

# PROCEEDINGS

THE IMPLEMENTATION OF THE  
EU WATER FRAMEWORK DIRECTIVE  
FROM INTERNATIONAL, NATIONAL  
AND LOCAL PERSPECTIVES



**LANDSCAPE**  
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## **IMPRINT**

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## INTRODUCTION

In 2000, the EU Water Framework Directive was enforced for all EU member countries. This directive considers each river basin as one planning unit. Water (and environmental) quality has to be improved or must not deteriorate. Water bodies have to achieve a good ecological status from chemical, biological and morphological viewpoints. At current state, the inventory of water bodies was carried out. A monitoring system to judge the ecological status has to be in place. A preliminary classification of “good” and “bad” was undertaken and reported to Brussels. Until 2009, measures to change the situation into “good” should be named, and until 2015 be in place; in a few exceptional cases until 2021 or latest by 2027.

Watersheds of the size of the Danube River employ many levels of planning. The Danube is also the largest river in EU territory with 815,000 km<sup>2</sup> and 18 countries contribute to the Danube River Basin. Thereby the Danube is not only the most international river, but also the most heterogeneous one. Income disparities and standard of life differences are most diverse within the Danube basin and it is difficult to regard the Danube as one entity from the management point of view. What works well in upstream countries does not necessarily work satisfactory in downstream and vice versa. For this reason the Danube was divided into 15 more homogenous sub river basins with perhaps 50,000 km<sup>2</sup> each. Here differences are less and a more homogenous landscape and water management becomes possible. While the sub river basins in of the Upper Danube countries have primarily problems with river morphology, the downstream sub river basins have other problems, primarily due to water pollution. The deviation from the good ecological status is in this case due to chemical and biotic indicators.

Austrian territory belongs with 80,000 km<sup>2</sup> or to 96% to the Danube river basin. In Austria, some 62% of water bodies are not classified with a good ecological status, primarily due to problems with river morphology. Even other rich European countries have similar problems as priority was traditionally given to chemical water quality issues. Enormous investments should take place within the next two decades to achieve the good ecological status. This impairs that the European Water Framework Directive becomes a major challenge for the planning profession. So far there exist some remarkable local scale Austrian projects, e.g. the re-cultivation of the river Liesing, a small tributary to the rivers Schwechat and Danube or the water retention areas of the Brenner tunnel that had to be ecologically altered along with a major infrastructure project. Despite some early and outstanding local examples, a general local management within the frame of the European water framework directive is not yet in place. We can further argue if the money be available for this purpose?

At the beginning of the WFD process, there was a selection of suitable approaches to monitor and classify the ecological status. Many methods that were in principle available – like the old saprobe system of water quality - to analyze the good ecological status are not considered in the current settings of the EU WFD. Numerous modern techniques, developed during the last decade – e.g. to detect particular genomes impairing water quality - are not yet in use. The current approach to classify the good ecological status is more oriented towards what is practically feasible and less towards what is scientifically possible. The WFD aims a relative improvement of the situation, but not an absolute standard. People within the region define what they consider as a good ecological status and develop action

plans how to improve the situation. They report this to Brussels. A new discussion of wanted environmental standards emerges: it is no longer related to local areas but to larger regions connected via their watersheds and any human action can have an impact. This means fresh approaches in landscape and physical planning going beyond the traditional local scales and sector borders are required. Planning for the EU WFD happens on many spatial levels, a European scale, a watershed scale, a regional watershed scale covering the whole territory of the EU in a systematic way and is accompanied by particular actions on hot spots of the local scale. Thereby, we get many regimes dealing with the issue of a good ecological status in watersheds, not necessarily connected to each other.

For this reason, the Department for Urban Design and Landscape Architecture, Vienna University of Technology, organized a two days conference related to the implementation of the European Union Water Framework Directive from international, national and local perspectives. The idea is draw attention to this process and to stimulate an even broader participation from the planning professionals and to inform students about the importance of this framework. The conference was divided into four blocks. The first one was primarily dealing with the administrative issues on international, national and local government level. The second block presented some major ongoing international and national projects in relation to the implementation. The third block highlighted some particular non Austrian approaches in relation to the framework. The fourth and last block dealt with stakeholders in the Danube river basin.

At this place we would like to thank the International Association for Danube Research (IAD) for the great support in organizing this conference.

Meinhard Breiling  
(Responsible for the organisation of the conference)

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## Key Conclusions and Outlook for Implementation of the EU WFD in the Danube River Basin (from ICPDR Roof Report 2004).

Background information for presentation of Dumitru Drumea, ICPDR, Moldavian Presidency 2006.

*Some sections of the Danube River are still rather untouched ecosystems and, despite possible pollution problems, constitute a unique heritage to be preserved. In addition, the Danube River Basin still hosts many species and habitats of outstanding ecological value and unique importance for biodiversity. In particular the Danube Delta is of global significance. The future management of the river basin needs to ensure that the focus of measures is not only the restoration of affected water bodies but equally important is the preservation of those few areas that are still ecologically intact.*

The [current analysis](#) shows that in the last two decades, considerable improvements in environmental conditions in the Danube basin have been made. Where investments, e.g. in wastewater treatment, have taken place, the improvement of the water quality is visible. However, a major part of pollution reduction can be attributed to the decline of industries and agricultural activities in the middle and lower parts of the basin since 1989. In these areas investments for a sustainable reduction of pollution levels has just started and will have to continue for another 10 to 20 years.

In surface waters, the loads of [organic pollution](#) are still unacceptably high in most of the Danube tributaries and in some parts of the Danube River. The considerable discharge of untreated or insufficiently treated wastewater from municipal, industrial and agricultural point sources is wide-spread, in particular in the middle and lower part of the basin. The indicators for impact from organic pollution show that the water quality is significantly affected, the major cause being insufficient treatment of waste-water from municipalities.

A significant reduction potential for organic pollution exists through the application of best available techniques for wastewater treatment facilities. Considerable efforts, in particular as regards financial investment will be necessary to reduce organic pollution to acceptable levels in some parts of the middle and lower basin. Financial programmes and initiatives from the EU and other international donors are already set up. The preparation of concrete projects and measures needs to be pursued without delay even well before 2009 since the successful resolution of this basic problem will be the first essential step to implement the Water Framework Directive and other relevant EU legislation. It will remain to be seen whether these load reductions will be sufficient to achieve the “good ecological status”, which are linked to organic pressures.

Overall, [nutrient loads](#) into the Danube basin have significantly decreased over the past 20 years, however, being still well above the levels of 1955. In the future this improvement in reduction of nutrient pollution may be lost, because of an increase in diffuse pollution from agriculture. Impacts from nutrients can mainly be seen in the receiving coastal waters of the Black Sea but also in many lakes and groundwater bodies throughout the basin. While in rivers nutrients generally cause fewer problems due to turbulent flow conditions, some slow flowing river stretches such as the middle Danube, impounded river sections, and lakes show effects of eutrophication.

In order to ensure the further reduction or at least stand-still of nutrient loads, the expected increase of diffuse sources needs to be compensated by the reduction of point source inputs. In addition to the investment strategies already described for dealing with organic pollution, the introduction of phosphate-free detergents throughout the Danube basin appears to be a cost-effective and necessary measure. Introducing such an instrument in a mandatory way could be undertaken at the EU level, however, options of voluntary instruments are already being explored in the context of the ICPDR.

As mentioned above, economic development in the middle and lower parts of the Danube region will inevitably increase diffuse nutrient inputs. It should be ensured that best environmental and agricultural practices are being developed and applied in order to create a sustainable agriculture in the long term. In this respect, there is still room for reduction of nutrient loads in the upper part of the Danube basin. The potential of the reformed EU Common Agricultural Policy should be fully explored in this regard.

Hundreds of [hazardous substances](#) are being used and released into the Danube river basin. Pollution from hazardous substances is significant although the full extent cannot be evaluated to date. There are only few data available for some hazardous substances such as heavy metals and pesticides, which indicate the transboundary scale of the problem. Cadmium and lead can be considered as the most serious heavy metals exceeding the target values considerably in many locations on the lower Danube. Also, pesticides show alarming concentrations in some tributaries and in the lower Danube. It will be necessary to improve the data base on pressures and impacts from hazardous substances, e.g. through further development of the existing inventories such as the European Pollutant Emission Register (EPER) to a comprehensive Pollutant Release and Transfer Register (PRTR). Despite the “knowledge gap” it is essential that measures for the introduction of “best available techniques” and “best environmental practices” are being developed without delay, otherwise it will be impossible to achieve “good ecological” and “good chemical status”. As mentioned above, many requirements and guidelines for appropriate measures exist in the European Union (e.g. the BAT reference documents under the IPPC Directive) and other international bodies, however, the appropriate investments need to be secured on the basis of a clear priority setting.

The extent of the [hydromorphological alterations](#) in the Danube basin has been significant over the past centuries. Such alterations include, *inter alia*, the building of dams, weirs and sluices, the canalisation of rivers and subsequent disconnection of their floodplains and old arms, erosion (incision) of the river bed and lowering of water tables with consequently higher flood risks. Some of these changes are irreversible, however, there is a potential for rehabilitation, which should be explored to the fullest extent. This is particularly the case, where floodplains could be reconnected with the main river thereby improving natural flood retention and enhancing fish migration to their natural habitats. In addition, migration path-ways would be needed on barriers on the Danube and most of its tributaries.

Due to these significant hydromorphological changes large parts of the Danube River and of numerous tributaries have been provisionally identified as heavily modified water bodies on the basin-wide scale. Dams and weirs on the Danube as well as bank reinforcements and fixations on the tributaries put these stretches “at risk” of failing to reach the “good ecological status”.

Future infrastructure projects such as planned hydropower developments and plans to expand navigation threaten the status of the riverine ecosystem on the Danube and its tributaries further, in particular, since some of these projects would affect the few remaining free-flowing sections of the Danube. It needs to be ensured that these future projects minimise environmental impacts in the Danube river basin and compensate inevitable environmental damage through appropriate mitigation measures.

The Danube River Basin contains a large number of [wetlands](#) offering unique habitats for a rich and diverse aquatic community. Many of these areas have high protection status such as the large wetland complexes protected under international conventions, others still deserve to be designated as protected areas, but have not been granted such status. 80 % of the historical floodplain on the large rivers has been lost during the last 150 years mainly from significant hydromorphological alterations, and many already protected areas deteriorate due to new human interventions. Still today, many wetlands are under pressure from navigation, hydropower plants, intensive agriculture and forestry as well as from new infrastructure projects. Wetland restoration can bring many benefits, in particular for flood protection. As a first step, an inventory of the most important water-related protected areas for species and habitat protection has been established for the Danube River Basin.

The [Danube Delta](#) has suffered significant impacts from anthropogenic pressures in the last 50 years. These were caused in part by high nutrient loads and heavy metals from the Danube. Nutrient inflow has led to eutrophication of the delta arms and its lakes; elevated concentrations of heavy metals occur especially in the delta lakes. In addition, severe hydromorphological alterations and intensive agriculture and forestry have led to the loss and deterioration of large areas of land formerly unused and interconnected within the delta. As a consequence species and habitat diversity has declined. The large number of hydraulic structures on the Danube and its tributaries has also considerably reduced the sediment transport thereby bringing the growth of the Danube Delta into the Black Sea in parts to a halt.

Although considerable restoration measures have been undertaken in the last decade new canalisation projects are still being planned and implemented. Sound environmental impact assessments need to be carried out and alternative solutions found in order to protect this unique natural heritage of global importance.

The [coastal waters](#) and the larger marine environment of the Black Sea have been strongly influenced by high nutrient loads from the inflow- ing rivers especially in the period up to the mid 1980s. Since then a significant reduction of nutrient input has taken place, but the nutrient level is still significantly higher than in the 1960s. The effects of reduced nutrient inputs are clearly visible particularly in the North- western Shelf of the Black Sea, which is shallow and therefore partic- ularly susceptible to eutrophication. The marine ecosystem of the Black Sea is highly complex and strongly influenced not only from high nutrient loads from the Danube and other Black Sea tributaries but also from other pressures such as over-fishing and changes in the food web.

[Groundwater](#) is mainly used for drinking water supply and for agriculture. In some areas significant pressures result from over- abstraction, high nutrient levels infiltrating the groundwater as well as from hazardous substances originating from inadequate waste treatment. For these reasons a few important transboundary groundwater bodies are estimated to be “at risk” to reach the environ- mental objectives. Since many of the groundwater bodies are highly vulnerable special protection strategies are needed to ensure the sustainable use and protection of groundwater.

Finally, the [economic aspects](#) of implementing the Water Framework Directive need to be strengthened. Currently, economic data are being collected based on administrative boundaries, which are not in accordance with the hydrological boundaries of the river basins. It has become apparent that this is a problem throughout Europe, not only in the Danube River Basin. Best practices on assessing cost- effectiveness and introducing water pricing strategies should be shared.

This first analysis of the Danube River Basin District is based on [available data](#) and is the best result that was possible within the given time frame. It thereby reflects the current level of preparation of a harmonised and integrated river basin management analysis. The starting point and the availability of data is vastly different throughout the Danube River Basin District. The extent, the quality and the degree of harmonisation of the data will improve with future reviews and updates of the characterisation and analysis, which will make later assessments more comprehensive and robust. In order to achieve this goal, the dedicated process needs to be set up to improve the data base, in particular as regards data availability and comparability.

Such an improved knowledge base would include, inter alia, the development of:

- an improved emission inventory leading to a Pollutant Release and Transfer Register (PRTR) for the Danube river basin;
- an inventory of hydromorphological alterations and of HMWB;
- improved transboundary monitoring programmes, mainly for the purpose of “surveillance monitoring” of the ecological and chemical status;
- an inventory on the quality status of protected areas and, where appropriate wetlands;
- an inventory of transboundary groundwater bodies and their status.

In addition, a Strategic Plan has been developed for a common, consistent and harmonised [Geographical Information System \(GIS\)](#) for the Danube River Basin. It addresses organizational, technical and financial issues, defines a planning procedure, and explains strategies and concepts for this important management tool. The aim is to facilitate the movement and analysis of data in a structured and seamless manner.

Furthermore, the [harmonisation of criteria and assessment methodologies](#) needs to be pursued. An improved analytical quality control system is needed. In particular, the harmonisation of elements of the ecological quality assessment is essential, including the typology and reference conditions as well as the harmonisation of criteria for designating heavily modified water bodies, which would finally lead to carrying out a Danube intercalibration exercise in 2007/2008.

Next steps are to integrate the results of the pressure and impact analysis with the results of the economic analysis of water uses in order to develop a coherent and integrated [programme of measures](#) for the water bodies “at risk” of failing to reach the environmental objectives.

