UNDP/GEF DANUBE REGIONAL PROJECT

"STRENGTHENING THE IMPLEMENTATION CAPACITIES FOR NUTRIENT REDUCTION AND TRANSBOUNDARY COOPERATION IN THE DANUBE RIVER BASIN"

ACTIVITY 1.1.2 "ADAPTING AND IMPLEMENTING COMMON APPROACHES AND METHODOLOGIES FOR STRESS AND IMPACT ANALYSIS WITH PARTICULAR ATTENTION TO HYDROMORPHOLOGICAL CONDITIONS"

FINAL REPORT

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ACTIVITY 1.1.2 - ADAPTING AND IMPLEMENTING COMMON APPROACHES AND METHODOLOGIES FOR STRESS AND IMPACT ANALYSIS WITH PARTICULAR ATTENTION TO HYDROMORPHOLOGICAL CONDITIONS

Common Approaches and Methodologies for Stress and Impact Analysis with particular Attention to Hydromorphological Conditions – Methodological Approach (Criteria for significant Impact)

OTTO MOOG & ILSE STUBAUER

1. INTRODUCTION

Paragraph 1.4 in Annex II of the Water Framework Directive (WFD) requires that Member States shall collect and maintain information on the type and magnitude of significant anthropogenic pressures to which surface water bodies in each River Basin District are liable to be subject. In particular, attention should be given to pressures from point and diffuse sources, water abstraction, flow regulation, hydromorphological alterations and land use. Member States shall carry out an assessment of the susceptibility of the surface water bodies to the pressures identified. Member States shall use the information collected, and any other relevant information including existing environmental monitoring data, to carry out an assessment of the likelihood that surface water bodies within the River Basin District will fail to meet the environmental quality objectives set for the bodies under Article 4. A summary of the key stages includes:

1. identifying driving forces and pressures,
2. identifying the significant pressures,
3. assessing the impacts, and
4. evaluating the likelihood of failing to meet the objectives.

2. AIMS OF THIS REPORT

The major goal of this part of the project *(Project Document Activity 1.1.2)* is to adapt and implement common approaches and methodologies for stress and impact analysis with particular attention to water abstraction, flow regulation, and morphological alterations, herein in summary called **hydromorphological pressures**, in the DRB. To achieve this goal three requests for information have been distributed to each of the national consultants in the Danube countries. The questionnaires aimed at compiling available information on hydromorphological pressures and impacts and the definition of criteria for significant pressures.

In the first phase of the UNDP/GEF Danube Regional Project the activities are limited to the Danube River itself. The Danube River is divided into sections of different typological characteristics (Project Document Activity 1.1.6 - Typology of Surface Waters and Definition of Reference Conditions for the Danube River). This

classification may serve as a framework for allocating the water bodies as described in the WFD.

With respect to the term water body the C.I.S guidance paper REFCOND states: *Where different reference conditions apply within a river, stream or canal, it must be sub-divided into separate water bodies. Furthermore, where there are significant differences in status in different parts of a river, stream or canal, it must be sub-divided into separate water bodies to achieve the desired environmental outcome in the most cost-effective way.*

The implementation of activity 1.1.2 should comprise two steps.

Step 1: Development of the methodological approach (overview on driving forces and according pressures, development of criteria for significant impacts of a pressure) (see the following chapters).

Step 2: Overview of stress and impacts caused by changes of hydromorphological conditions in the Danube River (see chapter 9).

For a common understanding of the terms the Impress guidance paper (C.I.S) has adopted the widely used DPSIR (Driver, Pressure, State, Impact, Response) analytical framework with the following definitions. Within the scope of the study a focus is given on only three criteria: drivers (driving forces), pressures and impacts (Table 1).

Table 1: Part of the DPSIR framework as used in the pressures and impacts analysis.

Term	Definition
Driver	An anthropogenic activity that may have an environmental effect (e.g. agriculture, industry)
Pressure	The direct effect of the driver (for example, an effect that causes a change in flow or a change in the water chemistry)
Impact	The environmental effect of the pressure (e.g. fish killed, ecosystem modified)

3. DEVELOPMENT OF METHODOLOGICAL APPROACH (CRITERIA FOR SIGNIFICANT IMPACT ANALYSIS)

The output of step 1 is the report at hand on “Common approaches and methodologies for stress and impact analysis with particular attention to hydromorphological conditions - Methodological approach (criteria for significant impact)”. The according activities of the international and national consultants followed the given scheme:

Part A: Developing/completing a list of **drivers** that may cause important hydromorphological pressures that change the ecological conditions in the Danube River stretch of the according country.

Part B: Developing/completing a list of **pressures** induced by each of the drivers that may cause important impacts on the biotic conditions in the Danube River stretch of the according country. This list can be used as a national checklist to inventory the relevant pressures in the Danube River. The checklist may be helpful/straightforward to note all pressures without concern for their significance. Finally emphasis will be put on a transnational agreement of the proposed pressures in the Danube countries.

Part C: Developing/discussing a system to assess if a pressure has a **significant impact** and the water body is at risk to fail the good ecological status.

The questionnaires for part A and part B have been sent to the national consultants on August 22nd, 2003. The deadline to return the answered questionnaires was September 4th, 2003. Questionnaire C was sent on August 25th, return deadline has been specified as September 11th. The questionnaires A, B, and C are attached to this report in Annex 1. Table 2 gives an overview on the persons who responded to the questionnaires.

Table 2: Persons who provided the answers to the questionnaires on drivers

Country	Person 1	Institution	Person 2	Institution
Germany	Sebastian Birk	University Duisburg-Essen	Franz Schöll	BFG Koblenz
Austria	Birgit Vogel	Ministry for Agriculture, Forestry, Environment and Water Management	Otto Moog	BOKU - University of Natural Resources and Applied Life Sciences
Slovakia	Jarmila Makovinska	Water Research Institute		
Hungary	László Perger	Országos Vízügyi Főigazgatóság / National Water Authority	Szilvia Dávid	Országos Vízügyi Főigazgatóság / National Water Authority
Croatia	Marija Jokic	Croatian Waters		
Serbia-Montenegro	Jovanka Ignjatovic	Ministry for Protection of Natural Resources and Environment of the Republic of Serbia	Momir Paunovic	Institute for Biological Research
Romania	Graziella Jula	National Administration "Apele Romane"		
Moldova	Liudmila Cunician	State Hydrometerological Service	Liudmila Serenco	State Hydrometerological Service
Bosnia-Herzegovina	Bozo Knezevic	JP za "Vodno podrucje slivova rijeke Save"	Naida Andelic	JP za "Vodno podrucje slivova rijeke Save"

Table 3: Date of distribution and reply of questionnaires

		Questionnaire sent		Reply obtained	
Country	**Name**	**Part A & B**	**Part C**	**Part A & B**	**Part C**
Germany	Sebastian Birk/Franz Schöll	22.8.03	25.8.03	27.10.03	27.10.03
Austria	Birgit Vogel/Otto Moog	22.8.03	25.8.03	27.10.03	27.10.03
Czech Republic	Ilja Bernardova	22.8.03	25.8.03	not filled in because no direct access to Danube	
Slovakia	Jarmila Makovinska	22.8.03	25.8.03	12.10.03	20.10.03
Hungary	Lazlo Perger/ Szilvia Dávid	22.8.03	25.8.03	3.11.03	3.11.03
Slovenia	Natasa Vodopivec	22.8.03	25.8.03	not filled in because no direct access to Danube	
Croatia	Marija Jokic	22.8.03	25.8.03	27.10.03	-
Bosnia-Herzegovina	Bozo Knezevic / Naida Andjelic	22.8.03	25.8.03	31.10.03	no direct access to Danube
Serbia-Montenegro	Momir Paunovic/Jovanka Ignjatovic	22.8.03	25.8.03	30.9.03	30.9.03
Bulgaria	George Mungov	22.8.03	25.8.03	-	-
Romania	Graziella Jula	22.8.03	25.8.03	16.9.03	19.9.03
Moldova	Liudmila Cunician/ Liudmila Serenco	22.8.03	25.8.03	29.8.03	10.10.03

4. BENEFITS FROM THIS REPORT

The report will yield a first overview of the kind and relevance of drivers and pressures in the entire Danube River focusing on the main river channel. The provided methodology of assessing the impacts of specific pressures may be a basis of establishing a decision support system, which serves as a methodological background for a more detailed pressures and impact analysis in the Danube River as well as in other Danube tributaries. It further will help to identify possible gaps of data availability. On the basis of this information national research projects can be tailored to fill the remaining gaps. As medium term ultimate object this study serves as important source of information for step 2, the overview of stress and impacts caused by changes of hydromorphological conditions in the Danube River.

Besides the pressures & impacts topics the criteria provided in the tables of questionnaire C may serve as a helpful tool within the discussion on heavily modified water bodies.

5. EVALUATION OF PART A - DRIVING FORCES

The aim of part A was to develop or complete a list of drivers that may cause important hydromorphological pressures that change the ecological conditions in the Danube River. This list should serve as a basis for estimating driver specific pressures.

Table 4 summarises the current status of identifying drivers in the Danube River countries. Three countries have already started with the process of identifying drivers (Germany, Austria, and Hungary). In Slovakia and Romania the process is under development. Croatia, Serbia-Montenegro, Bosnia-Herzegovina and Moldova have not started with identifying drivers.

Table 4: Current status of identification process for drivers

Country	**process started**	**process under development**	**deadline**	**process not started**
Germany (D)	x			
Austria (A)	x			
Slovakia (SK)		x	2004	
Hungary (H)	x			
Croatia (HR)				X
Serbia-Montenegro (YU)				X
Romania (RO)		x		
Moldova (MD)				X
Bosnia-Herzegovina (BA)				X

The next question asks for availability of information about driving forces on water bodies in the Danube countries that can be used in the analysis of pressures and impacts required by the WFD. The national experts should indicate the “type of driver” and – if available - the source of information (references, reports, position papers etc.). The outcome of these answered questions provides quite useful results that are summarised in Table 5.

Table 5: List of sources for drivers mentioned by national experts

Country	Type of Driver	Source of Information
Germany	navigation	BANNING (1998): Auswirkungen des Aufstaus größerer Flüsse auf das Makrozoobenthos - dargestellt am Beispiel der Donau. Essen (Westarp-Wiss.).
	flood defence	
	hydropower generation	
Austria	navigation	Danube waterway map (http://www.via-donau.org)
	flood defence	
	hydropower generation	Information about Danube hydropower stations (http://www.verbund.at)
	gravel extraction	river bed survey (http://www.wsd.bmv.gv.at) (http://www.donautechnik.at)
Slovakia	navigation	WRI, Danube River Authority, SK (GIS)
	hydropower generation	Danube River Authority, Slovak Electricity Company, Water Management Building Company SK (electronical data, maps, reports)
	flood protection	WRI, Danube River Authority, SK
Hungary	navigation	CD with ArcView shape available
	hydropower generation	
	flood defence	
	outdoor recreation	
	gravel extraction	
Croatia		
Serbia-Montenegro		
Romania	flood defence	Water Cadastre of Romania-1992- section Cadastre of Hydraulic Works – hard copy Hydrological Monograph-hard copy
	navigation	Water Cadastre of Romania-1992 – hard copy
	hydropower generation	
	water abstraction	
	fisheries	
Moldova		

To gain an overview on the driving forces in the Danube countries a list of the known most important drivers that may change the hydromorphological conditions in the Danube River was provided by the international consultants. The national consultants were encouraged to:

1. indicate drivers relevant for the Danube section in their country
2. indicate major driving forces in the Danube section

3. (if possible) perform a ranking of the major driving forces in the Danube section.

As a final result a list of driving forces relevant for sections of the Danube River in the countries, ranked due to their relevance for each national Danube section was expected.

The following tables provide a listing of the most important drivers that may change the hydromorphological conditions in the Danube River. Although most of the Danube countries are currently identifying the drivers or have not yet started respectively, all questionnaires contained responses to the types of drivers. Consultants from eight countries could rank the drivers according to their relevance (Table 6).

Table 6: Types of drivers (ranking: 1,2,3; if number not bold, no major driver; X: major driver, but not ranked; y: relevant, (y): only of local relevance)

Country	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
flood defence	**1**	**1**	**2**	**1**	y	**2**	**2**	**2**	**1**
navigation	**1**	**2**	**1**		y	4	**3**	4	y
hydropower generation	**1**	**1**	**1**	y*		**1**	**1**	**1**	**2**
water abstraction		y		**3**	y			3	y
gravel extraction		3	**3**	**2**		3			y
fisheries		(y)							
removal of plants/animals		(y)							
inshore habitat management									
outdoor recreation		y	**4**	y					
other drivers									
inter basin transfer				**X**					
water intake									

* not relevant, but from upstream measurable

Hydropower generation is seen as the most important driving force, followed by flood defence measures and navigation as the tertiary (Table 6). Fisheries, removal of plants/animals and inshore habitat management are not seen as relevant drivers with a remarkable pressure on the Danube environment. Two more drivers have been added by Hungary, the inter basin transfer and the water intake. All together eight drivers have been regarded as anthropogenic activities that may have an environmental effect on the Danube River. The relevant driving forces are summarised in order of their importance in Table 7.

Table 7: List of relevant drivers that cause a remarkable pressure on the Danube River environment

Drivers relevant for the Danube
hydropower generation
flood defence
navigation
gravel extraction
water abstraction
outdoor recreation
fisheries
inter basin transfer
water intake

6. EVALUATION OF PART B - HYDROMORPHOLOGICAL PRESSURES

The questionnaire starts with the query if the process of identification concerning hydromorphological pressures for the Danube River has started. If this process has started the national consultants were asked to indicate what kind of information about pressures on water bodies will be available. A focus should be given on information that can be used in the analysis of pressures and impacts required by the WFD, and - if available - the source of information (references, reports, position papers etc.).

Table 8 summarises the current status of identifying pressures in the Danube River countries. Three countries have already started with the process of identifying pressures (Germany, Austria, and Hungary). Romania is under development. Slovakia, Croatia, Serbia-Montenegro, Bosnia-Herzegovina and Moldova have not started with the process of identifying pressures.

