential for reconnection and/or improvement of water regime by 2015 and beyond. (A reported 31,932 ha in Serbia are already partly reconnected and further reconnection is foreseen).

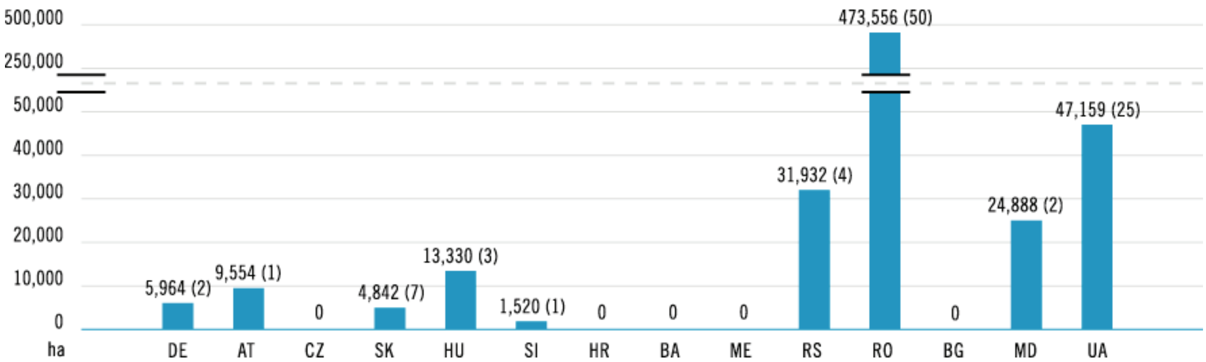


Table 5 shows the number of water bodies in the DRBD (in absolute numbers and percentage) that will be affected by the potential reconnection of wetlands/floodplains and/or improvement of the water regime that may have a positive effect on their water status. The absolute length of water bodies with restoration potential in relation to disconnected wetlands/floodplains is 2,171 km (9% of total river network).

Table 5: Number of river water bodies adjacent to wetlands/floodplains identified as having reconnection potential by 2015 and beyond as well as relation to the overall number of water bodies (Danube River, DRBD tributaries, all DRBD rivers).

	Total number of WBs	WBs with reconnection potential	% with reconnection potential
Danube River	45	8	17
DRBD tributaries	636	9	1
All DRBD rivers	681	17	2

2.1.4.3. Hydrological alterations

The DBA 2004 did not provide information on hydrological alterations due to a lack of respective data at that time. The findings below are the first ever results of a pressure analysis, based on reference data from 2009. Additional details on hydrological alterations can be taken from the respective national RBM Plans (see Annex 1 for national web links).

The main pressure types in the DRBD causing hydrological alterations are in numbers: 449 impoundments, 140 cases of water abstractions and 89 cases of hydropeaking[45]. Some of the hydrological alterations are dedicated to purposes classed as not specified. The consequences resulting from the above pressure types and criteria used to assess their significance are shown in Table 6.

[45] Multiple hydrological pressures (impoundment, water abstraction, hydropeaking) can be bound to one hydrological alteration (see also Figure 39 and Table 18). The number of individual hydrological pressures can therefore be larger than the total number of hydrological alterations.

Table 6: 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	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 the river	Flow below dam <50% of mean annual minimum flow[46] in a specific time period (comparable with Q95)
Hydropeaking	Alteration of flow dynamics/discharge pattern in river and water quantity	Water level fluctuation >1m/day or even less in the case of known/observed negative effects on biology

The pressure analysis concludes that 697 hydrological alterations are located in the DRBD – 62 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 the ICPDR criteria (Table 6) are outlined below as well as illustrated in Map 7a, b and c.

Table 7 shows the number of DRBD water bodies affected by hydrological alterations (in absolute numbers and percentage).

Table 7: Number of river water bodies significantly affected by hydrological alterations in relation to the overall number of water bodies (Danube River, DBBD tributaries, all DRBD rivers).

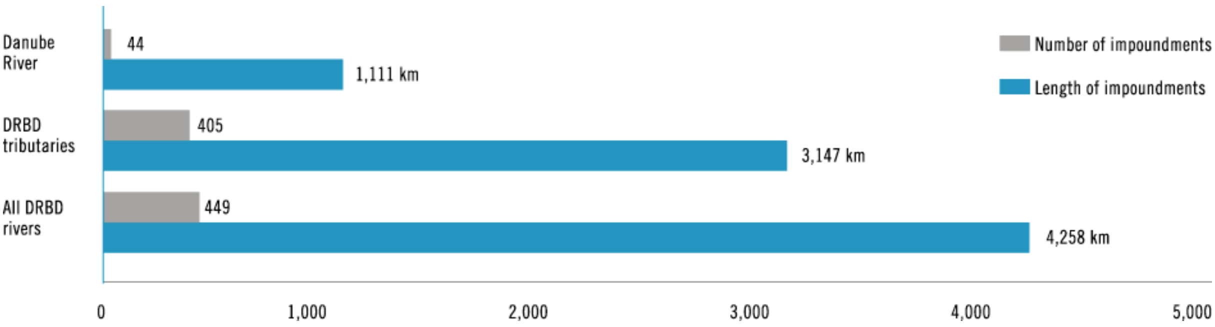
	Total number of WBs	WBs affected by hydrological alterations	Proportion of affected WBs to total number (%)
Danube River	45	25	56
DRBD tributaries	636	228	36
All DRBD rivers	681	253	37

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.

The pressure analysis concludes that 449 impoundments are located in the DRBD (see Figure 14 and Map 7a) affecting 201 water bodies. It can be concluded that out of 25,117 km of all rivers in the DRBD with catchment areas > 4,000 km^2, 4,258 km are affected by impoundments (17%).

Figure 14: Number and length of impoundments in the Danube River, DRBD tributaries and all DRBD rivers (with catchment areas >4,000 km²).



46 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.

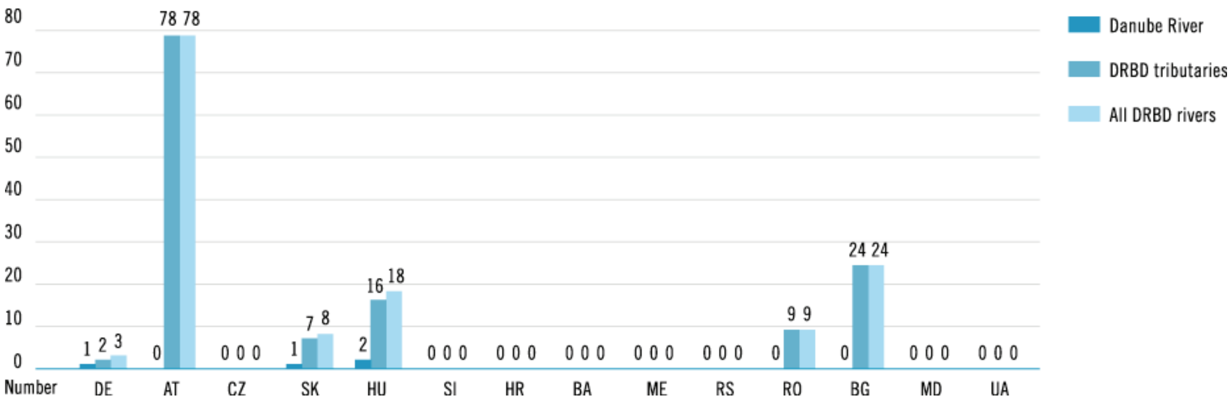
For the Danube River, impoundments are the key hydrological pressure type causing significant alterations. 1,111 km of its entire length (of 2,857 km) are impounded (representing 39% of the length) by 78 barriers including hydropower plants. In fact, impoundments are the major hydrological pressure type for the Danube River. Water abstraction due to hydropower generation occurs only in the bypass channel of the Gabcikovo Dam (bypass canal) and hydropeaking does not show any significant effects on water status on the basin-wide scale. The impoundment upstream of the Iron Gate Dams 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 significant length of the upper Danube River (approx. 269 km; representing 77% of the Austrian Danube River length share). However, significant free-flowing stretches are located upstream of Novi Sad to the Gabcikovo Dam and downstream of the Iron Gate Dams to the Black Sea.

Water abstractions

In the DRBD, the key water uses causing significant alterations through water abstractions are mainly hydropower generation (76%), public water supply (5%), agriculture and forestry (3%) and irrigation (9%)[47]. Water abstraction for energy production (cooling water), manufacturing industry, navigation and other major abstracts totals 5%, with the remaining 2% unspecified. These 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.

The pressure analysis concludes that 140 water abstractions are causing alterations in water flow in DRBD rivers >4,000 km^2 (Figure 15 and Map 7b). 77 water bodies are affected by these pressures. Out of the 140 water abstractions, 105 are significant going below the ICPDR criterion (Table 6). The Danube River itself is only impacted by alterations through water abstraction at Gabcikovo hydropower dam (bypass channel) and three water abstractions in Germany as well as Hungary.

Figure 15: Number of water abstractions in the Danube River, DRBD tributaries and all DRBD rivers with catchment areas >4,000 km^2 (by Danube country).



Hydropeaking

Hydropeaking is a pressure type that occurs in the DRBD and is undertaken by the hydropower sector to generate peak energy supply. Altered flow regimes below hydropower plants occur 89 times in the rivers of the DRBD. Out of those and according to the ICPDR criterion (Table 6), 32 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 Map 7c). Overall, 44 water bodies are affected by an altered flow regime.

[47] The percentage values refer to the analysed number of water abstractions in the DRBD.

2.1.4.4. Future infrastructure projects (FIP)

In addition to already existing hydromorphological alterations, a considerable number of future infrastructure projects are at different stages of planning and preparation throughout the entire DRBD (see Annex 7). These projects, if implemented without consideration to hydromorphological alterations, are likely to provoke pressures on water status.

A list of future infrastructure projects (until 2015) has been compiled based on specific selection criteria:

Danube River: Future infrastructure projects have been identified and listed for which Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed or transboundary effects are provoked.

Danube tributaries: Future infrastructure projects have been identified and listed for which a Strategic Environmental Assessment (SEA) and/or Environmental Impact Assessments (EIA) are performed *and* transboundary effects are provoked.

All FIPs (until 2015) including brief descriptions if provided are compiled in Annex 7 and Map 8.
The pressure analysis concludes that 112 FIPs have been reported for the DRBD. 70 of them are located in the Danube River itself. 64 (57%) are related to navigation; 31 (28%) to flood protection, four (4%) to water supply; three (3%) to hydropower generation and ten (9%) projects are concerned with other purposes (see Map 8). Therefore, it can be concluded that navigation and flood protection, followed by water supply and hydropower generation, are the key drivers that may provoke impacts on water bodies in the DRBD by 2015. 22 of the 112 FIPs are currently being implemented, 33 are officially planned and for 57 projects the planning is under preparation. Details are summarised in Annex 7.

2.1.5. Other issues

2.1.5.1. Quantity and quality aspects of sediments as pressure and impacts – addendum to the DBA 2004

This chapter provides a brief summary overview of the pressures and impacts related to sediment quantity and quality in the DRB. In the conclusion, follow up actions are proposed that are required for drafting the necessary measures in the future. Further details on the status of sediments in the DRB are available in Annex 8.

Sediment quantity

a. Sediment balance

At present the sediment balance of most large rivers within the DRB can be characterised as disturbed or severely altered. Morphological changes during the last 150 years due to river engineering works, torrent control, hydropower development and dredging, as well as the reduction of adjacent floodplains by nearly 90%, are the most significant causes of impacts.

Bed load material

Hydropower plants in the upper Danube catchments trap almost 80-90% of the sediment bed load (see Annex 8). The middle Danube, due to a decreasing slope, is characterised by a transition from a gravel river into a sand river. In the lower Danube, the suspended load dominates the overall sediment transport.

Suspended sediments

At present the torrent control works and impoundments on the upper catchments in the Danube River Basin retain about one third of the suspended load. During floods, large quantities of sediments can be remobilised and deposited e.g. in the inundated floodplains. In the lower Danube the transport of suspended load currently reaches only 30% of the original amount recorded, due to abundant anti-erosion and hydro-technical works throughout the entire DRB and significant sediment settling in the Iron Gate 1 reservoir.

b. Erosion and deposition

Upstream of a dam, in a reservoir or impounded sections, the reduction of the sediment transport capacity of water results in sediment deposition. This retained sediment has often to be extracted in order to maintain the river depth for navigation and reservoir operation and in order to limit the height of the water level in the case of floods. Downstream of dams the loss of sediment load requires an artificial supply of material or other engineering measures to stabilise the riverbed and to prevent incision.

c. Dredging

Dredging is very common throughout the DRB. The extraction of sediment is mostly related to navigation (minimum water depth); flood protection purposes; reservoir management and torrent control. The major dredging user groups include:

- Waterway transport maintenance dredging;
- Commercial extraction, construction sector;
- Channel maintenance for flood protection;
- Impoundment clearing for hydropower plants;
- Fish farming.

Sediment quality

The characterisation of sediment quality in the Danube is primarily based on the results of the Danube Surveys (JDS 1 and 2). During JDS 1 in 2001, significant concentrations of 4-iso-nonylphenol and di[2-ethyl-hexyl]phthalate were found in bottom sediments as well as in suspended solids (from a few µg/kg up to more than 100 mg/kg). During JDS 2 in 2007, polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (PCB) were more than one order of magnitude lower in all compartments when compared to the Elbe River. PCB levels did not exceed the related German quality standards in sediment. Polybrominated diphenylethers (PBDEs), polyaromatic hydrocarbons (PAH) and organochlorinated pesticides (OCP) concentrations in suspended particulate material (SPM) were an order of magnitude lower than their concentrations in Dutch rivers. The results of the Aquaterra survey in 2004 for PAHs, however, showed that fluoranthene exceeded frequently the proposed EU freshwater quality standard for sediment in the upper part of the surveyed reach (down to rkm 1,262).

The results of analysis of heavy metals in the sediment samples collected during JDS 1 and JDS 2 showed that mercury, cadmium, copper, nickel, zinc and lead are often found at elevated concentrations in the DRBD.

Conclusions and the way forward regarding sediment management in the DRB

The following concluding remarks outline recommendations, which should provide an essential basis for future decisions on sediment issues in the DRB, and for respective actions to be taken in the next RBM cycles.

Sediment quantity:

- There is an increasing discrepancy in the DRB between sediment surplus in reservoirs and retention basins of torrent control works and sediment deficit in the remaining free-flowing sections. In combination with river channelisation, this leads to river bed degradation and a loss of morphodynamic structures with associated problems concerning ecological status.
- To propose appropriate measures for improving the above mentioned situation, a sediment balance for the DRB has to be developed, including identification of possible consequences due to climate change (e.g. glacier retreat). Availability of sufficient and reliable data on sediment transport is a prerequisite for any future decisions on sediment management in DRB.
- Attention should be given to ensuring the sediment continuum (improving existing barriers and avoiding additional interruptions).
- Additional investigations are needed to identify the significance of sediment transport on the Danube basin-wide scale.
- River regulation works (e.g. to increase transport capacity) contribute to river bed degradation. River restoration is of key importance for reducing degradation and improving morphodynamics, necessary for achieving good ecological status (initiation of river type specific morphodynamics, including floodplains).
- Dredging contributes significantly to the bed load deficit. It is therefore recommended that commercial extraction of sediments be prevented and that material dredged for maintenance be inserted back into the river.

Sediment quality:

- While the JDS 2 results for the organochlorinated compounds in sediments and suspended particulate material (SPM) indicated relatively low concentration profiles of these contaminants in the Danube, concentrations of PAHs have been occasionally found at elevated levels. An appropriate assessment of sediment quality necessitates the establishment of environmental quality standards for sediments and SPM.
- Contamination of sediments and SPM by heavy metals (in particular by lead, cadmium, mercury and nickel) should be further investigated. A thorough evaluation of this issue requires the establishment of natural background concentrations of heavy metals to distinguish the anthropogenic impacts.
- Investigation on sediment grain size (fine suspended sediments) should be performed with regard to adsorption capacity and impact on aquatic communities (i.e. by decreasing photosynthesis, impairing fish-gills and filter-feeders, clogging the interstitial that homes amphibian and fish eggs, subsequent reduction of biodiversity, etc.).

2.1.5.2. Invasive alien species (neozoa and neophyta)

The DRB is very vulnerable to invasive species given its direct linkages with other large water bodies. Many invasives originate from the Ponto-Caspian area, Asia, Australia and North America. The Danube is a part of the Southern Invasive Corridor (Black Sea - Danube-Main/Danube Canal - Main-Rhine - North Sea waterway), one of Europe's four most important routes for invasive species. The river is therefore exposed to intensive colonisation of invasive species and further spreading in both north-west and south-east directions throughout the Basin.[48]

Results of the JDS 2 revealed that invasive species have become a major concern for the Danube and that their further classification and analysis is vital for effective river basin management. At present there are a number of theories, but no common consensus, as to the reasons for the take-over of invasive species in the Danube. Even the question of whether the ecological status of the Danube is really significantly impacted by neozoa is not addressed satisfactorily.

From the point of view of river basin management, neozoa dominate macrozoobenthic fauna at many places in the Danube and thus their classification is a crucial factor in assessing ecological status. Most of them indicate ß-mesosaprobic water quality, which results in an overall *good ecological status* due to their dominance. During JDS 2 the most frequent invasive macroinvertebrates were Asian clams (*Corbicula fluminea*) observed at 93% of sites sampled along the Danube River. Another ubiquitous invasive macroinvertebrates are the Caspian mud shrimp (*Corophium curvispinum*) and *Dikerogammarus villosus* observed at 90% and 69% of all sampled JDS 2 sites, respectively. The JDS 2 found that macroinvertebrate invasive species reached 100% abundance in specific river stretches in the Middle Reach of the Danube. In the Upper Reach, the invasives accounted for up to 90% of specimens observed at some sites. The Asian clams were often one of the only species found at many sites, given their ability to survive the current and bottom conditions there.

Among the Danube fish population along the Danube's Upper and Middle Reach, several *Neogobius* (goby) species, which are immigrants from the Black Sea, were found in high or even dominating abundances along the rip-rap protected and regulated banks. In contrast, downstream of the Iron Gate in the gobies' native range (rkm 850-0), where hydromorphological impacts on the river are much lower, goby abundance is low and only slowly increases towards the Danube Delta.

Within the macrophyte study of the JDS 2, the presence of water hyacinth (*Eichhornia crassipes*), most likely resulting from human impacts, was observed. Considered one of the worst aquatic weeds in the world, it is a fast growing plant with populations known to double in as little as 12 days. Infestations of the weed block waterways, limit boat traffic, swimming and fishing, and prevent sunlight and oxygen from penetrating the water surface.

[48] A list of key invasive alien species in the DRB has been compiled in the frame of the FP6 European project DAISIE and can be found under www.europe-aliens.org.

The approach for classification of invasive species is still the subject of many discussions in the EU MS. Thus, it is essential to deal with this issue in the Danube Basin further, focusing on the influence of invasive species on the assessment of ecological status.

2.2 Surface waters: lakes, transitional waters and coastal waters[49]

In the DRBD, six lakes are identified as being of basin-wide importance: Neusiedlersee/Fertö-tó consisting of two water bodies (AT/HU), Lake Balaton (HU), the Yalpug-Kugurlui Lake System (UA) consisting of the lake water bodies Yalpug and Kugurlui as well as the the Razim-Sinoe Lake System (RO) comprising Lake Razim and Lake Sinoe (also a transitional water body). The DBA 2004 includes a detailed analysis of impacts, as well as the risk of failure of the EU WFD objectives.

Table 8 summarises whether significant hydromorphological alterations and/or chemical pressures are affecting the DRBD lakes (analysed as of 2009). For further details, see the national RBM Plans.

Table 8: Presence of significant hydromorphological alterations and chemical pressures affecting DRBD lakes.

	Country	Hydromorphological alteration	Chemical pressure
Neusiedler See / Fertö-tó	AT/HU	No	No
Lake Balaton	HU	No	No
Lacul Razim	RO	No	Yes
Lacul Sinoe	RO	No	Yes
Lake Yalpug	UA	Yes	No information
Lake Kugurlui	UA	Yes	No information

Out of the four costal waters bodies (see Map 1 for location), two are identified with significant hydromorphological alterations, as a result of harbour activities.

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 DRB, as required under Article 5 and Annex II of the *WFD*, was performed in 2004 and identified 11 transboundary GWBs or groups of GWBs of basin-wide importance (listed in Table 9 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 DRB are dealt with at the national level.

From the time that the Article 5 report was published, some countries changed their method of delineation of GWBs and reconsidered their vertical dimension. As a consequence, the aggregated national part of a transboundary GWB may consist of more or less parts than was reported in the Article 5 Report. More detailed characteristics of the 11 transboundary GWBs of basin-wide importance, as well as their status assessment, are given in Annex 9.

For the current version of the DRBM Plan, the Moldovian part of GWB 3 is not included in the analysis, However, the datasets will be improved and included in the future.

[49] Further details on coastal waters are part of the respective national reports.

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 in Table 9 whereas detailed information on the relevant pressures for each groundwater body is given in Annex 11. The basic principles and assessment of pollution sources for surface waters described in Chapter 2.1 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

According to the DBA the main reasons for the pollution of groundwater were identified as:

a. Insufficient wastewater collection and treatment on the municipal level;
b. Insufficient wastewater treatment at industrial premises;
c. Water pollution caused by intensive agriculture and livestock breeding;
d. Inappropriate waste disposal sites.

These pressures, in combination with the high vulnerability of some of the aquifers, necessitate the development of appropriate GWB protection strategies based on conceptual models.

The overall assessment of pressures on the quality of the 11 transboundary GWBs of basin-wide importance showed that pollution by nitrates from diffuse sources is the key factor affecting the chemical status of these groundwaters. The major sources of this diffuse pollution are agricultural activities, non-sewered population and urban land use. This analysis confirms the findings of the risk analysis in the Article 5 Report for the DRB district.

Furthermore, in the national parts of two transboundary GWBs the following point sources of pollution were identified:

a. Leakages from contaminated sites;
b. Leakages from waste disposal sites (landfill and agricultural waste disposal);
c. Leakages associated with oil industry infrastructure;
d. Leakages from septic tanks;
e. Discharge of used thermal water.

Detailed information on the relevant pressures for each GWB is given in Table 9 and Annex 11.

2.3.2 Groundwater quantity

The DBA reported that groundwater used for the supply of drinking water plays a major role in Danube countries, estimating that about 60% of the population in the DRB depends on groundwater sources. In general, groundwater quantity in the DRB is affected by groundwater abstraction for drinking water supply or industrial and agricultural purposes. The expected development of future water demand has to be taken into account when identifying water exploitation and protection strategies.

The assessment of pressures on the quantity of the 11 transboundary GWBs of basin-wide importance showed that over-abstraction prevents the achievement of *good* quantitative status for two GWBs.

Table 9: GWBs or groups of GWBs of basin-wide importance and respective pressures, status, measures and exemptions.