[Public participation](#) should be carried out on different levels depending on the scale of the issues being addressed. In a large transboundary river basin like the Danube there is an international dimension to public information and consultation. An Operational Plan for the international level has been agreed for 2004 and will be further developed for the following years

## Die österreichische Position bei der Umsetzung der EU Wasserrahmenrichtlinie

### Mag. Gisela Ofenböck

Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft - Abt. VII 1  
email: gisela.ofenboeck@lebensministerium.at



## Entstehungsgeschichte der WRRL

### Wasserrelevante EU-Richtlinien

- Trinkwassergewinnung aus Oberflächengewässern (1975)
- Badegewässer-RL (1976)
- Gefährliche Stoffe RL (1976)
- Informationsaustausch f. Oberflächengewässer (1977)
- Fischgewässer RL (1978)
- Grundwasser RL (1980)
- Trinkwasser-RL (1980/1998)
- Kommunale Abwasser RL (1991)
- Nitrat-RL (1991)
- IPPC-RL (1991)

➔ Nutzungsorientiert

➔ Umfassende Neuordnung des europäischen Wasserrechts notwendig

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G. Ofenböck/V. Koller-Kreimel

19. Jänner 2006

## EU- Richtlinien

- sind „Gesetze“
- bestehen aus
  - Präambel
  - Artikel
  - Technische Anhänge



## Entstehungsgeschichte der WRRL

- **1994: erster Vorschlag für eine Ökologie-RL**
- **1995:** Einigung zwischen Europäischer Kommission – Rat – Parlament zur **Neuorientierung auf dem Wassersektor**
- **1996:** umfangreicher Konsultationsprozess
- **1997** Vorschlag der EK (1998 Ergänzung)
- **23. Okt. 2000:** (Wasserrahmenrichtlinie 2000/60/EG):  
RL zur *Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik*  
In-kraft-getreten am 22. Dez. 2000

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19. Jänner 2006

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19. Jänner 2006

### EU-Wasserrahmenrichtlinie (WRRL) (RL 2000/60/EC)



- Ordnungsrahmen für die europäische Wasserpoltik
  - im Sinne der Nachhaltigkeit
- Umfassender Schutz aller Gewässer
  - **Verschlechterungsverbot**
  - **Ziel: Guter Zustand aller Gewässer bis 2015**
  - **Auslaufen der besonders gefährlichen Stoffe (prioritäre Stoffe)**
- Grundsätzlich neu:
  - Verstärkte Ausrichtung auf Ökologie
  - Ökonomische Analyse und Anwendung wirtschaftlicher Instrumente
  - Öffentlichkeitsbeteiligung
  - Bewirtschaftung in Flusseinzugsgebieten

→ **Planungsrichtlinie**

### Güteziel:

(Natürliche) Oberflächengewässer:  
„guter ökologischer Zustand“

- differenziert nach Gewässertypen
- orientiert am (weitgehend) natürlichen Zustand
- Abweichung der Gewässerbiozönose vom gewässertypspezifischen Referenzzustand

Künstliche oder erheblich veränderte Gewässer:  
„gutes ökologisches Potential“



Bewertung des ökolog. Zustandes	Abweichung vom typspezifischen Naturzustand
sehr gut	minimal
gut	gering
mäßig	mäßig
unbefriedigend	stark
schlecht	sehr stark



### Güteziel der WRRL



- ♦ **Qualitätsziele sind festzulegen**, die sicherstellen sollen
  - für **Oberflächengewässer** einen **guten ökologischen und guten chemischen Zustand**
  - für **künstliche oder erheblich veränderte Wasserkörper** ein **gutes ökologisches Potential**
  - für **Grundwasser** einen **guten mengenmäßigen und guten chemischer Zustand** sowie die **Umkehr** von signifikanten, anhaltenden **negativen Trend**

### Bewertung des Ökologischen Zustands



#### Fließgewässer

- Makrozoobenthos
- Phytobenthos/Makrophyten
- Fische
- Generelle chemisch-physikalische Parameter

#### Seen

- Phytoplankton
- Makrophyten
- Fische



Entwicklung der Bewertungssysteme weitgehend abgeschlossen

„künstliche oder erheblich veränderte Wasserkörper“  
(§ 30 b WRG)

Eigene Kategorie: Gewässer(abschnitte), die hydromorphologisch stark verändert sind **und**

a) die Herstellung des guten Zustandes hätte **signifikante negative Auswirkungen** auf

- die **Umwelt** im weiteren Sinn
- **Nutzungen**

Stromerzeugung, Hochwasserschutz, Schifffahrt, Trinkwasserversorgung , Be-/Entwässerung, Freizeit, Siedlungstätigkeit, u.a. nachhaltige Entwicklungstätigkeiten

**und**

b) **Alternativen**, die eine **bessere Umweltoption** wären

- sind technisch nicht machbar
- würden unverhältnismäßig hohe Kosten verursachen

Planungszyklus

- *Übernahme in nationales Recht* 2003
- *Identifikation der Flussgebiete* 2003
- **Ist-Bestandsanalyse** 2004
- *Interkalibrierung* 2005/2006
- **Überwachung - Monitoring** 2006
- *Start Öffentlichkeitsbeteiligung* 2006
- **Flussgebietsbewirtschaftungsplan** 2009
- **Umsetzung der Maßnahmenprogramme** 2012
- **Erreichung der Umweltziele** 2015
- **Revolvierung** (2021) / (2027)

Wasserrahmenrichtlinie (WRRL)

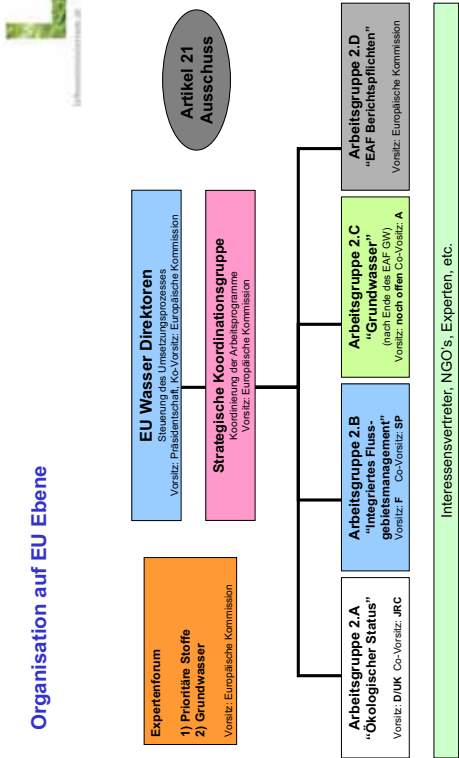
- ist Innerhalb von **3 Jahren** nach In-Kraft-treten im **nationalen Recht** zu verankern
- setzt alte EU-RL **außer Kraft** nach – **7 Jahren**
  - Informationsaustausch f. Oberflächengewässer (1977)
  - Oberflächenwasser f. Trinkwassergewinnung (1975)
- **13 Jahren**
  - Fischgewässer RL (1978)
  - Grundwasser RL (1980)
  - Gefährliche Stoffe RL (1976)



Was trägt die Europäische Kommission bei ?

- **Forcierung der Umsetzung des EU Rechtsbestandes**
- **Begleitung und Unterstützung der Umsetzung der WRRL**
  - Arbeitsgruppen + Leitdokumenten
  - WRRL - Artikel 21 Komitee
  - Forschungsprojekte
- **Neuausrichtung des Berichtswesens**
- **regelmäßiges Screening des Umsetzungsfortschrittes**

Organisation auf EU Ebene



Common Implementation Strategy (CIS)

CIS-Leitfäden

- Impacts & Pressures (IMPRESS)
- Reference Conditions (REFCOND)
- Intercalibration
- Monitoring
- Heavily modified water bodies
- Water bodies
- Economic Guidance
- Ecological classification
- Environmental objectives

<http://wasser.lebensministerium.at/>  
[www.forum.europa.eu.int](http://www.forum.europa.eu.int)

Umsetzung der WRRL in Österreich

5 Arbeitskreise (Bund/Länder)

- Arbeitskreis A - Allgemeines (Recht, Administration, Ökonomie)
- Arbeitskreis B - Ökologie
- Arbeitskreis C - Chemie/Emissionen und Maßnahmen
- Arbeitskreis D - Chemie/Überwachung und Ziele
- Arbeitskreis E - Grundwasser

Wasserrahmenrichtlinie (WRRL)

umgesetzt in nationales Recht  
mit

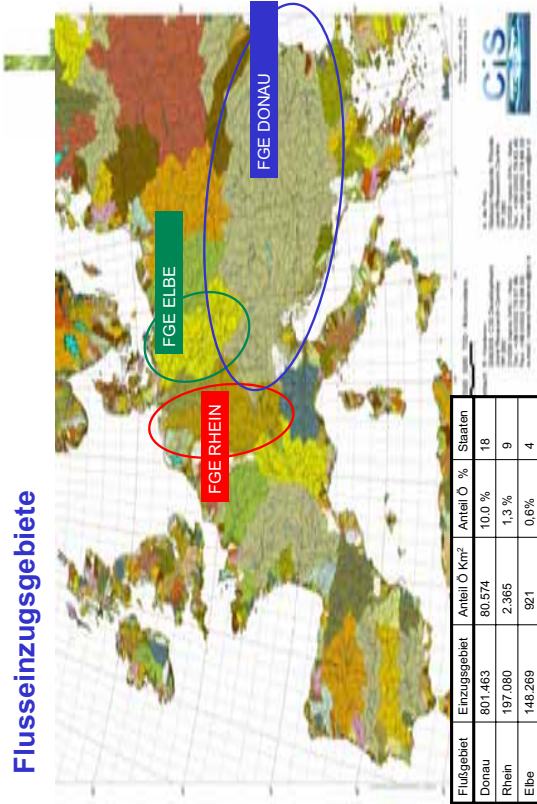
Wasserrechtsgesetz-Novelle 2003  
(BGBl. I Nr. 82/2003)

In Kraft getreten am 22.12.2003

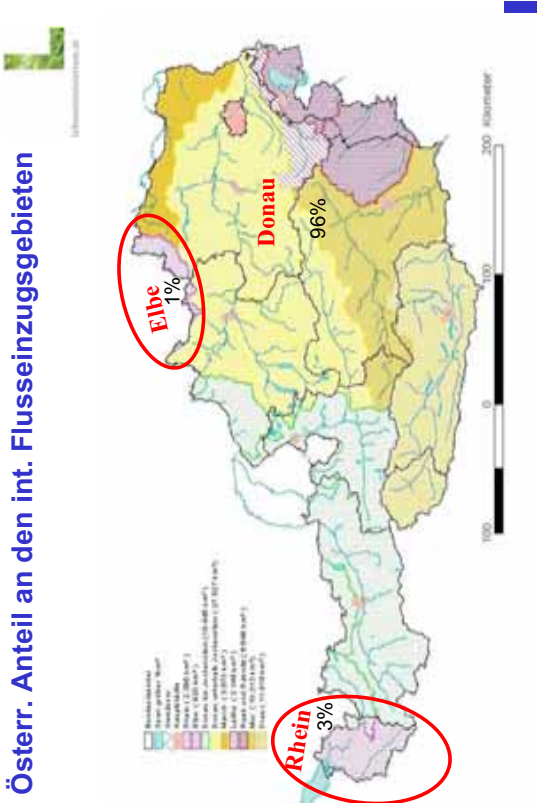
Intensive stakeholder-Diskussion!

Planungszyklus

- Übernahme in nationales Recht 2003
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- *Interkalibrierung* 2005/2006
- **Überwachung - Monitoring** 2006
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- **Erreichung der Umweltziele** 2015
- **Revolvierung** (2021) / (2027)



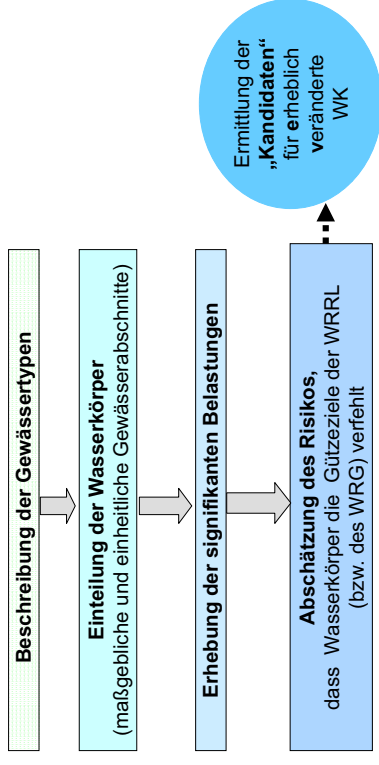
Österr. Anteil an den int. Flusseinzugsgebieten



Planungszyklus

- Übernahme in nationales Recht 2003
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- **Erreichung der Umweltziele** 2015
- **Revolvierung** (2021) / (2027)

## Ist-Bestandsanalyse 2004 für Oberflächengewässer umfasst...



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## Erhebung der signifikanten Belastungen...

### Signifikante Belastungen sind

- maßgebliche *stoffliche Belastungen*
- Eingriffe in den *Abfluss* (Hydrologie) sowie
- die *Struktur* der Gewässer (Morphologie)

... die dazu führen können, dass das Güteziel des guten Zustandes nicht erreicht wird

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G. Ofenböck/V. Koller-Kreimel

19. Jänner 2006

## Erhebung der Belastungen

### Hydromorphologie

- Wasserentnahmen
- Schwall
- Wasserspiegelschwankungen bei Seen
- Aufstau
- Wanderungshindernisse
- Morphologie

### Stoffliche Belastung/Chemie

- Messstellenbewertung: gefährliche Stoffe, allgemein
- chem-phys. Parameter

### Biol. Gewässergüte

## Risikoabschätzung

Abschätzung, welche Wasserkörper auf Grund der signifikanten Belastungen und Eingriffe *möglicherweise* das **Güteziel verfehlen**

3 Bewertungskategorien:

kein Risiko

Risiko

### Risiko nicht einstuftbar

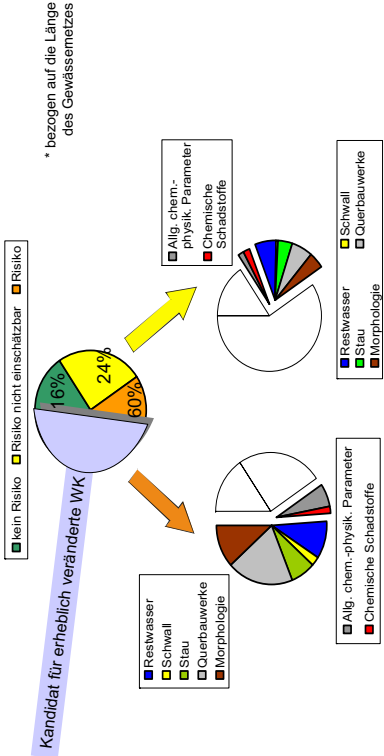
aufgrund nicht ausreichender Datenbasis oder Hinweis auf Belastung vorhanden, tatsächliche Auswirkungen aber derzeit nicht exakt abschätzbar

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19. Jänner 2006

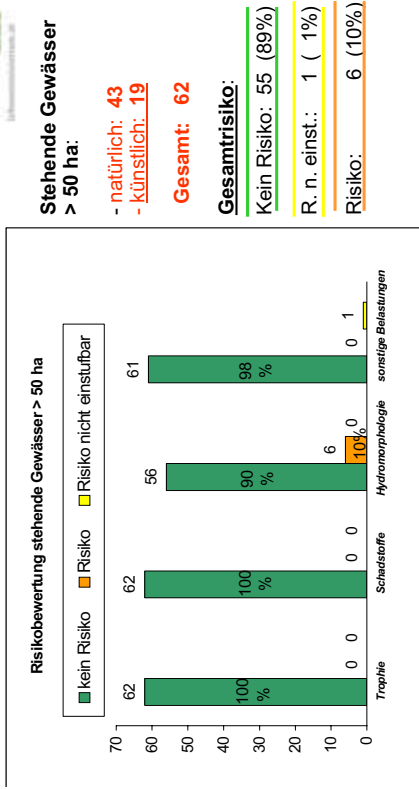
# Ergebnis der Risikoanalyse \* Österreichische Fließgewässer > 100 km²



## Ursachen für Risikoausweisung

- Österreich ist ein alpines Land
- Eingeschränkter Siedlungsraum → **Hochwasserschutz**
  - Nutzung der **Wasserkraft** als Ö einzig relevante erneuerbare Energiequelle

## Ergebnis der Risikoabschätzung – gegliedert nach den Belastungstypen



## Handlungsbedarf

Hausaufgaben in der Abwasserreinigung sind gemacht !