Table 8: Current status of identification process for pressures

Country	**process started**	**process under development**	**deadline**	**process not started**
Germany	x			
Austria	x			
Slovakia				x
Hungary	x			
Croatia				x
Serbia-Montenegro				x
Romania		x		
Moldova				x
Bosnia-Herzegovina				x

All suggested pressures of the driver "flood defence" (Table 9) have been confirmed as impacts induced by flood protection measures. No other pressures have been appended. Alteration of the river course and channel form/profile is regarded as the most important pressure (six votings out of eight; two times ranked as major pressure). The categories "flood defence dams, set-back embankments, dykes" (six votings out of eight; one time ranked as major pressure), "alteration of the hydrological/hydraulic characteristics" (six votings out of eight) and "alteration of the bank vegetation and banktop land use" (five votings out of eight) followed as major pressures.

Table 9: Pressures related to driver "flood defence", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of the driver "flood defence"	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
Alteration of the river course and channel form/profile (e.g. straightening, curvature, channelling, diversions)	X	1	X	X	not possible to answer		1		X
Disruptions of the vertical connectivity (e.g. siltation, colmation, embeddedness, plastering, concrete bottom)	y	3		X		Y	3		
Disruption of the longitudinal connectivity (e.g. weirs, ramps)	y	Y	X	y			4	y	X
Alteration/modification of morphological in-channel features/habitats; bank fixation, reinforcements, re-insectioning, embankment, groynes	X	1	y	X		X	X	y	y
Disruptions of lateral connectivity (e.g. detaching of side arms, tributaries)	y	2	X	X			2	y	y
Alteration of the bank vegetation and banktop land use (floodplains)	y	1		X		X	2		y
Flood defence dams, set-back embankments, dykes		2		X		X	1	X	X
Alteration of the hydrological/hydraulic characteristics (flow regime/sediment transport)	X	Y	X	X		Y	4	X	X
Other pressures									

Compared to the effects of flood defence the navigation impacts have been classified as less important in a countrywide average (Table 10). Anyhow all pressures proposed have been confirmed. No additional pressures driven by navigation have been suggested. In most countries the "alteration of the hydrological/hydraulic characteristics" (six votings out of eight) has been voted as important pressure, but never as major one. The ranking is followed by "alteration of the river course and

channel form/profile", "Disruptions of lateral connectivity" and "alteration of morphological features/habitats" with each five votings out of eight.

Table 10: Pressures related to driver "navigation", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of driver "navigation"	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
Alteration of the river course (thalweg) and channel form/profile	X	1	y	X	not possible to answer		3		X
Alteration of morphological features/habitats (e.g. embankments, bank reinforcement, groynes, deep-cutting, dredging, shipyards and harbours)	X	X	X	X			3		y
Disruptions of longitudinal connectivity	X	Y		y			3		
Disruptions of lateral connectivity, e.g. detaching sidearms, wetlands etc.	X	2	X	X			4		
Disruptions of the vertical connectivity	y	Y		X			4		
Alteration of the hydrological/hydraulic characteristics (flow regime/sediment transport)	X	2	X	X			2		X
Maintenance of the shipping channel (e.g. dredging)	y	1	y	y		y	3		X
Ship locks	y	Y	y	y		y	4		
Harbours	y	Y	y	y		y	2	y	y
Mechanic damage of aquatic flora caused by passage of ships, e.g. effect of vessel-induced waves	y	Y					3		
Other pressures									

With respect to hydropower use all pressures proposed have been confirmed (Table 11). No additional pressures driven by hydropower have been suggested. With seven quotings out of a total of eight countries the "disruptions of the longitudinal connectivity" is seen as the most important pressure of this category. The second category of high importance is the "alteration of the hydraulic characteristics" (six votings out of eight). This category has been ranked as the major pressure in three countries (Germany, Austria, Romania). All other categories have been indicated with lesser importance.

"Alteration of the river course and channel form", "disruptions of lateral connectivity", and "alteration of the hydrological (discharge) regime" with each four votings out of eight are regarded as important pressures in 50 percent of the countries.

Table 11: Pressures related to driver "hydropower use", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of driver "hydropower use"	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
Disruptions of the longitudinal connectivity (barrages, weirs, dams)	2	1	X	y	not possible to answer	X	1	X	X
Ship locks (water gates, sluices)		Y	Y	y		y	1		
Disruptions of lateral connectivity (embankments, dams)		1	X			y	2		X
Alteration of the river course (thalweg) and channel form, diversions		2	Y	X		X	1		y
Alteration of morphological features/habitats as described for flood defence measures	2	1	Y	y			1	y	y
Disruptions of the vertical connectivity (silting, colmation)		2	Y	y		X	1	y	
Alteration of the hydrological (discharge) regime		Y	X	y		X	2		X
Alteration of the hydraulic characteristics (current, sediment load)	1	1	X	y		**X**	1		X
Water abstraction, diversions (residual flow)							2		
Hydro-peaking (flushing; intermittent power generation)			Y	y		y	2	y	X
Other pressures				X*					

*: Pressure of hydropower use above Hungary

All proposed pressures with respect to the driver "water abstraction" have been confirmed by the national consultants (Table 12). No additional pressures driven by water abstraction have been suggested. The maximum number of voting were two out of eight countries, no ranking was performed. Only the first five pressure categories have been seen as possibly important.

Table 12: Pressures related to driver "water abstraction", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of driver "water abstraction"	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
Abstraction for hydropower use (see above)	not		Y		not		not	y	X
Abstraction for agriculture or floodplain irrigation		y		y				X	y
Abstraction for drinking water supply		y		X				y	X
Abstraction for industry		y		X				X	y

Pressures of driver "water abstraction"	D	A	SK	H	HR	YU	RO	MD	BA
Abstraction for cooling water facilities		y		X					
Abstraction for fish farming									
Abstraction for navigation (harbours; supplying canals)		y							y
Alteration of the river course (thalweg) and channel form				y					
Alteration of morphological features/habitats disruptions of longitudinal connectivity				y					
Disruptions of lateral connectivity									
Disruptions of the vertical connectivity									
Alteration of the hydrological/hydraulic characteristics (flow regime, sediment load)				y					y
Other pressures									

Gravel extraction has been regarded as pressure, but of minor importance (Table 13). Nevertheless four countries out of eight would expect modifications of river channel, in-channel habitats and banks, three countries noticed the alteration of amount and composition of the bed sediments as noticeable pressure. No new category of pressure induced by gravel extraction was added.

Table 13: Pressures related to driver "gravel extraction", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of driver "gravel extraction"	D	A	SK	H	HR	YU	RO	MD	BA
Alteration of amount and composition of the bed sediments	not relevant	X	y	X	not possible to answer	y	not relevant		X
Increased turbidity (suspended solids)		y							
Modifications of river channel, in-channel habitats and banks		X	X	X		X			y
Other pressures									

Pressures induced by the driver "fisheries" were not filled in by any country. The same with pressures of the drivers "removal (harvesting) of animals/plants", pressures of the driver "inshore habitat management" and "fine sediment deposition management", respectively.

Pressures induced by "outdoor recreation" were only mentioned as minor pressures by Austria and Hungary (Table 14).

Table 14: Pressures related to driver "outdoor recreation", most important pressures are ranked with numbers (not for all countries provided); major pressure indicated with X if no ranking possible, minor relevance indicated with y

Pressures of driver "outdoor recreation"	**D**	**A**	**SK**	**H**	**HR**	**YU**	**RO**	**MD**	**BA**
Modifications of river channel, in-channel habitats and banks for recreation purposes as there are fishing (facilities; houses; bank alterations), recreational navigation (e.g. harbours), boating, rafting, water skiing…		y		y					
Other pressures									

7. EVALUATION OF PART C - SIGNIFICANT PRESSURES AND IMPACTS

The third questionnaire (part C) aimed to provide an overview on methodologies and tools 1) that are currently used to assess the potential impact of human activity on water bodies, and 2) that are planned in the future. A third important focus of questionnaire C is to discuss an approach - proposed by the international consultants - to assess if a pressure has a **significant impact** and the water body is at risk to fail the good ecological status.

The answers to the first block of questions give an overview which methodologies and tools are currently used to assess the potential impact of human activity on water bodies (Table 15). With respect to morphological degradation Germany and Austria use eco-morphological classifications that are summarised as „strukturökologische Methoden". The methods used in Hungary have not been specified in detail. Germany, Austria, Slovakia and Hungary report on monitoring of the channel geometry that gives evidence to alteration of bed sediments (amount/structure).

Although all Danubian countries probably monitor the channel geometry due to the maintenance of the navigation channel this activity cannot be counted as a method to document structural deficits. Austria, Slovakia, Hungary, Serbia-Montenegro and Romania report on new methodologies and/or tools planned in the future to assess the potential impact of human activity (Table 16).

Table 15: Answers to question „Which methodologies and tools do you currently use to assess the potential impact of human activity on water bodies (focus: only hydromorphology)?"

Country	**Type of pressure**	**Methodologies and tools that are currently used to diagnose the potential impact of different anthropogenically induced hydromorphological pressures**
D	morphological degradation	LAWA Übersichtsverfahren zur Strukturgütekartierung von Fliessgewässern
A	morphological degradation	eco-morphological classification systems for all federal states, based on „Ökomorphologische Gewässerbewertung" (Werth 1987) and „Strukturökologische Methode zur Bestandsaufnahme und Bewertung von Fließgewässern" (Spiegler 1989)
	hydropower generation	hydrological monitoring
SK	hydrological regime	hydrological monitoring (discharges, water levels, sediment transport)
	changes in river bed morphology	monitoring of the River channel geometry
	alternation of morphological in-channel features, bank reinforcement	no tool currently used
H	alteration of amount and composition of the bed sediments	analysis of human impacts by means of different data (name of method not specified in questionnaire)
	modification of river channel, in-channel habitats and banks for recreation purposes on rivers	
	modification of river channel, in-channel habitats and banks for recreation purposes on lakes	
	intake of waste water, cooling water etc.	
YU	hydropower use	flow regime analyses, deposition overlook, observation of flora/fauna alternation in relation to period before the damming
RO		no assessment of potential impact of human activity on water bodies
MD	barrage	currently no method available

Table 16: Answers to question „Do you have any new methodologies/tools planned in the future to assess the potential impact of human activity, e.g. research & development projects or new mathematical models?"

Country	**Methodologies and tools planned in the future to assess the potential impact of human activity**
D	
A	research projects; eco-morphological classification system with common parameters for the whole country planned for the risk assessment (WFD), based on water bodies
SK	research projects
H	Since the end of the year 2001 Hungary owns the ADCP instrument which allows the measurement of suspended sediment and bed load too. Now there exists five of this instruments in the country, of which three are measuring on the Danube. The instrument is not calibrated on measurement of the sediment yet, but it is planned now.
YU	research projects
RO	mathematical model planned
MD	no tools planned

Each country with a direct access to the Danube indicates gaps in knowledge that will be needed to fulfil the WFD's requirements. Germany is missing a methodology for the assessment large rivers. The Austrian representatives state that future methods should detect all pressures and assess all impacts. The methodologies should cover the water bodies as typological entity. Besides the hydro-morphological methodology, Hungary claims for the measurement of some specific synthetic and non-synthetic pollutants and indicate gaps in their frequency. Serbia-Montenegro sees the necessity for additional investigations of 1) flow alternation to community structure, and the 2) influence of flow alternation to the dispersion of invasive species. The comments from Romania state that there is a lack of information on the relation between hydromorphology and biological elements. In a second comment Romania points out the difficulty in assessing river sections that are impaired by multiple stressors (Table 17).

Table 17: Answers to question „Please indicate any gaps in knowledge that will need to be filled to fulfil the WFD's requirements on the impacts of pressures, such as the effect of morphological alterations on biological elements."

Country	**Gaps in knowledge that will need to be filled to fulfil the WFD's requirements on the impacts of pressures**
D	Methodology for the assessment of large rivers is missing.
A	Methods should detect all pressures and assess all impacts, based on water bodies.
SK	

Country	Gaps in knowledge that will need to be filled to fulfil the WFD's requirements on the impacts of pressures
H	The WFD contains the hydromorphological quantity elements to be fulfilled for the good ecological status. Concerning these elements there is a gap in the measurement in Hungary of some specific synthetic and non-synthetic pollutants and in their frequency. The sampling of the water quality does not refer to the hydrological measurements because the sampling of the two elements belongs to two different authorities. Especially on small rivers quality samplings are not frequent enough, there are pollutions that can remain unknown. (On larger rivers there are samplings two times per month – on appointed places four times).
YU	The relation of many hydrobionts to migration is not properly studied; the differences between the macrozoobenthos of littoral part of the lakes and bank region of the potamon, when the substrate type is similar, are often tiny and hard to measure and express (as it is the case with oligochaete community) - in that direction, it is hard to express the impact of the alternation of the flow regime of potamon, especially in sectors with backwater effect, via biological elements such as aquatic macroinvertebrates - so, maybe, the additional investigation of flow alternation to community structure should be performed; the influence of flow alternation to the dispersion of invasive species is another important topic that should be seriously discussed.
RO	Not enough information on the relation between hydromorphology and biological elements available; synergy of different types of pressures on biological elements – sometimes difficult to assess the effect of only one type of pressure
MD	Methodologies and tools to assess morphological impact are not available.

The next questions assemble the views and details of practice in defining „significant" pressures as the WFD requires that Member States identify „significant" human pressures. Three countries, Germany, Austria, and Romania use an assessment of significant hydromorphological pressures as a water management tool (Table 18). More details about the status quo in these countries are given in Table 19.

Table 18: Answers to question „Do you use an assessment of 'significant' hydromorphological pressures within water management, perhaps as part of a risk based decision-making framework?"

Country	yes	no
D	x	
A	x	
SK		x
H		x
YU		x
RO	x	
MD		x

The Austrian national consultants state that Austria is applying an assessment for **„significant"** hydromorphological pressures (pressure criteria). Further, currently a method for the estimation of impact degree resulting from specific

hydromorphological pressures is being developed in Austria. The methodology follows the type-specific approach focusing on different effects of individual pressures on the ecological status within different river types. The method will be based on a scoring system including individual weighting of pressures. Overall, this management tool aims to enable the classification of pressures and their impact on the ecological status as well as the efficient fulfilment of WFD requirements concerning hydromorphology. For large rivers, especially the Danube, this new system has not been tested.