Code	Size [km²]	Aquifer characterisation		Main use	Overlying strata [m]	Criteria for importance	Pressures		Status		Measures		Exemptions
		Aquifer Type	Confined				Quality	Quantity	Quality	Quantity	Quality	Quantity	
1-DE-AT	5,900	K	Yes	SPA, CAL	100-2000	Intensive use	No	No	Good	Good	No	No	No
2-BG-RO	30,147	F, K	Yes	DRW, AGR, IND	0-600	> 4,000 km²	No	No	Good	Good	No	No	No
3-RO-MD	21,626	P	Yes	DRW, AGR, IND	0-150	> 4,000 km²	No	No	Good	Good	No	No	No
4-RO-BG	7,027	K, F-P	Yes	DRW, AGR, IND	0-10	> 4,000 km²	No	No	Good	Good	No	No	No
5-RO-HU	7,699	P	Y/N*	DRW, IRR, IND	2-30	GW resource, DRW protection	DS	No	Poor	Good	BM, SM	No	Yes
6-RO-HU	2,475	P	Y/N*	DRW, AGR, IRR	5-30	GW resource, DRW protection	No	No	Good	Good	No	No	No
7-RO-RS-HU	29,012	P	Y/Y/N*	DRW, AGR, IND, IRR	0-125	> 4,000 km², GW use, GW resource, DRW protection	DS	WA	G/G**/P	G/P**/P	BM	BM, OBM, SM	Yes
8-SK-HU	3,363	P	No	DRW, IRR, AGR, IND	2-5	GW resource, DRW protection	DS	No	G/P	Good	BM,	No	Yes
9-SK-HU	2,216	P	Yes	DRW,IRR	2-10	GW resource	No	No	Good	Good	No	No	No
10-SK-HU	1,090	K, F	Y/N*	DRW, OTH	0-500	DRW protection, dependent ecosystem	No	No	Good	Good	No	No	No
11-SK-HU	3,811	F, K	Y/N*	DRW, SPA, CAL	0-2500	Thermal water resource	No	WA	Good	G/P	No	No	Yes

Code	GWB code which is a unique identifier.
Size: km²	Whole area of the transboundary GWB covering all countries concerned in km².
Aquifer characterisation	[Aquifer Type: predominately **P** = porous/ **K** = karst / **F** = fissured] Multiple selection possible: predominantly porous, karst, fissured and combinations are possible. Main type should be listed first. [Confined: **Yes** / **No**].
Main use	[**DRW** = drinking water / **AGR** = agriculture / **IRR** = irrigation / **IND** = Industry / **SPA** = balneology / **CAL** = caloric energy / **OTH** = other]. Multiple selection possible.
Overlying strata	Range in metres. Indicates a range of thickness min., max. in metres.
Criteria for importance	If size <4,000 km², criteria for importance of the GWB have to be named and bilaterally agreed upon.
Pressures	Indicates the significant pressures. [**AR =** artificial recharge, **DS** = diffuse sources, **PS** = point sources, **OP** = other significant pressures, **WA** = water abstractions].
Status	[**G =** good, **P** = poor, **Risk** (only in the case that there are no monitoring data available)].
Measures	[**BM** = basic measures, **OBM** = other basic measures, **SM** = supplementary measures].
Exemptions	Indicates whether there are exemptions for the GWB.
*	The different national parts don't show a unique assessment.
**	The status information is of low confidence as it is based on risk assessment.

3. Protected areas in the DRBD

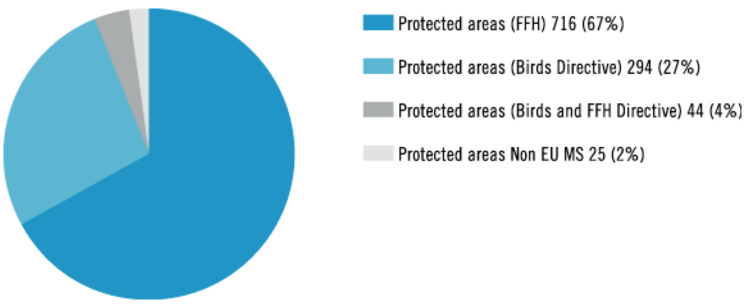
The information on protected areas in the DRBD has been collected according to WFD Article 6 and Annex IV. At the DRB basin-wide scale, protected areas for the protection of habitats and species; nutrient sensitive areas, including areas designated as vulnerable zones; and other protected areas in Non EU MS are compiled. Other types of protected areas according to WFD Article 6, Annex IV are not addressed at the Roof level but are an integral part of the national RBM Plans.

Map 9 illustrates 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)[50]. Furthermore, the map visualises protected areas in the Non EU MS and indicates the respective types. Annex 10 includes a detailed inventory of the protected areas illustrated in Map 9.

Figure 16 provides an overview of these protected area types for the DRBD. Out of a total of 1,079 protected areas (156,361 km^2), 716 (73,023 km^2) have been designated following the EU Habitats Directive and 294 (73,872 km^2) are bird protected areas (EU Birds Directive). Another 44 (5,810 km^2) 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. 25 (3,651 km^2) are protected area types reported by Non EU MS and are mainly nature reserves and Biosphere Reserves.

Map 26 identifies nutrient sensitive areas, including areas designated as nitrates vulnerable zones (EU Nitrates Directive) and areas designated as sensitive areas (EU UWWT Directive). This designation is only illustrated for EU MS as it is not obligatory for Non EU MS.

Figure 16: Overview on number of WFD relevant protected areas under the EU Habitats Directive and EU Birds Directive including reported protected areas for Non EU MS (location and type of these protected areas are shown in Map 9). (FFH: EU Habitats Directive).



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

4. Monitoring networks and ecological / chemical status

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 (DBA) 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, macroinvertebrates, phytoplankton, phytobenthos, 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.

The methods regarding the assessment of ecological status vary between different EU MS. However, the EU-wide intercalibration exercise shall ensure the comparability of water status class boundaries (*high/good, good/moderate*) among different countries in accordance with the normative definitions of the EU WFD. In the DRBD, the intercalibration exercise for the major area of the DRBD is performed through the work of the Eastern Continental Geographical Intercalibration Group (EC GIG). For some Danube countries, the work of the Central and Alpine GIG is also relevant. The assessment of *ecological status* of large rivers, such as the Danube, has been recognised as a particular challenge and is dealt with by the EC GIG as well as by a specific working group at the European level.

The intercalibration exercise of the EC GIG is not yet fully completed[51]. Therefore, full comparability and high confidence of ecological water status assessment results are not yet ensured throughout the entire area of the Eastern Continental region of the DRBD. Participation of a country in the intercalibration exercise and its completion influences the confidence level of the status data as only intercalibrated methods can produce high-confidence data.

Chemical status

Chemical status has to meet the requirements of environmental objectives for surface waters outlined in EU WFD Article 4(1). *Good chemical status* must not exceed the environmental quality standards established in line with the WFD Article 16(7), in EU Directive 2008/105/EC on environmental quality standards in the field of water policy.

The overall results of the status assessment can be found in Chapter 4.1.4. These results build mainly upon the outcomes of the TNMN (4.1.1) and the JDS 2 (4.1.2).

[51] See the respective EU Commission Decision on the intercalibration exercise.

4.1.1. Surface water monitoring network under the TNMN

Fulfilling the provisions of the DRPC, the TNMN in the DRB has been in operation since 1996. The original objective of the TNMN was to enable a reliable and consistent trend analysis for concentrations and loads of priority pollutants; to support the assessment of water quality for water use; and to assist in the identification of major pollution sources.

The TNMN laboratories have a free choice of analytical method, providing they are able to demonstrate that the method in use meets the required performance criteria. Therefore, the minimum concentrations expected and the tolerance required of actual measurements have been defined for each determinant so that the method compliance can be checked. To ensure the quality of collected data, a basin-wide Analytical Quality Control (AQC) programme is regularly organised by the ICPDR. The AQC shows satisfactory results for physico-chemical substances but certain laboratories experience problems with the quality of results from the trace analysis of the priority substances.

Implementation of the WFD necessitated the revision of the TNMN. A revised TNMN has been under operation since 2007[52] and provides data for this report (see Map 10).

The major objective of the revised 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.

To meet the requirements of both the WFD and the DRPC, the revised 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 2

The JDS2 was the world's biggest river research expedition in 2007 aiming to produce highly comparable and reliable information for the entire Danube River and many of its tributaries. The outcomes of JDS 2 were essential to attain the complete overview needed to meet the requirements of the WFD by 2015. Another important aspect of the survey was to increase public awareness in the DRB.

With regard to status assessment, the JDS2 results did not replace the national status assessment but rather allowed the formation of statements and suggestions for the *indication of ecological and chemical status*, to support member states in their national assessment process. The detailed results of the indication of ecological status for the four biological quality elements and chemical status can be found in the Final Report of JDS 2[53].

[52] ICPDR Document IC 122: Summary Report to EU on monitoring programmes in the DRBD designed under WFD Article 8 – Part 1 (ICPDR, 2007).

[53] ICPDR (2008): Joint Danube Survey 2 – Final Scientific Report; Eds: Liska et al; ICPDR Secretariat, VIC/D0412, P.O. Box 500, 1400 Vienna, Austria. www.icpdr.org/jds

Hydromorphology

The JDS 2 included the first systematic survey of hydromorphological parameters in the entire navigable longitudinal Danube stretch using a single method (for details see Chapter 2.1.4 and the JDS 2 report[53]).

Biology

The analysis of macroinvertebrates[54] indicated *good* biological water quality for almost 80% of the Danube sites. Significant organic pollution affecting living organisms was detected in the tributaries Sio, Jantra, and Rusenski Lom. Due to excessive pollution, the Arges River did not host any macroinvertebrates. Invasive species (Chapter 2.1.5.2) originating from the Ponto-Caspian area (the Black, Azov and Caspian Sea regions) were found to be a crucial factor influencing Danube macrozoobenthos.

The fish survey, the first ever for the entire length of the Danube, revealed that most of the investigated sites on the Danube indicated *moderate* status while only about one-third of sites indicated *good* status. The lack of migratory species in the Danube indicates a loss of river connectivity. However, a very high species diversity was found in the Danube (almost 50,000 fish of 66 species) indicating that the Danube could be ranked as 'top' river in Europe in terms of number of fish species.

In the regulated non-impounded stretches of the Danube, the macrophytes[55] often meet the conditions required for *good ecological status*. However the situation is unsatisfactory in the impounded stretches upstream of hydropower plants and a negative nutrient influence from some tributaries particularly in the lower Danube was observed.

The analysis of phytoplankton[56] found that most of the Danube comprised acceptable conditions. Elevated levels of chlorophyll-a and phytoplankton biomass were found only in the middle reach. The most polluted river indicated by the phytoplankton analysis was the Arges.

Phytobenthos,[57] in contrast to aquatic fauna, relates directly to nutrient content (mostly phosphorus) in the river and is considered to be a reliable indicator of long-term eutrophication processes. The indication of ecological status, based on phytobenthos analysis, suggested an increase of nutrients in the longitudinal profile of the Danube.

Microbial analysis found about one third of the sites polluted. The highest microbial contamination levels for the Danube River were found in the stretch between Budapest and Belgrade; while the tributaries, Arges and Russenski Lom, and side-arms, Rackeve-Soroksar and Moson Danube, can be considered as hot spots. This emphasises the need for ensuring the sufficient treatment of wastewaters.

Priority substances

Among the EU's priority substances, di-(2-ethylhexyl)phthalate (DEHP) was found in nearly all JDS 2 water samples at relatively high concentrations; proposed environmental quality standards (EQS) were exceeded in 44% of water samples. At several sites, an indication of WFD non-compliance was found for PAH, nonylphenol, tributyltin and trichlorobenzene. Metal concentrations in water were found to be above quality targets at only three sites (mercury at two downstream of Budapest; nickel at the Timok-Danube confluence). The analytical results obtained for polar compounds in the Danube (pharmaceuticals, pesticides, perfluorinated acids and phenolic endocrine disrupting compounds) were similar to those in other large European rivers such as the Rhine, Elbe or Po. The most relevant polar

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54 Freshwater benthic macroinvertebrates are animals without backbones that are larger than ½ mm. These animals live on rocks, logs, sediment, debris and aquatic plants during some period in their life. Benthos include crustaceans such as *Gammarus*; molluscs such as clams and snails; aquatic worms and the immature forms of aquatic insects such as stonefly and mayfly nymphs. Macroinvertebrates are Biological Quality Elements to be assessed under the EU WFD.

55 Aquatic macrophytes are aquatic plants that are large enough to be apparent to the naked eye. Aquatic macrophytes characteristically grow in water or wet areas and are quite a diverse group. For example, some are rooted in sediments while others float on the water's surface and are not rooted to the bottom. Macrophytes are Biological Quality Elements to be assessed under the EU WFD.

56 Aquatic phytoplankton are microscopic plants and are the autotrophic component of the plankton community. Phytoplankton is a Biological Quality Element to be assessed under the EU WFD.

57 Aquatic phytobenthos are plant organisms of the river bottom and sediments and are largely algae. Phytobenthos is a Biological Quality Element to be assessed under the EU WFD.

compounds identified in terms of frequency of detection, persistency and concentrations were anticorrosives benzotriazoles, pesticide 2,4-D and antiepileptics pharmaceutical carbamazepine.

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). Confidence levels for ecological and chemical status are described in Figure 17 and Figure 18 and are illustrated in Map 11 and Map 12.

Figure 17: Confidence levels for ecological status (see also Map 11).

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 18: Confidence levels for chemical status (also see Map 12).

Confidence level of correct assessment	Description	Illustration in map
HIGH Confidence	**Either:** No discharge of priority substances; ***<u>Or all</u> 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	***<u>All</u> 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	***<u>One or more</u> 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. Final designation of heavily modified and artificial water bodies

A *heavily modified water body* (HMWB) refers to a body of surface water that as a result of physical alteration by human activity is substantially changed in character. A surface water body is considered as *artificial* when created by human activity.

According to WFD Article 2 and 4(3), 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 reasonably cannot be achieved by a better environmental option, which is:
  - technical feasible and/or
  - not disproportionate costly.

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 provisionally identified HMWBs, and artificial water bodies (AWBs) were presented on the basis of specific basin-wide criteria. For this Plan, the Danube countries reported the nationally identified artificial water bodies, which are reflected accordingly on the basin-wide scale.

4.1.4.1. Approach for the final designation of heaviliy modified water bodies

4.1.4.1.1. Rivers

This DRBM Plan includes the final HMWB designation for EU MS. The Non EU MS performed a provisional identification based on the criteria outlined in the DBA 2004. The criterion for the size of water sections >50 km was changed and all water bodies have been fully considered for the designation. The designation of HMWBs will be revised for every river basin management cycle (every six years).

For the 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 is provisional) and on specific criteria for a step-by-step approach (see Annex 13). Both national and JDS 2 data were used for the designation of HMWBs.

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) were to follow the EC HMWB CIS[58] guidance document i.e. that the water body had to:

a. be *significantly physically altered* (not only in hydrology but also morphology) which has led to a change in character: the alteration is profound, widespread and permanent **and**
b. *fail 'good ecological status.'* This had to be proven with high confidence (that the biological monitoring result is based on a WFD-compliant assessment method and assessed worse than *good* status).

The harmonised designation of HMWBs for the Danube River was encountered with difficulties as the agreed criteria were not applied by all riparian Danube countries. Due to the fact that the intercalibration exercise has not yet been completed for all countries in the DRB only Austria, Germany and Slovakia can provide water status assessment results *(ecological status/ecological potential)* with high confidence and perform a final HMWB designation according to the agreed criteria as well as to the respective EC CIS Guidance. Although *clear cut situations*[59] (such as impoundments) have been identified to enable a harmonised final designation of HMWBs, the exercise has not been completed successfully. Therefore, Figure 19 on the HMWB designation for the Danube River reflects only partly a harmonised outcome based on the agreed ICPDR criteria. It can be concluded that the final HMWB designation still needs further validation.

4.1.4.1.2. 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 final designation of heaviliy modified and artificial water bodies

4.1.4.2.1. Rivers

Out of overall 681 river water bodies in the entire DRBD (Danube River and DRBD Tributaries) a total number of 270 are designated heavily modified (241 final and 29 provisional HMWBs). These are 40 % of the water bodies. Further, 21 water bodies are AWBs. This means that 9,835 km out of 25,117 river kilometres are heavily modified (83 % final HMWBs and 17 % provisional HMWBs) due to significant physical alterations causing a failure of the *good ecological status*. 1,592 km of the Danube River itself are designated as HMWB – this is 56 % of its entire length (83 % final and 17 % provisional). Table 10 summarises the designation of HMWBs for all DRBD rivers, the Danube River itself and the three transitional water bodies in the DRB indicating absolute numbers and length of water bodies designated as HMWB.

Table 10: Final designated HMWBs in the Danube River and all rivers of the DRBD (expressed in km, number of water bodies and percentage).

Rivers – Danube River Basin District (DRBD)		
Total WB length (km): 25,117	Total HMWB length (km): 9,835	Proportion HMWB (length): 39%
Total number of WBs: 681	Total number of HMWBs: 270 (241 final and 29 provisional HMWB)	Proportion HMWB (number): 40%
The Danube River		
Total length (km): 2,857	Total HMWB length (km): 1,592	Proportion HMWB (length): 56%
Total number of WBs: 45	Total number of HMWBs: 26 (21 final and 5 provisional HMWB)	Proportion HMWB (number): 58%

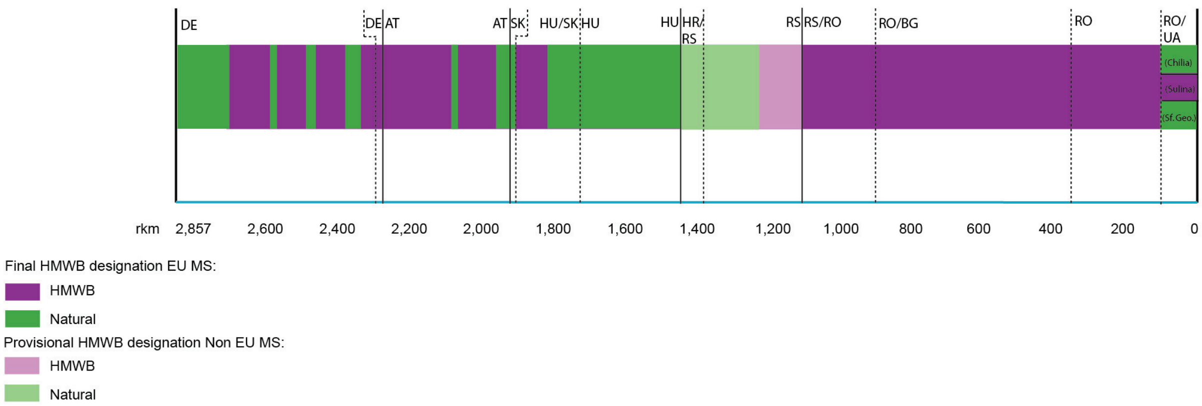
[58] EC HMWB CIS: European Commission's Common Implementation Strategy for HMWB.

[59] In the case of *clear cut situations*, a clear change of river type and/or category can be identified and g*ood ecological status* is not met. In specific cases, the definition of *clear cut situations* is therefore a practical tool to enable the final designation of HMWB, as the failing of *good ecological status* has already been proven by WFD-compliant assessment methods and monitoring data in some Danube countries.

HMWB designation for the Danube River

Map 13 shows the final and provisional HMWB designations. Out of a total of 45 Danube River water bodies, 21 water bodies were designated as finally heavily modified by the EU MS. 5 were designated as provisionally heavily modified by the Non EU MS (see Figure 19 and Table 10). Therefore, 1,592 rkm of the entire Danube River length (56%) have been designated as HMWB. No artificial water body has been designated.

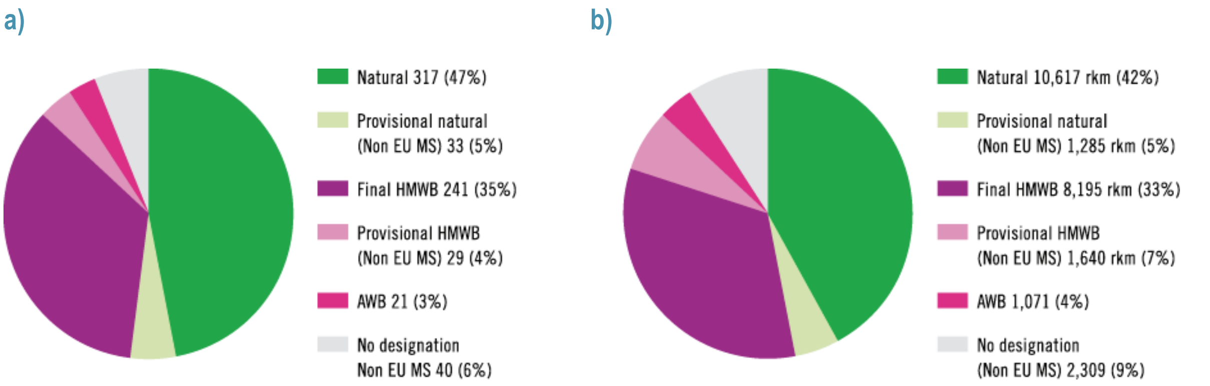
Figure 19: Heavily modified water bodies of the Danube River – results of the joint approach.



HMWB designation for all DRBD rivers with catchment areas >4,000 km²

Map 13 shows the final and provisional HMWB designations for all DRBD rivers with catchment areas >4,000 km^2. Out of 681 river water bodies 241 water bodies are designated as finally heavily modified by the EU MS. 29 are designated as provisional HMWB by the Non EU MS (see Figure 20). 21 are identified as artificial water bodies. This means that 9,835 rkm of the overall DRBD rivers (25,117 rkm) are designated as HMWB (39%) and 1,071 rkm as AWBs (4%).

Figure 20: HMWBs and AWBs and natural water bodies (indicated in numbers and relation to total number of river water bodies (a), as well as length (km) and relation to total length of river water bodies (b)).



4.1.4.2.2. Lakes and transitional waters

Out of seven lake water bodies (one of them being transitional), none was designated as finally heavily modified. No water body was identified as artificial.

4.1.4.2.3. Coastal waters

Out of the five coastal water bodies, two were designated as finally heavily modified. No water body was identified as artificial.

4.1.5. Ecological 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 (carried out under Article 8. and Annex V of the WFD) are presented both in map form and percentage values. More detailed results of the classification of all assessed surface water bodies according to particular biological, hydromorphological and chemical quality elements are provided in Annex 14.

4.1.5.1 Rivers

Figure 21 and Figure 22 illustrate the water status regarding *ecological status*, *ecological potential* and *chemical status* for the number and length (rkm) of water bodies. Further, their relation to the total number and length of water bodies in the DRBD is shown. Altogether 681 river water bodies were evaluated. Out of these 193 achieved *good ecological status* or *ecological potential* (28%) and 437 river water bodies achieved *good chemical status* (64%). Out of a 25,117 rkm network in the DRBD, *good ecological status* or *ecological potential* is achieved for 5,494 rkm (22%) and *good chemical status* for 11,180 rkm (45%). Figure 21 provides a general overview of water status including the data from Non EU MS and does not include information on the three different confidence levels. Details on the confidence levels are provided in Map 11, Map 12 and Annex 14. Figure 21 also illustrates the share of existing data gaps.

Figure 21: Ecological status and ecological potential for river water bodies in the DRBD (indicated in numbers and relation to total number of river water bodies (a), as well as length (km) and relation to total length of river water bodies (b)).