- Probleme konzentrieren sich auf die **Fließgewässer** und zwar auf die **hydromorphologischen Defizite**
- Herstellung der Durchgängigkeit (flächendeckend)
  - ausreichendes Restwasser (v.a. in Trockenstrecken)
  - Minimierung der Schwallauswirkungen (*alpine Gebiete*)

## Planungszyklus



- *Übernahme in nationales Recht* 2003
- *Identifikation der Flussgebiete* 2003
- **Ist-Bestandsanalyse** 2004
- **Interkalibrierung** 2005/2006
- **Überwachung - Monitoring** 2006
- *Start Öffentlichkeitsbeteiligung* 2006
- **Flussgebietsbewirtschaftungsplan** 2009
- **Umsetzung der Maßnahmenprogramme** 2012
- **Erreichung der Umweltziele** 2015
- **Revolvierung** (2021) / (2027)

## Interkalibrierung



**Annex V 1.4.1:** Vergleichbarkeit der Ergebnisse der biologischen Überwachung  
**Ziel:** gut muss überall gut sein!  
Grenze sehr gut/gut und gut/mäßig  
je 2 Stellen für eine Bandbreite von Typen in jeder Ökoregion



## Weitere laufende Aktivitäten ...



- **Interkalibrierung**  
(erste Ergebnisse bis Mitte 2006, Fortführung geplant)
- **Monitoring**
  - Programmerstellung bis Ende 2005
  - Start Ende 2006
- **Vervollständigung der Ist-Bestandsanalyse**  
( v.a. Belastungserhebung der Fließgewässer 10-100 km2)
- **Test der biolog. Bewertungsmethoden**
- **Vorbereitung der Sanierungsmaßnahmen**

## Umsetzung der WRRL bringt ...



- Herausforderung für die Wissenschaft  
z.B. bei der Entwicklung neuer Bewertungsmethoden
- **Ermessensspielraum**  
massgeschneiderte Lösungen im Sinne der Kosteneffizienz (ökonomisch effizienteste Maßnahme zur Zielerreichung!)
- **Öffentlichkeitsbeteiligung als neue Herausforderung**
- Zeitdruck durch enge Terminvorgaben
- **Komplexität und hoher Vernetzungsgrad** erfordern große Flexibilität / neue Wege in der Zusammenarbeit

## Maßnahmenvorschläge zur Erreichung des Zielzustandes gem. WRRL an der Großen Tulln

19. Jänner 2006

Gerhard Käfel

www.nbsg.at



## Ziele des Vortrages

- Vorschlag für Umsetzung WRRL an einem konkreten Beispiel
- „erheblich veränderte WK“ (HMWB)
- Ökol. Grundlagen für Sanierungsvorschläge
- Vorschlag v. Kompensationsmaßnahmen am Beispiel Grosse Tulln
- Kostenschätzung am Beispiel Grosse Tulln



## Ziele Projekt Große Tulln (2002-2004)

- Bewertung d. ökolog. Zustandes der Gewässerabschnitte der Großen Tulln
- Vorschlag Vorausweisung HMWB
- Vorschlag Definition MÖP
- Vorschlag v. Kompensationsmaßnahmen
- Kostenschätzung



## Projektsgebiet

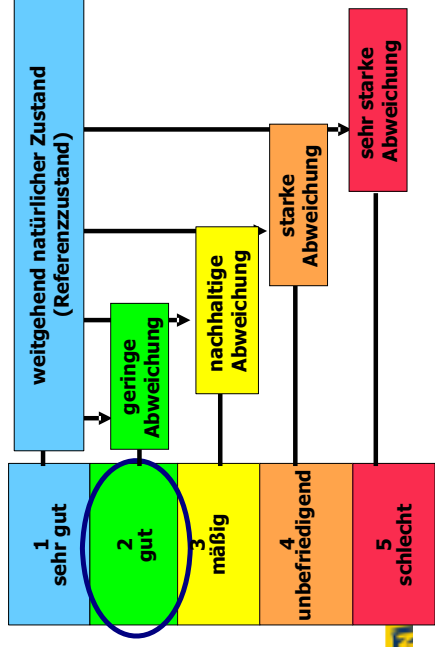


## Ziele des Vortrages

- **Vorschlag für Umsetzung WRRL an einem konkreten Beispiel / Bewertung ökol. Zustand**
- „erheblich veränderte WK“ (HIMWB)
- Ökol. Grundlagen für Sanierungsvorschläge
- Vorschlag v. Kompensationsmaßnahmen am Beispiel Grosse Tulln
- Kostenschätzung am Beispiel Grosse Tulln



## Zustand der Oberflächengewässer



## Risiko- Einstufung



EU-WRRL – IST- Bestandsaufnahme Risikoeinschätzung im Detail										Hydromorphologie					H B	M B
Detail- wasserkörper		Chemische Stoffe		Nähr- stoffe	Hydropho- ne					Telefio					Risiko	Stau
					Algen- prozent	Q <sub>10</sub>	Reau	Schall	Meyn							
	> 100 km <sup>2</sup>															
	4.103.350	Große Tüln	1	3	3	3	1	1	3	3	3	1	3	3		
	4091.700	Große Tüln	1	3	3	3	1	1	3	2	3	2	3	3		
	4091.600	Laubenzach	1	2	3	3	3	1	1	1	1	1	1	3	3	



## Bewertung Ökologischer Zustand

Absehrntr	Nurzung	Phynok	MZB	Sapno	Fische	Ok. Zust.
Mdgr-lagro	Wasserkraft					IV
Lagro-lrau	Wasserkraft					V
Jrau-Mksalf	Wasserkraft					V
Mksalf-Anurb	HW-Schutz					III
Neulgh-Ort	HW-Schutz					III
Neulgh-Lubg	-					III
Lubg-Altgh	-					II
Altgh-Wksalf	-					IV
Wksalf-Quell	-					I



## Ziele des Vortrages

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## Guter ökologischer Zustand

↗ orientiert sich an der geringen Abweichung der Lebensgemeinschaften von typspezifischer Referenz

↗ Abhängigkeit der Lebensgemeinschaften von ihren Lebensräumen

↗ Lebensräume geprägt durch

- ↗ hydrologischer Situation
- ↗ Immissionssituation und
- ↗ ökomorphologischer bzw. struktureller Situation



## hydrologische Situation

das natürliche Abflussverhalten



Glaziales Regime

Pluvio-Nivales Regime



## hydrologische Situation

anthropogene Einflüsse

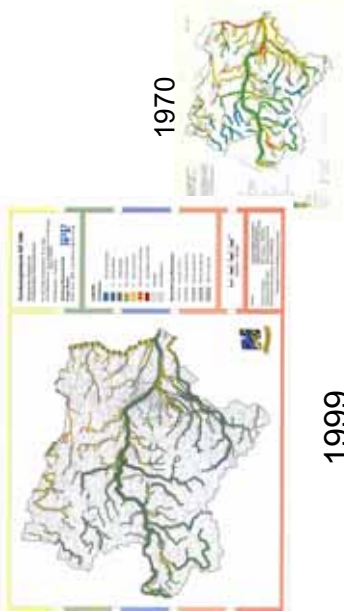


Immissionssituation

- chemisch- physikalische Verhältnisse
- trophische Verhältnisse
- saprobielle Verhältnisse



Biologische Gewässergüte



Biologische Gewässergüte

Pulkau Oberlauf      Pulkau Unterlauf

II-III			III-IV		
Saprobienstufe	%-Ant.	kum%	Saprobienstufe	%-Ant.	kum%
Xeno	2,9	2,9	Xeno	0,0	0,0
Oligo	21,1	24,0	Oligo	2,5	2,5
Beta	38,8	62,8	Beta	12,5	15,0
Alpha	29,3	92,1	Alpha	32,5	47,5
Poly	7,9	100,0	Poly	52,5	100,0
Taxazahl:		57	Taxazahl:		8



strukturelle Situation

- Linienführung und Fließverhalten

- gestreckt
- verzweigt
- pendelnd
- gewunden
- mäandrierend



## strukturelle Situation

- Verzahnung Wasser-Land
  - Breitenvariabilität
  - Ausprägung der Uferlinie
  - Totholz- und Geschiebeablagerungen



## strukturelle Situation

- Ufer bzw. Böschungen
  - Ausprägung von Ufer und Böschungen
  - Vegetationsschichtung
  - Beschattung



## Gehölze und Gewässer

- Funktionale Einheit
- Gewässer – Umland Lebensraum
- Migrationsleitlinie
- Puffer
- Gewässerbeschattung
- Temperaturregime
- Primärproduktion
- chemisch-physikalische Prozesse (Kläranlagen)



## strukturelle Situation

- Kontinuumsunterbrechungen



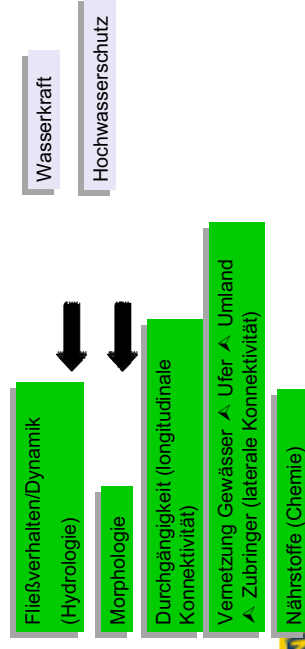
## Ziele des Vortrages

- Vorschlag für Umsetzung WRRL an einem konkreten Beispiel
- „**erheblich veränderte WK**“ (HMWB)
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- Vorschlag v. Kompensationsmaßnahmen am Beispiel Grosse Tulln
- Kostenschätzung am Beispiel Grosse Tulln



## Guter ökologischer Zustand?

Wiederherstellung gewässertypspezifischer Charakteristika (Lebensräume & Lebensgemeinschaften)



### Vorausweisung HMWB:

Abschnitte 1 bis 5 (Mündung in die Donau bis Ortsbereich Neulengbach): HMWB-Vorausweisung

Abschnitte 6 bis 9 (Oberhalb Neulengbach bis Quelle): Erreichung des Zielzustandes lt. WRRL (guter ökologischer Zustand)

## Ziele des Vortrages

- Vorschlag für Umsetzung WRRL an einem konkreten Beispiel
- Schwerpunkt „erheblich veränderte WK“ (HMWB)
- Ökol. Grundlagen für Sanierungsvorschläge
- **Vorschlag v. Kompensationsmaßnahmen am Beispiel Grosse Tullin**
- Kostenschätzung am Beispiel Grosse Tullin



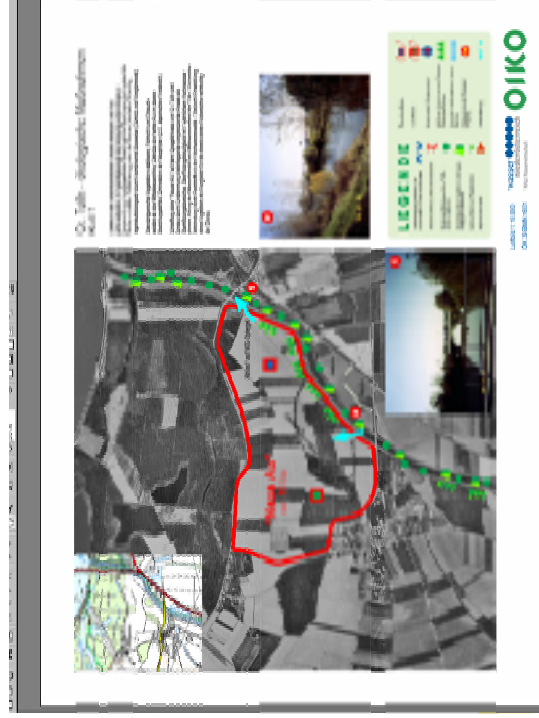
# Maximales Ökologisches Potential

- **ALLE** Kompensationsmaßnahmen die keine signifikanten Auswirkungen auf die Nutzung haben
- beste Annäherung an das ökologische Kontinuum (longitudinal, lateral)



## Maßnahmen zu Erreichung des guten ökologischen Potentials

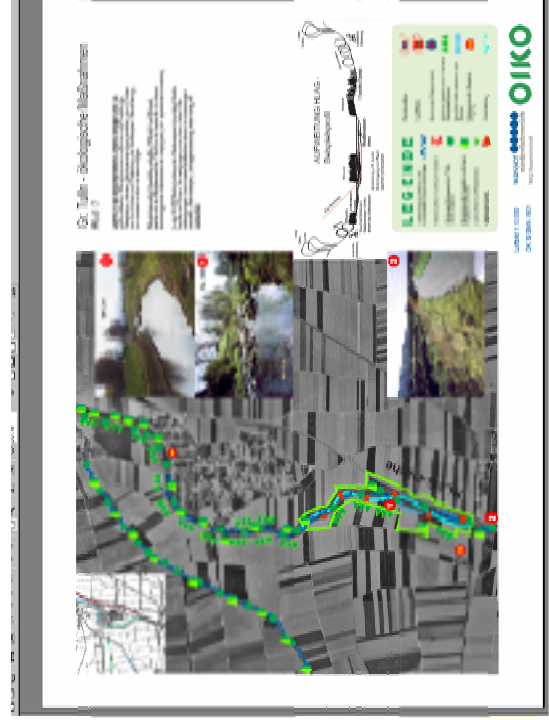
### Quantitativ geringe Abweichung von den Maßnahmen für MÖP



**GÖP (Maßnahmenvorschlag)**  
**Mündung bis Längenrohr:**

Standortgerechte Vegetation über weite Bereiche (ausserhalb von Siedlungen):

*Röhricht und Strauchweiden ab der Mittelwasserlinie; Gehölze der harten Au im oberen Böschungsdrittel und Elimination der Neophyten*



**Maßnahmen zu Erreichung des guten ökologischen Potentials**

Quantitativ geringe Abweichung von den Maßnahmen für MÖP



**GÖP (Maßnahmenvorschlag)**  
**Längenrohr bis oh. Judenau:**

Dämme versetzen und Fluss aufweiten im Bereich HLAG-Projekt ;  
standortgerechte Vegetation (sh. oben);  
Niederwasserrinne über gesamten Bereich und  
(ARA Längenrohr und Judenau anpassen)