Table 19: Assessment of significant hydromorphological pressures

Country	**Type of hydromorphological pressure**	**Assessment of significant hydromorphological pressures**
D	morphological degradation	river stretches are classified to have a significant pressure: if they are classified with a "structure quality class" (Gewässerstrukturklasse) of 6 or 7. stretches where the biota are significantly impacted due to certain morphological parameters such as culverting, concrete regulation of banks and river bottom etc.
	longitudinal continuity	river stretches are classified to have a significant pressure: if the longitudinal continuity is disrupted for biota (fish and benthic invertebrates) by upstream and/or downstream barriers.
	water abstraction	river stretches are classified to have a significant pressure: if less that 2/3 of the MNQ is remaining, when all water abstractions are regarded together. if they have no legal residual water requirement and if significant impacts on the biota are to be expected.
RO	disruption of the longitudinal river continuity by weirs, barrages etc.	criteria which indicate the significance threshold (see Table 20)
	disruption of the lateral river continuity by river engineering-connectivity to flood plains (dykes, agriculture works, fish farming works)	criteria which indicate the significance threshold (see Table 20)
	river engineering –banks regulation/consolidation	criteria which indicate the significance threshold (see Table 20)
	navigation channel	criteria which indicate the significance threshold (see Table 20)
	water abstraction, residual water flow, reservoirs outflow, flow deviation etc.	criteria which indicate the significance threshold (see Table 20)

The **German** contribution focuses on three topics: morphological degradation, longitudinal continuity and water abstraction. The criteria - delivered by the representatives of the University Duisburg-Essen - are taken from „LAWA AO ‚Oberirdische Gewässer und Küstengewässer': Kriterien zur Erhebung von anthropogenen Belastungen und Beurteilung ihrer Auswirkungen zur termingerechten und aussagekräftigen Berichterstattung an die EU-Kommission - Stand 31.03.03, translated".

River stretches are classified to have a significant pressure if they are classified with a „structure quality class" (Gewässerstrukturgüte-Klasse) of 6 or 7 out of a system with categories between 1 (very good status, reference) and 7 (far from nature).

With respect to „longitudinal continuity" German river stretches are classified to have a significant pressure if the longitudinal continuity is disrupted for biota (fish and benthic invertebrates) by upstream and/or downstream barriers.

In the case of water abstraction river stretches are classified to have a significant pressure if less that 2/3 of the average low flow (MNQ) is remaining (all water abstractions are regarded together). If they have no legal residual water requirement and if significant impacts on the biota are to be expected.

The national consultant from **Romania** presents a table for assessing six types of significant hydromorphological pressures: 1) Disruptions of the longitudinal river continuity by weirs, barrages, sills; 2) Disruptions of the lateral river continuity by river engineering – connectivity to flood plains (dykes, agricultural works, fish farming works etc); 3) River engineering – banks regulation/consolidation; 4) Navigation channel; 5) Water abstraction, water out-takes, flow deviation; 6) Dams discharges, hydropeaking. Threshold values are given for the likelihood and for the significance of a pressure to fail the environmental quality goal (Table 20).

Table 20: Assessment of significant hydromorphological pressures used in Romania

Hydromorphological pressure	**Effects**	**Parameter**	**Likelihood threshold**	**Significance threshold**
Disruptions of the longitudinal river continuity by weirs, barrages, sills	Affect the migration of biota[1] and the transport of sediments	Height of the structure[2] (cm)	< 20	> 50
Disruptions of the lateral river continuity by river engineering – connectivity to flood plains (dykes, agricultural works, fish farming works, etc.)	Affect the riverine vegetation	Length of dykes / Length of water body (%)	< 30	> 70
	Affect the lateral connectivity and floodplain vegetation	Affected surface/ floodplain surface (%)	< 30	> 70

Hydromorphological pressure	Effects	Parameter	Likelihood threshold	Significance threshold
River engineering – banks regulation/consolidation	Affects the river cross section, substrate structure and biota	Length of bank / Length of water body (%)	< 30	> 70
Navigation channel	Affects biota, the river bed	Width of navigation channel / width of river bed(%)	< 30	> 70
Water abstraction, water out-takes, flow deviation	Affect biota and bed stability	Intake or residual flow / multiannual mean flow (%)	< 10	> 50
	Affect biota	Low flow in river bed / $Q_{95\%}$[3] + 0,1 (m^3/s)	> 100	< 50
Dams discharges hydropeaking	Affects biota (low flow)	Low flow in river bed / $Q_{95\%}$[3] + 0,1 (m^3/s)	> 100	< 50
	Affects the flora and the banks stability	The water level gradient / hour (cm)	< 50	> 100

[1]: only the migrating biota

[2]: values are considered for a sequence > 3 sills / km. For the isolated sills, the height of the barrier > 2 m for the heavily modified water bodies is taken into account

[3]: $Q_{95\%}$ - Minimum monthly multiannual discharge with 95% probability (cm/s)

Comments on the guidance for the analysis of pressures and impacts

According to the REFCOND guidance paper there is not too much information published on the topic of pressures and impacts analysis. Neither the WFD nor the guidance papers contain sufficient practical help to implement the Directive's requirements. Nevertheless some countries in the Danube catchment have already started to work on the process (Table 18).

To keep the process going, a set of proposals how to classify pressures as significant impacts some tables have been sent by the international consultants to the national consultants for comments. A part of the tables represents the actual state of a process under development in Austria and partly in Germany. Other tables provided the consultants with suggestions that need to be discussed.

The tables are considered as a tool for estimating impacts within a variety of hydromorphological pressures with special emphasis to identify significant pressures.

The examples provided cover only those few pressures that have been investigated in previous studies or that are in the state of discussion.

The procedure is presented in three stages: 1) a descriptive indication of the likely-to-be relationship of a pressure's impact along a gradient of five steps of status classes, 2) an assessment of the likelihood and 3) an assessment of the significance that surface water bodies within the River Basin District will fail to meet the environmental quality objectives set for water bodies under Article 4 of the WFD.

Due to the lack of information the pressures described are fairly incomplete compared to the numbers of drivers given in Table 7 (see questionnaire part B). The tables started with descriptions in five steps (one reference and four steps of increasing deviation from the reference) to estimate if a water body is not at risk or at risk to fail the good status as shown in Table 21. The five class system has been chosen to enable the application of the evaluation tables that are in current use to pre-classify the ecological status of a site (e.g. Strukturgüte, adapted Saprobic System), and to be compatible with the ecological status classes of the WFD.

Table 21: Five class system to estimate if a water body is not at risk or at risk to fail the good ecological status

Code	Presumable status	Risk to fail the good status
1	Reference status	Water body surely not at risk
2	Good ecological status	Water body not at risk
3	Moderate ecological status	Water body needing further assessment to determine risk
4	Poor ecological status	Water body at risk
5	Bad ecological status	Water body clearly at risk

Out of the five classes two threshold ratios/values are used to describe:

1: the **likelihood** if the water body is at risk to fail the good ecological status, and

2: the **significance** of the water body failing the good ecological status

The impacts of the following pressures have been described:

1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters

2) Navigation channel

3) Disruptions of the longitudinal river continuity by weirs/barrages

3 a) Height of the in-channel structures

3 b) Composition of channel substrates (minerogenic bed sediments)

3 c) Migration barriers

4) River engineering – banks

5) Effects of water abstraction (residual water flow)

6) Effects of hydropeaking (incl. sudden flow reduction)

The international consultants strongly emphasised in the questionnaire, that the proposed system of determining significant pressures by pre-classifying the status of a site by abiotic criteria is to be seen as a tool for the purpose of this exercise but **does not replace the assessment of the ecological status** based on the investigation of biological quality elements (algae, macrophytes, benthic invertebrates, and fish). The national consultants were asked to comment on the proposed criteria.

1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters

The descriptions and threshold criteria for evaluating the possible effects of a disruption of the lateral connectivity with the floodplain-system (possibilities for movements of biota and water to and within floodplain water body types [only for floodplain rivers]).

The estimates are based on suggestions of BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003), JÄGER (2002), SCHMUTZ et al. (2001) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

Table 22: Impact 1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters

1	Flood plains correspond totally or nearly totally to undisturbed conditions; minimum lateral extension should guarantee any type of site-specific natural backwaters
2	At least 50% of the flood plains and/or important site-specific types of backwaters existing, lateral connectivity in most (at least 50%) cases intact.
3	Floodplain vegetation and lateral connectivity of most backwater types disrupted to between 50%-75%
4	Floodplain vegetation and lateral connectivity of most backwater types disrupted to between 75-90%
5	Less than 10% (of formerly existing) floodplains and/or backwaters present.

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	Floodplain vegetation and lateral connectivity of most backwater types disrupted to more than 50%*)
Threshold ratio to assess the significance of the water body failing the good ecological status:	Floodplain vegetation and lateral connectivity of most backwater types disrupted to more than 75%*)

*) Currently the decision should be based on expert judgement as precise criteria for classification need to be developed in the future.

Table 23: Comments of the national consultants to Table 22: Impact 1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters

Country	**comments**
D	no additional comments
A	The suggested criteria concerning lateral disruption are reasonable for pre-classifying the likelihood of eventual failure of good ecological status of a water body. The criteria correspond to the national criteria. Besides the suggested criteria, national methods can additionally contribute the pre-classification of this pressure. Further, we recommend the development of a guidance providing definitions on lateral connectivity of floodplains and on the applied identification of floodplain disconnection.
SK	Slovak stretch of the Danube can be pre-classified somewhere between 2 and 4 (floodplain vegetation and lateral connectivity of most backwater types probably disrupted to more than 50%.
H	Most of the Hungarian rivers bear a disruption of the lateral river connectivity by river engineering because of the situation of the country which predict the 2-3 groups that will characterise our rivers. The groups above classify clearly the water bodies of Europe so we accept this categorisation.
YU	Looks like applicable table – not complicated and clear ranking parameters; required data could be evaluated without extensive analysis of different information.
RO	see Table 20
MD	agree with statements

With the exception of Germany (no comments to the table) and Romania (Table 20) all countries agreed with the proposed classification system. The Romanian threshold value of less than 30% damage to the floodplains is more rigid (Table 20) than the suggested value of <50%. The values to estimate a significant impact are in a comparable order of magnitude (70 and 75%).

2) Navigation channel (large rivers)

The descriptions and threshold criteria for evaluating the possible effect of navigation on the biota refer to the share of the navigation channel with respect to the river's width. The estimates are based on mere suggestions of the benthic invertebrate

ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture), and expert consultancy. Navigation channel includes navigation channel plus parts of the river that are maintained or have constructions in combination with the navigation channel (e.g. deflectors, groynes, and harbours).

It needs to be discussed if in-channel measures outside the navigation channel that guarantee the functioning of the navigation channel (e.g. groynes) should be included into the area of the "navigation channel" sensu stricto. In discussing the effective width of the navigation channel please mind the effects of wash of the waves or of the ships' propeller on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels, respectively).

Table 24: Impact 2) Navigation channel (large rivers)

1	No navigation channel
2	Navigation channel covers <33% of the bottom area; no significant effects of wash of the waves or of the ships' propellers on the biota
3	Navigation channel covers about 33-66% of the bottom area; possible effects of wash of the waves or of the ships' propellers on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels respectively)
4	Navigation channel covers about 66-100% of the bottom area; possible effects of wash of the waves or of the ships' propellers on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels respectively)
5	Navigation channel covers 66-100% of the bottom area; significant effects of wash of the waves or of the ships' propellers on the biota (see above)

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold value to assess the likelihood if the water body is at risk to fail the good ecological status:	Navigation channel covers >33% of the bottom area
Threshold value to assess the significance of the water body failing the good ecological status:	Navigation channel covers >66% of the bottom area

Table 25: Comments of the national consultants to Table 24: Impact 2) Navigation channel (large rivers)

Country	Comments
D	no additional comments
A	So far the chosen criteria are reasonable for application in the Danube main channel; upcoming assessment experience on this specific issue will show if there will be a demand of criteria modification.
SK	Slovak stretch: navigation channel covers about 33-66% of the bottom area, but no significant effect of wash of the waves or of the ships´ propellers on the biota.
H	We do not make any comments to the tables, for Hungary the groups given above are entirely acceptable in the water management.
YU	It is good to evaluate the effect of navigation by the width of the route that is used for navigation. From the other side, we could not see the way of evaluating the effect of ship propeller induced waves (or ship induced waves - prow wave) to the biota. It is a significant parameter for sure, but maybe it should be mentioned that investigation of effects of that kind of pressure should be performed. The other parameter that could be relevant beside those that are mentioned in the table is evaluation of ship traffic in relation to relevant sector by, for example calculation of shipment (cargo) per time unit.
RO	see Table 20
MD	agree with statements

With the exception of Germany (no comments to the table) all countries agreed with the proposed classification system or provided suggestions in the same order of magnitude (Romania, Table 20). The consultants from Serbia-Montenegro stated that an investigation on the effect of ship propellers induced waves or ship induced waves - prow wave would be necessary for further assessment.

3) Disruptions of the longitudinal river continuity by weirs/barrages

3a) Criterion: Height of the in-channel structures

An essential criterion for the impact of morphological alterations on the ecological status of water bodies is the continuity for aquatic communities. This is why it is essential to identify any artificial obstructing features above a gradient (to be quantified in cm) and to assess their effect on the continuity of aquatic fauna (upstream and downstream movement). The descriptions and threshold criteria for evaluating the possible effects of weirs and barrages refer to the conditions in the parts of the river channel at, above, and below the in-channel structures. The estimates are based on suggestions of BMLFUW (2003), CHOVANEC (2003), JÄGER (2002), LAWA (2002) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture). The table has been provided for all types of water bodies, in this context only the part for large rivers should be regarded.

Table 26: Impact 3a) Disruptions of the longitudinal river continuity by weirs/barrages, Criterion: Height of the in-channel structures

1	No artificial in-channel structures
2	Artificial in-channel structures that do not affect the migration of biota/sediments. Description to estimate the significance of the pressure: in rhithral courses with a maximum free-fall of 10 cm (small)/30 cm (mid-sized)/70 cm (large rivers), in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers). The evaluation of the effect of in-channel structures has to include the migration possibilities during low flows as well as the technical options for migrations (e.g. start and landing facilities for jumping fish). If the height of the artificial in-channel structures exceeds 10/30/70 cm a well functioning passage of the biota must be available (e.g. by fish passes, bypasses or other measures; see 3c).
3	Artificial in-channel structures do affect the migration of biota/sediments. Description to estimate the significance of the pressure: the height of the artificial in-channel structures exceeds the limits of a maximum free-fall: in rhithral rivers of 10 cm (small), or 30 cm (mid-sized), or 70 cm (large rivers); in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers).
4	Artificial in-channel structures do severely affect the migration of biota/sediments. The height of the artificial in-channel structures clearly exceeds the migratory power of most of the biota.
5	Artificial in-channel structures do severely affect the migration of biota. The height of the artificial in-channel structures clearly exceeds the migratory power of any biota.