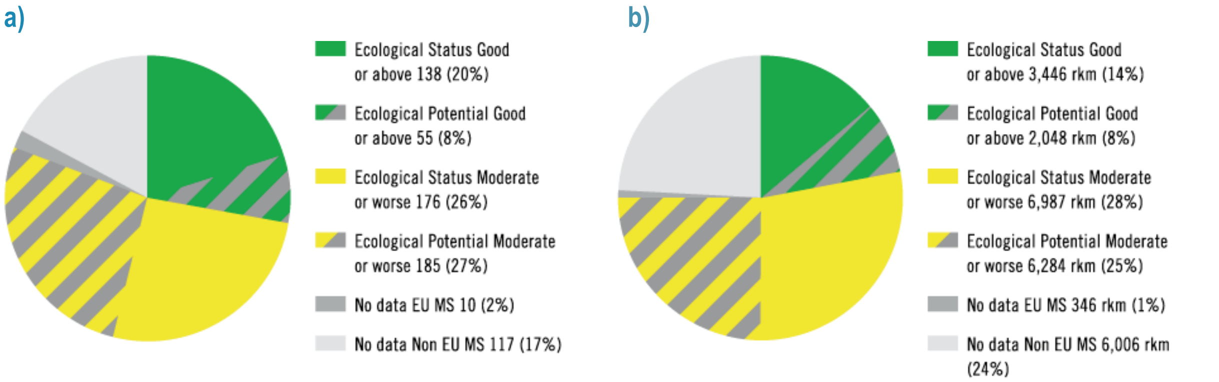
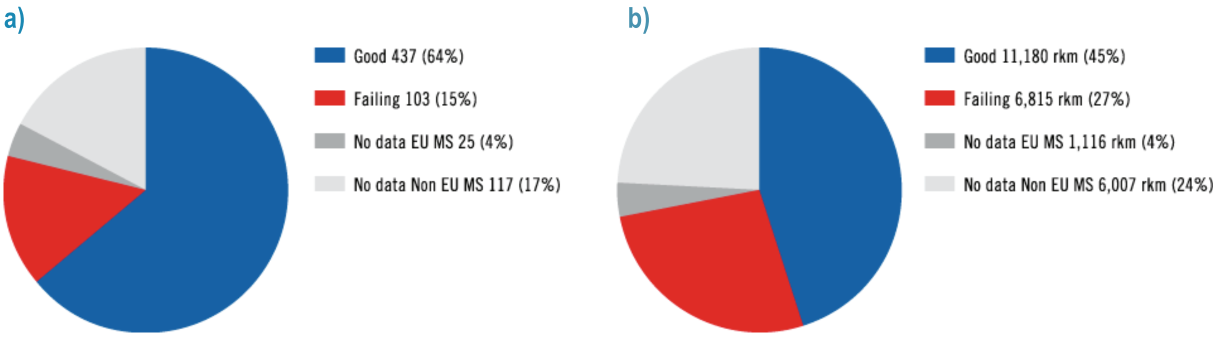


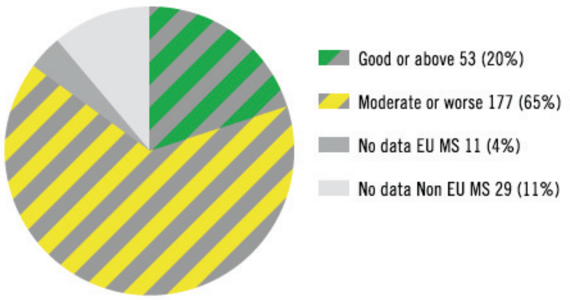
Figure 22: Chemical status of river water bodies in the DRBD (indicated in number and relation to total number of river bodies (a), as well as length (km) and relation to total length of river water bodies (b)).



In the case of final HMWBs (EU MS), 53 water bodies were assessed with a good or above ecological potential and 177 with moderate or worse ecological potential. More information on ecological potential for HMWBs for all DRBD rivers and the Danube River itself is illustrated in Figure 23 and Figure 25. The ecological potential for AWBs for all rivers in the DRBD is illustrated in Figure 24. Two out of the 21 AWBs were assessed with an ecological potential good or above. Both Figure 23 and Figure 24 include the share of Non EU MS that performed a provisional designation.

Figure 23: Ecological potential for HMWBs in relation to the overall number of HMWBs (incl. share of Non EU MS providing provisional designation). [a: all DRBD Rivers; b: Danube River].

a)



b)

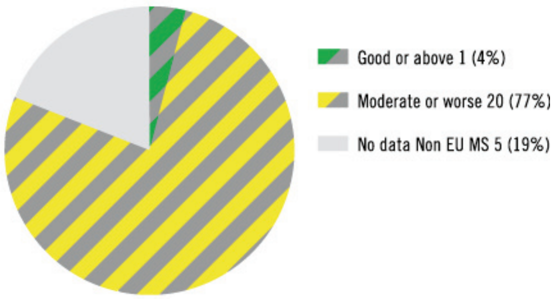


Figure 24: Ecological potential for AWB in relation to the overall number of AWBs (incl. share of Non EU MS providing provisional designation).

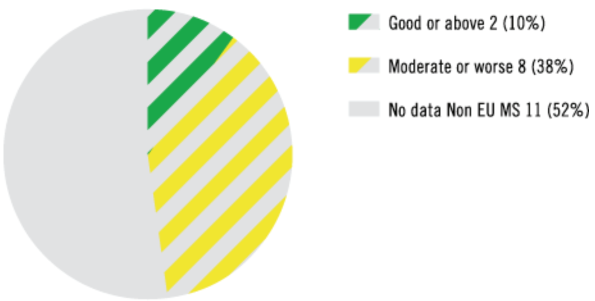
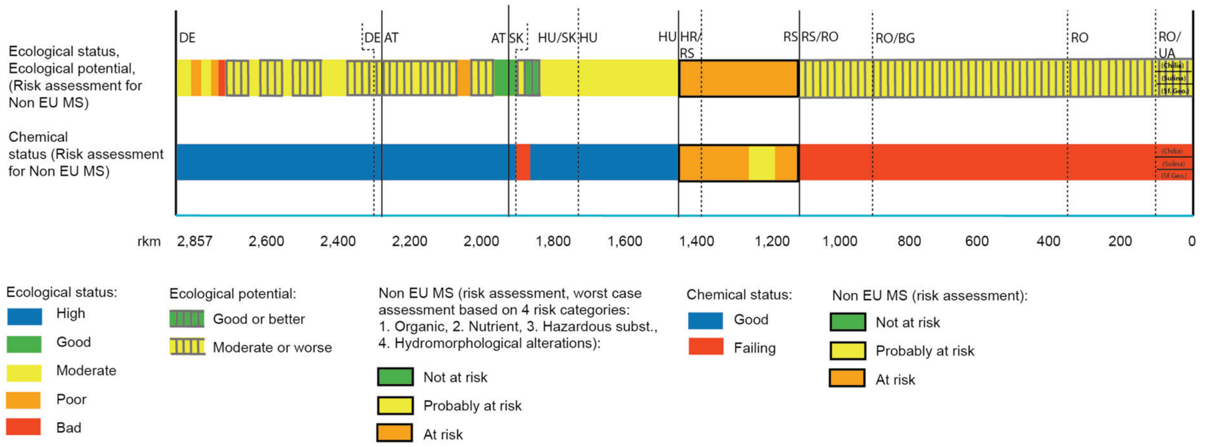


Figure 25 illustrates the water status classification for the Danube River itself regarding *ecological status, chemical status* and *ecological potential* (for those stretches that were designated as HMWB). Altogether 45 river water bodies were evaluated in the Danube itself. Out of these, three river water bodies achieved *good ecological status* (4%) and 30 achieved *good chemical status* (67%). For 21 final HMWBs (EU MS), one is assessed with good or above ecological potential.

Figure 25: Status classification for the Danube River represented as continuous bands.



More detailed information on data availability and on results of classification of all assessed surface water bodies according to particular biological, hydromorphological and chemical quality elements are provided in Annex 14.

4.1.5.2. Lakes and transitional waters

Six Lakes - consisting of seven lake water bodies - were evaluated, one of them a transitional water body. Out of these, three achieved *good ecological status* (43%) and two *good chemical status* (29%) (see Map 11 and Map 12). No lake was designated as a final HMWB.

4.1.5.3. Coastal waters

Altogether five coastal water bodies were evaluated. Out of these, none achieved *good ecological status*. Furthermore, all water bodies failed *good chemical status* (see Map 12). For the two coastal water bodies designated as final HMWBs, the *ecological potential* was assessed as bad for one and moderate for the other (see Map 11).

4.1.6. Gaps and uncertainties

This section comprises a description of all gaps and uncertainties encountered in relation to the assessment of ecological and chemical surface water status.

The assessment of the ecological status according to the requirement of the WFD was a challenge for all Danube countries. WFD compliant methods for the analysis of biological quality elements (BQEs) and their assessment had to be applied for the first time. Enormous efforts were needed to apply the new sampling methods for all BQEs, to establish appropriate classification systems and to put these new methods into practice at the national level. The intercalibration exercise of the Eastern Continental Region, aiming for international harmonisation and comparability of status class boundaries, demanded additional efforts and has not been fully completed so far.

Those ambitious activities logically brought along a number of gaps and uncertainties that were reported by the countries and which have to be taken into account when interpreting the results of the status analysis in the DRBM Plan.

Most of the countries did not so far manage to use all BQEs for the ecological status assessment as required by the WFD. The key data absent were those for macrophytes as well as for phytobenthos and fish. It has to be pointed out that in the intercalibration exercise performed for the Eastern Continental Region only two countries (AT and SK) completed the exercise regarding the harmonisation for their river classification schemes. Even in this case the intercalibration has been only for one BQE (benthic macroinvertebrates). However, efforts are currently underway to finish the intercalbration exercise of the EC GIG by 2011. The focus is on all BQEs. For the water bodies in the Danube countries belonging to the Central and Alpine GIGs (AT, DE, SI) a higher level of intercalibration was achieved but improvement are also still to be undertaken by 2011.

As regards the confidence of the ecological status assessment almost all Danube countries reported some cases of a preliminary assessment using the risk assessment data or insufficient monitoring data requiring further investigations and/or monitoring. In general the usually reported reasons for low and medium confidence of the ecological status assessment were:

- Lack of or insufficient monitoring data;
- Missing intercalibration of biological methods for individual quality elements.
- Impossibility of statistical correlations between BQEs and physical and chemical support elements because of monitoring data collected at different times;
- Missing data on hydromorphological elements;
- Lack of WFD compliant methodologies for certain BQEs;
- Missing classification schemes for ecological status;

These results indicate that achieving a fully coherent and WFD compliant ecological status assessment in the DRBD requires additional time. Those shortcomes are consequently also reflected for some countries in other implementation steps of the WFD such as in the final designation of Heavily Modified Water Bodies. Therefore, the final HMWB designation still needs validation based on fully intercalibrated and high confidence assessment results regarding the ecological status.

Regarding the improvement of the situation in confidence of the data several countries indicated following actions will be taken:

- Higher density of suitable monitoring sites;
- Higher sampling frequency;
- Improving QA/QC systems for BQEs;
- Improving taxonomic knowledge;
- Further development of ecological assessment methods (especially for phytobenthos, phytoplankton, macrophytes and fish)

The assessment of the chemical status was in most of the countries based on the EQS laid down in Part A of Annex I in the Directive 2008/105/EC of the European Parliament and of the Council on environmental quality standards in the field of water policy. Only Austria (due to an early start of monitoring of the priority substances before the Directive 2008/105/EC was adopted) applied the national Ordinance on Quality Standards – Chemistry - Surface Waters (BGBl. II Nr. 96/2006).

As regards the assessment methodology the countries applied the rule that the good chemical status is achieved when values of all parameters do not exceed AA-EQS and MAC-EQS. Some countries however did not use the values of MAC-EQS.

Another key principle applied by all countries was that, if for a substance the limit of detection of the analytical method available was above the EQS, this substance has been excluded from the chemical status assessment. Applying this principle led to exclusion from the assessment of the following substances in one or more countries: Benzo(g,h,i)perylene, Ideno(1,2,3-c,d)pyrene, Benzo(k)fluoranthene, Benzo(b)fluoranthene, Benzo(a)pyrene, Hexachlorobenzene, Chlorpyrifos, Tributyltin compounds, Brominated diphenylethers, Trifluralin, C10-13-chloroalkanes, Mercury, and Nickel.

Medium or low confidence of the chemical status assessment was reported primarily because of incomplete monitoring due to the lack of appropriate analytical equipment and also due to a low monitoring frequency.

4.2. Groundwater

According to the EU WFD, *good chemical and quantitative status* should be achieved for groundwater bodies.

Groundwater status is determined by the poorer of its *quantitative status and its chemical status*. *Good groundwater status* means the status achieved by a groundwater body when both its *quantitative and its chemical status* are at least good.

A GW body has good *quantitative status* when the level of water in the groundwater body is such that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.

The groundwater body has a *good chemical status* when its chemical composition is such that the concentrations of pollutants do not exhibit the effects of saline or other intrusions, do not exceed the EU quality standards and do not pose any significant damage to terrestrial ecosystems which depend directly on the groundwater body.

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 (see Map 4). 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. In line with the WFD, monitoring programmes meeting these requirements were operational by 22 December 2006 and a report on the GW TNMN was submitted to the EC.

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 current monitoring network designs are based on already existing national monitoring programmes which, in some countries, are still under adaptation to the requirements of Article 8 of the WFD.

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 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.

All groundwater monitoring data reported to the ICPDR are integrated into the ICPDR TNMN database. The major tool for this purpose is the Danube GIS, which also includes quality control processes. Interoperability with the European Information System on Water (WISE) is foreseen.

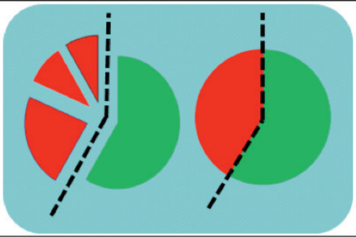
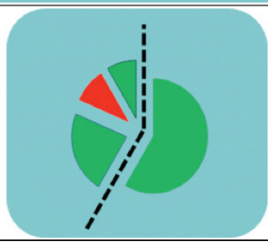
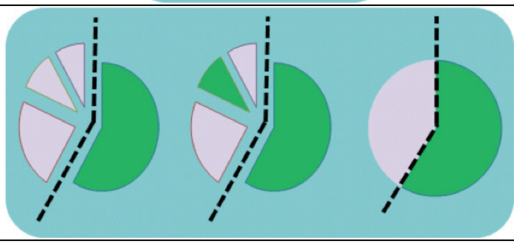
The number of groundwater monitoring stations and the density in a particular GWB is shown in Annex 12. This information has changed since the Article 5 report to the EC as three countries have changed the delineation of nominated transboundary GWBs.

4.2.2. Status assessment approach and confidence in the status assessment

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*.

The confidence of the status assessment for the whole national part of an ICPDR GWB is illustrated in Map 14). The confidence level indicates the (in)homogeneity of the status within an aggregated GWB and is presented as illustrated in Figure 26. The information on confidence level is indicated in maps on groundwater status. More detailed description of the technicalities of the GW TNMN and groundwater status assessment are given in the ICPDR Groundwater Guidance[60].

Figure 26: Confidence levels for groundwater status as illustrated in Map 14.

High confidence 1.) Status assessment is based on WFD compliant monitoring data. **2.)** If the national part of an ICPDR GW-body is formed by more than one GW-body or groups of GW-bodies, all have the same status.	
Medium confidence - If the national part of an ICPDR GW-body is formed by more than one GW-body or groups of GW-bodies, the status assessment is based on WFD compliant monitoring data and not all have the same status.	
Low confidence - Status assessment is based on risk assessment data.	

Poor status   Good status   Risk

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 9. The detailed information on status for each GWB is given in Annex 11.

For two national parts of GWBs there is currently no status information available due to a lack of information on status assessment. In this case the information based on risk assessment is included.

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 received and are presented in a map form (see Map 15). The description of the methodology for chemical status assessment and, in the case

[60] ICPDR document: IC 141 ICPDR Groundwater Guidance (2008).

of *poor status,* information on threshold values including their relation to background values and environmental quality objectives, is provided in the ICPDR document on characterisation methodology of status assessment (see Annex 9).

Out of 11 transboundary GWBs of basin-wide importance (22 national parts evaluated), *good chemical status* was observed in all national parts of 8 transboundary GWBs (73%). In two additional transboundary GWBs, *poor chemical status* was observed in one national part. In only one GWB were all national parts found to be in *poor status*.

Altogether, *poor chemical status* was identified in four out of 22 of the evaluated national parts of the 11 transboundary GWBs. Nitrates were the cause of the *poor* classification in every case.

4.2.3.2. Groundwater quantity

The results for the quantitative status of the transboundary GWBs of basin-wide importance are presented both in map form (see Map 15) and in Table 9 (see Chapter 2.3).

Out of 11 transboundary GWBs (22 national parts evaluated), *good quantitative status* was observed in all national parts of 9 transboundary GWBs (82%). In two transboundary GWBs, *good quantitative status* was observed in only one national part. The poor quantitative status is caused in two cases by the exceeding of available groundwater resources; in one case by damage to terrestrial ecosystems and in one case by damage to surface waters (springs). In the case of the national part of one GWB, former mining activities still have an impact on the quantitative status. Herewith it should be stated that *poor status* can be caused by more than one reason.

4.2.3.3. Gaps and uncertainties

As the overall coordination of groundwater management in the DRBD only started during preparation of the Article 5 report in 2002, there were differences in the approaches taken in the WFD implementation throughout the District. The Danube countries used a broad spectrum of different methodologies for the delineation and characterisation of GWBs; the assessment of the risk of failure to reach *good status*; the establishment of threshold values and status assessment. Despite there being overall coordination, further harmonisation of the national methodologies is still needed. Data gaps and inconsistencies have become apparent in the underlying data, resulting in uncertainties in the interpretation of data. Furthermore, additional information may be needed for a proper assessment of the water balance. In addition, some countries have identified the need to expand the current monitoring networks to include monitoring stations along national borders, where transboundary GWBs are located. In some cases, countries have assessed the need to adapt their current monitoring programmes to collect more comprehensive information on groundwater quality and quantity.

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. At present, no harmonised system for coding the various layers of the GWBs is available. The issue of different groundwater horizons needs further discussion and clarification.

As Serbia has not yet established a monitoring network based on the WFD, only a risk assessment could be carried out in this country due to the lack of monitoring data.

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 by – in principle – 2015:

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 provides an 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, the DRBM Plan (Part A) differs from the national RBM Plans (Part B) regarding the basin-wide scale, 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 2015 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 2015 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 2015 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 7 (The Joint Programme of Measures), which includes the relevant conclusions regarding the achievement/failure 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 2015, but either by 2021 or 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 681 river water bodies of the DRBD, it can be summarised that Article 4(4) is applied for 259 water bodies (38%) and Article 4(5) for 10 water bodies (1%). Article 4(7) is implemented in 20 water bodies (3%). Exemptions according to WFD Article 4(4) are applied in none of the six lakes and in none of the four coastal water bodies. Article 4(5) is not implemented at all for lakes but for two 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 7.1.4. Map 16 clearly illustrates which specific measures will be undertaken by 2015, which after 2015, or not at all due to exemptions according to Articles 4(4) and 4(5). Information on FIPs, which may be subject to apply WFD Article 4(7) during the planning process is provided in Chapter 7.1.4.4, Annex 7 as well as in Map 8.

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 a GWB. Details are illustrated in Map 17.

6. Economic analysis of water uses

6.1. WFD economics

The WFD requires that river basins are also described in economic terms. Economic principles are addressed in WFD Article 5 (and Annex III) and Article 9. An economic analysis of water uses was carried out in 2004 based upon the requirements of Article 5. Article 9 requires that by 2010, EU MS take account of the principle of cost-recovery, including environmental and resource costs. In addition to these direct references to economic instruments, the WFD refers implicitly to economic principles in many of its Articles e.g. by allowing for exemptions in the case of "disproportionate costs".

Results of economic analysis in DBA 2004

The economic analysis in 2004 covered three issues and was based on national contributions and basin-wide assessments, with the reference year 2000:

a. Assessing the economic importance of water uses;
b. Projecting trends in key economic indicators and drivers up to 2015;
c. Assessing current levels of recovery of costs for water services.

The assessment of the economic importance of water uses showed relatively high rates for connection to public water supply but lower rates for connection to the public sewerage system and to wastewater treatment plants. Differences identified in the economic structure of the Danube countries (level of agriculture, level of electricity generation etc.) contribute to the varied importance of economic values of water among the countries.

The analysis of projected trends in key economic indicators and drivers up to 2015 showed that factors such as the level of connection rates and efficiency improvements in water supply are important in assessing future trends; but quantitative forecasts in total water supply and demand were not available in the majority of the Danube countries.

The assessment of current levels of cost recovery for water services was based on data from pricing and tariffs. As a result of differing economic, financial and institutional conditions in the Danube countries, the pricing systems also varied considerably among the countries.

The Danube Economic Analysis 2009

The current basin-wide analysis, which is closely linked to national procedures, considers only those economic issues that are of relevance on the basin-wide scale and enable international comparison. For linking pressures with economics, so-called *horizontal economic issues* were identified. These are issues within each SWMI that should, as far as possible, be addressed as individual topics in the economic analysis. The horizontal issues are:

a. Baseline scenario up to 2015;
b. Cost recovery analysis;
c. Cost-effectiveness analysis;
d. Cost-benefit analysis[61].

A data collection system, based on agreed templates, was adapted in a way that reduces inconsistencies in data definition and collection and methodological difficulties that arose in 2004.

[61] The cost-benefit analysis has not been performed at the basin-wide scale. It is dealt with on the national level.

6.2. Description of relevant water uses and economic meaning

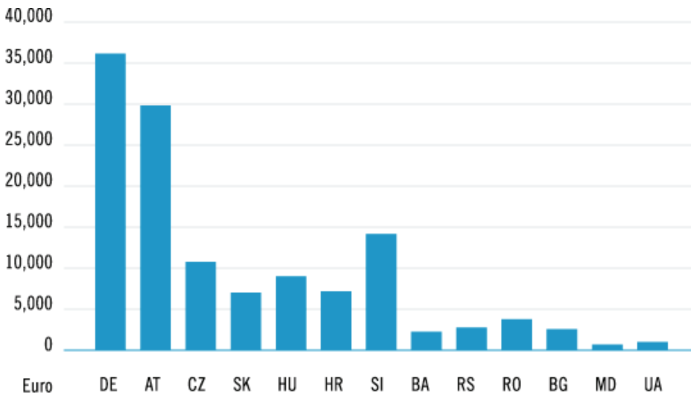
6.2.1. The economic analysis of water use

An economic analysis of water uses was carried out with the aim of assessing the importance of water use for the region's economy and assessing the socio-economic development of the river basin.

Data concerning the general socio-economic situation in the Danube countries have been collected and compiled at the basin-wide level (Annex 15, Table 1 & 2). The data reveals a significant disparity between economic circumstances in the Danube countries, with a clear decline in GDP from West to East. Germany, for example, has a GDP of approx. 36,000 EUR per capita/year and Moldova, a downstream country, has a GDP of less than 1,000 EUR per capita/year (see Figure 27).

Water abstraction among Danube countries is divided as follows: approx. 40% for agriculture, 40% for industry (including energy production) and 20 % for urban use (Annex 15, Table 4).

Figure 27: GDP per capita in the DRB (2005/2006)[62].