Ziele des Vortrages

- Vorschlag für Umsetzung WRRL an einem konkreten Beispiel
- Schwerpunkt „erheblich veränderte WK“ (HMWB)
- Ökol. Grundlagen für Sanierungsvorschläge
- Vorschlag v. Kompensationsmaßnahmen am Beispiel Grosse Tulln
- **Kostenschätzung am Beispiel Grosse Tulln**



Kostenschätzung zur Erreichung des GÖP\*

Kategorien von Sanierungsmaßnahmen innerhalb erheblich veränderter WK	Geschätzte Kosten in Euro
Immission/Abwasserentsorgung	7.000.000.– (2 Anlagen)
Niederwasserinne	1.960.000.– (rd. 20 km)
Fischpassierbarkeit	2.250.000.– (10 Anlagen)
Revitalisierungen (a la HLAG)	3.500.000.– (rd. 43 ha)
Standortgerechte Vegetation (Beschattung)	360.000.– (rd. 14,5 km)
Anbindung von Auwaldrest	300.000.– (rd. 10 ha)
Diverses	190.000.--
Hydromorphologie gesamt	8.560.000.--

\* excl. Maßnahmenvorschläge in der Fläche



Kostenschätzung zur Erreichung des guten ökol. Zustandes

Kategorien von Sanierungsmaßnahmen außerhalb erheblich veränderter WK	Geschätzte Kosten in Euro
Fischaufstiegshilfen	270.000.– (5 Anlagen)
Standortgerechte Vegetation (Beschattung)	150.000.– (rd. 5 km)
Hydromorphologie gesamt	420.000.–



weitere Schritte

- Auswirkungen der Sanierungsvorschläge auf Hydrologie und Statik der Dämme im Unterlauf
- Kosten-Nutzen-Analyse



## Results of the daNUbs project 2001-2005

Matthias Zessner

### Introduction

During the period between the seventies and the early nineties the North-Western and Western Black Sea coastal area has suffered from chronic harmful algal blooms, permanent hypoxic situations, as well as mass mortalities of benthic and pelagic organisms including fish. An excessive input of nutrients (nitrogen (N) and phosphorus (P)) was the main reason for this development. The river Danube can be identified as major source for nutrients in this part of the Black Sea ecosystem. Especially eutrophication problems close to the mouth of the Danube Delta as well as on the coast south of the Delta are a result of direct Danube influence, while moving to the north along the Ukrainian coast the influence from rivers Dniestr and Dniepr increases.

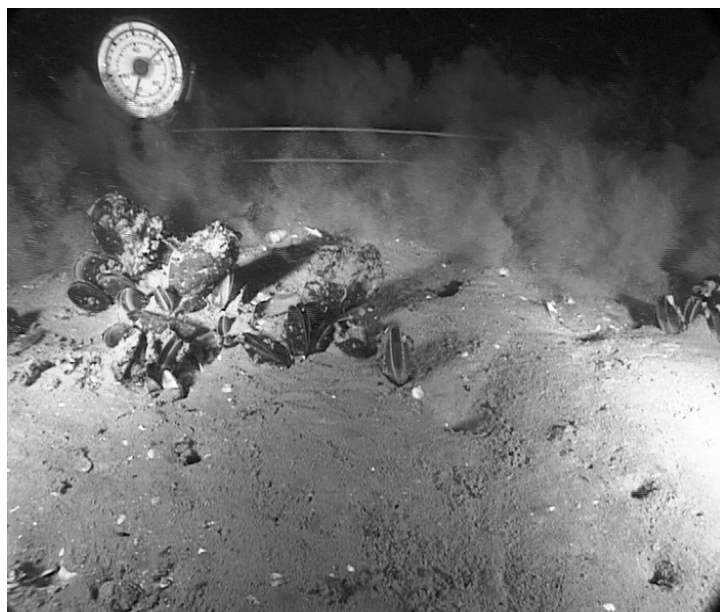
In the year 2000 the daNUbs project (“Nutrient management in the Danube River Basin and its Impact on the Black Sea”) was initiated for an integrated assessment of the nutrient fluxes in the Danube Basin and their impacts on the Western Black Sea ecosystem as basis for the development of efficient nutrient management strategies on basin scale. The daNUbs-project, coordinated by the Institute of Water Quality, Vienna University of Technology was finalised in March 2005.

### Improved ecosystem in the North Western and Western Black Sea

The situation in the North-Western Black Sea has improved considerably since the early 90s:

- reduced eutrophication (reduced phytoplankton biomass, frequency of blooms and extension of high chlorophyll area),
- considerable increase in water transparency
- improvement of near bottom oxygen regime (figure 1),
- regeneration of phytoplankton species (Diatoms) diversity,
- regeneration of phytobenthos,
- regeneration of macrozoobenthos (increase of species number).

Zooplankton community in the N-W and W Black Sea is still controlled by the gelatinous macrozooplankton (*Mnemiopsis*, *Aurelia*, *Pleurobrachia*), with respective consequences on the recovery of the pelagic fish stocks.

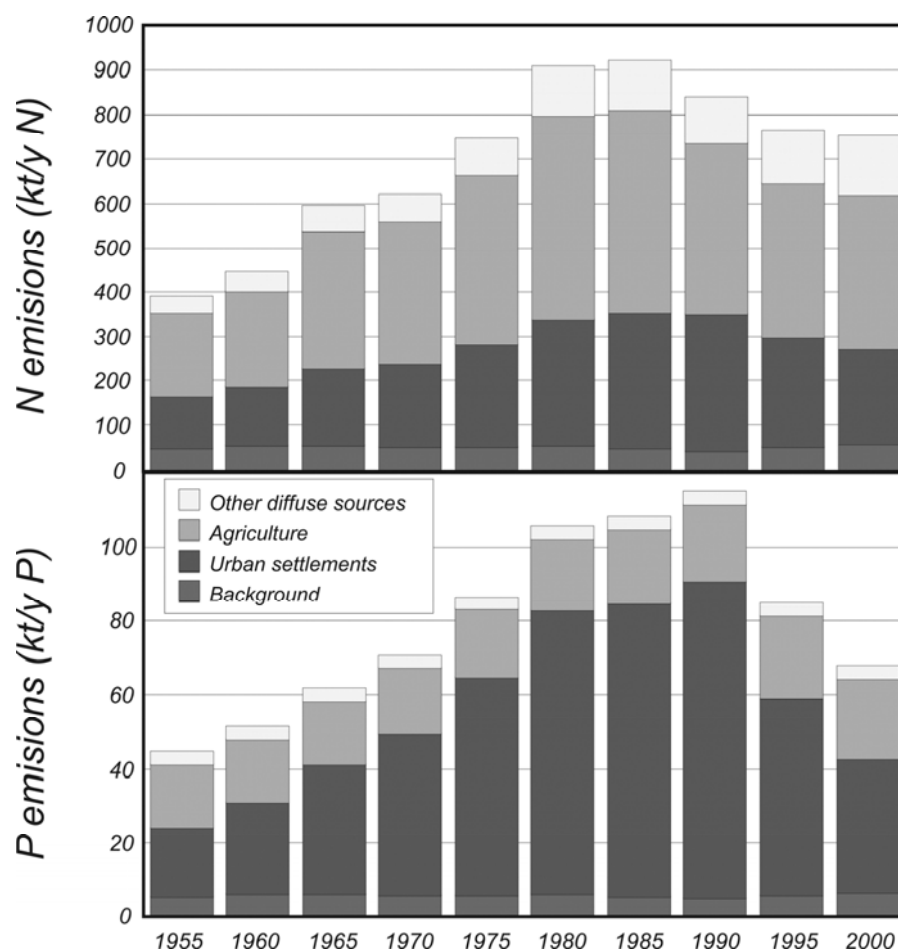


**Figure 1:** *Mytilus galloprovincialis* in front of the Danube Delta as an indicator, that anoxic conditions have disappeared (Horstmann, 2002).

The limiting factor for phytoplankton growth in the eutrophic areas of the N-W-Black Sea is P (since 1997). In the off shore waters mainly N limits the primary productivity. The improvement of the shelf ecosystem is a result of decreasing nutrient discharges (especially phosphorus) to this part of the Black Sea /figure 2).

Current low discharges of N and P to the Black Sea by Danube river are the result of

- improved nutrient removal from waste water in Germany, Austria and the Czech Republic
- reduced phosphate discharges from detergents and
- the consequence of the economic crisis in central and eastern European countries which lead to:
  - closure of large animal farms (agricultural point sources),
  - dramatic decrease of the application of mineral fertilizers and
  - closure of nutrient discharging industries (e.g. fertilizer industry).



**Figure 2:** Changes of nitrogen and phosphorus emissions into the river system of the Danube from 1955 to 2000

### Kick-off for efforts to reduce nutrient emissions

For a sustainable development of the N and NW Black Sea ecosystem the nutrient discharge from the Danube River should be further reduced but at least kept at its present level. Scenario calculations clearly show that the economic development in the Danube Basin may reverse the improving situation of the quality of the NW and W Black Sea ecosystem. Therefore, policy measures have to be proactive and should focus on continuous and long term control of all anthropogenic point and diffuse sources of nutrients (waste water management, agriculture, combustion processes). Monitoring the effects of nutrient

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management in the river Danube and the Black Sea is important but it has to be taken into account that there is a time lag (up to > 20 years) between cognition of deficiencies, implementation of control measures and corresponding effects in the river Danube.

It is recommended to apply a strong precautionary principle regarding nutrient emission based on

- best available techniques for waste water treatment (point sources)
- and best available agricultural practice for reduction of nutrient losses from agricultural areas (diffuse sources)

as such a management policy meets both objectives:

- protection of ground and surface water quality in the catchment area and
- coastal eutrophication abatement in the NW and W Black Sea shallow waters

This recommendation can be exemplarily specified as follows: consistent application of the EU IPPC directive for limitation of industrial point source emissions and “sensitive area requirements” according to the urban waste water directive with nutrient removal at municipal treatment plants in the Danube Basin with more than 10,000 p.e. should start immediately in order to avoid deterioration of the actual situation. Therefore the national governments should declare their total area in the Danube Basin as sensitive area. This would facilitate financial support of investments for waste water treatment with nutrient removal from international donor funds.

Furthermore, a consistent implementation of measures to limit nutrient emissions from agriculture is necessary.

### **Acknowledgement**

The results presented stem from the project "Nutrient Management in the Danube Basin and its Impact on the Black Sea" (daNUbs) supported under contract EVK1-CT-2000-00051 by the Energy, Environment and Sustainable Development (EESD) Programme of the 5th EU Framework Programme. Details on the project can be found on the project homepage: <http://danubs.tuwien.ac.at/>.

## **Water management issues: problems and measures (Interreg IIIB CADSES project KATER II)**

*Gerhard Kuschnig, MA31, Vienna Waterworks*

Water management is a central issue in the 21<sup>st</sup> century, because water is rapidly becoming a scarce resource. The focus in dealing with water resources on a global scale thus has to shift from a water development perspective to one of water management (WORLD BANK 1998). Water plays a vital role in human development, as the necessary basis for nutrition, a central factor for health and a resource in agricultural and industrial development.

The issues involved seem at first sight to differ quite strongly between developing countries and industrialised countries. In the developing countries studies in the last few years usually agreed on the main issues (LEE and BASTEMEIJER 1991). Nevertheless, they still apply in many respects to industrialised countries as well:

### **Need to address water source protection more systematically**

Although water related environmental problems have received much attention in the last few years, because of their central importance for sustainable development in many sectors, there is still the need for a more systematical identification and analysis of source problems.

### **Lack of reliable information**

Due to the complex interactions between natural environment and human action, which determine the quantity and the quality of water resources, the knowledge about water resources and their (possible) contaminations is often very low. This is especially true for karstic aquifers, because of their hydrogeological complexities, and presents an increasing problem, as currently karstic aquifers contribute 25% of world-wide water supply, which is supposed to rise to almost 50% in the near future (personal communication H. Trimmel, 2003).

### **Legislation not enforced**

Environmental legislation and water laws often concern only large watersheds and so do not provide adequate protection for smaller water resources. The enforcement of laws and regulations is often hampered by a lack of awareness of drinking water problems and the interactions between the environment and human action.

### **Lack of awareness**

A general lack of awareness of the environmental issues can be attributed to planners and decision-makers and sometimes even to water users. Short-term needs are often given higher priority than long-term protection of water resources. More attention should also be given to training of local staff and users, to increase awareness and to allow them to play a more active role in water resource protection.

The Interreg IIc project KATER was set up to provide solutions to some of the problems named above – especially the information gap and the systematical treatment of water issues. In the project period 1999-2001, information systems were developed to allow a comprehensive and integrative view of water measurements and their environmental conditions. KATER II – which was started in April 2003 – will concentrate on the knowledge base of decision making and on tools for technical support of the decision-making process. KATER II thus provides an information base and a knowledge-network which is in line with the current developments of the ‘World Water Portal’, which also focuses on water

information sharing and cooperation. KATER II and the “World Water Portal” share the following objectives (see also: United Nations: World Water Development Report 2003):

- using common structures, protocols, and standards to provide seamless access to a wide body of water information;
- provide technical support (metadata assistance/standards, “good practice“ guidance, search and database integration software, development of processes for data acquisition, etc.);
- Capacity-building in the area of information management (education and training for both managers and technicians);
- facilitation of working partnerships via a physical and virtual network, the use of reliable information, and the improvement of integrated water resource management decisions;
- providing a water information source for use by decision-makers, resource managers, researchers, students and the public at large.

### **The legislative framework**

On the European level, the base of legislation is the water framework directive. This directive has to be transformed into national legislation by all EU member states by the end of 2003. It is also part of the general provisions of becoming member states of the accession countries.

The key objectives of the directive at European level are generally protection of the aquatic ecology, specific protection of unique and valuable habitats, protection of drinking water resources, and protection of bathing water. All these objectives must be integrated for each river basin. It is clear that the last three – special habitats, drinking water areas and bathing water – apply only to specific bodies of water (those supporting special wetlands; those identified for drinking water abstraction; those generally used as bathing areas). In contrast, ecological protection should apply to all waters; the central requirement of the Treaty is that the environment be protected to a high level in its entirety.

On the source side, it requires that as part of the basic measures to be taken in the river basin, all existing technology-driven source-based controls must be implemented as a first step. But over and above this, it also sets out a framework for developing further such controls. The framework comprises the development of a list of priority substances for action at EU level, prioritised on the basis of risk; and then the design of the most cost-effective set of measures to achieve load reduction of those substances, taking into account product and process sources.

On the effects side, it co-ordinates all the environmental objectives in existing legislation, and provides a new overall objective of good status for all waters, and requires that where the measures taken on the source side are insufficient to achieve these objectives, additional ones are required (see: <http://europa.eu.int/comm/environment/water/water-framework/overview.html>).

All the elements of this analysis must be set out in a plan for the river basin.

The framework also addresses the need of public participation and informing the public as well as the problem of pricing. This includes the principle of recovery of the costs of water services, including environmental and resource costs.