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold values to assess the likelihood if the water body is at risk to fail the good ecological status:	Migration not possible for every organism. The height of the artificial in-channel structures exceeds the limits of a maximum free-fall: in rhithral rivers of 10 cm (small), or 30 cm (mid-sized), or 70 cm (large rivers); in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers).
Threshold values to assess the significance of the water body failing the good ecological status:	No migration possible.

Table 27: Comments of the national consultants to Table 26: Impact 3a) Disruptions of the longitudinal river continuity by weirs/barrages, Criterion: Height of the in-channel structures

Country	**comments**
D	no comments to the table
A	The disruption of longitudinal river continuity represents a frequent and therefore important pressure on ecological status. The suggested criteria are reasonable respecting differences in rhithral and potamal river courses. The chosen criteria are additionally in line with the Austrian national criteria.
SK	Slovak stretch of the Danube - 5 (no migration possible)
H	The groups given above to characterise the disruptions of the longitudinal river continuity by weirs/barrages are for Hungary totally acceptable because it will make possible the grouping of all the water bodies of the country.
YU	no comments to the table
RO	see Table 20
MD	agree with statements

With the exception of Germany and Serbia-Montenegro (no comments to the table) and Romania (Table 20) all other countries agreed with the proposed classification system. The Romanian threshold value to assess the likelihood if the water body is at risk to fail the good ecological status (height of the artificial in-channel structures exceeds 20 cm) is more rigid than the proposed value of 30 cm. The Romanian threshold value to assess the significance is >50 cm, whereas the proposal above just uses the descriptive criterion „No migration possible".

3b) Criterion: composition of channel substrates (minerogenic bed sediments, reduced flow in the river bed)

The descriptions and threshold criteria for evaluating the possible effect of weirs and barrages on the composition of bed sediments (e.g. bedrock, boulders, cobbles, pebbles, gravel, sand, mud, clay) refer to the conditions in the parts of the river channel at, above, and below the in-channel structures.

The estimates are based on observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture), the Austrian system for pre-classifying the ecological status of the AQEM and STAR projects (http://www.aqem.de, http://www.eu-star.at) and expert consultancy.

Table 28: Impact 3b) Disruptions of the longitudinal river continuity by weirs/barrages. Criterion: composition of channel substrates (minerogenic bed sediments, reduced flow in the river bed)

1	No artificial in-channel structures. Composition of channel substrates and features (bars, islands) correspond to near natural conditions.
2	River channel with natural bed sediments, channel features like side/point/mid-channel bars and current conditions in at least 70% of the section; the dominant minerogenic habitats comprise a share of at least 70% of the reference composition (e.g. beginning of the backwater area).
3	River channels' bed sediments turn to smaller grain sizes compared to the reference conditions, flow velocities diminuate. Most channel features like side/point/mid-channel bars under water (impounded). This section can be roughly estimated within the dammed/impounded river sections as the reach below the beginning of the backwater area and above the turning point [Wendepegel]. The share of dominant minerogenic habitats of the reference composition is between <70 and 30%.
4	Sediment conditions and flow velocities in the river channel are remarkably different from reference conditions (smaller grain diameters, lentic flows). This section can be roughly estimated within the dammed/impounded river sections the reach below the turning point [Wendepegel] and above a section as described below (5). The share of dominant minerogenic habitats of the reference composition is less than 30%.
5	Bed sediments of the river channel are quite remarkably different from natural conditions, in many cases consisting of untypical fine sediments (mud, pelal), nearly no current. Mainly restricted to dammed/impounded river sections in front of the weir.

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	The share of dominant minerogenic habitats of the reference composition is between <70 and 30%.
Threshold ratio to assess the significance of the water body failing the good ecological status:	The share of dominant minerogenic habitats is less than 30% of the reference composition

Table 29: Comments of the national consultants to Table 28: Impact 3b) Disruptions of the longitudinal river continuity by weirs/barrages. Criterion: composition of channel substrates (minerogenic bed sediments, reduced flow in the river bed)

Country	comments
D	no comments to the table
A	The suggested criteria are reasonable for pre-classification.
SK	Slovak stretch of the Danube - between 2-3
H	The criterions made on the grounds of the composition of channel substrates are without affixing acceptable for Hungary.
YU	The parameter "deposition of untypical fine sediment" that was used for class No. 5, could be used for classes 3 and 4 also - for example, the deposition of mud in near-bank habitats (littoral habitats) could be observed in back-waters even if the particular stream could not be characterised as No. 5 by disruption of the longitudinal continuity - so, the percentage of fine sediment in the littoral region (percentage of pelal habitats) could be used for additional parameter in other classes. From the other side, the parameter is not reflex of single alternation, in this case hydrological regime alternation, but the deposition of untypical fine substrates is result of eutrophication also. So, we have to be careful with the parameter.
RO	This phenomenon exists but only on very small rivers. For an analysis of water bodies at river basin level it is not significant and could not be taken into account in the first stage.
MD	agree with statements

With the exception of Germany (no comments to the table) all countries agreed with the proposed classification system. The comment of Serbia-Montenegro indicates the need for a better description of the decision table, especially with respect to river typology and location of the investigation sites. The current descriptions are only valid for rivers with stony sediments.

3c) Criterion: migration barriers

The descriptions and threshold criteria for evaluating the possible effect of weirs and barrages on the migration capacity of the biota refer to the conditions in the parts of the river channel at, above, and below the in-channel structures. The estimates are based on BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

Table 30: Impact 3c) Disruptions of the longitudinal river continuity by weirs/barrages. Criterion: migration barriers

1	The continuity of the river is not or only slightly disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms.
2	The continuity of the river is disturbed by anthropogenic activities; disturbed migration of aquatic organisms: passage for most species in most years; no species deficit upstream/downstream. Description to estimate the significance of the pressure: migration barrier with functioning passage facilities (e.g. “nature-like” bypass channel).
3	The continuity of the river is disturbed by anthropogenic activities; disturbed migration of aquatic organisms: passage for certain species or in certain years. Description to estimate the significance of the pressure: migration barrier with malfunctioning passage facilities (e.g. poor designed bypass channels).
4	The continuity of the river is disturbed by anthropogenic activities; significantly disturbed migration of aquatic organisms and sediment transport: passage for single species occasionally (e.g. passage via ship locks, defective in-channel structures, “compensation” flights, or terrestrial migration). Description to estimate the significance of the pressure: migration barrier with no or not functioning bypass facilities.
5	The continuity of the river is clearly disturbed by anthropogenic activities; no sediment transport; significant species deficits between upstream/downstream. Description to estimate the significance of the pressure: migration barrier completely disrupts the continuum (large technical constructions, banks and floodplains technically altered).

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	Migration barrier with malfunctioning passage facilities (e.g. poorly designed bypass channels)
Threshold ratio to assess the significance of the water body failing the good ecological status:	Migration barrier with no or not functioning bypass facilities

Table 31: Comments of the national consultants to Table 30: Impact 3c) Disruptions of the longitudinal river continuity by weirs/barrages. Criterion: migration barriers

Country	Comments
D	no comments to the table
A	As mentioned above the disruption of longitudinal river continuity represents a frequent and therefore important pressure on ecological status. Concerning the disruption of species migration, attention has to be paid to the functioning of fish bypass channels. This issue is integrated in the decision guidance for pre-classification and therefore the suggested threshold criteria are reasonable and correspond to national approaches.
SK	no comments to the table
H	The criteria made on the grounds of the migration barriers are without fixing acceptable for Hungary.
YU	no comments to the table
RO	The migration barriers have to be discussed only for migratory species; the research studies from Romania have indicated that other species can develop in upstream and downstream areas of hydraulic works.
MD	no comments to the table

Germany, Slovakia, Serbia-Montenegro and Moldova did not comment the table. Austria, Hungary and Romania accepted the proposal but pointed out the significance of migration barriers for migration species, especially fish.

4) River engineering – banks

The estimates are based on suggestions of BEIER et al (2002), BMLFUW (2003), CHOVANEC (2003), SCHMUTZ et al. (2001) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

Table 32: Impact 4) River engineering – banks

1	Bank structures correspond totally or nearly totally to undisturbed conditions, no river engineering. Riparian vegetation corresponds totally or nearly totally to undisturbed conditions, minimum width of vegetation should guarantee natural functions. % bank length (both sides) in natural state: small rivers to medium constrained rivers: >90% medium to large braided, anabranching and meandering rivers: >75%
2	Re-insectioned*) banks (e.g. alterations of the bank structures due to channel modifications); if rip-rap, then restricted to the lower 1/3 of the slope or not directly covered by water. Riparian vegetation covering the shore with a minimum cover of 50%; lateral extension should guarantee important natural functions. % bank length (both sides) in natural state: small to medium constrained rivers: 90 - >50% medium to large braided, anabranching and meandering rivers: <75 - >50%
3	Re-insectioned*) banks (e.g. rip-rap with direct water contact) Few or single row of riparian gallery, covering <50 - 20% of the banks % bank length (both sides) in natural state: small to medium constrained rivers: <50 % medium to large braided, anabranching and meandering rivers: <50 %
4	Reinforced**) banks; significant parts of impervious bank materials (plastering), higher bank vegetation restricted to single stands of shrubs and/or trees: <20% % bank length (both sides) in natural state: 0
5	Reinforced**) banks; impervious bank materials (e.g. concrete walls, sheet piling) Nearly no to no higher bank vegetation % bank length (both sides) in natural state: 0

*) Re-insectioned river (bank): Profile modified but not reinforced often to accommodate flood flow and access for maintenance machinery.

**) Reinforcement: Whole or part of the river (bank, bottom) artificially strengthened for bank protection purposes.

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	% bank length (both sides) in natural state:
Small to medium constrained rivers:	<50%
Medium to large braided, anabranching and meandering rivers	<50%
Threshold ratio to assess the significance of the water body failing the good ecological status:	% bank length (both sides) in natural state:
Small to medium constrained rivers:	<20%
Medium to large braided, anabranching and meandering rivers:	<20%

Table 33: Comments of national consultants to Table 32: Impact 4) River engineering – banks

Country	**Comments**
D	no comments to the table
A	Threshold criteria for pre-classification are reasonable.
SK	In Slovakian stretch - 3
H	In Hungary there is a strong intervention on most of the rivers, that is why we regard this question as particularly significant. With the categories we can agree without affixing of any reflexions.
YU	It is good that the quality of material that was used for bank structures has been mentioned in the table - the structures that have been made from larger units represent relatively sterile habitat in comparison with structures that are composed of smaller stones.
RO	see Table 20
MD	Agree with the statements

With the exception of Germany (no comments to the table) all countries agreed with the proposed classification system. The threshold values of the Romanian decision table differ from the proposal, the Romanian system is more rigid.

5) Effects of water abstraction (residual water flow), proposed significance criteria not tested for large rivers

The descriptions and threshold criteria for evaluating the possible effects of water abstraction refer to the conditions in that part of the river channel with the minimum residual water observed (except natural infiltration sections). Two suggestions are given. The first estimates are in accordance with BMLFUW (2003), JÄGER (2000). The second estimates are derived from a study of GRASSER & MOOG (2003).

MQ_{RW} mean annual discharge* in the residual water flow section ("Restwasserstrecke") (based on yearly recordings)

$MQ_{natural}$ mean annual discharge in the natural river section (channel with natural water flow)

$MNQ_{natural}$ mean annual low discharge in the natural river section

MNQ_{RW} mean annual low discharge in the residual water flow section

NNQ lowest observed low discharge

Table 34: Impact 5) Effects of water abstraction (residual water flow), proposed significance criteria not tested for large rivers

1	No or only marginal water abstractions. The hydrograph corresponds totally or nearly totally to undisturbed conditions.
2	Water abstraction present, but the residual water section of the river is without or only minimal ecological impairment. The amount of water abstraction does not exceed the value of the annual mean water discharge during mean annual low flow discharge conditions (MNQ_{RW}). Threshold ratio to asses if the water body is not at risk to fail the good ecological status: No Water abstraction at natural lowest low flow conditions (< NNQ) and the residual water flow corresponds to/simulates the natural annual flow regime and MQ_{RW} = >100% $MNQ_{natural}$ or monthly MQ_{RW} = >35 % monthly $MQ_{natural}$.
3	Water abstraction present, residual water discharge presumably too low and thereby with no tolerable effect on the biota. There is a risk to achieve a good ecological status. Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status: MQ_{RW} = <100% - >40% $MNQ_{natural}$ or Monthly MQ_{RW} = <35 % - >15 % monthly $MQ_{natural}$.
4	Total river water abstracted. Descriptive features to estimate the significance of the pressure: no or only few residual water below the weir, but in the tail water section some natural discharge occurs by groundwater exfiltration and/or by confluence of tributaries. Threshold ratio to assess the significance of the pressure: MQ_{RW} = <40% $MNQ_{natural}$ or monthly MQ_{RW} = <15 % monthly $MQ_{natural}$.
5	Total river water abstracted. There is a clear risk to achieve a good ecological status. Descriptive features to estimate the significance of the pressure: no residual water below weir; there is no groundwater exfiltration into the tail water section and/or no confluence of tributaries.

* Discharge (Q): The volume of water per unit time that passes a specific point on a stream.

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold value to assess the likelihood if the water body is at risk to fail the good ecological status:	MQ_{RW} = <100% $MNQ_{natural}$ or monthly MQ_{RW} = <35 % monthly $MQ_{natural}$
Threshold value to assess the significance of the water body failing the good ecological status:	MQ_{RW} = <40% $MNQ_{natural}$ or monthly MQ_{RW} = <15% monthly $MQ_{natural}$

Table 35: Comments of the national consultants to Table 34: Impact 5) Effects of water abstraction (residual water flow), proposed significance criteria not tested for large rivers

Country	Comments
D	no comments to the table
A	Threshold criteria are reasonable and correspond to national approaches.
SK	In the Slovak stretch (the Danube beside old Danube River bed 1851,6-1811 rkm) between 1-2; Old Danube River bed – 4
H	The water abstraction on surface waters is regulated since about 120 years in Hungary. There is an amount of water, which is the 75% of the long term lowest discharge of August, that can't be abstracted. This amount of water has always served for the ecological water supply and the navigation. For the Danube this discharge is set on a higher amount (100%) because of the navigation. The water abstraction has never caused a problem on the River Danube. Concerning the five water abstraction types, we absolutely accept your suggestion. Here we add that the water abstractions in Hungary have a particular situation because of the downstream location. So Hungary has always had to husband with the water resources, where the months in summer signify the most remarkable problems. Regarding our little rivers we would prefer the monthly mean discharge for the representation of the effects of water abstraction. We also accept the suggestion for the threshold values.
YU	clear table
RO	see Table 20
MD	Agree with the statements. But preferably the second estimate of Grasser & Moog study

With the exception of Germany (no comment to the table) all countries agreed with the proposed classification system. The consultant of Romania presented a different system.