Characteristics of water services

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

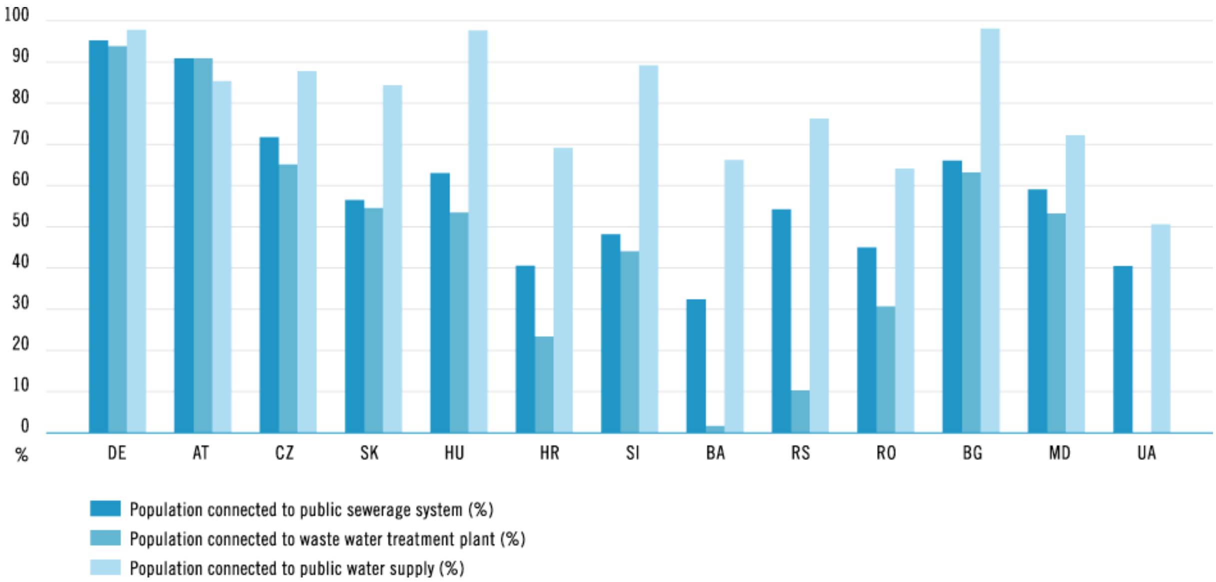
(a) abstraction, impoundment, storage, treatment & distribution of surface water or groundwater;

(b) wastewater collection and treatment facilities which subsequently discharge into surface water.

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 Figure 28 (see Annex 15, Table 4). Out of the 80.5 million inhabitants living in the DRB, about 57% live in urban areas. The share of population connected to public water supply varies from 51% in Ukraine to 99% in Bulgaria and Germany. In many Danube countries, the water supply networks are in poor condition due to faulty design and construction, and lack of maintenance and ineffective operation as a consequence of the economic decline in the past decade. 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 15% in Moldova to 95% in Germany.

[62] For BA only information for the Republika Srpska is included.

Figure 28: Wastewater services, public water supply and their connection rates (2005/2006)[63].



Many agglomerations in the region continue to discharge untreated municipal wastes into basin waters. Sewage treatment in a large number of agglomerations is also limited to screening before being discharged directly into rivers. A number of urban sector improvements in the 6 new EU MS (CZ, BG, SK, SI, HU, RO) have been realized in recent years and improved the level of collection and treatment of sewage. Tertiary treatment (N and P removal) is now also being applied in a large number of the upgraded and new wastewater treatment plants, but not in all cases. A detailed analysis of the population connected to wastewater treatment plants shows the situation on the national level, distinguishing between the share of population connected to primary, secondary and tertiary wastewater treatment facilities, as well as total connection rates (see Figure 3, Chapter 2.1.1.1 and Annex 15, Table 4).

Characteristics of other water uses

The WFD requires the identification of water uses: abstraction for drinking water supply, irrigation, leisure uses, industry, etc., and characterisation 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. The economic significance of water use in the DRB can be measured through wastewater discharge per sector in each country (expressed in inhabitant equivalents).

Present water consumption

The aggregated annual water consumption of the DRB population connected to centralised water supply systems is of the order of 30,849 million m^3. Urban water use has decreased in many Danube countries as a result of measures to reduce demand and as a consequence of economic restructuring (Annex 15, Table 3). An overview of the economic importance of most relevant water uses is provided in Annex 15, Tables 7-10.

6.3. Projecting trends in key economic indicators and drivers up to 2015

In order to assess key economic drivers likely to influence pressures (see Chapter 2) and thus water status up to 2015, a Baseline Scenario (BLS) has been developed. In the BLS, trends in water supply and water demand are evaluated. The focus is on changes in general socio-economic variables (e.g. population growth), in economic growth of main sectors and changes in implementation of planned investments linked to existing regulation. Future trend projections up to 2015, for developments of relevant sectors, are considered in the BLS calculation for measures (Annex 15, Table 10).

[63] For BA only information for the Republika Srpska is included.

Projection of water demand

The water demand projection for 2015 is calculated based on national methodologies, which considers minimum, average and maximum scenarios. The scenarios identified by all Danube Countries indicate a small increasing trend of water abstraction as a consequence of increases in water demand at basin wide level in industrial, urban and agricultural sectors (Annex 15, Table 10).

Some economic sectors indicate reductions in water demand mainly through technological changes which increase efficiency of water use in the industrial sector. Additionally, water abstractions for urban needs will decrease slightly in upstream Danube Countries under the analyzed scenarios and small increases in central and lower Danube Countries as consequence of increased connection rate to centralized water supply will occur. Water demand for agriculture is expected to become more significant due to a large increase of DRB population, intensification of agriculture in downstream countries, and anticipated climate changes.

Projection of wastewater discharge

The aggregated wastewater generation of the population connected to central sewerage systems is anticipated to increase. This should not result in increased pollution, as the amount of untreated wastewater will be significantly reduced and several measures will be implemented which contribute to the reduction of water pollution (such as reduction of losses; increased water efficiency in industry; proper norms for irrigation during drought events; effective pricing policies).

6.4. Economic control tools

6.4.1. Cost recovery as an incentive for efficient use of water resources and as a financing instrument

The WFD calls for accounting related to the recovery of costs of water services and information on who pays, how much and what for. 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. In most countries, the assessment of cost recovery focuses mainly on water supply as well as sewerage services for industry and households. Costs include management costs, depreciation, interests, taxes and fees, and the environment and resources costs. Environmental and resource costs are not taken directly into account in most countries as part of the economic analysis, due to both a lack of methodology and information. In some countries, existing economic instruments that are intended to partly internalise environmental and resource costs are considered separately in the cost recovery assessment. The issue of cost recovery is primarily an issue of national importance. Case studies are presented in Annex 16.

6.4.2. Cost-effectiveness as a criterion for selecting measures to achieve reduction targets

Cost-effectiveness analysis (CEA) can be a decision support at the national level for selecting the most cost-effective combinations of measures for inclusion in the Programme of Measures as described in Article 11 of the WFD. The application of CEA might be useful in assessing the effectiveness of supplementary measures, which are relevant in a transboundary context. Achieving the nutrient reduction targets cost-effectively, for example, requires analysis of the costs and effects of potential measures. It is planned that cost functions of various measures to reduce nutrients will be added in the MONERIS scenario calculations.

6.5. Conclusions

Information and data on economic variables and factors remains central to the implementation of the WFD. The economic analysis shows an increase in the availability of data that are comparable across countries and a large number of useful studies on the costs and prices of water services (including environmental and resource costs). With respect to the challenging environmental objectives of the WFD and the necessary financial resources (which may in the short term exceed the capabilities of some countries in the DRB), it seems essential to establish a pragmatic, targeted and integrated view of the economic analysis that is applicable within the first implementation cycle of the WFD.

7. 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 2015. It is firmly based on the national programmes of measures, which shall be made operational by December 2012, and describes the expected improvements in water status by 2015. 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 2015. 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 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 interlinkages between them. The basic principles of those interlinkages are described as part of Chapter 2.1.2. Regarding the conclusions on these three SWMIs but also hydromorphological alterations, an important follow-up will be the improvement of understanding with regards to the linkages between respective DRBD river loads and the ecologic response (ecological water status – see Chapter 4). This improvement will 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.

7.1. Surface waters: rivers

7.1.1. Organic pollution

7.1.1.1. 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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States:

- ⇨ Phasing out – by 2015 at the latest – all discharges for untreated wastewater from towns with >10.000 population equivalents and from all major industrial and agricultural installations, through:
  - ⇨ Implementation of the Urban Waste Water Treatment Directive[64].
  - ⇨ Where required, identification of construction and/or improvement of wastewater treatment plants according to the ICPDR Emission Inventory by 2015.
  - ⇨ Implementation of the Sewage Sludge Directive (86/278/EEC) and the Integrated Pollution Prevention Control Directive (96/61/EC).
  - ⇨ Increase of the efficiency and level of treatment thereafter when necessary.

Accession Country and Non EU Member States:

- ⇨ Specification of number of wastewater collecting systems (connected to respective WWTPs), which are planned to be constructed by 2015.
- ⇨ Specification of number of municipal and industrial wastewater treatment plants, which are planned to be constructed by 2015 including:
  - ⇨ Specification of treatment level (secondary or tertiary treatment)
  - ⇨ Specification of emission reduction targets

7.1.1.2. JPM approach towards the 2015 management objectives

Data for the JPM have been collected in combination with pressure information. Details on the data collection can be found in Annex 3. The JPM considers and addresses significant pollution pressures from agglomerations, industries and agriculture as identified in Chapter 2.

In order to estimate the effectiveness of specific measures regarding the reduction of organic pollution on the basin-wide scale a *scenario approach* has been developed. The scenario approach is relevant for both organic and nutrient pollution when point sources are addressed. To a certain degree the scenarios are also relevant for the reduction of hazardous substances in the DRB.

The scenario approach describes – as a starting point – the status-quo regarding wastewater treatment in the DRB (reference situation) and further its potential future development (three scenarios) using different assumptions. The **Reference Situation-UWWT 2005/2006** (RefSit-UWWT) gives an overview of the current situation regarding wastewater treatment and treatment efficiency in the DRB[65] (see Map 18).

- **Baseline Scenario-UWWT 2015 (BS-UWWT):**
  This scenario describes the agreed measures for the first cycle of the WFD implementation on the basin-wide scale until 2015 (see Map 19). Measures that are legally required for EU MS and other measures that are realistic to be taken by the Non EU MS have been taken into account. The Baseline Scenario is based on the fact that Romania has designated all of its territory (including its coastal waters) as a *sensitive area* under the UWWTD, in order to protect the Black Sea environment against eutrophication. Accordingly, the entire DRB is considered as a catchment area

[64] For RO the implementation year is 2018 regarding agglomerations 2.000 - 10.000 PE.
[65] Reference data 31/12/2005 or 31/12/2006 for all EU MS.

for the sensitive area under Article 5(5) of the UWWTD. This means that discharges from urban wastewater treatment plants situated in the Danube catchment area and which contribute to the pollution of the sensitive area need to apply more stringent treatment from agglomerations >10,000 PE. Or, as an alternative approach, these provisions do not apply to individual plants if it can be shown that the minimum percentage of reduction of the overall load in that area is at least 75% for total P and 75% for total N. The following assumptions for measures to be implemented by 2015 were taken:

- EU MS (except RO): Implementation of the UWWTD. For EU MS that have already fulfilled Article 5(4) of UWWTD in their national parts for the DRB by 2005/2006, the exact same reported treatment levels for agglomerations >10,000 PE were taken into account for the scenario. In the case of further improvement of wastewater treatment by 2005/2006 (for agglomerations <10,000 PE), this has been considered within the calculated scenario.
- RO (transition period for full UWWTD implementation: 31/12/2018[66]): The scenario considers agglomerations >10,000 PE: N and P removal. For further agglomerations 2,000 PE – 10,000 PE: secondary treatment for 77% of the total biodegradable load.
- Non EU MS: The scenario considers the reported number of wastewater treatment plants with secondary treatment/more stringent treatment to be constructed by 2015 (see Table 11 for specifications).

More information on the Baseline Scenario-UWWT 2015 can be found in Annex 17.

Table 11: Reported number of agglomerations in Non EU MS for which wastewater treatment plants will be constructed / rehabilitated by 2015 and indication of the respective generated load.

	HR	BA	RS	MD	UA	**Total**
No. of agglomerations for which WWTPs will be constructed / rehabilitated by 2015	14	8	8	4	14	**48**
Generated load (PE)	1,727,700	113,700	694,000	124,000	638,600	**3,218,000**

Two additional scenarios have been developed describing further steps toward the vision for organic pollution as an orientation for future policy decisions:

- **Midterm Scenario-UWWT (MT-UWWT):**
  This scenario (Map 20) is based on the BS-UWWT. In addition it assumes for Non EU MS, P removal for agglomerations >10,000 PE in order to achieve management objectives. This measure would clearly be a major step towards achieving the vision. Removal of P from all water treatment plants (>10,000 PE) was assessed as crucial for protecting waters in river basins, economically justified and technically simple[67]. In contrast to N removal, P removal can be realised more easily.

- **Vision Scenario-UWWT (VS-UWWT):**
  This scenario (Map 21) goes beyond the BS-UWWT as well as the MT-UWWT and therefore far beyond the requirements of the UWWTD. It is based on the assumption that the full technical potential of wastewater treatment regarding the removal of organic influents and nutrients is exploited for both EU and Non EU MS. If such a scenario is to be realised, it is assumed that agglomerations >10,000 PE are equipped with N and P removal (secondary/tertiary wastewater treatment), whereas all agglomerations ≥2,000 PE are equipped with secondary treatment.

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[66] The deadline for CZ is 2010 and the deadline for SI is 2015.
(see http://ec.europa.eu/environment/water/water-urbanwaste/legislation/deadlines/index_en.htm)

[67] daNUbs: Nutrient Management in the Danube Basin and its Impact on the Black Sea, EU FP 5 project (EVK1-CT-2000-00051).

7.1.1.3. Summary of measures of basin-wide importance

Implementation of UWWTD

The implementation of the UWWTD in the EU MS and the development of wastewater infrastructure in the Non EU MS are the most important measures to reduce organic pollution in the DRB by 2015 and also beyond.

At present extensive improvements in urban wastewater treatment are under implementation throughout the Basin. For full implementation of the UWWTD in the DRB for EU MS, facilities >10,000 PE have to be subject to more stringent treatment since the DRB discharges into a *sensitive area*. Alternatively, requirements for individual plants need not apply for sensitive areas in the case that it can be shown that the minimum percentage of overall load reduction entering all UWWTPs in that area is at least 75% for Total P and at least 75% for Total N. In general, the overall treatment efficiency is almost completely achieved in the upstream countries and is fulfilled less in the middle and lower Danube countries. Extensive efforts are underway in the middle and lower Danube countries to improve wastewater treatment. The overall application of nutrient removal technologies are expanding, particularly in response to the UWWTD in the new EU MS. It is necessary that the investments in wastewater collection and treatment in non EU MS also consider nutrient removal technologies during upgrade or new construction. This is necessary so that the overall increase in wastewater flow that will occur as more communities are connected to sewerage collection systems, does not create excessive amounts of nutrient pollution.

Regarding P removal, regulatory demands (under the UWWT Directive) for implementation of tertiary treatment are variable among the DRB countries and are dependent upon the classification in national legislation of *sensitive areas* of surface water. The majority of projects under construction or planned in the new EU MS contain tertiary treatment technology for P removal, as a result of legislative transposition during the EU accession period. N removal is more prevalent than P removal among the municipal projects.

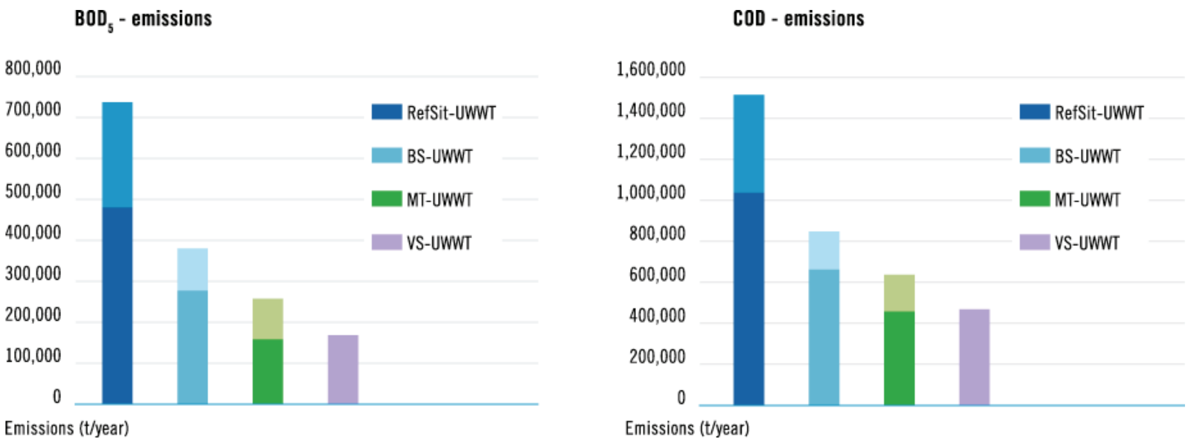
7.1.1.3.1. Results from calculated scenarios

The calculation results and the effects of agreed measures as part of the BS-UWWT 2015 (BOD_5/COD emissions) are presented in Figure 29. Figure 29 also illustrates the potential for further reduction as described by the MT-UWWT and VS-UWWT. These results allow conclusions regarding the achievement of the WFD environmental objectives, which are described in the end of this chapter.

By 2015 not all emissions of untreated wastewater from agglomerations with >10,000 PE will be phased out (see Map 19). For the reference year 2005/2006, 1,059 wastewater treatment plants serve a total of 1,255 agglomerations (>10,000 PE) in the DRB. However, 228 agglomerations with sewerage collecting systems are still lacking wastewater treatment plants (for parts of the collected wastewater). These need to be realised by 2015. 41 agglomerations >10,000 PE are not equipped with sewerage collecting systems and no wastewater treatment is in place for the entire generated load. There are 4,969 agglomerations between 2,000 and 10,000 PE. 1651 of these agglomerations have been reported to be served by 1,658 wastewater treatment plants (see Map 18).

As can be seen from Figure 29, the implementation of collecting systems (without treatment) for agglomerations ≥2,000 PE in the DRB will lead to a significant increase of organic pollutants and nutrients discharged to surface waters. In order to avoid a deterioration of the actual situation, the building of collecting systems is recommended to be combined with the implementation of appropriate wastewater treatment techniques. In the case of the DRB, these appropriate techniques include nutrient removal as the entire Danube Basin is a *catchment of sensitive area* under the UWWTD.

Figure 29: Emissions of BOD_5 and COD for the Reference Situation UWWT (RefSit-UWWT) and the three different scenarios (Baseline Scenario-UWWT 2015; Midterm Scenario-UWWT; Vision Scenario-UWWT)[68]. [The lighter coloured parts of the columns represent wastewater emissions that are not collected in sewerage systems and not treated in a wastewater treatment plant.]



In the DRB, there are approx. 6,224 agglomerations ≥2,000 PE, which generate a load of more than 94.7 million PE. There are 137 large cities >100,000 PE in the DRB that produce about 46% of the total wastewater load generated.

Implementation of the Sewage Sludge Directive

The progressive implementation of the UWWT Directive in the EU MS is increasing the quantities of sewage sludge requiring disposal. This increase is mainly due to the practical implementation of the Directive as well as the slow but constant rise in the number of agglomerations connected to sewers and the improvement of treatment (tertiary treatment with removal of nutrients). Full implementation will ensure that contaminated sewage sludge is no longer contributing to organic pollution via application in the agricultural sector.

Implementation of the Integrated Pollution Prevention Control (IPPC) Directive

Organic point source pollution coming from industrial units is partly addressed by the IPPC Directive as well as a number of specialised EU Directives covering specific sectors and specific Best Available Techniques (BAT) regulations. According to the IPPC Directive, authorities need to ensure that measures of pollution prevention and control are up-to-date with the latest developments in BAT. The main reporting requirement of the IPPC Directive is the publication of an inventory of chemical emissions and sources called the European Pollutant Emission Register (EPER).

The EU Member States have been implementing the IPPC Directive and as of end 2006 over 200 facilities had permits, which were reported to EPER. Romania and Bulgaria have, however, received gradual transition periods for IPPC implementation up to 2015 and additional facilities would be receiving permits and implementing BREF up to this date. It is expected that all facilities in the EU Member States will meet the IPPC requirements according to the legal timelines.

ICPDR BAT industrial sector recommendations

In the framework of the ICPDR, the Danube countries have adopted the Recommendations on Best Available Techniques in the following industrial sectors: chemical, food, chemical pulping and papermaking[69].

An assessment of BAT implementation in the Danube countries has been undertaken based on case studies of selected pilot IPPC installations in two industrial sectors: chemical and pulp and paper. The

[68] Note: there are different scales of the Y- axis.

[69] ICPDR Doc IC 033: Recommendation on Best Available Techniques in the Food Industry (2000); ICPDR Doc IC 034 Recommendation on Best Available Techniques in the Chemical Industry (2000); ICPDR Doc IC 035 Recommendation on Best Available Techniques in the Chemical Pulping Industry (2000) and ICPDR Doc IC 037 Recommendation on Best Available Techniques in the Paper Making Industry (2000).

pulp and paper industry was selected because it is the largest discharger of COD, accounting for almost 50% of total discharges in the DRB (Emission Inventory 2004).

The estimates are very preliminary and only based upon existing data. Actual reductions may be higher or lower and are subject to a variety of factors, such as the closure of installations and building of new ones.

The analysis shows that BAT implementation will have a positive impact on pollution reduction in the DRB. The estimated reduction of 50% for COD for the pulp and paper industry would result in an annual reduction of 26,653 t/a in that sector. Applying the same calculation to total industrial COD discharges of 133,950 t/a (for all Danube countries except AT/DE as they have already implemented all BATs), the reduction would be 66,975 t/a.

In developing the DRBM Plan, the ICPDR's role is to encourage all the Danube countries to adopt and implement IPPC legislation. The majority of countries have a mandatory obligation to the EU, while the remaining countries could be encouraged to adopt legislation requiring the application of BAT as basic measures in the JPM.

Recommendation on BAT at agro-industrial point sources

Agriculture is an important source of organic pollution. The wastewater discharged by agro-industrial point sources contains large amounts of organic substances. As installations for the intensive rearing of poultry or pigs must meet the requirements of the IPPC Directive, the application of BAT is seen as a way to reduce this pollution. For EU MS, biodegradable industrial wastewater from plants representing ≥4,000 PE belonging to the food industry that does not enter urban wastewater treatment plants before discharge to receiving waters, shall respect conditions established in the UWWTD.

The ICPDR has developed a recommendation on BAT at agro-industrial units including (i) technical in-plant measures for the reduction of wastewater volume and abatement of pollution load; (ii) reduction of pollution load by end-of-pipe measures and (iii) environmental management improvement actions. Additional measures are proposed to improve environmental compliance at the plant and enforcement of the permitting environmental authority. The full application of these BATs for agro-industrial units is recommended to take place in the Non EU MS not covered by the IPPC Directive.

The recommendation also includes a provision that all agro-industrial units be required to prepare a Manure Management Plan, when applying for a permit to discharge.

7.1.1.3.2. Estimated effects of national measures on the basin-wide scale

In comparison with the Reference Situation-UWWT 2005/2006 (RefSit-UWWT), a reduction of emissions regarding organic pollution will be achieved by the implementation of any of the three scenarios. However, it can be concluded that:

- **The Baseline Scenario-UWWT 2015 implements the management objectives** but will not ensure the achievement of the WFD environmental objectives on the basin-wide scale for organic pollution by 2015 (see Map 19).
- **The Midterm Scenario-UWWT goes beyond the 2015 management objectives.** However, the Midterm Scenario-UWWT will not ensure the achievement of the WFD environmental objectives on the basin-wide scale for organic pollution by 2015. The measures proposed are not fully able to be implemented by 2015 for economic, administrative and technical reasons (see **Map 20**).
- **The Vision Scenario-UWWT goes beyond the 2015 management objectives (beyond the BS-UWWT and MT-UWWT and therefore beyond the requirements of the UWWTD) and would ensure the achievement of the WFD environmental objectives on the basin-wide scale by 2015 for organic pollution.** However, the measures proposed within this scenario are not fully able to be implemented by 2015 for economic, administrative and technical reasons (see Map 21).