In addition, the ESDP (European Spatial Development Perspective) explicitly aims at a linkage between groundwater protection and spatial development policy.

## Decision problems in water management

The basic tasks of water management can be divided into

- administration,
- crisis management and
- planning activities.

A more detailed task list for the roles of “Water Supply” and , “Water Protection” can be defined as follows:

Task category	Water supplier	Water protection
<b>Administration</b>	<ul style="list-style-type: none"> <li>• monitoring of discharge and outlet (water quantity and water quality)</li> <li>• regulation of used amount of water</li> </ul>	<ul style="list-style-type: none"> <li>• Property Management</li> <li>• Monitoring of Land Use Activities</li> <li>• Monitoring of Natural Environment</li> </ul>
<b>Crisis management</b>	<ul style="list-style-type: none"> <li>• technical accidents</li> <li>• water contamination</li> </ul>	<ul style="list-style-type: none"> <li>• Elementary Natural Accident</li> <li>• Global Contamination</li> <li>• Local Contamination</li> </ul>
<b>Planning</b>	<ul style="list-style-type: none"> <li>• maintenance work</li> <li>• forecast of quantity and quality</li> <li>• analyses supply versus demand</li> </ul>	<p>Analyses concerning possible changes in interdependences:</p> <ul style="list-style-type: none"> <li>• Land Use with Water Balance</li> <li>• Natural environment with Water Balance</li> </ul>

Figure 1: Task lists for “water supplier” and “water protection”

A detailed analysis of tasks shows that the nature of decision making and the time scale of decisions is clearly different between task categories. Planning needs long-term decisions under conditions of low time-pressure, whereas administration and, above all, crisis management need immediate decisions. The support of decisions in water management must take into account the differing information needs and tailor the decision-support system (including the structuring of data access, the manner of data presentation and the system functionality) according to user needs.

## Data collection and integration in GIS database

The first step was to integrate data sources of various disciplines. These include geology, hydrogeology, meteorology, vegetation mapping, pedology, remote sensing, surveying, etc. The data was transformed into one consistent system of spatial reference, including the activities of assessment of data quality and plausibility. The systematic integration of direct spatial information, like geological or hydrogeological maps could easily be used within GIS. It proved to be more difficult to integrate the measurement data of various measurement campaigns and monitoring stations into the same system of reference. The objective of integrating the measurement data is to have online access via the information system to the measurement stations. This is especially important for the tasks of crisis management and also administration.

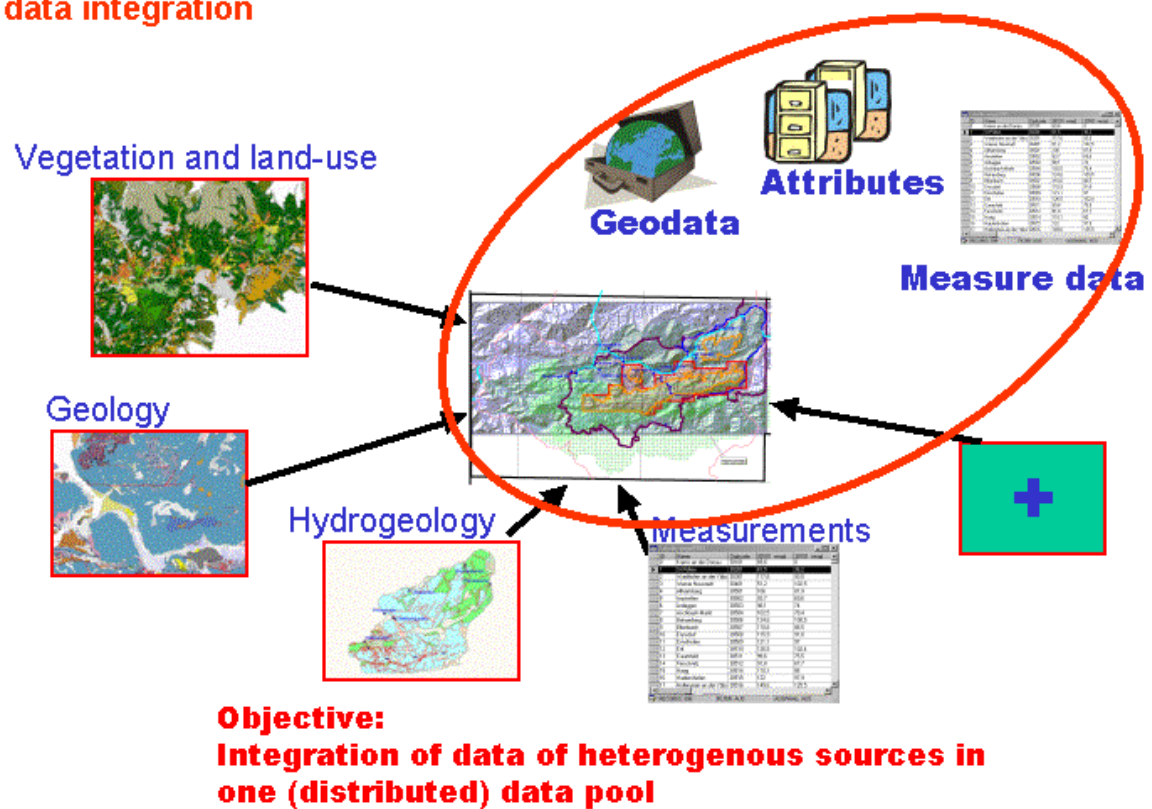
**data integration**

Figure 2: Data integration

# TU Wien

Institut für Städtebau, Landschaftsarchitektur u. Entwerfen

## Aktuelle Themen zur Landschaftsplanung

*Ernst Mattanovich, Jakob Grohmann:*

**Wasserrahmenrichtlinie und UVP bei Infrastrukturprojekten**



Wasserrahmenrichtlinie und Großprojekte

### Wasserrahmenrichtlinie (WRRL 2000)

#### Fließgewässer

- **Umweltziele in der Wasserrahmenrichtlinie: Art.4, Abs. 1:**  
*(...) Die Mitgliedstaaten schützen, verbessern und sanieren alle Oberflächenwasserkörper (...) mit dem Ziel, spätestens 15 Jahre nach Inkrafttreten dieser Richtlinie (...) einen guten Zustand der Oberflächengewässer zu erreichen.*
- **Erstellung von Bewirtschaftungsplänen mit Analyse Zustand und Definition Zielen (Guter Zustand, Referenzstrecke) sowie festgelegtem Zeitplan zur Erreichung der Ziele**
- **Regelmäßige Kontrolle der Zielerfüllung (alle 6 Jahre)**
- **Umsetzung in nationalen Gesetzen (Wasserrechtsgesetz, Wasserbautenförderungsgesetz, Verordnungen etc. )**

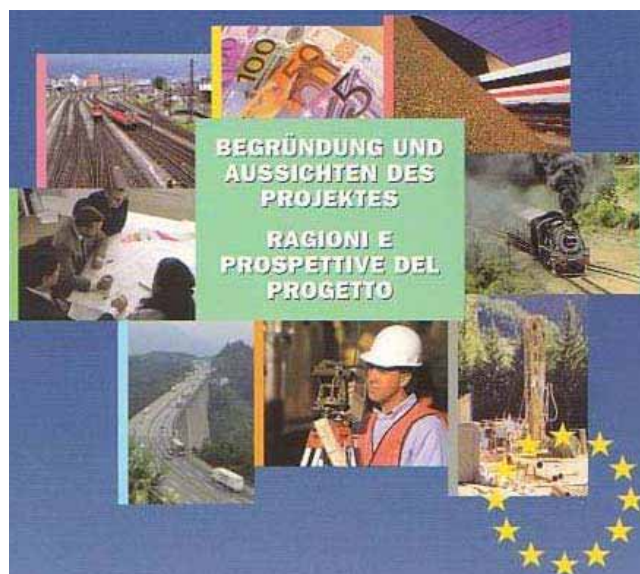


## Infrastruktur-Vorhaben im UVPG

### Schutzgut Wasser (Oberflächenwasser und Grundwasser)

- Beurteilung der Ist-Situation im Untersuchungsraum
- Ansprache der Auswirkungen des Projektes auf die Oberflächengewässer und bestehende Wassernutzungen
  - *Quantitativ*: Hochwasserschutz, Retentionsraum, Ein/Ausleitungen
  - *Qualitativ*: biologische Gewässergüte, Ökomorphologie (Strukturausstattung), Ökologische Funktionsfähigkeit
- Ermittlung der Eingriffserheblichkeit
- Festlegung von Maßnahmen zum Schutz, zur Vermeidung und zum Ausgleich
- Beurteilung der Restbelastung

## Projektbeispiel Brenner Basistunnel



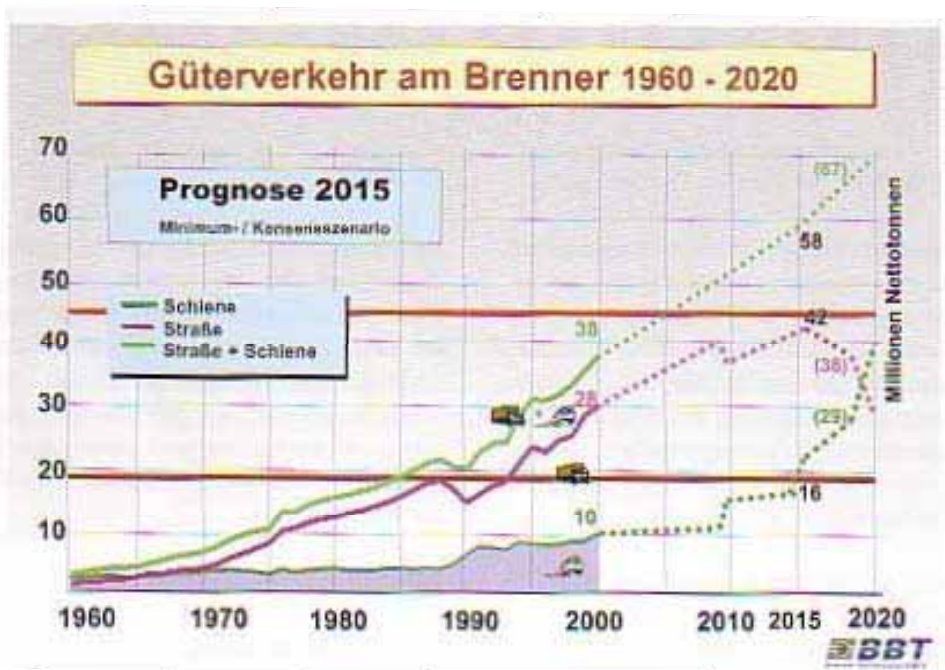
## Wasserrahmenrichtlinie und Großprojekte

## Projektbeispiel Brenner Basistunnel



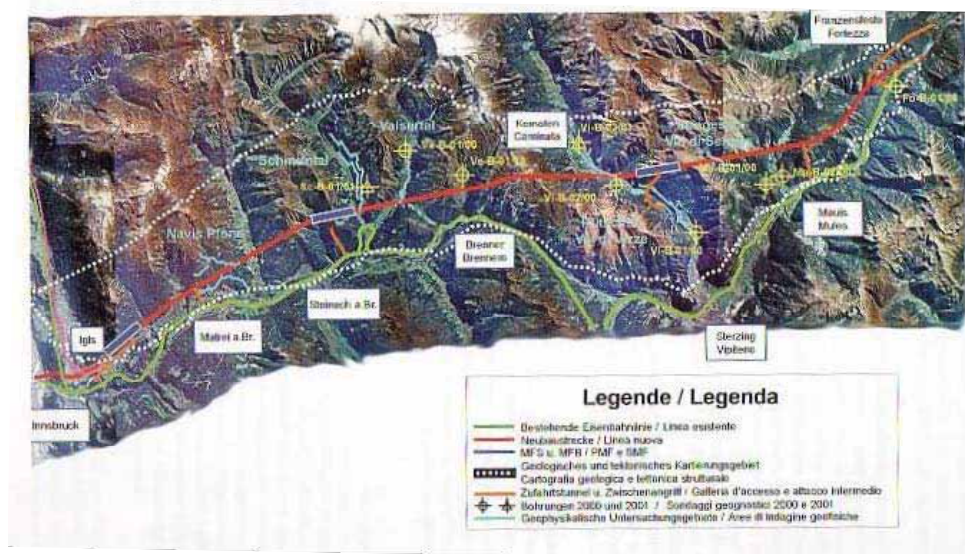
## Wasserrahmenrichtlinie und Großprojekte

## Projektbeispiel Brenner Basistunnel



## Wasserrahmenrichtlinie und Großprojekte

## Projektbeispiel Brenner Basistunnel



## Wasserrahmenrichtlinie und Großprojekte

## Mittellauf der Sill in der Gemeinde Steinach

- Gewässer entspricht nicht dem Leitbild, weist aber hohes ökologisches Potential auf
- Tunnelbauten bedingen Schutzbauten am Flusssufer
- Baustelleneinrichtung führt zu temporärer Reduktion des Retentionsraumes und der ökologischen Funktionsfähigkeit des Flusses
- Temporär: Schutzmaßnahmen während der Bauphase
- Dauerhaft: Wiederherstellung des Gewässers gemäß Leitbild, d.h. stärker pendelnde Linienführung als vor Projekt
- Maßnahmen nicht nur vor Ort und an anderen Gewässerabschnitten mit hohen Defiziten möglich, zB. Neue Retentionsräume, Vernetzung Zubringerbäche

## Zusammenfassung

### Konsequenzen der WRRL für Großprojekte

- **Stärkere Betrachtung des gesamten Einzugsgebietes**
- **Nicht nur Eingriffspunkt, sondern „System Gewässer“ erfassen und beurteilen**
- **Entwicklung von Ausgleichsmaßnahmen auf das Leitbild bezogen**
- **Bewirtschaftungspläne (Leitbild) müssen Projektplanung umfangreich reflektieren**

## **Water management under extreme conditions of conflict in the Gaza Strip**

Anwar Awadallah

### **Abstract**

Land use planning in the Gaza Strip has actually started directly after the establishment of the Palestinian Authority in 1994. Related issues (such as infrastructure and natural resources) have been in the core of interest and a comprehensive planning approach was considered so as to include all relative issues which had never received any planning interest under any of the British mandate, the Egyptian administration or the Israeli occupation for several decades. In particular, the natural resources have been the main issue of interest for the Israeli occupation. These resources included mainly land and water; in the Gaza Strip, the later of which is almost completely dependent on the former. This paper describes water related issues in the Gaza Strip and shows how the political conflict has had a negative role on both quantity and quality of water. It also presents concepts related to water resources management in the Gaza Strip mainly before and after the first Israeli withdrawal from the Gaza Strip in May 1994.