6) Effects of hydropeaking (incl. sudden flow reduction)

The descriptions and threshold criteria for evaluating the possible effects of hydropeaking refer to the conditions in that part of the river channel with the maximum hydropeaking ratios observed. The estimates are based on suggestions of BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003), JÄGER (2002) and the Austrian system for pre-classifying the ecological status of the AQEM and STAR

projects (http://www.aqem.de, http://www.eu-star.at). The table is given for several stream types. National consultants were encouraged to focus on giving comments to large rivers.

HQ_{PF} high flow during flood pulse (peak operation)

NQ_{PF} low flow between flood pulses

Table 36: Impact 6) Effects of hydropeaking (incl. sudden flow reduction)

1	Natural hydrograph corresponds totally or nearly totally to undisturbed conditions, no hydropeaking. If some hydropeaking effects (e. g. caused by tributaries) occur, the total river bottom (100%) stays water-covered and the ratio of peak discharge (HQ_{PF}) to low discharge (NQ_{PF}) does not exceed the factor 1.5.
2	Hydropeaking without or only minimal ecological impairment. River morphology only minor disturbed and near to nature, with "shelters" available. Hydropeaks are not suddenly released (e.g. intermittent storage reservoir) and at least 80% of the river channel are covered by water during low flow and the average flow velocity is not reduced more than at least 20%. Threshold ratio to assess if the water body is not at risk to fail the good ecological status: Constrained river sections: The ratio of peak flow (HQ_{PF}) to low flow (NQ_{PF}) does not exceed the factor 3; [peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <3]. Braided/anabranched rivers: The ratio of peak flow (HQ_{PF}) to low flow (NQ_{PF}) does not exceed the factor 2; [peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <2]. Large rivers: peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <?
3	Hydropeaking with only moderate ecological impairment; river habitats impaired, parts of the river fall dry during low flow, but "shelters" available. Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status: Constrained river sections: HQ_{PF}:NQ_{PF} 3 - <10. Braided/anabranched rivers: HQ_{PF}:NQ_{PF} between 2 - <4 Large rivers: HQ_{PF}:NQ_{PF} ?.
4	Hydropeaking remarkably affects the ecological status. Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status: Constrained river sections: HQ_{PF}:NQ_{PF}>10 - <50. Braided/anabranched rivers: HQ_{PF}:NQ_{PF} between 4 - <10 Large rivers: HQ_{PF}:NQ_{PF} ?
5	Hydropeaking causes a total disruption of the environment and the biota. Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status: Constrained river sections: HQ_{PF}:NQ_{PF} >50 Braided/anabranched rivers: HQ_{PF}:NQ_{PF} >10 Large rivers: HQ_{PF}:NQ_{PF} ?

Decision guidance to pre-classify the likelyhood (border between 2 and 3) or significance (worse than 3) of the water body failing the good ecological status:

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	
Constrained river sections:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) 3 - <10
Braided/anabranched rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) 2 - <4
Large rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) >?
Threshold ratio to assess the significance of the water body failing the good ecological status:	
Constrained river sections:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) >10.
Braided/anabranched rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) >4
Large rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) >?

Table 37: Comments of the national consultants to Table 36: Impact 6) Effects of hydropeaking (incl. sudden flow reduction)

Country	**comments**
D	no comments to the table
A	Suggested threshold criteria are acceptable for a pre-classification. Criteria for large rivers (Danube) need – as mentioned anyway – further expert discussion.
SK	In the Slovak stretch of the Danube – 1
H	According your statements above we do not really have experience in analysing the effects of hydropeaking. Several studies have been realised about the impacts of the edifices and their function of the planned hydroelectric power station for the stretch between Gabcikovo and Nagymaros which documents are accessible. For further information an ecological research is needed. In default of other specifications we agree with the table above until there does not exist a document based on deep researches.
YU	no comments to the table
RO	It is recommended to use the water level gradient, because it is more representative for hydropeaking, having a lower variability from one river to another than the peak flow, see Table 20.
MD	agree with the statements

With the exception of Germany and Serbia-Montenegro (no comments to the table) and Romania all countries agreed with the proposed classification system. Hungary sees the necessity of more research work on the effects of hydropeaking on the Danube biota. Romania recommended to use the water level gradient for documenting the hydropeaking effects. A value for large rivers, where the international consultants did not make a suggestion, was not proposed by any country.

8. SUMMARY

Among the "universe of **drivers**" that may cause detrimental effects to the hydro-morphological conditions of the Danube River hydropower generation is seen as the most important driving force, followed by flood defence measures and navigation as the tertiary (Table 6). Fisheries, removal of plants/animals and inshore habitat management are not regarded as relevant drivers with remarkable pressures on the Danube environment. Two more drivers have been added by the Hungarian consultants, the inter basin transfer and the water intake. All together eight drivers have been regarded as anthropogenic activities that may have an environmental effect on the Danube. These relevant drivers that cause a remarkable hydro-morphological pressure on the Danube River environment are (in order of their relevance): hydropower generation, flood defence, navigation, gravel extraction, water abstraction, outdoor recreation, fisheries, inter basin transfer, and water intake.

Three countries have already started with the process of identifying pressures (Germany, Austria, and Hungary). In Romania this process is under development. Slovakia, Croatia, Serbia-Montenegro, Bosnia-Herzegovina and Moldova have not started with the process of identifying pressures.

All proposed **pressures** of the driver **"hydropower use"** have been confirmed (Table 11). No additional pressures have been suggested by the national consultants. The "disruptions of the longitudinal connectivity" are seen as the most important pressure of this category followed by the "alteration of the hydraulic characteristics" which has been ranked as the major pressure in Germany, Austria, Romania. All other categories have been indicated with lesser importance ("alteration of the river course and channel form", "disruptions of lateral connectivity", and "alteration of the hydrological (discharge) regime").

All suggested pressures of the driver **"flood defence"** (Table 9) have been confirmed as impacts induced by flood protection measures. "Alteration of the river course and channel form/profile" is regarded as the most important pressure. The categories "flood defence dams, set-back embankments, dykes", "alteration of the hydrological/hydraulic characteristics" and "alteration of the bank vegetation and banktop land use" followed as major pressures.

All proposed pressures driven by **"navigation impact"** (Table 10) have been confirmed. No additional pressures have been suggested. In most countries the "alteration of the hydrological/hydraulic characteristics" has been voted as important pressure, followed by "alteration of the river course and channel form/profile", "disruptions of lateral connectivity" and "alteration of morphological features/habitats".

"Gravel extraction" has been quoted as a driver of minor importance (Table 13) although the consultants from four countries would expect "modifications of river

channel, in-channel habitats and banks". Three nominations noticed the "alteration of amount and composition of the bed sediments" as noticeable pressure. No new category of pressures induced by gravel abstraction was added.

All proposed pressures with respect to the driver **"water abstraction"** have been confirmed by the national consultants (Table 12). No additional pressures have been added. Only the first five pressure categories have been seen as possibly important, no ranking was performed.

Pressures induced by **"outdoor recreation"** were nominated as of minor relevance by Austria and Hungary (Table 14).

With respect to identify the likelihood and/or the significant impact of a pressure the **German** contribution focuses on three topics: 1) morphological degradation, 2) longitudinal continuity and 3) water abstraction. The criteria are published in a LAWA AO paper (2003).

Romania presents a table for assessing six types of significant hydromorphological pressures: 1) Disruptions of the longitudinal river continuity by weirs, barrages, sills; 2) Disruptions of the lateral river continuity by river engineering – connectivity to flood plains (dykes, agricultural works, fish farming works etc.); 3) River engineering – banks regulation/consolidation; 4) Navigation channel; 5) Water abstraction, water out-takes, flow deviation; 6) Dams discharges hydropeaking. Threshold values are given for the likelihood and for the significance of a pressure to fail the environmental quality goal (Table 20).

A set of eight tables with proposals how to classify a pressure as significant impact has been commented by national consultants. The impacts of the following pressures have been described: 1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters; 2) Navigation channel; 3) Disruptions of the longitudinal river continuity by weirs/barrages (3 a) height of the in-channel structures; 3 b) Composition of channel substrates; 3 c) Migration barriers); 4) River engineering – banks; 5) Effects of water abstraction; 6) Effects of hydropeaking.

The tables are considered as a tool for estimating the impacts of a variety of hydromorphological pressures with special emphasis to identify significant pressures. The tables use a three-tiered procedure: 1) a descriptive indication of the likely-to-be relationship of a pressure's impact along a gradient of five steps of status classes, 2) criteria for an assessment of the likelihood and 3) criteria for an assessment of the significance that surface water bodies within the River Basin District will fail to meet the environmental quality objectives set for the bodies under Article 4 of the WFD. This approach can serve as a first step which has finally to be followed by biological investigations to classify the impacts.

The following table summarises the reaction of the national consultants to the procedure proposed. Germany gave no comments and refers to the LAWA paper. Romania referred to the national procedures. Yugoslavia did not respond to three options. Slovakia and Moldavia gave no comment to one suggestion. The majority of the recommended procedure have been accepted by Austria, Slovakia, Hungary, Yugoslavia and Moldavia.

Table 38: Summary of responses of national consultants to the procedure proposed

Country/	**Comments**							
Pressures	**1**	**2**	**3a**	**3b**	**3c**	**4**	**5**	**6**
D	nc	nc	nc	nc	nc	nc	nc	nc
A	✓	✓	✓	✓	✓	✓	✓	✓
SK	✓	✓	✓	✓	nc	✓	✓	✓
H	✓	✓	✓	✓	✓	✓	✓, op	✓
YU	✓	✓	nc	✓	nc	✓	✓	nc
RO	op	op	op	nr	ru	op	op	op
MD	✓	✓	✓	✓	nc	✓	✓	✓

Legend: nc...no comment; ✓...agreed; op...own proposal; nr...not relevant; ru...of restricted use

Summarising the outcome of questionnaire part C we have to state that three methods exist to carry out an estimation of the likelihood that a given section (water body) of the Danube River will fail to meet the environmental quality objectives:

- the German LAWA methodology with a focus on general morphological degradation, longitudinal continuity and water abstraction
- the Romanian procedure as contributed to the recent UNDP/GEF Danube Regional Project
- the proposal of the international consultants of this UNDP/GEF Danube Regional Project which was developed in co-operation with Austrian scientists, technicians and the state and federal administration

In a preliminary analysis it can be stated that the Romanian way comes quite near to the international consultants' proposal. As there is anyway the necessity to adapt any decision system to the local typological conditions the international consultants see no obstacles to harmonise these two methodologies.

The German methodology is based on a existing scheme of classifying „structure quality classes", and besides on more simple descriptions that cover a smaller aspect of potential pressures. The „structure quality class" approach is only used in Germany and Austria, but the system has never been applied at the Danube in Austria. Nevertheless a comparison of the German and Austrian „structure quality class" approaches is possible although some methodological features do actually

differ. But the interpretation of the outcome of the „structure quality class" result clearly differs between the countries. According to the German system river stretches are classified to have a significant pressure if they are classified with a „structure quality class" of 6 or 7 out of a system with categories between 1 (very good status, reference) and 7 (far from nature). The Austrian philosophy in contrast would classify a water body to have a significant pressure if a „structure quality class" >5 is recorded.

With respect to „longitudinal continuity" the German system gives no more detailed information: river stretches are classified to have a significant pressure if the longitudinal continuity is disrupted for biota (fish and benthic invertebrates) by upstream and/or downstream barriers. As there is no definition about when a continuity is disrupted it may be possible to harmonise the methods.

In the case of water abstraction the German procedure classifies river stretches to have a significant pressure if less than 2/3 of the average low flow (MNQ) is remaining if they have no legal residual water requirement, and if significant impacts on the biota are to be expected. This value comes quite near to the 40% MNQ threshold that has been proposed by the international consultants of the current UNDP/GEF Danube Regional Project.

Consequently the next step must be to validate and to harmonise the three methodologies. This procedure should be done in a working group including at least experts from the three protagonists.

After a common procedure to carry out an estimation of the likelihood that a Danube water body will fail to meet the environmental quality objectives has been developed, this methodology needs to be adapted to the type-specific needs of the different water bodies.

Not until these activities have been successfully undergone it will be possible to start with a stress and impact analysis with particular attention to hydromorphological conditions in the entire stretch of the Danube River.

9. OUTLOOK

The planned output of step 2 was a report on "Stress and impact analysis with particular attention to hydromorphological conditions in the Danube River". As the activities of step 1 of the UNDP/GEF Danube Regional Project have been quite time consuming the consultants were not able to include the assignment of step 2 in their working program. Due to the lack of information on determining hydro-morphologically relevant drivers, pressures and the assessment of their impacts on

the biota, most of the methodologies were developed during the GEF project and need to be tested now.

To apply these tools on the Danube River for assessing the likelihood and the significance if a water body is at risk to fail the good ecological status it will be necessary to

1. harmonise the different methodologies and consolidate the different approaches in one common procedure to carry out an assessment of the likelihood that a Danube water body will fail to meet the environmental quality objectives,
2. perform methodological tests about the functionality of this tool,
3. sub-divide the Danube in a system of section types and water bodies, respectively, and
4. to adapt the methodology to type-specific conditions of a water body (if necessary).

10. REFERENCES

The questionnaires were based on the following references:

Baden-Württemberg: FLEISCHHACKER, T. & K. KERN (2002/2003): Vorläufige Einstufung der Oberflächengewässer nach Wasserrahmenrichtlinie in Baden-Württemberg, geändert am 22.1.2003.

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German and Austrian experiences (pers. comm.)