The effectiveness of measures for the reduction of organic pollution from industry and agriculture in the DRB is currently not sufficiently quantified, but further efforts will be undertaken in this regard within the next WFD cycle.

Ultimately, the magnitude of reduction depends on political decisions and the economic support for investments in wastewater treatment. To support further steps toward the environmental objectives, strategic discussions (e.g. with regard to potential financing mechanisms – see Chapter 7.4) are foreseen in the framework of the ICPDR.

7.1.2. Nutrient pollution

7.1.2.1. 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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and Non EU MS:

- ⇨ Reduction of the total amount of nutrients entering the Danube and its tributaries to levels consistent with the achievement of the good ecological/chemical status in the Danube River Basin District by 2015.
- ⇨ Reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.
- ⇨ Reduction of phosphates in detergents preferably by eliminating phosphates in detergent products as it is already the case for some Danube countries.
- ⇨ Implementation of the management objectives described for organic pollution with additional focus on the reduction of nutrient point source emissions (see above).
- ⇨ Implementations of best environmental practices regarding agricultural practices (for EU Member States linked to EU Common Agricultural Policy (CAP)).
- ⇨ Create baseline scenarios of nutrient input by 2015 taking the respective preconditions and requirements of the Danube Countries (EU Member States, Accession Country, Non EU Member States) into account.
- ⇨ Definition of basin-wide, sub-basin and/or national quantitative reduction targets (i.e. for point and diffuse sources) taking the respective preconditions and requirements of the Danube Countries (EU Member States, Accession Country, Non EU Member States) into account.

In addition, for EU Member States:

- ⇨ Implementation of the UWWTD (91/271/EEC) as described for organic pollution (see above) taking into account the character of the receiving coastal waters as a sensitive area.
- ⇨ Implementation of the EU Nitrates Directive (91/676/EEC) taking vulnerable zones into account in case natural freshwater lakes, other freshwater bodies, estuaries, coastal waters and marine waters of the DRBD are found to be eutrophic or in the near future may become eutrophic.

7.1.2.2. JPM approach towards the 2015 management objectives

The sources of nutrient emissions and measures to reduce respective pollution strongly overlap with those from organic pollution. These inter-linkages are considered within the working methodology. In addition to measures related to the improvement of wastewater treatment and the application of BAT for industry and agriculture, measures to control diffuse nutrient pollution are required. Further, measures to reduce phosphate emissions from household laundry and dishwater detergents are addressed and, finally, nitrogen pollution from atmospheric deposition is also dealt with.

Nutrient removal is required to avoid eutrophication in many DRB surface waters and the Black Sea North Western Shelf, in particular taking into account the character of the receiving coastal waters as a *sensitive area* under the UWWTD. The nutrient loads discharged from the DRB are an important factor responsible for the deterioration and eutrophication of parts of the Black Sea ecosystem. The

Danube countries committed themselves to implement the Memorandum of Understanding adopted by the International Commission for the Protection of the Black Sea (ICPBS) and the ICPDR in 2001[70] and agreed that *"the long-term goal is to take measures to reduce the loads of nutrients discharged to such levels necessary to permit Black Sea ecosystems to recover to conditions similar to those observed in the 1960s"*. In 2004 the Danube countries adopted the Danube Declaration[71] in the framework of the ICPDR Ministerial Meeting and agreed that in the coming years they would aspire *"to reduce the total amount of nutrients entering the Danube and its tributaries to levels consistent with the achievement of good ecological status in the Danube River and to contribute to the restoration of an environmentally sustainable nutrient balance in the Black Sea"*. Since Romania is an EU MS, the environmental objectives of the EU WFD are also to be applied to transitional and coastal waters in the Black Sea. Also for the Black Sea, the EU Marine Strategy Framework Directive will be implemented.

For the assessment regarding the effects of measures to reduce nutrient pollution by 2015 the MONERIS model (see Chapter 2.1.2.2) has been applied[72]. The model takes into account both nutrient point source as well as diffuse emissions. The scenarios presented (see below) are based on assumptions for organic pollution regarding wastewater treatment (see previous chapter for details). MONERIS compares the calculated nutrient input (scenario 2015) with the observed nutrient loads (reference situation average 2001-2005) in the rivers of the DRB and allows the respective conclusion for measures implementation.

There is still a high uncertainty regarding the cause-effect relationships between nutrient pollution and the ecological status of the surface water bodies of the Danube and the Black Sea. Therefore further research and monitoring is needed, as well as a continuous improvement and calibration of the MONERIS scenarios.

7.1.2.3. Summary of measures of basin-wide importance

On the basin-wide level, basic measures (fulfilling the UWWTD and EU Nitrates Directive) for EU MS and the implementation of the ICPDR Best Agricultural Practices Recommendation for Non EU MS are the main measures contributing to nutrient reduction.

Implementation of measures regarding urban wastewater treatment

The implementation of the UWWTD by EU MS and the reported measures of Non EU MS significantly contribute to the reduction of nutrient point source pollution, as already outlined above. Map 18 illustrates the Reference Situation-UWWT that indicates the current situation regarding nutrient point source pollution in the DRB. Map 19 to Map 21 show the three different scenarios for UWWT (Baseline Scenario-UWWT 2015, Midterm Scenario-UWWT, and Vision Scenario-UWWT) and therefore the future development and improvement regarding point source pollution. It is clear from the results that an additional measure to decrease phosphates in detergents would further contribute to the P emission reduction.

Implementation of the EU Nitrates Directive

A key set of measures to reduce nutrients relate to farming practices and land management. Nitrates in particular, leach easily into water from soils that have been fertilised with mineral fertilisers or treated with manure or slurry. High nitrate levels are one of the greatest challenges facing the WFD implementation in the DRB. Action programmes have been established in the EU MS by either applying the *whole territory approach* or in so called *Nitrate Vulnerable Zones* under the Nitrates

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[70] ICPDR Document IC 027: Memorandum of Understanding between the ICPBS and the ICPDR, 2001 (www.icpdr.org).
[71] ICPDR Document IC 089: The Danube Basin – Rivers in the Heart of Europe (Danube Declaration), 2004 (www.icpdr.org).
[72] The MONERIS Model integrates the findings of point source analysis with those related to diffuse sources and reflects the overall nutrient input in the DRB in total and per Danube country. SI is using a method based on the OECD method: *Environmental indicators for agriculture. Methods and Results (2006)*.

Directive (see Map 26). The EU Nitrates Directive aims to limit the amount of nitrate permitted and applied and the resulting concentrations in surface waters and groundwaters.

Implementation of Best Agricultural Practice (BAP)

Within the DRB, a concept of BAP[73] has been developed. This is different but complementary to the existing EU concepts of Codes of Good Agricultural Practice (GAP) under the EU Nitrate Directive and verifiable standards of Good Farming Practice (GFP) under the EC Rural Development Regulation 1257/1999.

To be effective, any BAP must not only be technically and economically feasible, it must also be socially acceptable to the farming community. As such, BAP can be applied as a uniform concept across the whole DRB, but the level of environmental management/performance that can be expected from farmers in different regions/countries will vary significantly according to: (i) the agronomic, environmental and socio-economic context in which they are operating, and (ii) the availability of appropriate policy instruments for encouraging farmers to adopt more demanding pollution control practices.

A key action for successful implementation of BAP is ensuring adequate storage capacity for manure generated on farms and the application of advanced techniques for spreading manure. It is apparent that implementation of BAPs should be linked to the EU CAP. Future reforms of the CAP, its funds and strategic priorities can also contribute to WFD objectives. In particular, the voluntary agri-environmental measures can be used to address diffuse and point sources of agricultural water pollution (nitrates, phosphates and pesticides) as well as soil erosion.

Implementation list of possible measures to control diffuse pollution

The information provided by countries in the national programmes of measures to control diffuse pollution has been used in the development of the DRBM Plan. Possible measures include: soil and manure sample analysis; a parcel-specific field balance for each growing season and annual farm balance for N and P. These are not costly but require a commitment and proper technical support.

Lack of information at the national, regional and local level on the causes of agricultural pollution and the practical measures available to farmers for reducing the risk of pollution can be addressed. It is important to link the promotion of more environmentally friendly farming methods to economic benefits such as improvements in yield and savings in the cost of agrochemical inputs. The development of appropriate and well written agricultural advisory messages is therefore essential, as are demonstration plots/farms, training for advisors and other capacity building measures for agricultural extension services.

Basic considerations on the introduction of phosphate-free detergents

The ICPDR has initiated a process to support the introduction of P-free detergents in the Danube countries. This measure is part of the **Phosphate Ban Scenario-Nutrients** (see Map 25 and below). At the moment, phosphates are completely replaced in laundry detergents in DE and AT. The introduction of P-free detergents is considered to be a fast and efficient measure to reduce nutrient emissions into surface waters. For the large number of settlements of <10,000 PE, the EU UWWTD does not legally require P removal. A reduction of phosphate in detergents could have a significant influence on decreasing nutrient loads in the Danube, particularly in the short term before all countries have built a complete network of sewers and wastewater treatment. Dishwashing detergents are an important and increasing source of that pollutant in all Danube countries. Efforts to regulate this source are also likely to be needed.

[73] The concept of BAP in the DRB is defined as: "…the highest level of pollution control practice that any farmer can reasonably be expected to adopt when working within their own national, regional and/or local context in the Danube River Basin."

7.1.2.3.1. Scenarios for nutrient reduction

While point source inputs from urban wastewater treatment plants and industry are directly discharged into rivers, diffuse emissions into surface waters are caused by the sum of different pathways that are realized by separate flow components. MONERIS[74] considers seven pathways regarding inputs into surface waters via pathways outlined in Figure 8 (Chapter 2). In addition, the retention of nutrients in rivers (divided in main rivers and tributaries) is calculated.

To explore the potential and effect of nutrient reduction measures, the effect of measures are estimated for point and diffuse sources using MONERIS and scenarios for nutrient reduction have been calculated and are presented.

The **Reference Situation-Nutrients 2000-2005** (RefSit-Nut) describes (as a starting point) the status-quo regarding nutrient emissions in the DRB (see Map 22 and Map 23). The Reference Situation-Nutrients is based on average nutrient emissions (N and P) for the years 2000-2005 and includes the situation for these years described by analysing urban wastewater development and other point sources of nutrients.

Furthermore, four nutrient scenarios have been calculated from the data provided by the countries and using some assumptions, in order to draw a picture of potential future developments.

The scenario analysis is focused on possible measures, or developments, related to the main sources of nutrients (UWWTPs/point sources, agriculture) and the introduction of P- free detergents. Changes to important input parameters (from these sources) have been developed and agreed by the Danube countries to be evaluated by the model. The net effects of changes in input parameters on emissions have then been calculated while keeping the emissions from other sources constant (as in the Reference Situation).

In a second step, the most likely developments related to each source are combined to give the overall baseline scenario for nutrient reduction.

The different scenarios for urban wastewater treatment development are described in Chapter 7.1.1.2, and in short the assumptions are as follows:

- **Baseline Scenario-UWWT 2015 (BS-UWWT):** Implementation of the UWWTD for EU MS; implementation of commitments by Non EU MS.
- **Midterm Scenario-UWWT (MT-UWWT):** Baseline scenario plus additional, momentarily not financially secured projects in Non EU MS, implementing at least P-elimination for treatment for agglomerations above 10,000 PE.
- **Vision Scenario-UWWT (VS-UWWT):** N and P removal for all agglomerations above 10,000 PE in all countries.

Due to the large uncertainty in both industrial development and in the IPPC implementation and related reporting, it is assumed that industrial emissions remain constant for the purpose of this analysis.

There are still major uncertainties related to future agricultural development. To account for this situation three different options have been considered and used for scenario calculations.

The first scenario **Baseline Scenario – Agriculture 2015** combines the best estimates of the countries for future agricultural development. It is based on *moderate development* of the agricultural sector and the implementation of measures foreseen by the countries. This scenario is the most realistic one compared with the other two agricultural scenarios (**Agricultural Scenario-Nutrients 1 2015 and Agricultural Scenario-Nutrients 2 2015**). These two scenarios have been calculated assuming an increase in the level of intensity of agricultural development for the middle and lower DRB. The implemented measures are identical to the first scenario.

These two scenarios use different sets of estimates for relevant input parameters, especially N surplus.

[74] Behrendt et al. (2007): The Model System MONERIS (2007) – User Manual; Leibniz Institute for Freshwater Ecology and Inland Fisheries in the Forschungsverbund Berlin e.V., Müggelseedamm 310, D-12587 Berlin, Germany.

In summary:

- **Baseline Scenario – Agriculture 2015 (BS-Agri-Nut):**
  This reflects a moderate development of agriculture and builds upon agreed measures to reduce nutrient emissions in the DRB. This scenario forecasts the future NO_x deposition and incorporates changes in agriculture. The parameter set can be found in Table 12.
- **Agricultural Scenario-Nutrients 1 2015 (I-Agri-Nut-1)**:
  This assumes that the N surplus of Danube countries will be the same as for the EU 15 in the year 2000 (i.e. 57 kg/ha/a). Further, it is assumed that no change in atmospheric deposition will occur.
- **Agricultural Scenario-Nutrients 2 2015 (I-Agri-Nut-2):**
  This assumes that the N balance for the Danube countries will be same for CZ, BA, HR, SK, RS, BG, HU, RO and UA as the upstream countries DE, AT and SI (see Table 13). Further, it is assumed that no change in atmospheric deposition will take place and N surplus in the remaining countries stays unchanged.

A further scenario evaluation calculated the impacts of a phosphate ban for laundry and dishwasher detergents:

- **Phosphate Ban Scenario-Nutrients (PBan-Nut):**
  This explores the reduction potential of an introduction of reduction of phosphates in laundry detergents and dishwashers as recommended by the Resolution of the 10th ICPDR Ordinary Meeting, December 2008.

After exploring the reduction potential of the measures addressing the various sources of nutrient inputs, the **overall Baseline Scenario-Nutrients** (**BS-Nut-2015**) combines the agreed most likely developments in different sectors (urban wastewater, agriculture and atmospheric deposition[75]) and describes the expected nutrient emissions in 2015 (Map 24 and Map 25). This scenario has been compared to the expected emissions of nutrients based upon application of the management objectives for the basin-wide scale.

Table 12: Changes in input parameters affecting agricultural diffuse emission for the Baseline Scenario – Agriculture 2015 in percentage relative to the Reference Situation-Nutrients.

	DE	AT	CZ	SK	SI	HR	BA	RS	HU	RO	BG	UA	MD
Nitrogen surplus	-23,0	-18,0	-12,8	19,5	-20,1	8,6	14,2	95,4	14,9	36,8	18,0	42,7	18,2
Projection livestock	-14	-6	0	0	-10	10	0	10	10	25	0	0	10
Projection fertilizer application	-2	4	10	21	0	20	20	20	20	24	30	20	30
Projection agricultural land	0	0	-1	-2	0	0	0	-1	-1	-1	0	0	-2
Projection NHy deposition	-14	-6	0	0	-10	10	0	10	10	25	0	0	10
Projection NOx deposition	-25	-38	-45	-40	-42	39	5	-45	-45	-33	-47	24	96

Table 13: Changes in nitrogen surplus as input parameter for the two scenarios reflecting an intensified agricultural development in percentage relative to the Reference Situation-Nutrients (the other input parameters are identical to the BS Agri- Nut).

	DE	AT	CZ	SK	SI	HR	BA	RS	HU	RO	BG	UA	MD
2005 (kg/ha/a)	81,6	43,6	47,4	26,5	73,8	34,1	17,5	13,3[76]	22,5	22,8	15,5	13,4	20,0
I-Agri-Nut-1	30,1	30,8	20,4	115,3	-22,7	67,5	226,0[77]	328,9[77]	153,0	150,1	267,5[77]	327,1[77]	185,5
I-Agri-Nut-2	-0,9	-0,5	105,4	183,2	2,5	35,5	122,5	425,6[77]	173,7	128,3	250,4[77]	196,3[77]	138,5

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75 BS-Nut Scenario considers inputs from the Baseline Scenario for urban wastewater, moderate agriculture and the level of NO_x from the atmospheric deposition.

76 It is clear that the starting figure in the reference situation in 2005 (13.3 kg/ha/a) might significantly underestimate the N-Surplus which is very low compared with other neighbor countries. As there is a large uncertainty on this very low starting figure for RS of the reference situation in 2005, the increase foreseen in 2015 should be also seen with caution.

77 The very high increase in the two intensified agricultural scenarios for BA, BG, RS and UA does not indicate that these countries will be large contributors of nutrients at all: even with this increase, the situation in these countries is currently far below the EU average and this should put the increase in the baseline scenario into a comparable context.

7.1.2.3.2. Results from calculated scenarios and pollution reduction effects 2015: Nitrogen and phosphorous emission in the DRB

Figure 30 and Figure 31 present the changes relative to the reference situation for different scenarios. Figure 30 illustrates the results for nitrogen. It can be clearly seen that the expected development will lead to a decrease of inputs. However, the intensified agricultural scenarios (I-Agri-Nut-1 and I-Agri-Nut-2) show that a potentially significant increase in N pollution would occur for several countries.

Figure 30: Relative changes in Nitrogen emissions compared to the Reference Situation 2005 for the different scenarios for UWWT and agricultural development. The Baseline Scenario-Nutrients (BS-Nut-2015) consists of the Baseline scenario for UWWT 2015 (Baseline Scenario UWWTP-2015) and the Baseline Scenario for Agriculture (BS-Nut-2015).
(The national RBM Plans provide additional information on Nitrogen emissions.)

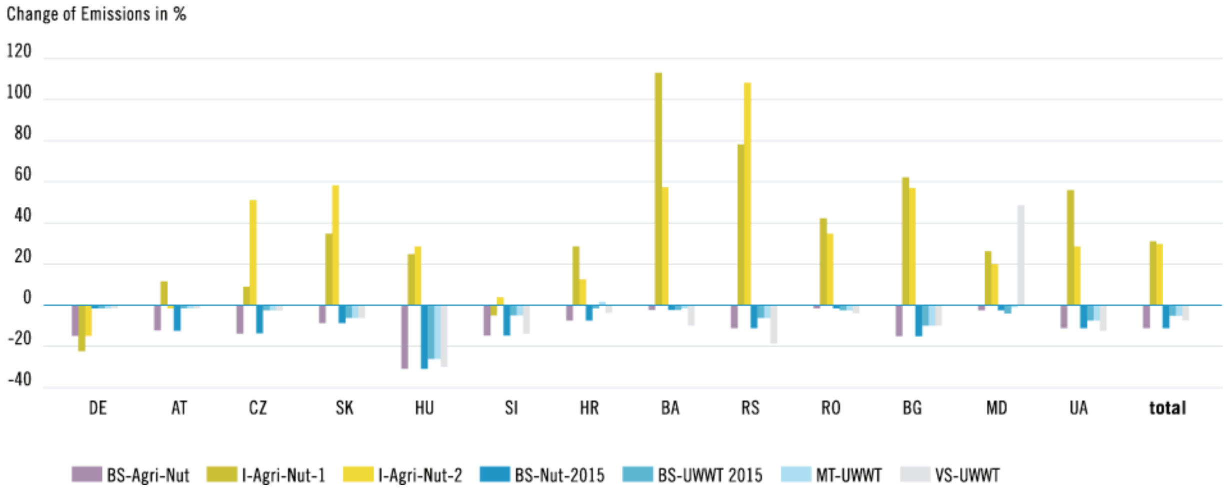


Figure 31: Relative changes in Phosphorus emissions compared to the Reference Situation 2005 for the different scenarios for UWWT, agricultural development scenarios and the scenario of a basin-wide ban of Phosphorous containing laundry detergents and dishwashers (PBan-Nut).
(The national RBM Plans provide additional information on Phosphorus emissions.)

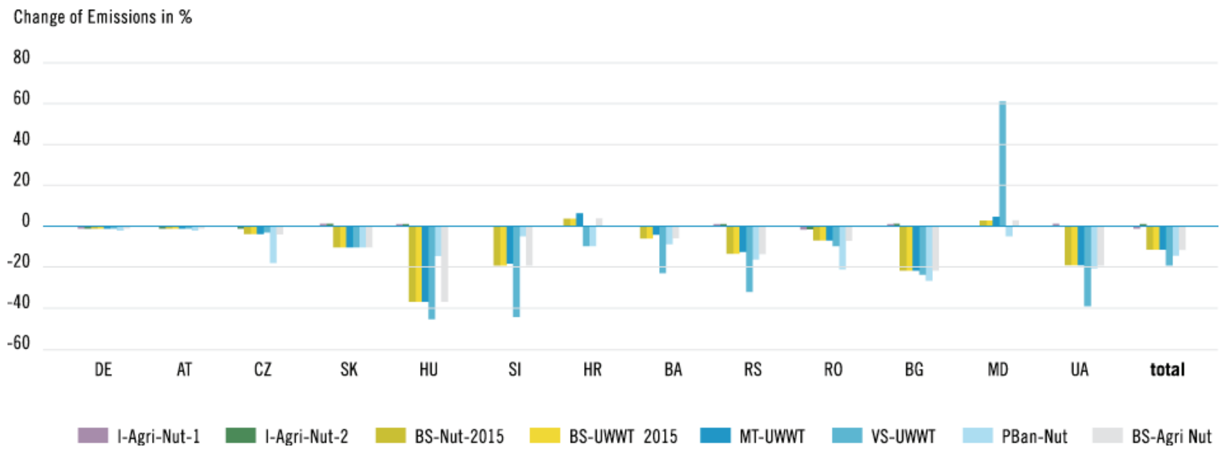


Figure 31 illustrates the Phosphorus load changes relative to the Reference Situation-Nutrients. The parameter changes for the intensified agriculture scenarios do not influence the results for P, as additional input is temporally stored in the soil, leading only to changes on a longer time scale.

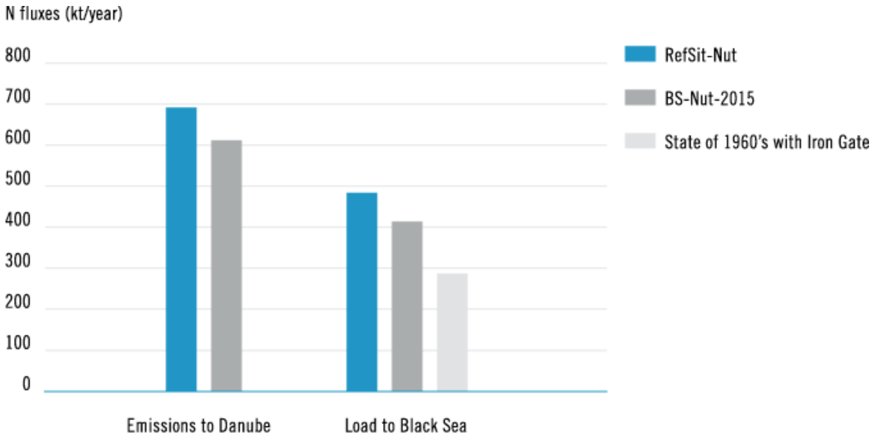
The significance of P reduction in detergents (laundry and dishwashers detergents) was also calculated and the results are presented in Figure 31. This figure also illustrates the values for urban wastewater treatment development in the DRB (based on the EU MS basic measures and the commitments of non EU MS in achieving wastewater treatment plants until 2015).

The results for the calculated Phosphate Ban Scenario-Nutrients show that that the P emission would be significantly reduced. This relatively cheap measure has a reduction potential similar to the investments in urban waste water treatment. This leads to a very favourable cost-effectiveness solution.

The following section presents the calculated results for the overall effects for N and P.