### **Key Words**

Water resources, conditions of conflict, management

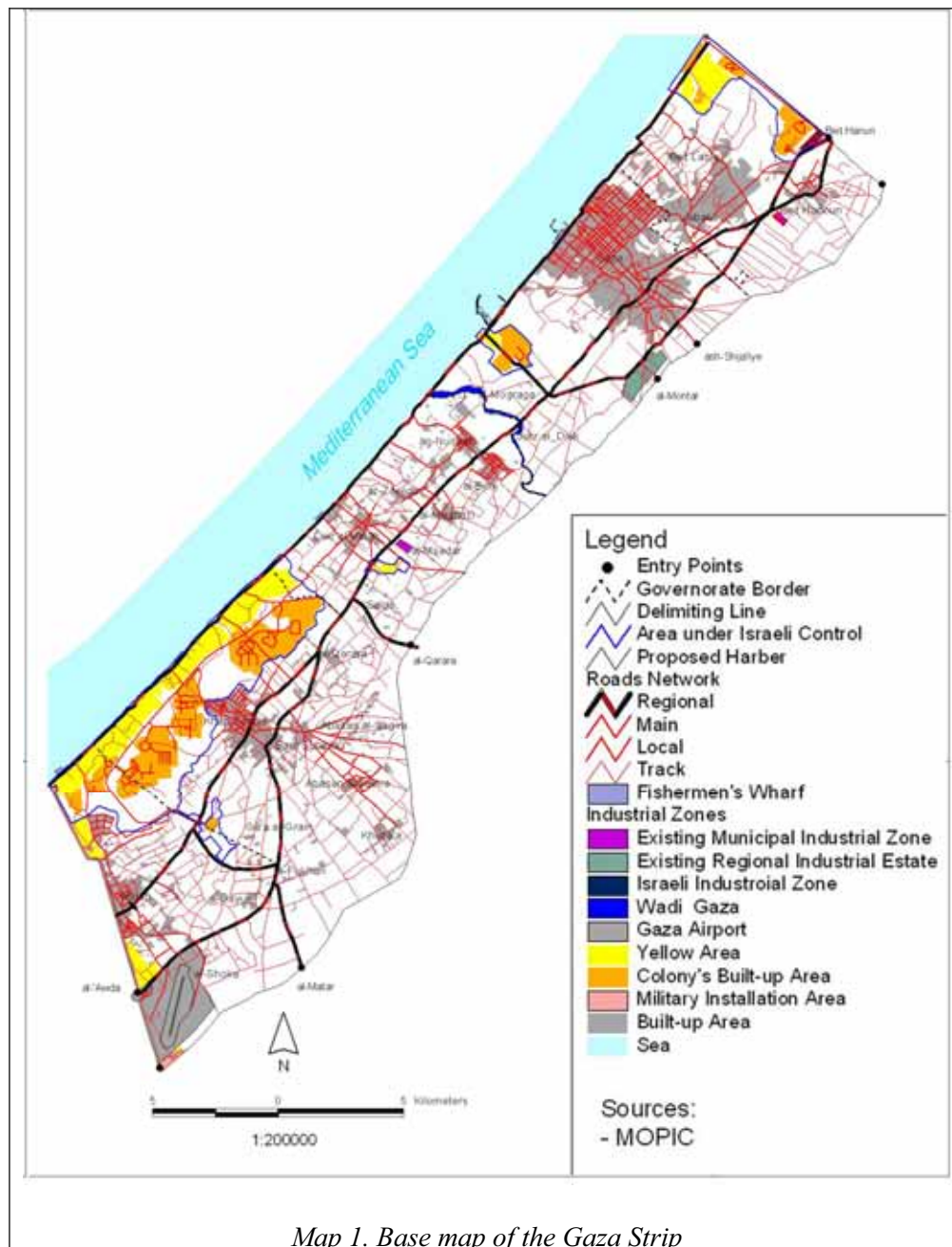
### **Introduction**

Natural resources have been one important (if not the most important) reason standing behind wars and conflicts worldwide. This reason is also applied to the case of the Palestinian Territories. The story of the Palestinian problem started directly after the First World War, when the region of Palestine was put under the British Mandate which, by its turn, enabled Jews from worldwide (but mainly from Europe) to immigrate and to establish a homeland in Palestine. The State of Israel was established in May 1948 over the whole Palestinian lands excluding the West Bank and the Gaza Strip which Israeli Army occupied in June 1967. The game of the peace process in the Middle East started after the first Gulf war in 1991 and it leads to the first Israeli withdrawal from parts of the West Bank and the Gaza Strip. During the Israeli occupation, 17 Israeli settlements were established in the Gaza Strip while more than 148 settlements were established in the West Bank. In the Gaza Strip, natural resources, in particular water, were strongly standing behind this settlement strategy. Map (1) shows the 'yellow areas', where the Israeli settlements were established and which were kept under the Israeli occupation after the first Israeli withdrawal from the Gaza Strip in 1994 as a first phase of the peace process. The conditions of conflict left the Gaza Strip with very low levels of welfare and deteriorated the quality of life represented by environment, natural resources, respective public awareness, and the institutional and legal frameworks that could integrate and manage all of those efficiently. This paper presents a brief description of the water status in the Gaza Strip, the impacts from conditions of extreme condition on the water sector and the management response by local authorities.

### **Background on water status in the Gaza Strip in 1995**

In the Gaza Strip some hydrological data do exist; some of which date back to the 1930s, while in the 1970s comprehensive monitoring programmes were established for rainfall, groundwater quality, groundwater table, groundwater abstraction and so forth (MoPIC, 1996b). Nevertheless, data is not complete since these times. Too there is no guarantee that these data are accurate because the source of this data is mainly the Hydrological Service of

Israel. The conditions of conflict in the whole area is the reason standing behind this doubt, especially because both water and land are in the core of conflict reasons. However, this data has been the only basis that Palestinian Authority has had to rely and to formulate policy direction upon. The data from 1994 and 1995 includes the following (based on MoPIC [1996b]):



Map 1. Base map of the Gaza Strip

- Around 1.4 billion m<sup>3</sup> of fresh groundwater was left in the shallow aquifer; this amounts one third of its former capacity.
- Average annual rainfall is around 315 mm/year (or 115 million m<sup>3</sup> per year over the entire area); on average only 40% (46 millions m<sup>3</sup>) of total rainfall replenishes the groundwater. The remaining evaporates or disappears as runoff. Evaporation accounts for most of it.
- Annually around 7 million m<sup>3</sup> of fresh groundwater flows across the border into the Gaza Strip
- On average the wadi (valleys) flows around 10 days per year. Total recharge in the wadi bed during these ten days could be as high as 2 million m<sup>3</sup>.

- In 1995 around 46 million m<sup>3</sup> were pumped into the municipal networks (around 28 million m<sup>3</sup> of the water pumped into the network arrives in the households [only 2 million m<sup>3</sup> of which are used for drinking and cooking]<sup>1</sup>, whilst about 18 million m<sup>3</sup> are lost). With a total population of around 905,000 in 1995; the average quantity pumped per person amounts to 50 m<sup>3</sup> per year, or 140 litres per day while, by removing leakage, the average quantity pumped per person amounts to 80 litres per person per day). Recently, with a (projected) population of about 1.472 million inhabitants (PCBS, 1999), the average per person per day decreased to less than 50 litres.
- Around 8 million m<sup>3</sup> of wastewater ended up in the sea while the rest of the 26 million m<sup>3</sup> of domestic wastewater evaporates (~ 4 million m<sup>3</sup>) or recharges to the groundwater (~14 million m<sup>3</sup>).
- Only 7% of domestic water pumped into the network is "potable" according to WHO standards: i.e. < 250 mg Cl/l chloride-concentration and < 50 mg NO<sub>3</sub>/l of Nitrate-concentration.
- the total water use in agriculture is around 80-86 million m<sup>3</sup> per year; almost 60% of which is of "poor" quality, 40% is "deteriorated" and 2% is of "potable" water quality

In addition to quantity, quality of water is obviously a key issue in the Gaza Strip. There are different sources of both fresh and saline groundwater. Rain is the main source of fresh water while sea water and brackish<sup>2</sup> groundwater are the reasons of deteriorated and poor water. Table 1 summarizes components of both water inflow and outflow (overall as well as fresh groundwater balance) in the Gaza Strip.

*Table 1: components of both water inflow and outflow (overall as well as fresh groundwater) in the Gaza Strip (Source: MoPIC, 1996b)*

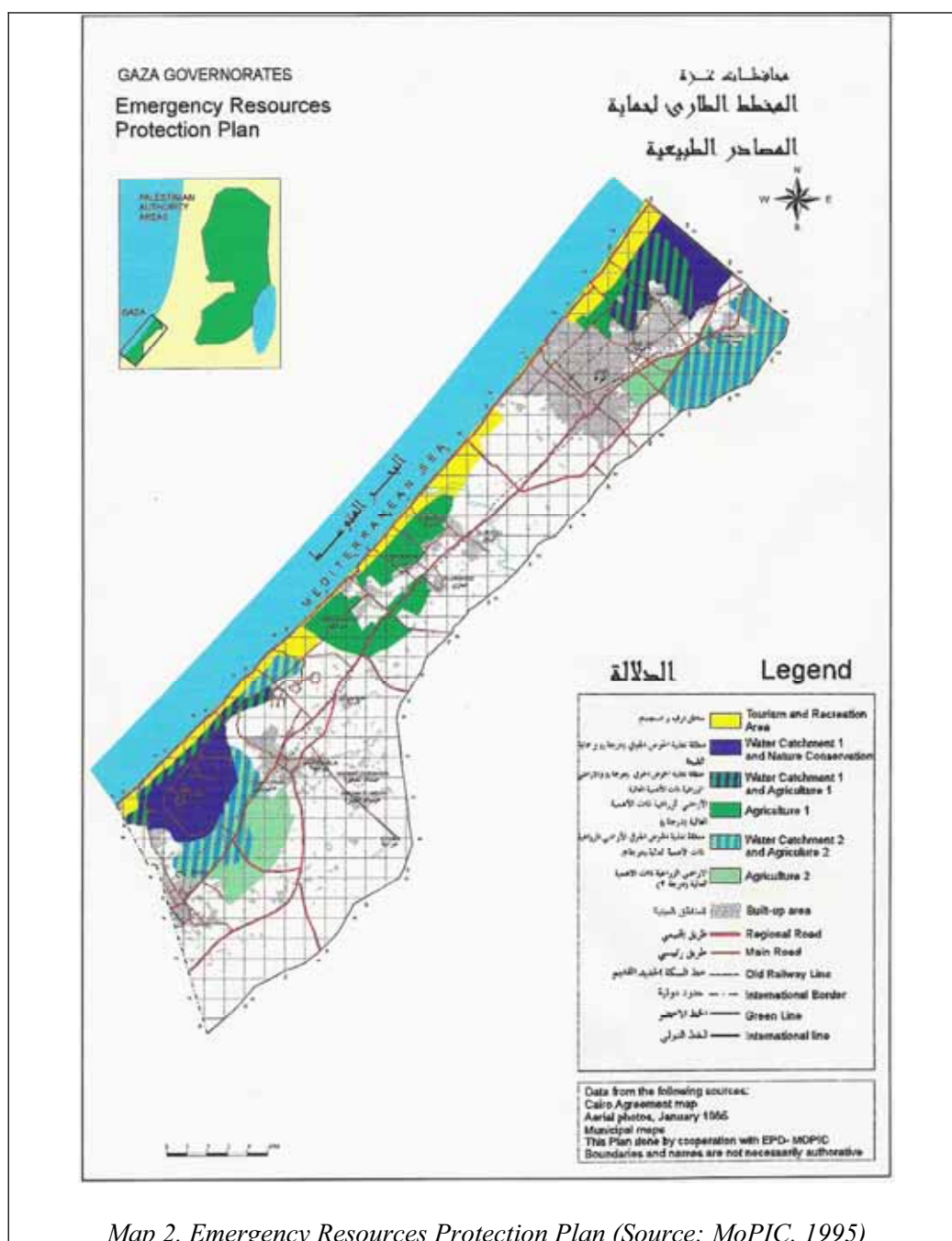
<b>Inflow Component</b>	<b>Overall</b>	<b>Fresh</b>	<b>Outflow component</b>	<b>Overall</b>	<b>Fresh</b>
	Million m <sup>3</sup> /year	Million m <sup>3</sup> /year		Million m <sup>3</sup> /year	Million m <sup>3</sup> /year
Average recharge by rain	46	21	Domestic abstraction	42	32
Recharge from wadis	2	0	Irrigation abstraction	81	40
Groundwater inflow Israel	10	7	Industrial abstraction	2	1
Return flow (domestic)	27	13	Settlement abstraction	6	6
Return flow (irrigation)	30	18	Groundwater outflow	2	2
Saline/brackish inflow	16	20	Evaporation Mawasy area	1	0
			Drop in groundwater table	- 3	- 2
<b>Total</b>	<b>131</b>	<b>79</b>		<b>131</b>	<b>79</b>

## Water and political conflict

As has been mentioned, water (being an important natural resource) has been a main reason of conflict in the Gaza Strip. For the last 40 years, but more obviously for the last 12 years after the peace agreements had been signed, water has been the reason because of which Israel continued occupying parts in the south and north of the Gaza Strip. Map (2) shows the main natural resources in the Gaza Strip in 1995. Those include groundwater, agriculture, undisturbed landscapes, natural areas, and archaeological sites. Comparing groundwater locations with the locations of the Israeli settlements from Map (1) shows that the Israeli existence in the Gaza Strip was greatly related to water issues.

<sup>1</sup> The use for drinking water (including cooking) in most countries does not exceed 3 to 5 litre per person per day. This is 2 to 4% of total water demand. The rest is used for washing, cleaning, toilets, and so forth

<sup>2</sup> Water with chloride content between 500 and 5000 mg/l. It has remained stagnant in a deeper part of the aquifer but has in recent years been mobilized by increased groundwater abstraction



Map 2. Emergency Resources Protection Plan (Source: MoPIC, 1995)

Great hopes were put on the peace process in the Occupied Palestinian Territories in the beginning and a lot of planning works were done between 1994 and 1998 when these hopes started to disappear with the obstacles Israelis put on the negotiation table refusing to withdraw from other parts according to the peace agreements. These negotiations completely stopped in 2000 and the second Intifada started in September the same year. During the period from Sep. 2000 to October 2004, all negotiations resulted in nothing and the Israeli army entered Palestinian areas in the Gaza Strip several times with more violence affecting humans, buildings, nature, etc., and causing a lot of damage throughout the Palestinian territories. Table (2) shows data on houses demolished and land swept in the different governorates. From this table, it is clear that southern (Rafah and Khan Younis governorates) and northern (North Governorates) parts of the Gaza Strip were much more affected than other parts. The reason is clearly the higher rates of Palestinian-Israeli conflict in these areas because of the Israeli existence in these areas in particular, which is because of water. This situation resulted in deteriorating of, in particular, environmental and socio-economic conditions. Rates of poverty and unemployment significantly increased. Many locals, according to this situation,

worked with jobs with relation to natural resources as they do not have to offer any capitals for buying any raw materials at the time that they, by selling these materials, get money to keep themselves survived. Others used natural resources, such as woods from cutting trees, as free sources of fuel, and others used underground water as a free source of water for household using and irrigation, others depend completely on grazing in the natural areas, and many dump solid wastes and let the sewage water to flow in the natural landscapes. Much of these activities have relation to the water issue in the Gaza Strip. Using the groundwater improperly reduced its quantity and, consequently its quality, whilst pumping sewage water in the natural landscapes aggravated its quality problems.