GRASSER, U. & O. MOOG (2003): Das Makrozoobenthos als Indikator des "Ökologischen Zustandes" von Restwasserstrecken – Ergebnisse der Auswertungen von 249 Untersuchungsstellen (1983-2002) im Hinblick auf die Beeinträchtigungen der Abflussverhältnisse.- Natur in Tirol 12: Ökologie und Wasserkraftnutzung, Innsbruck: 111-121 (ISBN 3-902-169-03-6).

JÄGER, P. (2002): Hydromorphologische Fließgewässeraufnahme von Salzburg 2003, Gewässerschutz Salzburg

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MLIM-EG (2003): Typology and reference conditions for surface water bodies. Final working paper, 13 May 2003: 13pp.

SCHMUTZ, S., MUHAR, S. & G. EGGER (2001): Definition des guten Zustandes (gemäß WRRL) für die Flusslandschaftstypen der Möll. Positionspapier zu Teilmodul 3/T15; KLF-Projekt: Flusslandschaften Österreichs

11. QUESTIONNAIRES

The questionnaire is divided into three parts to be filled in for methods in use or planned to describe A) drivers, B) pressures and C) impacts of the Danube River. The original questionnaires are attached in the annex of this report.

ANNEX

UNDP-GEF DANUBE REGIONAL PROJECT

ACTIVITY 1.1.2 - ADAPT AND IMPLEMENT COMMON APPROACHES AND METHODOLOGIES FOR STRESS AND IMPACT ANALYSIS WITH PARTICULAR ATTENTION TO HYDROMORPHOLOGICAL CONDITIONS

Identifying hydromorphological pressures on the Danube River

Questionnaires: – step1

Introduction

Paragraph 1.4 in Annex II of the Water Framework Directive (WFD) rules that Member States shall collect and maintain information on the type and magnitude of the significant anthropogenic pressures to which the surface water bodies in each River Basin District are liable to be subject. In particular, attention should be given to pressures from point and diffuse sources, water abstraction, flow regulation, hydromorphological alterations and land use. Member States shall carry out an assessment of the susceptibility of the surface water status of bodies to the pressures identified. Member States shall use the information collected, and any other relevant information including existing environmental monitoring data, to carry out an assessment of the likelihood that surface water bodies within the River Basin District will fail to meet the environmental quality objectives set for the bodies under Article 4. A summary of the key stages includes:

- identifying driving forces and pressures
- identifying the significant pressures
- assessing the impacts, and
- evaluating the likelihood of failing to meet the objectives

Aims of this study

The major goal of this part of the project *(Project Document Activity 1.1.2)* is to adapt and implement common approaches and methodologies for stress and impact analysis with particular attention to water abstraction, flow regulation, and morphological alterations, herein in summary called **hydromorphological pressures**, in the DRB. This request for information is distributed to each of the national consultants in the Danube countries and aims at compiling available information on hydromorphological pressures

and impacts and the definition of criteria for significant pressures.

In the first phase of the project the work is limited to the Danube River itself. The Danube River will be divided into sections of different typological characteristic (Project Document Activity 1.1.6 - Typology of and Definition of Reference Conditions for the Danube River). This classification may serve as a framework for allocating the water bodies as described in the WFD.

With respect to the term water body the C.I.S guidance paper REFCOND states: *where different reference conditions apply within a river stream or canal, it must be sub-divided into separate water bodies. Furthermore, where there are significant differences in status in different parts of a river, stream or canal, it must be sub-divided into separate water bodies to achieve the desired environmental outcome in the most cost-effective way*.

The two implementation steps of activity 1.1.2 comprise:

Step 1: Development of the methodological approach (overview on driving forces and according pressures, development of criteria for significant impacts of a pressure)

Step 2: Overview of stress and impacts caused by changes of hydromorphological conditions in the Danube River

For a common understanding of the terms the Impress guidance paper (C.I.S) has adopted the widely used DPSIR (Driver, Pressure, State, Impact, Response) analytical framework with the following definitions.

Within the scope of our study a focus will be given on only three criteria: drivers (driving forces), pressures, and impacts (table 1).

Table 1 Part of the DPSIR framework as used in the pressures and impacts analysis.

Term	Definition
Driver	an anthropogenic activity that may have an environmental effect (e.g. agriculture, industry)
Pressure	The direct effect of the driver (for example, an effect that causes a change in flow or a change in the water chemistry)
Impact	The environmental effect of the pressure (e.g. fish killed, ecosystem modified)

The information we ask you to provide will be used to perform the following tasks:

Ad step 1) Development of methodological approach (criteria for significant impact analysis)

The output of step 1 will be a report on "Common approaches and methodologies for stress and impact analysis with particular attention to hydromorphological conditions - Methodological approach (criteria for significant impact)". The according activities of the international and national consultants will follow the scheme given below:

(1) Developing/completing a list of **drivers** that may cause important pressures that change the hydromorphological conditions in the Danube River stretch of the according Country.

(2) Developing/completing a list of **pressures** induced by each of the drivers that may provide important impacts on the biotic conditions in the Danube River stretch of the according Country.

This list can be used as a national checklist to inventory the relevant pressures in the Danube River. This checklist may be helpful/straightforward to note all pressures without concern for their significance. Finally emphasis will be put on a transnational agreement of the proposed pressures in the Danube countries.

(3) developing/discussing a system to assess if a pressure has a **significant impact** and the water body is at risk to fail the good ecological status.

(4) The drafts of the study will be discussed and reviewed with the UNDP/GEF project team as well as the relevant ICPDR Expert Groups before finalisation.

Ad step 2) Overview of stress and impacts caused by changes of hydromorphological conditions in the Danube River

The output of step 2 will be a report on "Stress and impact analysis with particular attention to hydromorphological conditions in the Danube River". To compile this overview of Danube River specific pressures and impacts the following procedures will be applied.

- Search/review of existing information on Danube River specific pressures and impacts (www, literature). According to the "Terms of Reference (ToR)" the international consultants will take into account also the results from the Pollution Reduction Program, in particular the Map with hydraulic structures and identified Significant Impact Areas and how the SIAs, hydromorphological structures and pollution sources are related.

- The international consultants - in co-operation with the ICPDR staff in Vienna and other committees - will provide the national consultants with the hitherto-collected materials. The national consultants will contribute their own information to this topic.
- based on the tools developed in step 1 the national consultants will provide more detailed information based on available data, expert consultancy and/or own surveys.
- in accordance with the UNDP/GEF project team as well as the relevant ICPDR Expert Groups a first overview of Danube River specific pressures and impacts will be compiled by the international consultants.

Your benefits from this study

The study will yield a first description of the pressures and impacts in the entire Danube River by the end of 2003, including the specific Danube sector in your Country. This may be a basis of establishing a decision support system, which serves as a methodological background for a more detailed pressures and impact analysis in the Danube River as well as in other Danube tributaries in your Country. It further will help to identify possible gaps of data availability. On the basis of this information national research projects can be tailored to fill the remaining gaps. Besides the pressures & impacts topics the criteria provided in the tables of questionnaire C may serve as a helpful tool within the discussion on heavily modified water bodies.

The questionnaire is based on the following references:

BADEN-WÜRTTEMBERG: Fleischhacker, T. & K. Kern (2002/2003): Vorläufige Einstufung der Oberflächengewässer nach Wasserrahmenrichtlinie in Baden-Württemberg, geändert am 22.1.2003.

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HOW TO RESPOND TO THIS DOCUMENT

We do appreciate if you would fill in **all** empty spaces and tick the appropriate boxes. Some questions are more complex and may need more documentation to be answered.
It is also very important that you send additional information on this topic (hard copies or digital documents of reports, maps etc.) to the address given below. Furthermore, we would be pleased to receive all comments, hints and links that are related to the discussed topics. The more information you provide, the higher the value of the studies' output will be – also for your national purposes! If necessary, we will of course return the material you have sent to us by the end of this study.

Information in English is appreciated.

The questionnaire on step 1 is divided into three parts to be filled in for methods in use or planned to describe drivers, pressures and impacts of the Danube River.

WHERE TO SEND YOUR INFORMATION

Ilse Stubauer/Otto Moog

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DEADLINE

Closing dates will be

Questionnaire A	**September 4th 2003**
Questionnaire B	**September 4th 2003**
Questionnaire C	**September 14th 2003**

We'd like to thank you for your efforts in advance and look forward to receiving your replies!

INFORMATION PROVIDED BY:

Please specify below which person(s) have contributed to the information submitted.

Date:

Country:

Name (1):
Institution:
Address:
Telephone-No.:
Fax-No.:
E-mail Address:

Name (2):
Institution:
Address:
Telephone-No.:
Fax-No.:
E-mail Address:

Identifying hydromorphological pressures on the Danube River

Questionnaire: - step1

A) DRIVERS

EXISTING INFROMATION ABOUT **DRIVING FORCES** THAT MAY CAUSE A SIGNIFICANT **HYDROMORPHOLOGICAL PRESSURE** ON THE DANUBE RIVER

Questions:

1. Have you started to identify driving hydromorphological forces on the Danube in your Country?

☐ yes

☐ under development (To be finished in which month/year?)

☐ no

If **yes**, or under development please answer question 2. Besides, please check table 2 and give comments:

If **no,** please use the information in table 2 to give an overview about driving forces in your section of the Danube River.

2. What information about driving forces on water bodies will be available for your Country that can be used in the analysis of pressures and impacts required by the WFD? Please write your answer in the form given below. Indicate "type of driver" and – if available - the source of information (references, reports, position papers etc.).

Types of **drivers** that may cause hydromorphological pressures	Source of information and form of availability (e.g. electronical data)

Table 2 provides a list of the most important drivers that may change the hydromorphological conditions in the Danube River.

Table 2 List of drivers relevant for hydromorphological pressures on the Danube River[1]

	indicate drivers relevant for the Danube section in your Country	indicate major drivers	ranking of the drivers***)
Flood defense	☐	☐	
Navigation	☐	☐	
Hydropower generation	☐	☐	
Water abstraction	☐	☐	
Gravel extraction	☐	☐	
Fisheries	☐	☐	
Removal of animals/plants*)			
Inshore habitat management **)	☐	☐	
Outdoor recreation	☐	☐	
Other drivers	☐	☐	
	☐	☐	

*) (E.g. weed cutting, tubificidae or macrophyte harvesting for pet-shop demands)
**) (Sediment deposition management)
***) If possible, perform a ranking of the major driving force in the Danube section under examination (1,2,3,x; 1 is the most important driver)

The national consultants are encouraged to add missing drivers in the field "other drivers".

The following activities need to be done by the national consultants:

1) indicate drivers relevant for the Danube section in your Country; do not tick those drivers that are not significant for the Danube section in your Country.
2) indicate major driving force in the Danube section in your Country.
3) if possible, perform a ranking of the major driving force in the Danube section in your Country (1,2,3,x; 1 is the most important driver).

As a final result we expect a list of driving forces relevant for section of the Danube River in your Country, ranked due to their relevance for your national Danube section.

The information of this questionnaire will be used to list the pressures among the according drivers.

[1] The list has been compiled using the C.I.S "Impress" guidance (Guidance for the analysis of Pressures and Impacts in accordance with the Water Framework Directive)", the MLIM working paper from 13 May 2000 "Typology and reference conditions", C.I.S Project 2.1 – Guidance on the analysis of pressures and impacts (Environment Agency & LAWA), ICPDR Draft-2 DOC-138 15_Oct.-2001, and other German and Austrian experiences.

Identifying hydromorphological pressures on the Danube River

Questionnaire step 1

B) PRESSURES

EXISTING INFORMATION ABOUT **HYDROMORPHOLOGICAL PRESSURES** THAT MAY CAUSE AN IMPACT ON THE DANUBE RIVER

1. Have you started to identify hydromorphological pressures for the Danube in your Country?

   ☐ yes

   ☐ under development (To be finished in which month/year?)

   ☐ no

   If **yes**, or **under development** please answer question 2. Besides, please check table 3 and give comments.

   If **no**, please proceed with question 3.

2. What information about pressures on water bodies will be available for your Country that can be used in the analysis of pressures and impacts required by the WFD? Please write your answer in the form given below. Indicate "Type of hydromorphological pressure" and – if available - the source of information (references, reports, position papers etc.).

Types of hydromorphological pressure	According driver/Information/Source of information

3. To achieve a common procedure in the DRB we want to develop a list of pressures that can be allocated to specific drivers. Check the list (table 3) and

   a) indicate pressures relevant for the Danube section in your Country; do not tick those pressures that are not significant for the Danube section in your Country,

   b) indicate major pressures in the Danube section in your Country, and

c) if possible, perform a ranking of the major pressures in the Danube section in your Country (1,2,3,x; 1 is the most important pressures).

Table 3 provides a list of the most important pressures that may change the hydromorphological conditions in the Danube River. The pressures have been grouped into classes of driving forces that may impact the water bodies and prevent them from meeting the WFD's objectives.

The drivers/pressures checklist given below contains an uncompleted list of pressures that should be considered as part of the WFD pressures and impacts assessment. The list can be considered as a reminder of the driving forces and the pressures that should be considered and therefore represents a precursor to the actual pressures and impacts analysis. The national consultants are encouraged to add missing pressures in the field "other pressures". Missing drivers inclusive can be added in the field "Other drivers" below the category "outdoor recreation".