Reference Situation and calculated Baseline Scenario-Nutrients 2015 (BS-Nut 2015)
Nitrogen emissions and loads
Regarding N emissions, Figure 32 illustrates the N loads for both the Reference Situation-Nutrients and the overall Baseline Scenario-Nutrients 2015 (see also Map 22 and Map 24). The light grey bar gives an indication of the fulfilment of the management objective regarding the reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.

Figure 32: Nitrogen emissions for the Reference Situation-Nutrients (RefSit-Nut), Baseline Scenario-Nutrients 2015 (BS-Nut 2015) and the situation in the 1960s[78].

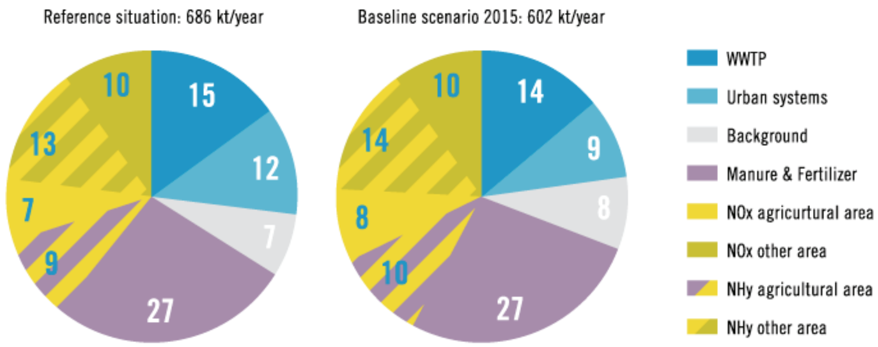


Nitrogen emission sources
Figure 33 shows the main sources of N emission in the DRB. Regarding the **Reference Situation-Nutrients**, about 49% of the N emissions are related to agriculture (27% directly due to fertilizer and manure application; 22% indirectly due to NHy deposition coming from agriculture) (see Map 22). Significantly, 41% of the N emissions (NHy emissions from agriculture and NOx emissions mainly from industrial incineration processes and traffic) cannot be directly influenced by the Danube countries alone because it is partly due to atmospheric deposition from sources outside the DRB.

With regard to the Baseline Scenario-Nutrients 2015, changes for the share of contribution of each source are expected. This is mainly caused by the fact that with the further development of UWWT within the DRB, the share of N coming from urban agglomerations will be reduced (see Map 24). The share of most of the other sources will correspondingly increase.

[78] Both emissions and load values are normalized to the longterm hydrological situation.

Figure 33: Sources of nitrogen emissions in the DRB for the Reference Situation-Nutrients and Baseline Scenario-Nutrients 2015 (BS-2015).



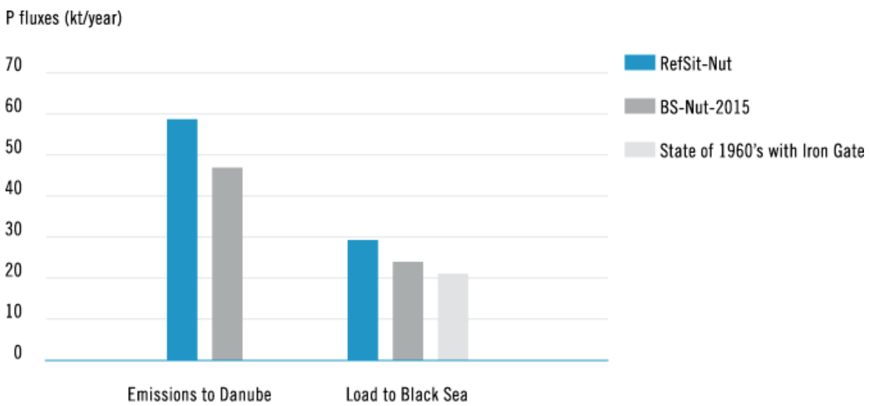
Basic considerations regarding nitrogen load due to atmospheric deposition

As mentioned above, nutrient emissions via atmospheric deposition in the DRB are significant (41% of the total nitrogen load). These nitrogen emissions, from atmospheric deposition do not exclusively originate from the DRB but come as well from countries outside the DRB. The reduction of this source of nitrogen will require a broader regional approach. Normalized

Phosphorus emissions and loads

Regarding P emission, Figure 34 illustrates P loads for both the Reference Situation and the Baseline Scenario 2015 (see also Map 23 and Map 25). The light grey bar gives an indication of the fulfilment of the management objective regarding the reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.

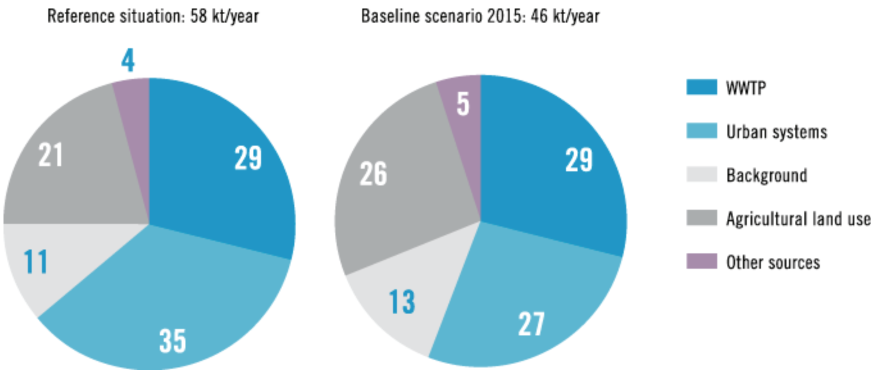
Figure 34: Phosphorus emissions for the Reference Situation-Nutrients (RefSit-Nut), Baseline Scenario-Nutrients 2015 (BS-Nut 2015) and the situation in the 1960s[79].



[79] Both emissions and load values are normalized to the longterm hydrological situation.

Phosphorus emission sources
Figure 35 shows the main sources of P emission in the DRB.

Figure 35: Sources of phosphorus emissions in the DRB for the Reference Situation-Nutrients and Baseline Scenario-Nutrients 2015.



7.1.2.3.3. Estimated effects of national measures on the basin-wide scale

Nitrogen pollution
Comparison between the Baseline Scenario-Nutrients 2015 and the Reference Situation-Nutrients shows a reduction of N pollution in the DRB.

For the Reference Situation-Nutrients, the N emissions to surface waters are 686 kt/a, whereas the calculated Baseline Scenario-Nutrients 2015 to achieve the management objective 2015 will be 602 kt/a, which is a reduction of 12% (84 kt/a). However, the total nitrogen load into the receiving Black Sea is currently 468 kt/a, the BS 419 kt/a, which is still 40% higher than the loads of the 1960s. Therefore, it can be estimated that for nitrogen pollution the management objective 2015 regarding the reduction of nutrient loads to such levels, which permit the Black Sea ecosystem to recover to conditions similar to those observed in the 1960s will not be achieved.

Therefore, it can be concluded that the measure taken by 2015 on the basin-wide scale to reduce nitrogen pollution will not be sufficient enough to achieve to achieve the respective management objective and the WFD environmental objectives 2015.

Phosphorus pollution
The comparison between the Baseline Scenario-Nut 2015 and the Reference Situation-Nutrients shows a reduction of phosphorus pollution in the DRB.

For the **Reference Situation-Nutrients**, P emissions to surface waters are 58 kt/a, whereas the calculated **Baseline Scenario-Nutrients 2015** to achieve the management objective 2015 will be 46 kt/a, which is a reduction of 21% (12 kt/a). However, the total Phosphorus load into the receiving Black Sea (taking into account retention processes) is currently 29 kt/a, and according to the BS 23.5 kt/year, which is still 15% higher than the loads of the 1960s.

Therefore, for Phosphorous the **respective management objective on the basin-wide scale will not be achieved by 2015, and this is most likely also the case for the WFD environmental objectives.** A ban of P containing laundry detergents by 2012 and dishwasher detergents by 2015 (**Phosphate Ban Scenario-Nutrients**) is seen as a cost effective and necessary measure to complement the efforts of implementing urban waste water treatment. This ban – as already recommended by the 11th Ordinary Meeting of the ICPDR (December 2008) – would further reduce the P emissions by aproximately 2 kt/a to a level only 5% above the values of 1960s. This measure appears necessary to bring the DRB closer to reaching the management objectives as well as the WFD environmental objectives.

Concluding for both N and P pollution in the DRB this means that the management objective by 2015 related to the reduction of nutrient load to the level of 1960's will be partially achieved for Nitrogen and Phosphorus.

7.1.3. Hazardous substances pollution

7.1.3.1. 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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and Non EU MS:

- ⇨ Elimination/reduction of the total amount of hazardous substances entering the Danube and its tributaries to levels consistent with the achievement of the good chemical status by 2015.
- ⇨ Implementation of Best Available Techniques and Best Environmental Practices including the further improvement of treatment efficiency, treatment level and/or substitution.
- ⇨ Explore the possibility to set up quantitative reduction objectives for pesticide emission in the Danube River Basin District.

In addition, for EU Member States

- ⇨ Implementation of the Integrated Pollution Prevention Control Directive (96/61/EC), which also relates to the Dangerous Substances Directive *76/464/EEC*.

7.1.3.2. JPM approach towards the 2015 management objectives

Reducing hazardous substances emissions is a complex task that requires tailor made strategies as the relevance of different input pathways is highly substance-specific and generally shows a high temporal and spatial variability.

Although there is insufficient information on the magnitude and implications of problems associated with hazardous substances at a basin-wide level, it is clear that continued efforts are needed to ensure the reduction and elimination of discharges of these substances. This is particularly the case because hazardous substances can remain in the environment for a very long time, can bioaccumulate and can harm ecosystems and human health, even in very low concentrations.

As discussed in Chapter 2, the sources of hazardous substances vary. They include: direct and indirect discharge from industrial point sources (including air pollutants); municipal wastewater from households and through urban runoff; direct application of pesticides and other hazardous substances and accidental pollution. Therefore, measures to reduce or eliminate hazardous substances need to be based on a variety of approaches addressed to the individual pressures and sectors.

7.1.3.3. Summary of measures of basin-wide importance

Implementation of measures regarding urban wastewater treatment

Due to the synergies between measures to address organic, nutrient pollution and hazardous substances, the further implementation of the UWWTD for EU MS contributes to the reduction of hazardous substances pollution from urban wastewater and from indirect industrial discharges. For Non EU MS, the construction of 47 municipal WWTPs by 2015 will improve the situation (although it should be noted that the construction of new sewerage collecting systems which are not connected to respective WWTPs may have a detrimental effect).

A further area of importance is the input from urban areas via storm water overflows. Here, the reduction of emissions requires improved storm water management.

Implementation of measures regarding the industrial sector

For the industrial sector, the implementation of the EU IPPC Directive is the most important measure for the EU MS. The IPPC Directive is a comprehensive instrument to integrate and address different aspects of pollution control at large-scale industrial activities. The EU MS must ensure that installations of a specified size are neither established nor altered without an IPPC permit. One of the main obligations for operators of facilities is to ensure that Best Available Techniques (BAT) are applied. In addition, the implementation of respective EU Directives will reduce pollution by hazardous substances as well.

Measures include *reduction of point source emissions*, especially from industrial sources, by applying BAT as a first, inevitable step. These measures have been proven to bring significant reduction in a short time period. BAT, as required by the implementation of the IPPC Directive and the ICPDR BAT recommendations for Non EU MS, comprises technological changes in the production process, substitution of specific substances and the use of end of pipe technologies.

Other relevant measures for substances being released to the environment include chemical management measures. These are mostly based on EU regulations such as REACH (EU regulation on Registration, Evaluation, Authorization and Restriction of Chemicals) or the Pesticides Directive and involve e.g. bans/substitution of certain substances or measures which ensure the safe application of products (e.g. pesticides) – often referred to as Best Environmental Practices (BEP). Further, the Dangerous Substances Directive (2006/11/EC) aims to reduce pollution of waters by certain dangerous substances, which have been selected mainly on the basis of how toxic or persistent they are, including how much they may accumulate in organisms.

The implementation of BAT in different industrial sectors – outlined for EU MS by the IPPC Directive and for Non EU MS by relevant ICPDR Recommendations – will further contribute to achieving the management objectives.

Implementation of measures regarding the agricultural sector

For agro-industrial installations, implementation of the IPPC and application of BAT and BEP are relevant measures for the EU MS. With regard to the use of pesticides and other hazardous substances in agriculture, the concept of BAP is expected to result in positive effects both in EU MS and Non EU MS. For EU MS, the EU CAP offers potential for additional reductions in pollution from agriculture. However, a possible increase of agricultural activities (particularly in countries of the middle and lower DRB) might offset these efforts if the increased activity is not undertaken in a sustainable way. An immediate pesticide ban for the most hazardous priority pesticides (e.g. Atrazine, Lindane, Diuron and Endosulfan) in Non EU countries would also reduce input of hazardous substances in the DRB.

Implementation of measures regarding accidental pollution

With regard to accidental pollution, the most important measures are prevention of accidents and ensuring effective contingency planning in the case of an incident. In the framework of the ICPDR, the Danube countries have taken important steps to ensure such mechanisms are in place. An *Accident Early Warning System* has been developed and is being maintained, used and continually improved.

The Accident Emergency Warning System (AEWS) in the DRB

The need for an Accident Emergency Warning System (AEWS) in the DRB is recognized in Article 16 of the DRPC. Established in the early 1990s, the AEWS is an integral part of the activities of the ICPDR and all Danube countries are involved (not yet Montenegro). The AEWS is activated whenever a risk of transboundary water pollution exists, or threshold danger levels of hazardous substances are exceeded. The System sends out international warning messages to countries downstream. This helps national authorities put environmental protection and public safety measures into action. Principal International Alert Centres (PIACs) in each country form the central points of basin-wide cooperation in early warning. The ICPDR Secretariat maintains the central GSM based communication system, which is integrated within the ICPDR information system (Danubis).

In addition, the ICPDR has developed an inventory of potential accident risk spots (ARS Inventory). The Danube countries reported a total of 97 contaminated sites (86 deposit sites, 11 industrial sites and/or abandoned industrial sites) that have potential accidental risks for water. For 12 contaminated deposit sites (out of 23 contaminated sites with all relevant information), *short, middle and long-term-measures* are recommended. In cases of contaminated industrial and/or abandoned industrial sites, the information is limited. For approx. 27% of the reported contaminated industrial sites, *short, middle and long-term-measures* are necessary.

7.1.3.3.1. Estimated effects of national measures on the basin-wide scale

The Dangerous Substances Directive, the IPPC Directive and UWWTD implementation by EU MS, as well as widespread application of BAT/BEP throughout the DRB, will improve but not solve problems regarding hazardous substances pollution. **The reduction/elimination of the amount of hazardous substances entering the Danube and its tributaries to levels consistent with the achievement of *good chemical status* may not be possible by 2015 and further efforts are needed.**

Due to the lack of reliable information, an assessment as to whether the management objectives will be achieved by 2015 is not possible.

Against this background, an overall improvement in the information available on the use and input to water of hazardous substances is a priority task for the ICPDR in the future. Experience in other basins has shown that simply ensuring the availability and calculation of data on hazardous substances discharged has initiated a sustainable reduction.

Therefore, it is an important additional objective of the JPM to **improve knowledge** on sources and relevant input pathways of the various hazardous substances. To this extent, the inventory of emissions, discharges and losses required under the EU Daughter Directive on Priority Substances, adopted by the Environment Council in October 2008, should be used. The Danube countries should perform this inventory in a comparable and coordinated way. The ICPDR and its expert groups should ensure coordination and reporting.

7.1.4. Hydromorphological alterations

The pressure analysis and water status assessment show that surface waters of the DRBD are impacted by hydromorphological alterations to a significant degree. In fact a majority of surface waters fail the WFD objectives because of those alterations, which signals the need for measures to achieve the management objectives and WFD environmental objectives. Interruption of river and habitat continuity, disconnection of adjacent wetland/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. The objectives are the same for EU MS and Non EU MS.

Measures reported by the Danube countries to restore hydromorphological alterations – in the case that *good ecological status/good ecological potential* is not achieved or measures are needed to achieve *good ecological status/good ecological potential* – have been screened for their estimated effect on the basin-wide scale. Priorities for implementation on the basin-wide scale and the expected status improvement between 2009 and 2015 are summarised for each hydromorphological component.

As also outlined in Chapter 2.1.4., in cases where countries share river stretches it is likely that some hydromophological components (river and habitat continuity interruption, hydrological alterations) include double-counts. This is because the information has been reported separately by the Danube countries and is not bilaterally harmonised. However, the discrepancy between the results of the analysis and the factual values without double-counts is estimated to be only between 1 and 4%. of the total. For the cases where countries reported separately for shared river stretches the information needs to be harmonised in the future.

7.1.4.1. Interruption of river and habitat continuity

7.1.4.1.1. Vision and management objectives – interruption of river and habitat continuity

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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and non EU MS:

⇨ Construction of fish migration aids and other measures to achieve/improve river continuity in the Danube River and in respective tributaries to ensure reproducing and self-sustaining of sturgeon species and specified other migratory species.
  - Specification of number and location of fish migration aids and other measures to achieve / improve river continuity, which are intended to be implemented by 2015 by each country.

⇨ Restoration, conservation and improvements of habitats and their continuity for sturgeon species and specified other migratory species in the Danube River and the respective tributaries.
  - Specification of location, extent and measure type, which are intended to be implemented by 2015 by each country.

⇨ Performance of a feasibility study regarding the possibility for sturgeon and other important species to migrate upstream and downstream through the Iron Gate I & II dams including habitat surveys. If the results of this feasibility study will be positive the respective measures should be integrated into the DRBM Plan and Joint Programme of Measures for implementation.

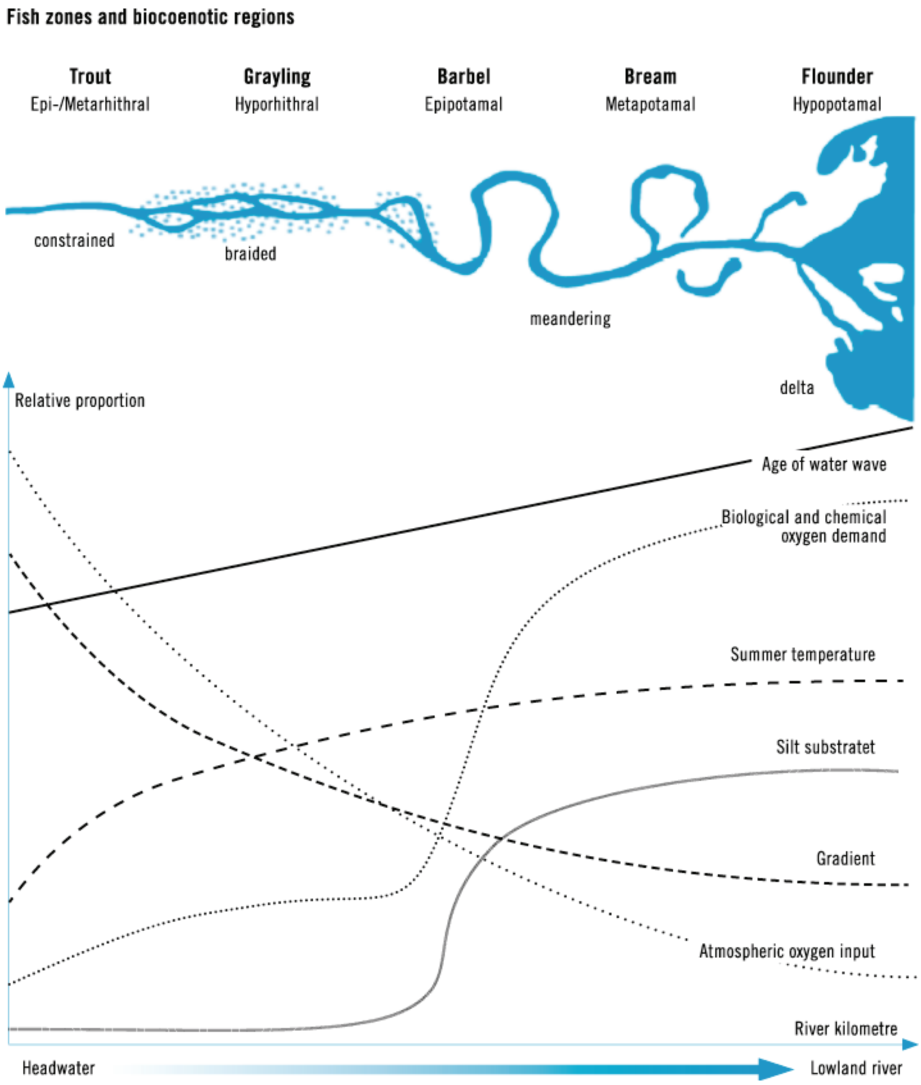
7.1.4.1.2. JPM approach towards the management objectives – interruption of river and habitat continuity

The DRB rivers with catchment areas >4,000 km² are large to medium sized and include crucial living and spawning habitats, vital to the life cycles of fish species. These rivers can be classified as ecologically very sensitive as they are the key routes and 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 and habitat continuum 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 already undertaken at the national level (related to the application of WFD Article 4(5)), some restoration measures will not be implemented (see Figure 37 and Map 27).

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 36).

Figure 36: Fish zones, abiotic conditions and rhithral (headwater)/potamal (lowland river) sections (*adapted from Jungwirth et al. 2003*)[80].



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[81]. 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 14 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 Project EFI+. The technical report on the ecological prioritisation approach (Annex 18) includes more details on LDMs and MDMs.

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

81 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.

Table 14: Examples for long and medium distance migrants in the DRB
(based on EFI+ guild classification (see http://efi-plus.boku.ac.at).

	Nr.	Scientific name	English name
DRB Long Distance Migrants (LDM)			
	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

The 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 (for a list of the respective fish species in the DRB, see Table 14 and Annex 18). This results in a decrease in the level of ecological measure priority (on the basin-wide scale) from the Danube River to the DRBD headwaters. In order to enable a sound estimation of where to target measures most effectively at the basin-wide scale, it is necessary to carry out an ***ecological prioritisation of measures to restore river and habitat continuity*** in the DRBD. A respective study has been performed for this DRBM Plan in coordination with the Danube countries (Annex 18). The elaborated approach provides indications on the step-wise and efficient implementation of restoration measures at the basin-wide scale. It provides useful information on the estimated effects of national measures in relation to their ecological effectiveness at the basin-wide scale and serves as a supportive tool for implementation of future measures. Therefore, it also supports feedback from international to national level and vice versa. The approach allows the illustration of key migration routes for long and medium distance migrants of the DRB (see Map 28). 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. Details of the prioritisation approach are part of the full technical report (see Annex 18).

In general, the approach is based on various criteria (see Annex 18 for details) focusing on the migratory behaviour of LDMs as well as MDMs in the DRB. The criteria are weighted differently, to perform an ecological prioritisation of measures for continuity restoration on the basin-wide scale.

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). 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 36 indicates the *utmost priority,* whereas a PI of 0 indicates a *low priority* for a measure (see Map 28). The PI was grouped into classes of ecological priority (utmost priority: PI >13, very high priority: (PI 10-12), high priority: PI 7-9, medium priority: PI 4-6), low priority: PI 1-3). Based on the results, the approach allows an illustration of potential key migration routes for long and medium distance migrants in the DRB (see Map 28). The achievement of free fish migration for the identified key migration routes by 2015 (taking into account the existing barriers in the DRBD and reported measures for continuity restoration to be taken by 2015 – see Figure 37 and Table 15 for details) will contribute to both the implementation of the DRB management objectives for river and habitat continuity and achievement of the WFD environmental objectives and their maintenance in the future.