*Table 2: data on houses completely or partially demolished and lands swept by Israeli military troops between 29.9.2000 and 23.10.2005 (Source: PCHR website)*

Governorate	Number of houses completely demolished	Number of houses partially demolished	Land sweeping (du <sup>3</sup> )
North	258	330	14,204
Gaza	178	295	3295
Deir Al-Balah	157	150	3,695
Khan Yunis	644	325	6,894
Rafah	1467	1087	3,546
Total	2704	2187	31,634

### Water and planning in the Gaza Strip

As has been mentioned, the whole activity of physical planning in the Palestinian territories began only after the establishment of the Palestinian Authority in 1994. Previously, policies from the previous monarchies had been applicable (MoPIC 1998). However, this had almost nothing to work on especially with ‘the little administrative experience’ (MoPIC, 1995), and ‘the absence of territorial management as reflected in the almost total absence of rules and regulations for orderly physical development’ (MoPIC, 1996a). The Palestinian Authority benefited from the considerable international financial help from the donor countries<sup>4</sup> and the professional and technical experience from many countries, especially Norway and The Netherlands. Water issues got considerable attention and experiences, mainly from the Netherlands; however, this was limited to the areas under the Palestinian control and to the limited periods of real peace. Besides, plans have never reached the implementation and management phases. Attention has been completely given to the peace/conflict situation on the expense of other issues especially those related to human welfare. From another point of view, high levels of uncertainty regarding future changes have overbalanced the use of the scenario and alternative approaches in the planning process. MoPIC (1996a) use three scenarios in the design of the structure plan 1996-2010 for each of which water demand as well as water supply was estimated as shown in table (3). The three scenarios are:

1. Status Quo Scenario according to which no significant changes in trends and patterns of economic development are assumed.
2. Autonomous Growth Scenario which assumes that Gaza develops its own economy with little interaction and cooperation with Israel and Arab countries.
3. Social Welfare Scenario which assumes open borders, improved security, and lower population pressure.

<sup>3</sup> du = 1000 m<sup>2</sup>

<sup>4</sup> Counting 42, donor countries and multilateral agencies met in October 1993 to provide the economic underpinning for the peace process in the Middle East and to mobilize the resources needed to make the political peace agreement between the Palestinians and the Israelis work.

Table 3: Water demand and water supply expected for each scenario in the year 2010 (Source: MoPIC, 1996a)

		1995	Scenario 1	Scenario 2	Scenario 3
<b>Total water demand</b> (MCM / year)	Domestic	46	89	110	88
	Irrigation	81	55	61	83
	Industry	2	6	16	6
	Settlements	6	10	0	0
	Evaporation	3	3	3	5
	<b>Total water demand</b>	<b>138</b>	<b>163</b>	<b>190</b>	<b>182</b>
<b>Total water supply</b> (MCM / year)	Recharge by rain	48	41	40	46
	Inflow from Israel	10	10	10	10
	Import	4	4	0	50
	Desalination	0	0	60	0
	Return flow (domestic)	27	33	51	45
	Return flow (irrigation)	30	20	20	30
	Deficit	19	55	9	1
	<b>Total</b>	<b>138</b>	<b>163</b>	<b>190</b>	<b>182</b>

The main planning output in the Gaza Strip has been the long term Regional Plan for Gaza Governorates (RPGG), 1998-2015<sup>5</sup>; however, it has never been approved by the Palestinian Authority. Nevertheless, it has been used as a reference for other planning activities during the last years since it has been drafted in February 1998. Politics and hot conflict issues were the reasons of this ignorance for this long time. Water issues were not included from ‘demand and supply’ point of view but more from ‘infrastructure and networks’ point of view; however, recommendations from previous planning documents were considered regarding the water resources; and mainly groundwater resources. The RPGG, therefore, planned areas of groundwater with high quality (as mentioned in the map 2 of the Emergency Resources Protection Plan) as nature reserves, sometimes accompanied with agriculture.

### Water management in the Gaza Strip

Water situation in the Gaza Strip has been critically deteriorating without any real control as there is indeed no national strategy to cope with it. Frederick (1993) mentioned three constraints that lead to water management failures, all of which apply to the Gaza case (MoPIC, 1996b):

- inadequate institutional arrangements and good functioning;
- ignorance of financial accountability participation; and
- insufficient awareness regarding water quality, health and environment

Integrating as many sectors as possible in the water resources management is likely the best approach to deal with such a complicated situation as the one in the Gaza Strip and the areas of conflict. This integrated management is therefore interdisciplinary and multi-sectoral that requires comprehensive planning where socioeconomic issues should be placed in the heart of the planning process. A number of parallel steps which interfere with the planning process is required. Dealing with issues related to water problems over the earth surface is likely the first step. Building institutions as well as legal frameworks and enforcement bodies, managing and reorganizing all wells, controlling water consumption and improving water supply and waste

<sup>5</sup> It has been recently updated and redrafted as ‘the Regional Plan for Southern Governorates, 2005-2015’

water infrastructure, for example, should be done before making other steps that focus on groundwater quantity and quality, although both are related to each other. Details related to these issues are necessary; e.g. measures to protect groundwater from pollution is required to stop infiltration of untreated wastewater in urban areas, especially in areas very close to public water supply wells. Unfortunately, management of water resources on the formal level in the Gaza Strip has not exceeded activities of measuring and collecting data related to groundwater quality. On the other hand, few projects which were implemented for other purposes have had positive impacts on groundwater resources. The 'Emergency Employment Generation Program (EEGP) on the Development of the Wadi Gaza' project is a very good example. It has been implemented by the 'United Nations Development Programme's Programme of Assistance to the Palestinian People' (UNDP/PAPP) (UNEP, 2003). One main part of this project was to clean the Wadi from waste water which had been there for the last two decades and was a main source of groundwater pollution.

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## Sweden and the EU Water Framework Directive

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The EU Water Framework Directive aims to establish a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater (Black & Veatch). The EU Water Framework Directive also aims to create new tools for sustainable water use. A number of the ideas contained within the EU Water Framework Directive can be seen to support this goal. Perhaps the most often expounded idea in this context is the promotion of a more comprehensive view on water management (Boverket 2004).

The implications of the EU Water Framework Directive in Sweden begin with understanding the regulatory instruments and water administrations.

The Swedish strategy is based almost solely on regulatory instruments unlike for example the French and accordingly to the EU Water Framework Directive model use both economic incentives and regulatory steering instruments. Furthermore, water administrations in Sweden are spread over different institutions at different levels (Beatrice Hedelin, 2005).

### Current situation in the Swedish water sector

#### Control and Legislation

The three most important pieces of legislation regulating urban water supply and sewage disposal are:

- the Public Water and Wastewater Plant Act (Lag (1970: 244) om allmänna vatten- och avloppsanläggningar)
- the Environmental Code (Miljöbalk (1998:80))
- the Food Act (Livsmedelslagen, SFS 1971:511)

The Public Water and Wastewater Plant Act states that it is a municipal responsibility to arrange sufficient water supply and sewage treatment services to assure the municipal population good health. The law also articulates that water charges are not to exceed necessary costs to provide the services and that water charges only can be used within the water sector. It is thus illegal for any owner of “for the public necessary” water and sewage facilities to “profit” from these services. Consequently, municipalities can not gain money to be used in other sectors and private companies can not expect to pay profit based dividends to their shareholders (Mats Lannerstad, 2002).

The Environmental Code regulates environmental standards and stipulates measures to be taken to prevent and minimise impacts on the environment caused by water abstractions and sewage effluents (Mats Lannerstad, 2002).

The Food Act states that drinking water is to be considered foodstuff and that it must be handled with equal standards as other food production (Mats Lannerstad, 2002).

### **The Public Water and Wastewater Plant Act**

The Public Water and Wastewater Plant Act declares that the municipalities have the responsibility to either themselves arrange or to make sure that someone else arranges adequate “public” water supply and wastewater treatment to secure the health of their urban population. If water supply and sewage treatment facilities are inadequate to meet the health needs of the municipality residents the County Administrative Board under penalty of fine can order the municipality to fulfil their obligations (Water and Wastewater Plant Act, Section 2).

### **Water Management and Responsible Institutions**

The current system for water planning in Sweden is mainly based on the 289 municipalities, which represent the local level of the national administrative organisation. Since 1987 the responsibility for planning of land and water has rested on the municipalities, regulated by the Building and Planning Act (SFS 1987:10)

Central institutions are generally responsible for permits; regional governmental institutions and municipalities manage the environmental supervision, while the municipalities are responsible for the long-term land and water planning, through their master plans (Beatrice Hedelin, 2005).

Through different tools (plans, regulations and permits) the municipalities steer the use of land and water within their administrative boundaries. Thus, planning of land and water are currently integrated into one system. The municipalities have a far-reaching formal mandate to control land use, though mechanisms remain for the state to exert influence to some extent (Beatrice Hedelin, 2005).

Swedish municipal water supply and sewage disposal services are coordinated through the trade organisation Swedish Water and Wastewater Association, Svenskt Vatten AB. The aim of Svenskt Vatten is to support the members with assistance in technical, economic and administrative issues. Svenskt Vatten AB is a member of the European Union of National Association of Water Supplies (EUREAU) and administers the national secretariat for the International Water Association (IWA). Through Swedish Water Development, SWD, the organisation also promotes Swedish know-how internationally (Mats Lannerstad, 2002).

## Implications of the EU Water Framework Directive

At this as yet still early period in the terms of implementation of the EU's new Water Framework Directive, the important organisational changes can be identified based on the summarised regulations in Swedish municipalities' current water planning :

- The most obvious difference is the change of geographical planning unit from the municipal boundaries to the boundaries of the Water Basin Districts. As the municipal borders are not related to hydrological boundaries, the change represents a shift from a purely administrative to a more natural regional basis for water planning (Beatrice Hedelin, 2005).
- Secondly, the 289 geographical units for water planning have been reduced to five River Basin Districts, each draining into one of the major sea basins around Sweden. The Districts are prescribed in the regulation on the administration of the quality of the water environment (Beatrice Hedelin, 2005)



*River Basin Districts in Sweden*  
([www.vattenportalen.se](http://www.vattenportalen.se))

- Thirdly, instead of an integrated approach to the planning of land and water these issues are now to be handled separately. The municipalities will still have an important role to play in planning issues relating to land and water within their territories, but the new water planning system will limit their formal power substantially. Water planning will be performed separately on a regional level influencing the municipal physical planning from above (Beatrice Hedelin, 2005).

These aspects all suggest that large changes will occur as a result of the implementation of the EU Water Framework Directive in Sweden. Furthermore, municipalities have been criticised for not dealing with water issues in a satisfactory way in their physical planning (Boverket 2004).

## Private versus Municipal Ownership

Water supply and sewage disposal services according to Swedish law are a municipal responsibility and therefore for a long time have been part of the municipal administration (Mats Lannerstad, 2002). The Present legislation includes no laws forbidding private ownership and/or operation of public water and sewage facilities. The Municipality Act and the Public Water and Wastewater Plant Act, do however clearly state that profit making from ownership of public water services is illegal (Mats Lannerstad, 2002).

Out of Sweden's 289 municipalities all public water supply and sewage disposal services except two are entirely owned and controlled by the municipalities themselves. Municipal ownership and operation are of two types: within the municipal administration or as a municipally owned limited company (Mats Lannerstad, 2002).

During the 1990s the municipalities have experienced a troublesome financial situation. To improve their financial situation many municipalities have chosen to sell their local energy and multi-utility companies including companies that provide the water supply and the sewage disposal services (Mats Lannerstad, 2002).

In 1991 a non-Socialist majority under Conservative leadership on national level and in many municipalities pushed hard for private initiatives to increase efficiency in the public sector (Mats Lannerstad, 2002).

As Sweden became member of the European Union in 1994 the pressure has increased for privatisation and recent development in the water supply and sewage disposal sector must thus be considered in a pan-European and global context (Mats Lannerstad, 2002).

Starting with 1998 Sweden has experienced a new privatisation trend of water supply and sewage disposal facilities with private ownership, and a multinational management contract. Most municipalities since many years experience a strained economy. Liberalisation of the energy sector during the last century opened up possibilities for the municipalities to strengthen their financial situation by selling their energy assets (Fakta om vatten och avlopp 2001). The development has started a new debate among water professionals and local politicians and has also attracted national interest.

This period privatisation issues are discussed in a more analysing way focusing on organisation in general, financial situation in the municipalities, cooperation alternatives, globalisation and, not to forget, the legislation. Associate Professor Jan-Erik Gustafsson at the department of Land and Water Resources at the Royal Institute of Technology, Stockholm explains current trend of privatisation as a result of a European/global ideological desire to transform the society according to neo-liberal ideas. With a number of comparing data Jan-Erik Gustafsson claims the Swedish Water Sector to be very competitive. He is also of the opinion that there exist no arguments that can motivate private entrance into the Swedish water sector. Public ownership has proved to be both economically and ecologically efficient (Mats Lannerstad, 2002).

Even if the political majority in some municipalities carry out privatisation of ownership or put the management on contract it must clearly be stated that there is a broad consensus among all political parties (national and municipal), municipal water professionals, unions and others that the Swedish water sector is most beneficially operated under public ownership and control. As a result there has not during the last decade up till recent years been any national debate focusing on the ownership and organisational structure (Mats Lannerstad, 2005).

The Social Democratic Party is and has been the dominating party in Sweden since World War Two. Their ideological standpoint is that municipal assets must be regarded as a strategic resource under public control. It is therefore of great importance for future privatisation how this party acts.

## **Maintenance of Water Quality and Costs**

Total cost for water supply and sewage disposal services was in 1999 estimated to 14.1 billion SKr (EUR 1.5 billion), including 25% VAT. All large municipalities today entirely cover their costs for water and wastewater services through water charges (Fakta om vatten och avlopp, 2001). Comparisons with other European cities also show that water charges are quite reasonable (Mats Lannestad, 2002).

The average water charge per cubic metre calculated this way comprises all costs for drinking water production, water distribution, wastewater diversion and wastewater treatment (Mats Lannestad). In comparison with other cities also show that Swedish water charges are quite reasonable (Mats Lannestad, 2002).

Today 95 percent of the wastewater is treated both biologically and chemically and as much as 54 percent also go through special nitrogen removal. Water resources in Sweden are both abundant and of good quality, a combination offering excellent prerequisites for also good drinking water quality. In the end of the 1980s drinking water was given classification as foodstuff with stricter regulations further increasing the quality. Compared to other countries water charges are quite modest. This is the result of a combination of efficient management and the Public Water and Wastewater Plant Act stipulating prime cost water fees □ (Fakta om vatten och avlopp, 2001).

The costs for water supply and sewage disposal are charged the property owner connected to the public network. Consumed water volume is metered for each property, single house or block of flats. Costs for both supply and disposal are included in the water charges. In Sweden there is not any environmental tax directly connected to water supply and sewage disposal in urban areas (Mats Lannestad, 2002).

A further principle of sustainable development, the polluter pays principle, is also emphasised in the Water Framework Directive. As such, the costs of water services, protection and

restoration should fall on the main users of water (industry, agriculture and households) (Beatrice Hedelin, 2005).