Table 3 Checklist of drivers and pressures

*) Indicate pressures relevant for the Danube section in your Country

**) Indicate those pressures that are of major relevance for the Danube section in your Country

Drivers	**Pressures**		
		***)**	****)**
Flood defense	Alteration of the river course and channel form/profile (e.g. straightening, curvature, channelling, diversions)	☐	☐
	Disruptions of the vertical connectivity (e.g. siltation, colmation, embeddedness, plastering, concrete bottom)	☐	☐
	Disruption of the longitudinal connectivity (e.g. weirs, ramps)	☐	☐
	Alteration/modification of morphological in-channel features/habitats; bank fixation, reinforcements, re-insectioning, embankment, groynes	☐	☐
	Disruptions of lateral connectivity (e.g. detaching of side arms, tributaries)	☐	☐
	Alteration of the bank vegetation and banktop land use (floodplains)	☐	☐
	Flood defense dams, set-back embankments, dykes	☐	☐
	Alteration of the hydrological/hydraulic characteristics (flow regime/sediment transport)	☐	☐
	Other pressures:	☐	☐
Navigation	Alteration of the river course (thalweg) and channel form/profile	☐	☐
	Alteration of morphological features/habitats (e.g. embankments, bank reinforcement, groynes, deep-cutting, dredging, shipyards and harbours)	☐	☐
	Disruptions of longitudinal connectivity	☐	☐
	Disruptions of lateral connectivity, e.g. detaching sidearms, wetlands etc.	☐	☐
	Disruptions of the vertical connectivity	☐	☐
	Alteration of the hydrological/hydraulic characteristics (flow regime/sediment transport)	☐	☐
	Maintenance of the shipping channel (e.g. dredging)	☐	☐
	Ship locks	☐	☐
	Harbours	☐	☐
	Mechanic damage of aquatic flora caused by passage of ships, e.g. effect of vessel-induced waves	☐	☐
	Other pressures:	☐	☐
Hydropower use	Disruptions of the longitudinal connectivity (barrages, weirs, dams)	☐	☐
	Ship locks (water gates, sluices)	☐	☐
	Disruptions of lateral connectivity (embankments, dams)	☐	☐
	Alteration of the river course (thalweg) and channel form, diversions	☐	☐
	Alteration of morphological features/habitats as described for flood defense measures	☐	☐
	Disruptions of the vertical connectivity (silting, colmation)	☐	☐
	Alteration of the hydrological (discharge) regime	☐	☐
	Alteration of the hydraulic characteristics (current, sediment load)	☐	☐
	Water abstraction, diversions (residual flow)	☐	☐
	Hydro-peaking (flushing; intermittent power generation)	☐	☐
	Other pressures:	☐	☐

Water abstraction	Abstraction for hydropower use (see above)	☐	☐
	Abstraction for agriculture or floodplain irrigation	☐	☐
	Abstraction for drinking water supply	☐	☐
	Abstraction for industry	☐	☐
	Abstraction for cooling water facilities	☐	☐
	Abstraction for fish farming	☐	☐
	Abstraction for navigation (harbours; supplying canals)	☐	☐
	Alteration of the river course (thalweg) and channel form	☐	☐
	Alteration of morphological features/habitats disruptions of longitudinal connectivity	☐	☐
	Disruptions of lateral connectivity	☐	☐
	Disruptions of the vertical connectivity	☐	☐
	Alteration of the hydrological/hydraulic characteristics (flow regime, sediment load)	☐	☐
	Other pressures:	☐	☐

Gravel extraction (mining)	Alteration of amount and composition of the bed sediments	☐	☐
	Increased turbidity (suspended solids)	☐	☐
	Modifications of river channel, in-channel habitats and banks	☐	☐
	Other pressures:	☐	☐

Fisheries	Modifications of river channel, in-channel habitats and banks for fisheries	☐	☐
	Other pressures:	☐	☐

Removal (harvesting) of animals/plants	Modifications of river channel, in-channel habitats and banks for commercial removal of animals (weed cutting, tubificidae or macrophyte harvesting for pet-shops) and plants (water gardeners)	☐	☐
	Other pressures:	☐	☐

Inshore habitat management Fine sediment deposition management	Modifications of river channel, in-channel habitats and banks for inshore habitat management/fine sediment deposition management	☐	☐
	Other pressures:	☐	☐

Outdoor recreation	Modifications of river channel, in-channel habitats and banks for recreation purposes as there are fishing (facilities; houses; bank alterations), recreational navigation (e. g. harbours), boating, rafting, water skiing etc.	☐	☐
	Other pressures:	☐	☐

Other drivers:	Other pressures:	☐	☐
		☐	☐
		☐	☐

If possible please perform a ranking of the major pressures in the Danube section under investigation. Write your answer in the form given below.

Type of Pressure	**Ranking of pressures** (please rank the major pressures in the Danube section under examination (1,2,3,x; 1 is the most important pressure)

Identifying hydromorphological pressures on the Danube River

Questionnaire – step 1

C) SIGNIFICANT PRESSURES/IMPACTS

EXISTING INFORMATION ABOUT **SIGNIFICANT HYDROMORPHOLOGICAL PRESSURES** THAT HAVE AN **IMPACT** ON THE WATER BODY THAT MAY CAUSE A FAILURE TO MEET THE ENVIRONMENTAL QUALITY OBJECTIVES IN THE DANUBE RIVER

Within the context of WFD's philosophy, it is important that the countries are capable of differentiating between different pressures and their impacts. The C.I.S. "Impress" Guidance (2002) states that "pressure and impact quantification tools are available only for a limited number of pressure types, mostly dealing with organic and nutrient pollution loads. Considering the groups of tools, implemented tools can exemplify only 10% of these groups. On the contrary, **a large number of groups** (about 45% each) **still require efforts** either for implementation or scientific development, mainly in **morphology** linked assessments".

"Quantifying the pressure, would ideally be done using monitored data. However such data cannot exist in many circumstances, or are not monitored. Hence, the existing tools use alternative information to quantify the pressure". Summarzing the state of the art the C.I.S guidance paper IMPRESS states that "**no implemented tool** capable **of assessing the impact of** changes in **hydrological regime** or **morphology** could be **identified**".

However, several experiences could be used to design ad hoc indicators. For example, fish spawning conditions, fish ladder efficiency or damming impact etc. can be assessed using statistics computed from environmental data (discharge, substrates etc.) and simple parameter (e.g. height of the weir) or relationships (e.g. ratio of low to high flows).

Before going into detail we need an overview about the current state of hydromorphological pressure/impact assessment in your Countries.

Please answer the following questions:

1) Which methodologies and tools do you currently use to assess the potential impact of human activity on water bodies (FOCUS: **only hydromorphology**)? In your answers please indicate which methods and tools can diagnose the impact of different hydromorphological pressures. For example in Germany and Austria the "ecomorphological quality assessment (Strukturgüteerhebung)" is used to describe the status of morphological degradation of river sections whereas the saprobic approach is used to assess the effect of organic pollution in rivers.

To answer the question please use the following form.

Types of hydromorphological pressure	Methodologies and tools that are currently used to diagnose the potential impact of different anthropogenically induced hydromorphological pressures

2) Do you have any new methodologies/tools planned in the future to assess the potential impact of human activity, e.g. research & development projects or new mathematical models? In your answers please indicate which methods and tools can diagnose the impact of different hydromorphological pressures.

Please insert your answer into the following form.

Methodologies and tools planned in the future to assess the potential impact of human activity (e.g. research **&** development projects **or new** mathematical models**); Focus: hydromorphology.**

3) Please indicate any gaps in knowledge that will need to be filled to fulfil the WFD's requirements on the impacts of pressures, such as the effect of morphological alterations on biological elements. Please insert your answer in the form below.

Gaps in knowledge that will need to be filled to fulfil the WFD's requirements on the impacts of pressures, such as the effect of hydromorphological alterations on biological elements

The next questions seek your views and details of practice in defining "significant" pressures. The WFD requires that Member States identify "significant" human pressures. One of the most important aspects will be to define criteria to determine what a "significant" pressure is, as the Directive does not provide such a definition.

4) Within your Country, do you use an assessment of **"significant"** hydromorphological pressures within water management, perhaps as part of a risk based decision-making framework?

if **not**, please tick the box "no assessment result" ☐

if **yes**, please insert your answer in the following two forms.

Type of hydromorphological pressures	Assessment of significant hydromorphological pressures

What criteria do you use to determine the significance of a pressure?
Please include any quantitative information you have.

Please insert your answer in the following form.

Criteria used to determine the significance of a pressure

The last part of this questionnaire focuses on the **creation of a guidance** on the "analysis of pressures and impacts".

The report on "Common approaches and methodologies for stress and impact analysis with particular attention to hydromorphological conditions - Methodological approach" produced as a result of this project will address the key issues relating to the identification of hydromorphological pressures and impacts in the Danube. As we stated earlier, there is not too much information published on this topic and neither the WFD nor the guidance papers contain sufficient practical help to implement the Directive's requirements. On the other hand many countries have started to work on the process of pressures and impacts analysis. We want to encourage the whole consortium of consultants to contribute their knowledge to keep the process going on.

By adding your expertise (e.g. what is going on in other Countries or EU Member States) and by answering the questions you have the opportunity to influence the content of the report.

A part of the following tables represents the actual state of a process under development in Austria and partly Germany. Other tables provide you with suggestions that need to be discussed. As the pressures and impact analysis is still under work it will be a great challenge for all contributors to help bring this important topic to an end.

The tables are considered as a tool for classifying the impacts of a variety of hydromorphological pressures with special emphasis to identify significant pressures. The examples provided cover only those few pressures that have been investigated in previous studies or that are in the state of discussion.

The procedure is presented in three stages: 1) a descriptive indication of the likely-to-be relationship of a pressure's impact along a gradient of 5 steps of status classes, 2) an assessment of the likelihood and 3) an assessment of the significance that surface water bodies within the River Basin District will fail to meet the environmental quality objectives set for the bodies under Article 4 of the WFD.

Due to the lack of information the pressures described are fairly incomplete compared to the numbers of pressures given in table 3 (see questionnaire 2).
The following tables start with descriptions in 5 steps (1 reference and 4 steps of

increasing deviation from the reference) to assess if a water body is not at risk or at risk to fail the good status as shown in table 4. The five class system has been chosen to enable the application of the evaluation tables that are in current use to pre-classify the ecological status of a site (e.g. Strukturgüte, adapted Saprobic System), and to be compatible with the ecological status classes of the WFD.

Table 4

Code	**Presumable status**	**Risk to fail the good status**
1	Reference status	Water bodies surely not at risk
2	Good ecological status	Water bodies not at risk
3	Moderate ecological status	Water bodies needing further assessment to determine risk
4	Poor ecological status	Water bodies at risk
5	Bad ecological status	Water bodies clearly at risk

Out of the five classes two threshold ratios/values have been pointed out to:

1: to assess the **likelihood** if the water body is at risk to fail the good ecological status, and

2: to assess the **significance** of the water body failing the good ecological status

The impacts of the following pressures have been described:

1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters
2) Navigation channel
3) Disruptions of the longitudinal river continuity by weirs/barrages
   3 a) height of the in-channel structures
   3 b) Composition of channel substrates (minerogenic bed sediments)
   3 c) Migration barriers
4) River engineering – banks
5) Effects of water abstraction (residual water flow)
6) Effects of hydropeaking (incl. sudden flow reduction)

The international consultants want to strongly emphasise that the proposed system of determining significant pressures by pre-classifying the status of a site by abiotic criteria is to be seen as a tool for the purpose of this exercise but **does not replace the assessment of the ecological status based on** the investigation of **biological quality** elements (algae, macrophytes, benthic invertebrates, and fish).

1) Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters

The descriptions and threshold criteria for evaluating the possible effects of a disruption of the lateral connectivity with the floodplain-system (possibilities for movements of biota and water to and within floodplain water body types [only for floodplain rivers].

The estimates are based on suggestions of BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003), JÄGER (2002), SCHMUTZ et al. (2001) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

1	Flood plains correspond totally or nearly totally to undisturbed conditions; minimum lateral extension should guarantee any type of site-specific natural backwaters
2	At least 50% of the flood plains and/or important site-specific types of backwaters existing, lateral connectivity in most (at least 50%) cases intact.
3	Floodplain vegetation and lateral connectivity of most backwater types disrupted to between 50%-75%
4	Floodplain vegetation and lateral connectivity of most backwater types disrupted to between 75-90%
5	Less than 10% (of formerly existing) floodplains and/or backwaters present.

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	Floodplain vegetation and lateral connectivity of most backwater types disrupted to more than 50%*)
Threshold ratio to assess the significance of the water body failing the good ecological status:	Floodplain vegetation and lateral connectivity of most backwater types disrupted to more than 75%*)

*) currently please base your decision on your expert judgement as precise criteria for classification need to be developed in the future

Please give your comments to this table using the frame given below.

Comments to the table "Disruptions of the lateral river connectivity by river engineering – connectivity to flood plains, sidearms and backwaters"

2) Navigation channel (large rivers)

The descriptions and threshold criteria for evaluating the possible effect of navigation on the biota refer to the share of the navigation channel with respect to the river's width. The estimates are based on mere suggestions of the benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture), and expert consultancy. Navigation channel includes navigation channel plus parts of the river that are maintained or have constructions in combination with the navigation channel (e. g. deflectors, groynes, and harbours).

It needs to be discussed if in-channel measures outside the navigation channel that guarantee the functioning of the navigation channel (e.g. groynes) should be included into the area of the "navigation channel" sensu stricto. In discussing the effective width of the navigation channel please mind the effects of wash of the waves or of the ships' propeller on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels respectively).

1	No navigation channel
2	Navigation channel covers <33% of the bottom area; no significant effect of wash of the waves or of the ships‘ propellers on the biota
3	Navigation channel covers about 33-66% of the bottom area; possible effects of wash of the waves or of the ships' propellers on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels respectively)
4	Navigation channel covers about 66%-100% of the bottom area; possible effect of wash of the waves or of the ships' propellers on the biota (in regard to width and depth of the channel and the size, type and frequency of vessels respectively)
5	Navigation channel covers 66%-100% of the bottom area; significant effect of wash of the waves or of the ships' propellers on the biota (see above)

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold value to assess the likelihood if the water body is at risk to fail the good ecological status:	Navigation channel covers >33% of the bottom area
Threshold value to assess the significance of the water body failing the good ecological status:	Navigation channel covers >66% of the bottom area

Please give your comments to this table using the frame given below.

Comments to the table "Navigation channel"

3) Disruptions of the longitudinal river continuity by weirs/barrages

3a) Criterion: Height of the in-channel structures

An essential criterion for the impact of morphological alterations on the ecological status of water bodies is the continuity for aquatic communities. This is why it is essential to identify any artificial obstructing features above a gradient (to be quantified in cm) and to assess their effect on the continuity of aquatic fauna (upstream and downstream movement). The descriptions and threshold criteria for evaluating the possible effects of weirs and barrages refer to the conditions in the parts of the river channel at, above, and below the in-channel structures. The estimates are based on suggestions of BMLFUW (2003), CHOVANEC (2003), JÄGER (2002), LAWA (2002) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture). As the table has been provided for all types of water bodies please regard only the part for large rivers.