The key findings of the ecological prioritisation approach are part of the next sub-Chapter 7.1.4.1.3..

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 strong indicator of the ecological condition 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. Further information regarding the effects of the dams on fish migration can be found in Chapter 2.1.4. (JDS 2 info box).

In particular, the impact of the Iron Gate Dams I and II has resulted in sharp declines in most Danube sturgeon species (now endangered), with significant regional economic impacts on the productivity of fisheries.

As a result, the ICPDR has developed a step-by-step approach (see Annex 19) to jointly ensure the achievement of the management objectives related to the restoration of river and habitat continuity in the DRB. As part of the DRBM Plan and JPM, the first step foresees the performance of a **feasibility study to re-open the Iron Gate Dams for free fish migration**, with a focus on sturgeon species. The technical and ecological problems to be investigated and overcome are complex. However, at present, joint investigations are still ongoing regarding the funding of the feasibility study. Due to the respective timeframe, results of the feasibility study can only be expected during the second and/or third WFD cycles.

The feasibility study's key objectives are to:

- Identify the management and restoration measures required to ensure availability of suitable habitats for migratory fish, especially sturgeon, along the main Danube River from the Black Sea to upstream of the Iron Gates Dams.
- Develop innovative means of adapting the Iron Gate Dams I and II so that the sections and habitats of the river above and below the dams are ecologically 'reconnected' in a way that meets the needs of migrating aquatic species.
- Undertake all necessary pre-implementation studies so that the solutions identified are fully developed and justified from environmental, economic, social and cultural perspectives.
- Demonstrate how such solutions could be developed and implemented for large dams elsewhere in the DRB.

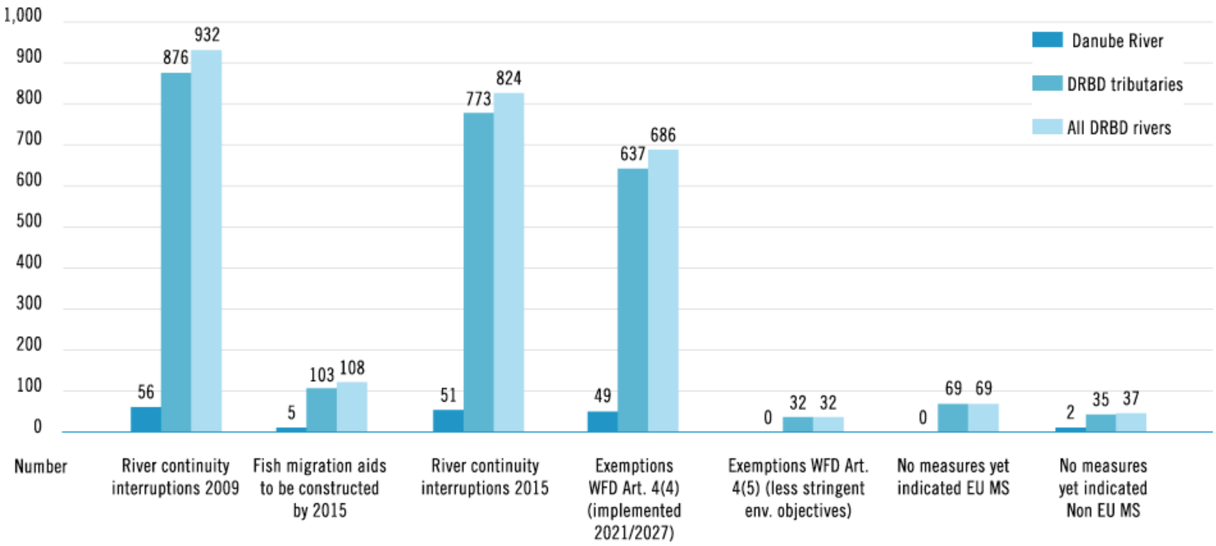
In case the results from the feasibility study are positive, the next steps for the ICPDR approach include the implementation of measures for the Iron Gate Dams and a similar feasibility study regarding Gabcikovo Dam. Once the decision is made to assist sturgeon species in bypassing the Gabcikovo Dam,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

7.1.4.1.3. Summary of measures of basin-wide importance – interruption of river and habitat continuity

Overview of measures to restore river continuity in the DRBD

The Danube countries have reported on the measures that will be undertaken by 2015 to ensure fish migration (where still needed) e.g. construction of fish migration aids. Measures that will be taken are intended to ensure both up and downstream migration of fish and will also help to improve the migration of other fauna. Figure 37 and Map 27 illustrate that, as of 2009, 932 interruptions of river and habitat continuity are located in the DRBD (56 of which are located in the Danube River). By 2015, 108 fish migration aids will be constructed in the DRBD that should ensure the migration of all fish species and age classes according to best available techniques. The figure is limited to 108, as 686 measures to restore river continuity interruptions are subject to an exemption according to WFD Article 4(4) and 32 measures to WFD Article 4(5). This indicates that most restoration measures will not be undertaken until the second and third WFD cycle (Article 4(4)) and that some migration barriers will not be restored at all due to technical infeasibility and disproportionate costs (Article 4(5))[82]. Consequently, 824 interruptions of river continuity will remain impassable for fish migration by 2015 and *good ecological status* may not be ensured. To date, the status regarding 106 interruptions has yet to be clarified by the respective Danube countries and no measures have yet been indicated. This means that at present no measures are foreseen and neither WFD Article 4(4) nor 4(5) can be applied. However, it has to be taken into account and further investigated that some measures may not be necessary as the ecological status/potential is already achieved in 2009 despite the presence of a continuity interruption (see also Map 27).

Figure 37: Interruption of river continuity in the DRBD as of 2015 (including the number of exemptions according to WFD Article 4(4) & 4(5)).



[82] Details on those barriers are available in Figure 37 and Map 27.

Table 15 shows the information provided in Figure 37 for each Danube country.

Table 15: Overview for each Danube country on the number of river continuity interruptions 2009 & 2015, restoration measures (e.g. fish migration aids) and exemptions according to WFD Article 4(4) and 4(5).

	River continuity interruptions 2009	Fish migration aids to be constructed by 2015	River continuity interruptions 2015	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures yet indicated	
						EU MS	Non EU MS
DE	244	8[83]	236	236	0	0	-
AT	270	71	199	199	0	0	-
CZ	68	2[84]	66	66	0	0	-
SK	98	16	82	82	0	0	-
HU	18	9	9	9	0	0	-
SI	12	0	12	12	0	0	-
HR	2	0	2	0	0	-	2
BA	5	0	5	0	0	-	5
ME	-	-	-	-	-	-	-
RS	30	1	29	0	0	-	29
RO	145	1	144	48	27	69[85]	-
BG	39	0	39	34	5	0	-
MD	1	0	1	0	0	-	1
UA	0	0	0	0	0	-	0
Total	**932**	**108**	**824**	**686**	**32**	**69**	**37**
Danube	**56**	**5**	**51**	**49**	**0**	**0**	**2**

Table 16 indicates the estimated river km to be restored by 2015 for the Danube River. Further, it outlines the respective number of water bodies that will provide free migration routes.

Table 16: Number and percentage of river water bodies restored by 2015 through fish migration aids (referencing to total water body number).

	Total number of water bodies	Water bodies affected by continuity interruptions	Water bodies restored for continuity by 2015
Danube River	45	21 (43%)	3 (7%)
DRBD tributaries	636	275 (43%)	34 (5%)
All DRBD rivers	**681**	**296 (43%)**	**37 (5%)**

[83] A DE national prioritisation of river continuity restoration is in process. In addition to the listed 8 continuity interruptions, DE will make 90 additional passable for fish by 2015, which are relevant for the basin-wide scale. However, those 90 obstacles to be made passable for fish migration by 2015 are not yet localised. For this reason all barriers have been temporarily classified as "Exemptions WFD Art 4(4) - continuity restored by 2021/2027" and appear as such in Table 15, Figure 37 and Map 27. They are not reflected and visualised as measures to be taken by 2015 but will in fact be implemented by 2015. Those measures are relevant for the future report on the progress of measure implementation on the basin-wide scale. The DE national RBM Plan provides more detailed information.

[84] CZ is currently finalising a national prioritisation concept for river continuity restoration. Five continuity interruptions will be made passable for fish by 2015 and will be displayed in the national RBM Plan. In the DRBM Plan those interruptions are temporarily indicated and illustrated as "Exemptions WFD Article 4(4)".

[85] No measures are needed as the good ecological status/potential is already achieved in 2009. Further, measures for headwater fish species that migrate over comparable short distances are not taken into account on the A-Level.

Results of the ecological prioritisation approach for continuity restoration in the DRB

The ***key findings*** of the ecological prioritisation approach are illustrated in Map 28 and show that some continuity interruptions in the lower (Iron Gate Dams), middle (Gabcikovo Dam) but also the upper Danube River receive utmost ecological priority for measures with Prioritisation Index (PI) values between 13 and 24. The Iron Gate Dams clearly show the highest priority for continuity restoration with PI values larger than 20. In the upper Danube River the PI ranges largely between 8 and 16 based on the fact that this reach is classified as a LDM habitat. The barriers within the LDM habitat of the DE Danube River generally receive higher values for ecological restoration compared to the Austrian reach due to the fact that longer habitats are reconnected and most obstacles are within Natura 2000 areas. The priority for continuity restoration is currently considered as low in the headwater of the Danube River itself. Measured from the Danube's source this headwater reach is only 17 km long (Map 28). For the DRB tributaries it can be concluded that barriers closer to the confluence with the Danube River generally have a higher priority for continuity restoration than those located further upstream.

In total 946[86] continuum interruptions have been considered. Out of the 681 prioritised interruptions, 29 (3%) show utmost priority for ecological restoration, 99 interruptions (10%) are of medium and 543 (58%) of low ecological priority. More than a quarter (27%) of the continuity interruptions are not of ecological priority at all for restoration (PI=0) on the basin-wide scale as they are located in headwaters or artificial canals. However, it has to be stated that the importance to restore upstream/headwater interruptions will increase as soon as downstream continuity interruptions will be restored.

The 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. economic and/or administrative issues) exist alongside ecological prioritisation, which will also be taken into account when deciding where priority measures will be implemented by 2015 and beyond.

7.1.4.1.3.1. Estimated effect of national measures on the basin-wide scale

Water bodies with migration barriers that should be restored by 2015 (and that are not subject to WFD Article 4(4) or 4(5)) are indicated in Figure 37 and highlighted in Map 27. Based on the approach of *ecological prioritisation of measures to restore river and habitat continuity in the DRBD*, Map 28 illustrates where priority measures could be implemented to achieve the estimated highest effectiveness of measures on the basin-wide scale and WFD environmental objectives.

For river and habitat continuity interruption, the WFD environmental objectives on the basin-wide scale will not be achieved in 2015, but it is likely that these objectives can be achieved after 2015 through implementation of all measures indicated to be undertaken by 2015 and beyond 2015 under WFD Article 4(4). For these measures, the ecological prioritisation for continuity restoration in the DRBD should be taken into account that are summarised above.

[86] 1,688 barriers are located in the DRBD (see Figure 37 and Table 15). For the prioritisation approach specific criteria have been applied for analysis pre-selection of barriers, which resulted in the value of 946 continuity interruptions. Details regarding this pre-selection are outlined in Annex 18.

7.1.4.2. Disconnection of adjacent floodplains / wetlands

7.1.4.2.1. Vision and management objectives – disconnection of adjacent floodplains / wetlands

The ICPDR's basin-wide vision for is that floodplains/wetlands in the entire DRBD are re-connected 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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and non EU MS:

⇨ Protection, conservation and restoration of wetlands/floodplains to ensure biodiversity, the good status in the connected river by 2015, flood protection and pollution reduction.

⇨ To determine the implementation steps for restoration and reconnection of lost floodplains and wetlands along the Danube River and its tributaries, a priority ranking needs to be developed and introduced taking flood retention, nutrient reduction and wetland/floodplain re-connection into account (the identified 17 sites identified along the Danube River and tributaries of approximately 330.000 ha should be considered[87]

⇨ Implementation of the "*no net-loss principle*"[88]

7.1.4.2.2. JPM approach towards the management objectives – disconnection of adjacent floodplains / wetlands

Floodplains/wetlands 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[89], major restoration efforts and measures are needed in order to achieve reconnection of floodplains/wetlands in the entire DRBD (although some restoration projects have already 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 have provided information on:

- national floodplains/wetlands >500 ha with a potential to be reconnected to the adjacent river;
- respective reconnection measures to be undertaken by 2015 or beyond regarding WFD Art.4(4).

The analysis shows the area of floodplains/wetlands to be reconnected by 2015 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.

The approach will be further developed during the second RBM cycle as improvements in knowledge are expected. Current activities on the production of flood risk maps will e.g. significantly contribute to the compilation of an inventory of connected and disconnected floodplains/wetlands and therefore increase the knowledge on reconnection potential. Further, activities in the frame of projects such as the IUCN European Green Belt or the WWF Lower Danube Green Corridor will contribute to knowledge increase on wetlands and floodplains in the DRB.

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87 The 330.000 ha restoration potential refers to findings of the WWF-Danube Pollution Reduction Programme report: Evaluation of Wetland and Floodplain Areas in the DRB (1999). The 330.000 ha restoration potential served as a general orientation but have not been taken into account in the DRBM Plan to compare the factual reconnection area of wetlands/floodplains neither to conclude on the achievement/failing of the WFD environmental objective.

88 No net loss principle = conservation of floodplains and wetlands whenever possible – if surface areas of wetlands are converted to other uses, the total wetland resource base has to be offset through restoration and creation of other wetlands.

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

7.1.4.2.3. Summary of measures of basin-wide importance – disconnection of adjacent floodplains / wetlands

Figure 38 and Map 6 illustrates that from the 612,745 ha of wetland areas identified in 2009 with potential for reconnection, 62,300 ha are expected to be reconnected to DRBD rivers by 2015 (5 wetlands representing 10% of identified potential). An area of 45,308 ha will be reconnected to the Danube River itself (11 wetlands representing 73%). According to the application of Article 4(4), two wetlands will be reconnected after 2015, within the second and third RBM cycles.

Figure 38: Restored lateral connectivity by total area (ha) by 2015 (areas >500 ha).

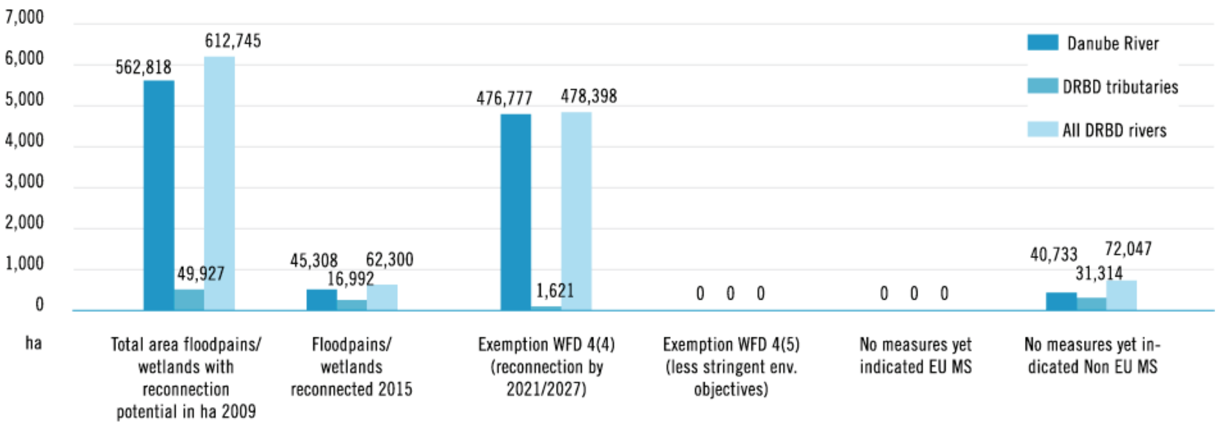

Table 17 shows the information provided in Figure 38 for each Danube country.

Table 17: Overview of wetland/floodplain area (ha) to be reconnected by 2015 and/or for which water regime improvements will be made by 2015, as well as WFD exemptions (per country) [90].

	Floodplains/wetlands with reconnection potential 2009 (ha)	Floodplains/wetlands to be reconnected by 2015 (ha)	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures yet indicated	
					EU MS	Non EU MS
DE	5,964	5,964	0	0	0	-
AT	9,554	9,554	0	0	0	-
CZ	0	0	0	0	0	-
SK	4,842	0	4,842	0	0	-
HU	13,330	13,330	-	0	0	-
SI	1,520	1,520	0	0	0	-
HR	0	0	0	0	-	0
BA	0	0	0	0	-	0
ME	-	-	-	-	-	-
RS	31,932	31,932	0	0	-	0
RO	473,556	0	473,556	0	0	-
BG	0	0	0	0	0	-
MD	24,888	0	0	0	-	24,888
UA	47,159	0	0	0	-	47,159
Total	**612,745**	**62,300**	**478,398**	**0**	**0**	**72,047**
Danube	**562,818**	**45,308**	**476,777**	**0**	**0**	**40,733**

90 Explanation of table content: "0": no basin-wide relevance of issue in Danube country; "-": no information has been provided by the respective Danube country. However, measures may be taken on the national level.

7.1.4.2.3.1. Estimated effect of national measures on the basin-wide scale

Based on the JPM results, the measures of basin-wide importance for reconnection of wetlands/ floodplains (where *good ecological status/ecological potential* is not achieved or measures are needed to maintain *good ecological status/ecological potential*) are now identified. Their implementation will be crucial to achieve the WFD environmental objectives by 2015 and partly beyond (2021/2027) in the DRBD. It is difficult at this stage to indicate what the exact effect of such measures would be at the basin-wide scale. The installation and application of appropriate control mechanisms at the national level regarding measure implementation will be important in order to achieve this basin-wide aim[91]. A respective feedback mechanism between the national and international level and vice versa will enable the further estimation of the basin-wide effect of the implemented national measures.

7.1.4.3. Hydrological alterations

7.1.4.3.1. Vision and management objectives – hydrological alterations

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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and non EU MS:

⇨ Performance of a respective analysis as an addendum to the Danube Basin Analysis 2004 to be part of the Danube River Basin Management Plan. Management objectives will be defined as soon as the analysis is finalised.

7.1.4.3.2. JPM approach towards the management objective - hydrological alterations

As shown by the pressure analysis and status assessment, hydrological alterations impact the status of water bodies (see Chapter 3 and Chapter 4). Impoundments, water abstraction and hydropeaking are key pressures that require measures on the basin-wide scale.

The initial management objective, as shown above, only included the execution of a pressure analysis and stated that the definition of management objectives would be undertaken as soon as the analysis has been finalised. Based upon the now completed analysis, the management objective can be supplemented. As steps towards the vision for hydrological alterations, the implementation of the following management objectives by 2015 are foreseen:

EU MS, Accession Country and Non EU MS:

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.

Water abstractions: The ***management objective*** foresees the ***discharge of a minimum ecological flow,*** ensuring that the biological quality elements are in good ecological status respectively good ecological potential.

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.

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[91] Exact control mechanisms need to be further defined on national level (e.g. ordinances). See the respective national RBM Plans and Programmes of Measures (see web links in Annex 1).

7.1.4.3.3. Summary of measures of basin-wide importance – hydrological alterations

Figure 39, Maps and 7 a, b & c illustrate that, as of 2009, 697 hydrological alterations are located in the DRBD whereas 558 are reported for 2015 (Map 29). Multiple hydrological pressures (impoundment, water abstraction, hyropeaking) can be bound to one hydrological alteration in Figure 39. The number of individual hydrological pressures can therefore be larger than the total number of hydrological alterations. Table 18 and Annex 20 inform on the detailed number of the individual hydrological pressures. 449 impoundments are located in the DRBD rivers, 44 of them in the Danube River. 140 water abstractions are causing alterations in water flow (4 on the Danube River: one of them in the German reach, one at the Gabcikovo Dam and two in the Hungarian reach). Out of them, 105 are significant alterations with insufficient minimum flows. 89 sites of impacts regarding altered flow regimes through hydropeaking were analysed, 32 being significant alterations with water level fluctuations larger than 1 m/day below a hydropower plant (or less in the case of known negative effects on biology).

Overall, it is foreseen that 139 measures to improve impacts on water bodies caused by hydrological alterations will take place by 2015 (Figure 39 and Map 29). 52 measures will address impoundments and 3 measures the buffering of hydropeaking. 42 measures will be implemented regarding water abstractions and specifically 28 regarding insufficient minimum flows. 236 measures are subject to WFD Article 4(4) and will therefore be implemented after 2015. Only two hydrological alterations (impoundments) will not be addressed with measures as WFD Article 4(5) is applied.

Besides the 44 existing impoundments, for the Danube River itself, water abstraction with insufficient residual water is only relevant for the Gabcikovo hydropower dam. Hydropeaking is not analysed as a significant pressure in the Danube River and occurs in a buffered way over short river stretches downstream of tributary confluences (Enns, AT) or downstream of large dams (Gabcikovo and Iron Gate Dams).

Figure 39: Measures for hydrological alterations by 2015 and exemptions according to WFD Articles 4(4) and 4(5) for the remaining alterations.

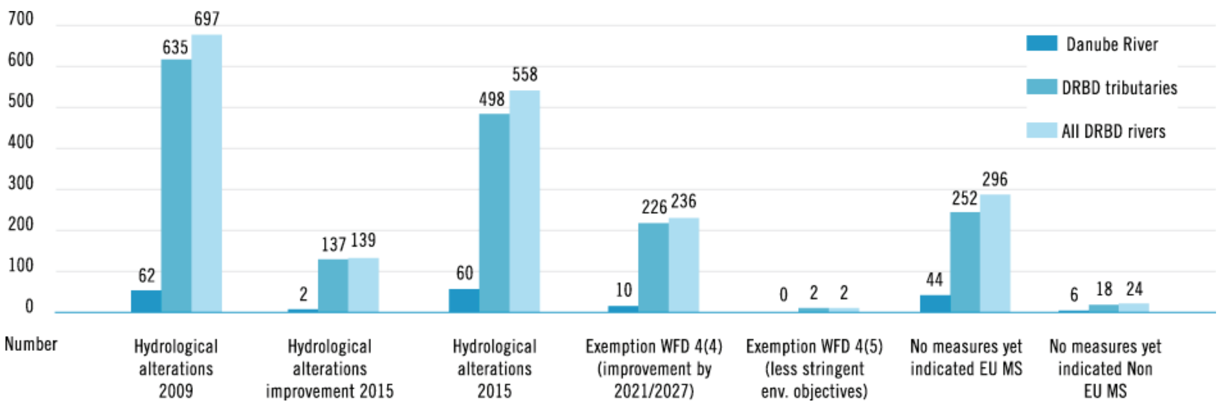

Table 18 shows the information provided in Figure 39 for each Danube country. Details on hydrological alterations in the DRB are also provided in Maps 7 a,b & c, Map 29 as well as in Annex 20.

Table 18: Overview for each Danube country on the number of hydrological alterations 2009 & 2015 and exemptions according to WFD Article 4(4) and 4(5)[92].