1	No artificial in-channel structures
2	Artificial in-channel structures that do not affect the migration of biota/sediments. Description to estimate the significance of the pressure: in rhithral courses with a maximum free-fall of 10 cm (small)/30 cm (mid-sized)/70 cm (large rivers), in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers). The evaluation of the effect of in-channel structures has to include the migration possibilities during low flows as well as the technical options for migrations (e. g. start and landing facilities for jumping fish) If the height of the artificial in-channel structures exceeds 70/30/10 cm a well functioning passage of the biota must be available (e. g. by fish passes, bypasses or other measures; see 3c).
3	Artificial in-channel structures do affect the migration of biota/sediments. Description to estimate the significance of the pressure: the height of the artificial in-channel structures exceeds the limits of a maximum free-fall in rhithral rivers of 10 cm (small), or 30 cm (mid-sized), or 70 cm (large rivers) in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers).
4	Artificial in-channel structures do severely affect the migration of biota/sediments. The height of the artificial in-channel structures clearly exceeds the migratory power of most of the biota.
5	Artificial in-channel structures do severely affect the migration of biota. The height of the artificial in-channel structures clearly exceeds the migratory power of any biota.

Decision guidance to pre-classify, if a water body is likely to fail the good ecological

status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold values to assess the likelihood if the water body is at risk to fail the good ecological status:	Migration not possible for every organism the height of the artificial in-channel structures exceeds the limits of a maximum free-fall • in rhithral rivers of 10 cm (small), or 30 cm (mid-sized), or 70 cm (large rivers) • in potamal river courses with a maximum free-fall of 10 cm (small to mid-sized) or 30 cm (large rivers).
Threshold values to assess the significance of the water body failing the good ecological status:	No migration possible

Please give your comments to this table using the frame given below.

Comments to the table "Disruptions of the longitudinal river continuity by weirs/barrages – dimension (height of the in-channel structures)"

3b) Criterion: composition of channel substrates (minerogenic bed sediments, reduced flow in the river bed)

The descriptions and threshold criteria for evaluating the possible effect of weirs and barrages on the composition of bed sediments (e.g. bedrock, boulders, cobbles, pebbles, gravel, sand, mud, clay) refer to the conditions in the parts of the river channel at, above, and below the in- structures.

The estimates are based on observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture), the Austrian system for pre-classifying the ecological status of the AQEM and STAR projects (www.aqem.de, www.eu-star.at) and expert consultancy.

1	No artificial in-channel structures. Composition of channel substrates and features (bars, islands) correspond to near natural conditions.
2	River channel with natural bed sediments, channel features like side/point/mid-channel bars and current conditions in at least 70% of the section; the dominant minerogenic habitats comprise a share of at least 70% of the reference composition (e.g. beginning of the backwater area).
3	River channels bed sediments turn to smaller grain sizes compared to the reference conditions, flow velocities diminuate. Most channel features like side/point/mid-channel bars under water (impounded). This section can be roughly estimated within the dammed/impounded river sections as the reach below the beginning of the backwater area and above the turning point [Wendepegel]. The share of dominant minerogenic habitats of the reference composition is between <70 and 30%.
4	Sediment conditions and flow velocities in the river channel are remarkably different from reference conditions (smaller grain diameters, lentic flows). This section can be roughly estimated within the dammed/impounded river sections the reach below the turning point [Wendepegel] and above a section as described below (5). The share of dominant minerogenic habitats of the reference composition is less than 30%.
5	Bed sediments of the river channel are quite remarkably different from natural conditions, in many cases consisting of untypical fine sediments (mud, pelal), nearly no current. Mainly restricted to dammed/impounded river sections in front of the weir.

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	• The share of dominant minerogenic habitats of the reference composition is between <70 and 30%.
Threshold ratio to assess the significance of the water body failing the good ecological status:	• The share of dominant minerogenic habitats is less than 30% of the reference composition

Please give your comments to this table using the frame given below.

Comments to the table "Disruptions of the longitudinal river continuity by weirs/barrages – composition of channel substrates (minerogenic bed sediments)"

3c) Criterion: migration barriers

The descriptions and threshold criteria for evaluating the possible effect of weirs and barrages on the migration capacity of the biota refer to the conditions in the parts of the river channel at, above, and below the in-channel structures. The estimates are based on BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

1	The continuity of the river is not or only slightly disturbed by anthropogenic activities and allows undisturbed migration of aquatic organisms.
2	The continuity of the river is disturbed by anthropogenic activities; disturbed migration of aquatic organisms: passage for most species in most years; no species deficit upstream/downstream. Description to estimate the significance of the pressure: migration barrier with functioning passage facilities (e.g. "nature-like" bypass channel).
3	The continuity of the river is disturbed by anthropogenic activities; disturbed migration of aquatic organisms: passage for certain species or in certain years. Description to estimate the significance of the pressure: migration barrier with malfunctioning passage facilities (e.g. poor designed bypass channels).
4	The continuity of the river is disturbed by anthropogenic activities; significantly disturbed migration of aquatic organisms and sediment transport: passage for single species occasionally (e. g. passage via ship locks, defective in-channel structures, "compensation" flights, or terrestrial migration). Description to estimate the significance of the pressure: migration barrier with no or not functioning bypass facilities
5	the continuity of the river is clearly disturbed by anthropogenic activities; no sediment transport; significant species deficits between upstream/downstream Description to estimate the significance of the pressure: migration barrier completely disrupts the continuum (large technical constructions, banks and floodplains technically altered)

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	Migration barrier with malfunctioning passage facilities (e.g. poorly designed bypass channels)
Threshold ratio to assess the significance of the water body failing the good ecological status:	Migration barrier with no or not functioning bypass facilities

Please give your comments to this table using the frame given below.

Comments to the table "Disruptions of the longitudinal river continuity by weirs/barrages – Migration barriers"

4) River engineering – banks

The estimates are based on suggestions of BEIER et al (2002), BMLFUW (2003), CHOVANEC (2003), SCHMUTZ et al. (2001) and observations of the fish and benthic invertebrate ecology group of the BOKU (Department Hydrobiology, Fisheries & Aquaculture).

1	Bank structures correspond totally or nearly totally to undisturbed conditions, no river engineering Riparian vegetation corresponds totally or nearly totally to undisturbed conditions, minimum width of vegetation should guarantee natural functions % bank length (both sides) in natural state: small rivers to medium constrained rivers: >90% medium to large braided, anabranching and meandering rivers: >75%
2	Re-insectioned*) banks (e.g. alterations of the bank structures due to channel modifications); if rip-rap, then restricted to the lower 1/3 of the slope or not directly covered by water Riparian vegetation covering the shore with a minimum cover of 50% ; lateral extension should guarantee important natural functions % bank length (both sides) in natural state: small to medium constrained rivers: 90->50% medium to large braided, anabranching and meandering rivers: <75->50%
3	Re-insectioned*) banks (e.g. rip-rap with direct water contact) Few or single row of riparian gallery, covering <50% - 20% of the banks % bank length (both sides) in natural state: small to medium constrained rivers: <50 % medium to large braided, anabranching and meandering rivers: <50 %
4	Reinforced**) banks; significant parts of impervious bank materials (plastering), higher bank vegetation restricted to single stands of shrubs and/or trees: <20% % bank length (both sides) in natural state: 0
5	Reinforced**) banks; impervious bank materials (e.g. concrete walls, shet piling) Nearly no to no higher bank vegetation % bank length (both sides) in natural state: 0

*) Re-insectioned river (bank): Profile modified but not reinforced often to accommodate flood flow and access for maintenance machinery.

**) Reinforcement: Whole or part of the river (bank, bottom) artificially strengthened for bank protection purposes.

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	% bank length (both sides) in natural state:
• Small to medium constrained rivers:	<50%
• Medium to large braided, anabranching and meandering rivers	<50%
Threshold ratio to assess the significance of the water body failing the good ecological status:	% bank length (both sides) in natural state:
• Small to medium constrained rivers:	<20%
• Medium to large braided, anabranching and meandering rivers:	<20%

Please give your comments to this table using the frame given below.

Comments to the table "River engineering – banks"

5) Effects of water abstraction (residual water flow), proposed significance criteria not tested for large rivers

The descriptions and threshold criteria for evaluating the possible effects of water abstraction refer to the conditions in that part of the river channel with the minimum residual water observed (exceptive natural infiltration sections). Two suggestions are given. The first estimates are in accordance with BMLFUW (2003), JÄGER (2000). The second estimates are derived from a study of GRASSER & MOOG (in print.).

MQ_{RW} mean annual discharge* in the residual water flow section (Restwasserstrecke) (based on yearly recordings)

$MQ_{natural}$ mean annual discharge in the natural river section (channel with natural water flow)

$MNQ_{natural}$ mean annual low discharge in the natural river section

MNQ_{RW} mean annual low discharge in the residual water flow section

NNQ lowest observed low discharge

1	No or only marginal water abstractions. The hydrograph corresponds totally or nearly totally to undisturbed conditions.
2	Water abstraction present, but the residual water section of the river is without or only minimal ecological impairment. The amount of water abstraction does not exceed the value of the annual mean water discharge during mean annual low flow discharge conditions (MNQ_{RW}) Threshold ratio to asses if the water body is not at risk to fail the good ecological status: No Water abstraction at natural lowest low flow conditions (< NNQ) and the residual water flow corresponds to/simulates the natural annual flow regime and MQ_{RW} = >100% $MNQ_{natural}$ or Monthly MQ_{RW} = >35 % monthly $MQ_{natural}$
3	Water abstraction present, residual water discharge presumably too low and thereby with no tolerable effect on the biota. There is a risk to achieve a good ecological status. Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status MQ_{RW} =<100% - >40% $MNQ_{natural}$ or Monthly MQ_{RW} = <35 % - >15 % monthly $MQ_{natural}$
4	Total river water abstracted. Descriptive features to estimate the significance of the pressure: no or only few residual water below the weir, but in the tail water section some natural discharge occurs by groundwater exfiltration and/or by confluence of tributaries. Threshold ratio to assess the significance of the pressure: MQ_{RW} =<40% $MNQ_{natural}$ or monthly MQ_{RW} = <15 % monthly $MQ_{natural}$
5	Total river water abstracted. There is a clear risk to achieve a good ecological status. Descriptive features to estimate the significance of the pressure: no residual water below weir; there is no groundwater exfiltration into the tail water section and/or no confluence of tributaries

* Discharge (Q): The volume of water per unit time that passes a specific point on a stream.

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold value to assess the likelihood if the water body is at risk to fail the good ecological status:	MQ_{RW} = <100% $MNQ_{natural}$ or monthly MQ_{RW} = <35 % monthly $MQ_{natural}$
Threshold value to assess the significance of the water body failing the good ecological status:	MQ_{RW} =<40% $MNQ_{natural}$ or monthly MQ_{RW} = <15% monthly $MQ_{natural}$

Please give your comments to this table using the frame given below.

Comments to the table "Water abstraction"

6) Effects of hydropeaking (incl. sudden flow reduction)

The descriptions and threshold criteria for evaluating the possible effects of hydropeaking refer to the conditions in that part of the river channel with the maximum hydropeaking ratios observed. The estimates are based on suggestions of BEIER et al. (2002), BMLFUW (2003), CHOVANEC (2003), JÄGER (2002) and the Austrian system for pre-classifying the ecological status of the AQEM and STAR projects (www.aqem.de, www.eu-star.at).
As the table is given for several stream types, please focus on giving comments to large rivers!

HQ_{pf} high flow during flood pulse (peak operation)

NQ_{pf} low flow between flood pulses

1	Natural hydrograph corresponds totally or nearly totally to undisturbed conditions, no hydropeaking. If some hydropeaking effects (e. g. caused by tributaries) occur, the total river bottom (100%) stays water-covered and the ratio of peak discharge (HQ_{PF}) to low discharge (NQ_{PF}) does not exceed the factor 1,5.
2	Hydropeaking without or only minimal ecological impairment. River morphology only minor disturbed and near to nature, with "shelters" available. Hydropeaks are not suddenly released (e. g. intermittent storage reservoir) and at least 80% of the river channel are covered by water during low flow and the average flow velocity is not reduced more than at least 20%. Threshold ratio to assess if the water body is not at risk to fail the good ecological status: Constrained river sections: The ratio of peak flow (HQ_{PF}) to low flow (NQ_{PF}) does not exceed the factor 3; [peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <3.] Braided/anabranched rivers: The ratio of peak flow (HQ_{PF}) to low flow (NQ_{PF}) does not exceed the factor 2; [peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <2. Large rivers: peak discharge: low discharge (HQ_{PF}:NQ_{PF}) <?
3	Hydropeaking with only moderate ecological impairment; River habitats impaired, parts of the river fall dry during low flow, but "shelters" available; Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status Constrained river sections: HQ_{PF}:NQ_{PF} 3 - <10. Braided/anabranched rivers: HQ_{PF}:NQ_{PF} between 2 - <4 Large rivers: HQ_{PF}:NQ_{PF}?.
4	Hydropeaking remarkably affects the ecological status; Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status Constrained river sections: HQ_{PF}:NQ_{PF}>10 - <50. Braided/anabranched rivers: HQ_{PF}:NQ_{PF} between 4 - <10 Large rivers: HQ_{PF}:NQ_{PF} ?

5	Hydropeaking causes a total disruption of the environment and the biota Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status Constrained river sections: HQ_{PF}:NQ_{PF}>50 Braided/anabranched rivers: HQ_{PF}:NQ_{PF} >10 Large rivers: HQ_{PF}:NQ_{PF} ?

Decision guidance to pre-classify, if a water body is likely to fail the good ecological status (border between 2 and 3) respectively is significantly failing the good ecological status (worse than 3):

Threshold ratio to assess the likelihood if the water body is at risk to fail the good ecological status:	
• Constrained river sections:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) 3-<10
• Braided/anabranched rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) 2-<4
• Large rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF})>?
Threshold ratio to assess the significance of the water body failing the good ecological status:	
• Constrained river sections:	High discharge : low discharge (HQ_{PF}:NQ_{PF})>10.
• Braided/anabranched rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF})>4
• Large rivers:	High discharge : low discharge (HQ_{PF}:NQ_{PF}) >?

Please give your comments to this table using the frame given below.

With the exception of Gabcikovo-Nagymaros the Danube River seems not to be affected by hydropeaking from our state of knowledge. However, as there are no comments available on the threshold ratios of high discharge to low discharge for large rivers we ask you for your opinion on this topic. Please don't forget that this topic – together with water abstractions – will be quite essential for many Danube tributaries (next project phase).

Comments to the table "Effects of hydropeaking (incl. sudden flow reduction)"