	Total no. of hydrological alterations (2009)	Improvement by 2015	Total no. of hydrological alterations 2015	Exemptions WFD Article 4(4)	Exemptions WFD Article 4(5)	No measures yet indicated	
						EU MS	Non EU MS
DE	180	3	177	0	0	177	-
AT	255	54	201	201	0	-	-
CZ	6	0	6	0	0	0	-
SK	35	8	27	0	0	27	-
HU	27	18	9	9	0	0	-
SI	12	0	12	12	0	0	-
HR	4	0	4	0	0	-	4
BA	-	-	-	-	-	-	0
ME	-	-	-	-	-	-	-
RS	19	0	19	0	0	-	19
RO	58	3	55	8	2	45	-
BG	100	53	47	6	0	41	-
MD	1	0	1	0	0	-	1
UA	-	-	-	-	-	-	-
Total	**697**	**139**	**558**	**236**	**2**	**296**	**24**
Danube	**62**	**2**	**60**	**10**	**0**	**44**	**6**
Imp.[93]	**449**	**52**	**397**	**153**	**1**	**220**	**23**
Abstr.[93]	**140**	**42**	**98**	**71**	**0**	**27**	**0**
HyPe[93]	**89**	**3**	**86**	**38**	**0**	**47**	**1**

7.1.4.3.3.1. Estimated effect of national measures on the basin-wide scale

Based on the results of the JPM, the measures of basin-wide importance for restoration of hydrological alterations are now identified. Their implementation will be crucial in order to achieve the WFD environmental objectives by 2015 and partly beyond (2021/2027) in the DRBD. It is difficult at this stage to indicate what the exact effect of such measures would be at the basin-wide scale. The installation and application of appropriate control mechanisms at the national level[94] regarding measure implementation will be important to achieve this basin-wide aim. A respective feedback mechanism between the national and international level and vice versa will enable the further estimation of the basin-wide effect of implemented national measures.

[92] Explanation of table content: ‘0’: no basin-wide relevance of issue in Danube country. ‘-‘: no information has been provided by the respective Danube country. However, measures may be taken on the national level (see national RBM Plans);

[93] Multiple impacts from hydrological pressures (impoundment, water abstraction, hydropeaking) can be bound to one hydrological alteration. The number of individual hydrological pressures can therefore be larger than the total number of hydrological alterations. Explanation of abbreviations: Imp = Impoundments, Abstr = Water abstractions, HyPe = Hydropeaking.

[94] Exact control mechanisms need to be defined further on the national level (e.g. ordinances). See the respective national RBM Plans and Programmes of Measures (see web links in Annex 1).

7.1.4.4. Future infrastructure projects

7.1.4.4.1. Vision and management objective – future infrastructure projects

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.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

EU Member States, Accession Country and non EU MS:

- ⇨ Conduction of Environmental Impact Assessments and/or a Strategic Environment Assessment in conjunction with the EU Water Framework Directive requirements of Article 4(7) during the planning phase of the respective future infrastructure project if needed.
- ⇨ Fulfilment of the conditions set out in WFD Article 4, in particular the provisions for new modifications specified in Article 4, Paragraph 7.
- ⇨ Recommendations for stakeholders for the implementation of best environmental practices and best available techniques.

7.1.4.4.2. JPM approach towards the management objectives – future infrastructure projects

As analysed in Chapter 3, many future DRBD infrastructure projects (navigation, hydropower, flood protection) may have negative impacts on water status by 2015 and need to be addressed accordingly. The DRBD management objectives include precautionary measures (BEP and BAT) that should be implemented to reduce and/or prevent impacts on *good ecological status/ecological potential*.

7.1.4.4.3. Summary of measures of basin-wide importance – future infrastructure projects

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 right from the beginning of the process. In the framework of the ICPDR, it is intended to develop respective processes/guidance in this regard. Such a process is already taking place in the navigation sector to reduce and prevent effects from new projects, but also current maintenance works – see the Joint Statement described in detail below. Similar approaches could be performed for other sectors in the framework of the ICPDR (e.g. BEP/BAT for hydropower generation).

For 22 FIPs, SEAs have been performed during the planning process. Further, EIAs have already been performed for 31 FIPs, and are planned for another 63 FIPs, whereas no EIAs were performed for 18 projects (see details in Annex 7). 91 FIPs will have a negative transboundary effect on other water bodies and 87 FIPs are even expected to provoke deterioration of water status. Exemptions according to WFD Article 4(7) are applied for 89 planned FIPs and are summarised in Chapter 5 as well as illustrated in Map 16.

Joint Statement on the guiding principles for the development of inland navigation and environmental protection in the DRB.

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 Navigation Commission and the International Commission for the Protection of the Sava River Basin, an intense, cross-sectoral discussion process involving all relevant stakeholders and NGOs, which led to a "Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin".

In October 2007, the Joint Statement was concluded and subsequently agreed by the three Commissions involved.

The Joint Statement provides an overview on the legal background regarding both Inland Waterway Transport and environmental issues. Relevant legal documents and action programmes (i.e. TEN-T, NAIADES, etc.) are listed. 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. The Joint Statement is a guiding document for:

- the development of the Programme of Measures requested by the EU WFD;
- the maintenance of current inland navigation;
- the planning and investments in future infrastructure and environmental protection projects.

Overall the Joint Statement and its practical implementation will ensure the integration of economic development and environmental standards during the planning/implementation of new navigation infrastructure projects. It provides the basis for potential win-win situations for the navigation sector and the environment.

7.2. Surface waters: lakes, transitional waters and coastal waters[95]

Measures that are currently foreseen regarding the significant hydromorphological alterations in Lake Razim (RO) are an investigation to assess the extent of pressures and also identify the measures that can be taken to achieve improvement and ensure the WFD environmental objective is met.

Regarding two coastal water bodies in RO affected by significant pressures, measures will be pursued according to the philosophy of the Joint Statement on Guiding Principles for the Development of Inland Navigation and Environment in the DRB, which aims for integrated solutions.

[95] Further details on coastal water are part of the respective national reports.

7.3. Groundwater

This chapter summarises the measures that are planned for the 11 GWBs of basin-wide importance. An indicative overview of the measures is shown in Table 9 (see Chapter 2.3). Detailed information on the relevant measures for each GWB is given in Annex 11.

7.3.1. Groundwater quality

7.3.1.1. 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 way towards the vision will be achieved through the implementation of the following management objectives by 2015:

EU Member States, Accession Country and non EU MS:

- ⇨ 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 of surface waters (see above).
- ⇨ Increase of the wastewater treatment efficiency and level thereafter.
- ⇨ Implementation of Best Available Techniques and Best Environmental Practices.
- ⇨ Reduction of pesticide/biocides emission in the DRBD.

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 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 76/464/EEC.

7.3.1.2. 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. Habitats Directive (92/43/EEC);
d. Integrated Pollution Prevention Control Directive (96/61/EC).

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 7.

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.

7.3.2. Groundwater quantity

7.3.2.1. 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 way towards the vision will be achieved through the implementation of the following management objectives by 2015:

EU Member States, Accession Country and Non EU MS:

- ⇨ 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.

7.3.2.2. 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 (GWB1). 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.

7.4. Financing the JPM

Although some measures in the DRBM Plan and the JPM are able to be achieved without major investment of financial resources, it is clear that significant financial resources are needed to put in place the full range of measures necessary to achieve the management objectives.

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 programmes are available for some of the measures. This is particularly important for new EU 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 programmes (CAP, Life, etc.) have in the past, and can be in the future, utilised by EU MS to address a number of specific problems and to implement necessary measures. Fortunately as well, some of the necessary measures are not expensive and can be funded through existing programmes or by applying legislation or policy initiatives.

The DRB is composed of both EU MS and Non EU MS. In general the funding of measures in Non EU MS 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 MS do not have Cohesion Funds which they can draw upon to finance wastewater treatment or other necessary measures. Consideration has therefore been given, within the framework of preparing the DRBM Plan, as to how the financing of necessary measures in Non EU MS could be supported.

In particular, the potential of International Financial Institutions to fund investment needs at the basin-wide scale, or in those countries where external financing may be needed, will be explored by initiating a targeted dialogue with key institutions EU, European Investment Bank, European Bank for Reconstruction and Development, World Bank, DABLAS etc. The ICPDR would be the forum under which such a dialogue would take place. The dialogue would ensure that the overall actions needed are presented and possibilities discussed for funders to support these actions and the mechanisms needed to facilitate the support.

In addition, specific actions in individual countries will be developed and explored. Cooperation with funders needs to take place via initiatives of individual countries but will also be facilitated where possible by the ICPDR.

In order to respond to uncertainties and fill existing knowledge gaps regarding various management issues highlighted in this DRBM Plan, joint actions should be undertaken to enable access to EU and international funding, particularly for research projects relevant at the basin-wide scale.

7.5. Key conclusions

The key conclusions focus on aspects of water management and the implementation of the WFD at the basin-wide scale. Complementary information on the considerable and important work taking place at the national level can be obtained from the national river basin management plans.

Status assessment

- At this stage, the status assessment of water bodies is not yet directly linked to the measures and the effects of the measures at the basin-wide scale. A follow-up is needed in order to better understand the linkage between the effects of the measures and the water status at the basin-wide scale.
- The assessment of biological quality elements will be further improved to enable complete intercalibration as well as assessment of the ecological status and potential.
- The improvement in status assessment will also increase confidence levels for ecological status.

Organic pollution

- Measures identified for the baseline scenario regarding organic pollution will result in a considerable reduction of BOD_5 and COD loads but will not ensure the achievement of the WFD environmental objectives on the basin-wide scale by 2015.
- Significant further efforts for the next RBM cycles will still be necessary. In the long-run, the technical implementation of the UWWTD requirements as well as the IPPC Directive by EU MS and an equal level of measures in Non EU MS would be sufficient to solve the problem of organic pollution.

Nutrient pollution

- Compared to the present state (averaging the years 2000-2005), nitrogen emissions to surface waters in 2015 will, through the planned measures, be approx. 12% lower. The load to the Black Sea will reach a level that is below the present state but still far above (40%) that of the 1960's. This means that the situation in the DRBD and the Black Sea regarding nitrogen pollution will improve but not ensure the achievement of the management objectives and the WFD environmental objectives on the basin-wide scale by 2015.
- Compared to the present state (avg. 2000-2005) the P emissions to surface waters will, through the planned measures, be in 2015 about 21 % lower. The load to the Black Sea will reach a level, which is still 15 % above the level in the 1960‘s. Therefore, for Phosphorous the respective management objective on the basin-wide scale will not achieved by 2015, and this is most likely also the case for the WFD environmental objectives.
- The implementation of the Nitrates Directive in the EU MS and an improved implementation of the concept of BAP in Non EU MS are expected to contribute to reductions in nutrient pollution from agriculture. Nevertheless the reduction potential for the agricultural sector is difficult to quantify due to uncertainties in the future economic development of this sector, mainly in the middle and lower DRB.
- Reductions in nutrient pollution will be achieved as soon as more stringent UWWT obligations with N and P removal for agglomerations >10,000 PE are applied for EU MS. This could reduce the discharged emissions in EU MS of N_{tot} by 37% – 43% and of Ptot by 45% - 56% compared to the reference situation.
- The introduction of limitations on P in detergents, i.e. a P ban in laundry detergents in 2012 and in dishwasher detergents in 2015, is seen as a cost effective and necessary measure to complement the efforts of implementing urban wastewater treatment.
- As an important share of nutrient pollution stems from atmospheric deposition of nitrogen (currently estimated at 41%), coordinated measures on a wider scale are needed to tackle this source of nitrogen pollution.
- The knowledge and understanding of the interlinkages between Danube loads and the ecological response in the NW shelf of the Black Sea still need to be refined and improved.

Hazardous substances pollution

- The implementation of the Dangerous Substances Directive, the IPPC Directive, the UWWT Directive and the widespread application of BAT/BEP will improve but not solve the problem of hazardous substances.
- It is estimated that the management objectives and WFD environmental objectives will not be achieved in 2015 regarding hazardous substances, however there is a need for more monitoring data on hazardous substances, as well as information on sources and relevant pathways.
- Further measures are the appropriate treatment of priority substances from industrial discharges and further strengthening of prevention and safety measures at contaminated sites. In addition, the continued upgrade of WWTPs with biological treatment (which results in some hazardous substances accumulating in the sewage sludge) as well as increases in the number of WWTPs will contribute to reduce the load of hazardous substances. Finally, additional reduction through product related measures should be considered.
- The present lack of knowledge on the sources, pathways, discharges and losses of hazardous substances will be reduced by monitoring, PRTR reports and reporting of EU REACH, as well as by the results of the inventory on the new EU Priority Substances Daughter Directive. For the DRB, this inventory should be the basis for ICPDR actions to achieve comparable results.

Hydromorphological alterations

- Measures will be taken to improve river continuity, reconnection of floodplains/wetlands and hydrological alterations by 2015. However, a significant number of respective pressures will still remain in 2015 and *good ecological status/ecological potential* will not be achieved by 2015.
- In many cases an extension of the deadline to achieve good ecological status/ecological potential (WFD Article 4(4)) will be applied. In a few cases, a less stringent objective in line with WFD Article 4(5) will be applied.
- Significant further efforts for the next RBM cycles will be necessary to address the pressures from all hydromorphological components. For further specifications, see below.

River and habitat continuity interruption

- By 2015, it is expected that 108 barriers will be made passable for fish, whereas 824 river and habitat continuity interruptions will remain. This means that the self-sustainability of sturgeon species and other migratory species in the DRB will be enhanced but impacts will remain. Remaining continuity interruptions will be addressed by 2021 and 2027.
- In order to achieve the WFD environmental objectives in an ecologically effective way on the basin-wide scale, it is recommended that initial measures focus on defined ecological priority river stretches.
- The implementation of measures for the migration of sturgeon and medium distance migratory fish species needs to be improved (starting with securing funding to proceed with the planned feasibility study on the re-opening of the Iron Gate Dams).

Disconnection of adjacent floodplains/wetlands

- By 2015 62,300 ha will be reconnected and/or the hydrological regime improved, and additional restoration efforts will be taken beyond 2015.
- Although there is a positive cumulative effect of connected wetlands/floodplains and improvement of the water regime to adjacent water bodies, further investigation is required as to the extent that these reconnections will improve the water status at the basin-wide level, in order to better target measures.

Restoration of hydrological alterations

- Measures will be taken to improve the ecological status of water bodies impacted by significant hydrological alterations on the basin-wide scale.
- A part of the significant pressures will be reduced as a consequence of measures implemented by 2015, but a larger part will only be addressed by 2021 or 2027.

- Although data gaps on hydrological alterations still exist, it is quite likely that more measures need to be taken to ensure the achievement of WFD environmental objectives, taking into account eventual future effects of climate changes and related adaptation measures.

Future infrastructure projects

- According to developed criteria for future infrastructure projects that may have effects at the basin-wide scale, there are 25 such projects identified in EU MS, which may be subject to analysis according to Article 4(7). 19 future infrastructure projects are located in Non EU MS.

Groundwater

Groundwater quality

- Preliminary findings show that nitrate contamination is a key hindrance to achieving *good chemical status*. Measures regarding SWMIs for surface waters will also help to achieve *good chemical status* of groundwater bodies. Although it is difficult to quantify, the amount of nitrates will be reduced, primarily through the implementation of the EU Nitrates Directive and the EU UWWTD.
- Where it is not yet the case, an effective regulatory framework has to be put in place at the national level ensuring prohibition of direct discharge of pollutants into groundwater.
- Prevention of significant losses of pollutants from technical installations and prevention and/or reduction of the impact of accidental pollution incidents is needed.

Groundwater quantity

- For groundwater bodies of basin-wide importance that show poor quantitative status, groundwater use has to be properly balanced, taking into account the conceptual models for particular groundwater bodies, and should not exceed the available groundwater resource.
- Where it is not yet the case, appropriate controls over the abstraction of fresh surface water and groundwater and impoundment of surface waters (including registers of water abstractions) must be put in place.
- Where it is not yet the case, an effective policy of authorisation of abstractions must be provided.

Other relevant issues

More investigations are needed on the significance of other relevant issues such as the quality and quantity of sediments, invasive species, water quantity issues and climate change.

8. Flood risk management and climate change

8.1. Interlinkage of the DRBM Plan 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 overall goal of the Action Programme is to achieve a long-term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems. The Action Programme has been designed in line with the provisions of the EU Flood Directive (2007/60/EC).

The river basin approach belongs to key principles of the ICPDR Action Programme on Sustainable Flood Protection in the DRB. Respecting this principle, the Action Programme stipulates that the development of the action plans for sub-basins should be based on an integrated approach, taking into account the EU WFD and its daughter directives, as well as river basin management plans under the WFD at all levels. The synergy between river basin management and flood risk management in preparation of action plans for sub-basins is also emphasised in the targets of the Action Programme.

The ICPDR Action Programme on Sustainable Flood Protection in the DRB stresses that human interference into the processes of nature should be reversed as much as possible, compensated for and, in the future, prevented. The Action Programme encourages the promotion and harmonisation of changes in water policies and land-use practices, as well as environmental protection and nature conservation, in order to improve flood management and also meet the targets and measures of Integrated River Basin Management. The results of the flood action plans should be integrated into the River Basin Management Plans (RBMP) at an appropriate stage for information purposes.

Being aware of the necessity of visualisation of the risks stemming from flood events and making this information available for the public, the Action Programme includes the recommendation for a common approach in assessment of flood-prone areas and flood risk mapping. The general objectives of flood maps are to increase public awareness of the areas at risk from flooding, to provide information of areas at risk to give input to spatial planning and to support management and reduction of the risk to people, property and the environment.

In practical terms, the synergy between river basin management and flood risk management will be achieved through the following concerted actions:

- Ensuring a coordinated approach in land-use planning;
- Reactivation of former wetlands and floodplains to achieve increased water retention along with *good surface water status*. As start-up actions, available data should be collected on e.g. inventory of floodplains; floodplains which are dis- or reconnected to their rivers; potential flood retention areas; future flood infrastructure projects etc.;
- Prevention of accidental pollution during floods affecting the storage facilities of dangerous substances;
- Preparation of an overview of the implementation of future measures to achieve the WFD environmental objectives while ensuring appropriate level of flood protection.

8.2. Climate change and the DRBD

8.2.1. Reasons for integrating climate change adaptation issues into river basin planning

The EC Green Paper[96] "Adapting to Climate Change in Europe – Options for EU Action" (June 2007), acknowledged that the WFD provides a consistent framework for integrated water resource management but does not directly address climate change. However, the Green Paper recognised that the challenge for the EU MS will be to incorporate consideration of climate change issues in the first river basin management planning cycle by 2009. This also concerns the DRB. The European Commission's White Paper on climate change adaptation[97] proposes that guidance needs to be developed to ensure that the next generation of River Basin Management Plans due in 2015 are fully climate proofed, and to ensure that climate change is taken into account in the implementation of the EU Floods Directive.

In preparation for the DRBM Plan, an international conference on Climate Change in the Danube River Basin was held in Vienna in December 2007. The conclusions from the Conference were:

- Climate change impacts:
  - Are an issue of Danube basin-wide significance;
  - Will be addressed by a step-wise approach;
  - Will be addressed respecting all SWMIs for the DRB;
  - Will address the issues of flood protection, low water discharges, drought and land use;
- Climate change signals for the DRB are sufficient to act beyond existing scientific uncertainties;
- Ongoing DRB related scientific projects and their outcomes should have a guiding role. Therefore, existing DRB scientific activities are the basis for the further development of measures (see Annex 21. for a selected list of projects on climate change relevant for the DRB);

[96] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007DC0354:EN:NOT
[97] Adapting to Climate Change: Towards a European Framework for Action (April 2009).

- Future infrastructure projects need to be *climate proof*:
  - Holistic and coherent in their approach (linking all relevant sectors);
  - Provide flexible management tools and no regret measures.

8.2.2. Responses to climate change and potential effects within the DRBM Plan / JPM

Climate change in the DRB are a significant threat to the DRB environment and further actions need to be taken as a consequence. The priority at this stage is to identify eventual future pressures on the aquatic environment (see Annex 21 for a summary on such eventual pressures) and to ensure that aquatic ecosystems are climate resilient. Furthermore, future measures implemented in the DRB, that might have additional negative impacts on water status, are to be made *climate proo*f or *no/low regret measures*.

It is clear that there is still much work needed to clearly understand the scale and magnitude of pressures and impacts, but it is obvious that there are actions that can and must be taken now and this should be a priority for the overall management of the DRB.

Following this DRBM Plan and in the framework of the ICPDR, the Danube countries will develop an approach and strategy to ensure that the DRBM Plan will be followed-up by specified actions regarding climate change adaptation. On this basis, the second and third cycles of WFD implementation in the DRB will collect and ensure more evidence, enable greater precision on the impacts of climate change and will fully integrate climate issues within DRBM planning.

Concluding, the following list summarises the perceived future issues for investigation to be addressed in subsequent RBM cycles of the WFD:

- Ensure that monitoring systems used in the DRB have the ability to detect climate change impacts on *ecological and chemical water status* as well as the effects of climate change adaptation measures;
- Investigate on the effects of climate changes on ecoregions, typologies and reference sites as well as proposals for solutions;
- Foster the improvement of models (climate and hydrological aspects) and of scenarios for the DRB as well as ensure the improvement regarding the presentation on climate fluctuations;
- Investigate on effects of climate change on the various sectors active in the DRB and the evaluation of indirect increases in impacts on water status;
- Conduct a climate vulnerability assessment of basin ecosystems;
- Promote and apply methodologies and standards for climate-proofing infrastructure projects and integrating climate considerations into EIA and SEA procedures,
- Enhance the sharing of research information on climate change in the DRB;
- Ensure that scientific information is ‘translated’ to water managers;
- Integrate all knowledge, results and lessons learnt related to climate change threats in the next DRBM Plan;

9. Public information and consultation

In the context of the implementation of Article 14 of the WFD, the ICPDR has put a special emphasis on the promotion of public participation and the implementation of certain activities on the international level. These activities were carried out on the basis of the guidelines described in the Danube River Basin Strategy for Public Participation in River Basin Management Planning 2003-2009[98] and compliment the efforts undertaken at the national level.

Providing information to the general public

During the entire process, the ICPDR website www.icpdr.org has been used as the main information tool, providing access to all relevant documents (such as the DBA and the document on SWMI´s in the DRB) as well as further information. In addition, articles have been issued in internal and external communication tools (e.g. the magazine "Danube Watch"). Also, special outreach activities, the annual celebration of International Danube Day on June 29 (see www.danubeday.org) and several public events including press events during the Joint Danube Survey 2 (www.icpdr.org/jds2), have been used to communicate the goals of the WFD. Special effort has been put into raising awareness about the Danube and the goals of the WFD amongst children by developing the "Danube Box" education tool (available for Austria, Germany, Hungary and Romania; under preparation the Czech Republic, Bulgaria and Serbia). The education material is also available online www.danubebox.org.

Consultation of the interested public

The ICPDR has organised several round-table discussions on selected topics with relevant organisations, such as on the use of phosphates in detergents with representatives from the detergent industry or on the issue of navigation on the Danube with representatives from the navigation sector. In order to have an in-depth discussion on the DBA, the First ICPDR Stakeholder Forum was organised in 2005. The two-day conference provided the opportunity to consult the relevant stakeholders. The draft DRBM Plan has been available to the wide public for comments from May 18 until July 31 2009 via the ICPDR website **www.icpdr.org/participate.** An on-line questionnaire has also been developed and offered to the public. The Second ICPDR Stakeholder Forum on the draft DRBM Plan was organised on 29-30 June 2009 in Bratislava. The comments received during the Stakeholder Forum and the public consultation process have been evaluated and are reflected in this DRBM Plan as far as possible.

Active involvement of stakeholder groups

According to the DRPC, stakeholder groups can be granted observer status to the ICPDR. Organisations holding this status have the possibility to actively participate at the meetings of the ICPDR and its expert groups. During recent years, the ICPDR has spent considerable effort in including representatives of relevant stakeholders as observers. Today, 21 organisations are holding observership status and can therefore actively shape the decisions made by the ICPDR.

[98] www.icpdr.org