A clean environment, good drinking water quality, low water charges and a reliable supply explain the present status of the water sector as more or less invisible. People take a well functioning water supply and sewage distal and sewage disposal sector for granted (Mats Lannestad, 2002).

The future challenge is to bring about efficiency and strengthen users influence at the same time as the long-term perspective remains (Mats Lannestad, 2002)

### **Approaching Situation in the Swedish Water Sector**

A situation in which to two parallel planning systems for water will be created due to the coming changes in respect of the implementation of the EU Water Framework Directive in Sweden (Boverket 2004).

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## Water management in urban context, case study of Belgrade

### Abstract

This paper focuses on investigation of the of water management in urban landscape, using the research results of assessment of hydrological pattern within the territory of Belgrade, as case studies. Attention is paid to the treatment of waters in urban areas and natural and anthropogenic processes that have influenced its characteristics over history, as well as formal and informal instruments of water management in that context. Presentation of water management on urban territory of Belgrade has the aim to define past and existing water treatment within urban complexity and within to investigate possibilities for future integration of water protection measurements under the new legislative conditions in European Union and its implication on the water management in Serbia. Canvassing of issues of water management in the urban landscape is being undertaken through an exploration of the historical aspects under which water pattern, its processes and functions has been developed, ecological statement of water currents in territory of Belgrade and further legislative management frameworks under which future planning and rehabilitation of urban areas is possible. Further attention is drawn to the need for further planning and research, in order to preserve and to define the future potential of waters within urban areas. In the respect of the EU recommendations, legislation and instruments for treatment of urban waters, as a consistent part of the urban landscape, the conditions, under which it is possible to integrate landscape planning in the actual planning processes in Serbia, are investigated.

Key words: water management, urban landscape, hydrological pattern, Belgrade

### Introduction

The life quality in urban area, as a biggest conurbation area, is deeply related to the existing quality of water resources. Water in urbanized area presents the significant infrastructure component that is incorporated in each urban function and that serves for maintenance of the natural and man created processes in urban landscape. There is almost any one urban function, that is not related to the water (living, working, recreating etc.) and therefore there is not town that exists without water. Through history up to cites of today, urban development in economical, cultural and in political sense have been dependant from arrangement and distribution of water resources. The colonization of the oldest known settlements is related to the water reach areas, as the appropriate and only possible living ground space (example: the cultures along Danube corridor, as Lepenski Vir in area of the Iron Gates Gorge). The developed water system was the precondition for the economical and political development of the urban area. This is confirmed by different historical phases of the human settlements, where water in first human colonials was used for fishing, ritual ceremonies, than its protection role around medieval fortifications, trough industrial cites, where it was crampon iron of the fabric processes up to modern and post-modern cites, where its usage and functionalism have been transferred in to the structural and creative foresees for improvement and protection of the urban environment in general.

Water of the larger cites have been long time constructed and adopted to food control, water supply, drainage of built area and others one sided strength purposes. Due long lasting purposes of water economy, such as: water supply, water drain, flood control and water usage, natural character of urban water has been neglect and in great measure lost. Water is also presented as negative feature of urban area, because of what surface as well as underground water were not integrated in urban structure. Larger built up and settled area, as specific phenomenon in the landscape, presents the highest consumers of the water resources. Urban growth and compression of urban land led to the totally sealing of urban land, what cause both losing of surface water, trough its including in drainage system of the city or its hydrological regulation and also losing of underground water, trough its pressure in deepest soil levels and disturbance of its recharge area. The relation to water issue in urban area started first from river regulation aimed to the flood preventions and construction anticipated mostly to the economical usage of water. Under the actions of urban revitalization or urban renewal, particularly arising the awareness of the necessity to protect the urban

water itself, the first revitalization of urban waters in European cities were undertaken during the late '80s (Manchester, Oslo, Munich, etc.). The revitalization measurements up to nowadays have been developed for urban rivers, lakes, streams and generally for the diverse types of surface waters or "visible waters". However the consideration of urban waters related to overall urban area, areas of visible as well as in invisible waters is less investigated. These endeavours of water protection stay under the specific sectoral interests, such as: urban development, hydraulic engineering, nature protection interests and others, because of what nowadays urban waters, in contrast to water currents in open landscape, are results of heterogeneous spatial complexity.

### Development of hydrological pattern of Belgrade

Hydrological pattern has been playing significant role in urban development of larger metropolitan area of Belgrade. There are three main issues that influence the hydrological pattern of the area: historical city development, natural features of the area and cultural characteristic of population. The main historical elements are related to the location of the city around two great rivers, Sava and the Danube, that have been inhabited already in early palaeolithic period. The founding of Singidunum in 279 B.C. (Singi-"round" and dunum-"fortress" or "town") is related to the Romans conquered, who has been under rule for full four centuries, created main solution for water supply (public fountains, wells, etc.). The rivers had important military role and were the fortified Roman border - the "limes". The influence of Serbian Orthodox Church began in 1284, when the Serbian king Dragutin was given rule over Mačva and Belgrade and from that time Belgrade was the most important economic, cultural and religious role of the country. Belgrade is supposed to have about 40-50,000 inhabitants in that period. Beside of military role of two main rivers, they were important economic corridors. Using these examples was built also other fortified settlements, like Smederevo in downstream of Danube. The enlargement of introducing the water in to the city, for hygienic reasons came under the influence of the Hungarian population and later on under the strong influence of Turkish Empire. In this time rivers became very important military borders and in the city were built larger number of public fountains and Turkish baths. The specific cultural habits of Turkish population were transmitted in the creation of public squares and culture of public baths. Turkish name for fortification Kalemegdan -"Breg za razmisljanje" (Turkish -"Bajir El Fikr", English - "The Hill for Thinking") tells that great town beside of its military purpose was very important cultural and social center and had amenity function, as a place that offered marvellous views on two larger rivers. Particularly importance had public baths and their relation to the ritual washing. For that purposes, each city district was supplied with the mosques, public fountains with drinking water and public baths. Turkish nation had advance techniques for water transportation to the most distant city districts and for that purpose on Terazije were built strong water pump for already second large city in Turkish empire (after Istanbul). In the second half of the XIX century, it was brought closer to Europe in the aspect of city planning etc. The town got modern water supply system and first public parks, where water was introduced as central decorative element (Topcider park and Kalemegdan). The first Serbian architect Emilina Joksimović in 1867 made a concept for reconnecting the fortification areas with Sava and Danube river shorts ("Regulisanje dela varoši Beograda u šancu"). The architect Dimitrije T. Leko (1887-1964) made the urban plan for Savska slope and Kosančićev Venac and suggested the "arrangement of this city part as one of the most beautiful parks of Belgrade, with terraces, gardens, sears, fountains and monuments". Technical suitable conditions gave the possibility to establish new town-New Belgrade from moody and sandy left Sava side nearly after II World War.

Natural features of the area had the great impact on the attempts to integrate the urban area with water. Danube flows on the territory of Belgrade with the length about 60km and Sava in the length from about 30 km until the mouth with Danube. The area of Belgrade is characterized by very developed hydrological network, where there are dominance of two main international rivers and about 16 streams, mostly located in the south east and south west area (Figure 1, 2).

Water level on Sava and Danube is controlled by the hydropower station "Đerdap" and with passive measurements for the water protection (embankment, etc.). The specific of the area is presents by pretty conserved river adas and islands, particularly in the flat areas as: Great and Small War Island (nature reserve and landscape of special features), Ada Ciganija (that were arranged in great recreation area of Belgrade and area of special natural features), Ada Medica (recreation area and area of special natural features), Ada Huja (depony and industrial area with partly diverse domestic vegetation), other islands and

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ada on Sava and Danube (registered as the landscape unites with special natural features). Today open river bodes, beside their navigation role play also recreation role. There are about 100 floating ships-restaurants, more than 20 marines, where it is about 3000 boots and recreation flowing ships. Most of floating restaurants are not suitable designed and they produce large amount of trash (water pollution and others). In river short zone, there are about 600 on the column standing houses (sojenica) and mostly the river short is not adequate arranged, with deponies, storages of trash, the pipes of town sewage system. The particulate important for Belgrade is the port area on Sava river in the area of Kosančićev Venac, that according to the last Master plan from 2001 should be moved on the downstream area. This area builds specific town pictures and presently is neglected in urban structure. The main picture of the city is built from Sava river to the Kalemegdan fortress, part of Orthodox church and central city zone. The main problem of use open spaces associated with water bode is not arranged river shores, but also very low water quality.



Figure 1: River corridors in area of Belgrade today, from south-west



Figure 2: Hydrological network of Belgrade  
 Resource: Master plan of Belgrade for 2021

#### Water treatment – level of river catchments area

Example of state, level and type of water treatments on the example of river catchments area in shouter part of Belgrade presents the most transparent interrelation among urban development and water management issues. The smaller water courses can be classified as erosion streams and they are characterized by having short and strong flood waters. The streams are relatively short (about 10km) and their gradients are moderate (up to 10°) while their beds are very narrow (up to 7m) and their catchments areas are about 8 km<sup>2</sup>. Most downstream sections are canalized during '60s and '70s and integrated in the storm water and sewerage system.

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Figure 3: Regulated course of Topcider river



Figure 4: Non regulated course of Kumodraski stream

The water qualities is class III or IV, while some of them unclassified, such as the Mokroluski stream, and therefore are not used for recreation or for water supply. The river beds in downstream areas are hydro technically engineered (Figure 3) and only Kumodraski stream has not been regulated (Figure 4). Most of streams are characterized by "city regulation", characterized by existing of modified ecosystem (Table 1). In regulation of these streams, only measurements from the stand of point of protection of flood and soil stabilization were done. Covering of river beds by concrete was done in long line, what caused destroying of biocenoses and ambient value. This kind of acting, which is led only to the protection of flood, was neglected ecological, social and aesthetic evaluation of stream as a biotope and the most thoroughbred part of environment. The vegetation communities are spontaneous, where primary vegetation has been replaced by secondary species. In the lower river terraces the hydrophilic vegetation communities, have been replaced by helophyte vegetation due to drying out (*Populetum-Salicetum*, *Quercus pubescens-Fraxinus*), have given way to shrubs and grass communities). Eutrophic water is present in large parts of the river bed as well as ruderal types of vegetation. Nowadays, there are only short segments of forests, mainly with impoverished composition and with high level of degradation. Intensive building of settlements and with this influence the possibilities for water self-clearing is reduced and wetlands as a biofilters have been disappeared and pushed out former vegetation.

The agricultural land is dominant in the upper stream courses (about 70%) with a small percentage of forest cover, while the lower parts of the middle and upper stream terraces are transformed into built up area (with settlements and traffic infrastructure). In some of them, the illegal settlements have been built on parts of the lower stream terraces (Kumodraski stream). On the left side of Sava and Danube river there are also small water currents, that are mostly artificial and made from former water channels (Galovica, Vicelj, Kalovita, etc.). Urbanized area is characterized by small parcelation what means frequent changes of different land use. Purpose of land surface usage is different in lower and upper part of streams. Along the upper part of streams, there are mainly the areas, which are used in agriculture purposes. There are very small numbers of greened parcels. The settlements, along the streams, are mostly bulk type without precise regulation of parcels. In the upper part of streams, there are parcels with production function. Along Kumodraski and Topcider streams factory areas are located. The recreation area omits almost in all of stream valleys, in spite of that it should be one of the first function of these spaces. Exception is one part of Topcider River, in area of Tocider Park, which has recreation character.

Table 1: Characteristic of small streams of Belgrade

Name of water stream	Location	Lenght (km)	Width of stream bed(m)/surface of stream basin (km <sup>2</sup> )	Regulation of water stream	Ecological conditions*	Speed of water course (m <sup>3</sup> /sek.)	Remark
Mirijevski stream	Mirijevski hill→Danube channel	2,6	3-4	+	●	0,35-80	Use coast area for landscaping

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<b>Kumodraški stream</b>	Kumodraz settlement naselje→Sava	5,8	1-2/7,7	-	②	0,70-1,25	Protect trees species
<b>Mokroluški stream</b>	Mali Mokri Lug→Sava river	9,2	2/13	+	③	0,93-1,73	Sanation of endangered areas
<b>Stream of Lipica</b>	Topličiki Vis→Jelezovac	7,5	2-3	-	③	0,50	Use coast area for landscaping
<b>Stream of Jelezovac</b>	Right branch of Topčider river	12	2-2,5	-	③	0,95	Present vegetation is indicator of bad habitat condition
<b>Kaljavi stream</b>	Right branch of Jelezovac	4	2	+	②	0,2-0,4	Significant for settlement around
<b>Topčiderska river</b>	Peak of Avala mountain→Right branch of Sava river	30	6,5-2,5/145,23	+	③	0,88-1,66	Reintegration and renaturalization is the most important

\*regulation of currents: + covering of river beds by concrete blocks; -absence of regulation

\*ecological condition: ③high level of degradation ②middle ①low ④absence of degradation

**Legislative framework for water management and need for new planning paradigm**

In Serbian planning practice water protection is only defined through the protection from hazard materials and damages. The water protection, as a consistent environmental element, is not explicitly defined, neither in strategic nor in operational plans and projects. The level of strategic planning in Serbia (Spatial Plan of Republic of Serbia, 1997), attempts through indirect instruments of nature protection, to define the protection of rivers, streams and lakes, and for some larger area outside of the built up area, beside hydro-technical, anticipate also bio engineering protection measurements (in inundation area in order to control floods, it is anticipated the establishment of phytosanitation zones).

Water management plans on national, but also international level (water management plan for Danube and its sub-catchments areas in Serbia), excludible considers water related issues in urban areas, although their big environmental impact and put in the category of "metropolis, cities, towns". Cities present the significant conurbation place related to people life and their survival. Strength of cities as centers of political, social and economic power leads to permanent increasing of urban population (in the world about 6% each year and currently in Europe about 80% of people live in urban areas). Concentration of people in urbanized regions is related to increased water demand, both in density built up urban areas, but also in urban fringes, that due repopulation of urban centres and continued processes of suburbanization are characterized by increased water demands. The planning act (e.g. Water Act, 1991) related to water in urban, as well as in rural area, threatens the water from three aspects: flood prevention, water protection and water use. On the urban planning level, water issue is included as the sectoral planning issue (water management plan), that is observed completely separately from other planning. For purposes of urban planning, city territory is divided on "convenient" and "less convenient areas" for building construction and in the relation to flood risk and other hydrological parameters. Further on water issue in open space and landscape planning is completely excluded. The water management of Belgrade is divided between two public offices "JP Sava" and "JP Srbijavode", what interferes the integrated water treatment.

Implicitly some of national laws address the protection of water, as: Environmental Protection Act (1995), which focuses on natural values, Water Act (1991), that is focused more on the factual protection of water for economic purposes and less as a natural resource and Communal Affairs Act (1997), which deals indirectly with water treatment. The lack of comprehensive water protection is also due lack of planning acts and regulation related to landscape planning, that is aimed to integrated diverse sectoral interests and policies.

According to planning limitation and obstacles in Serbia, it is necessary to draw attention to:

- the lack of a legislative framework according to which water issue requires to be treated as part of the infrastructure of urban, suburban and rural landscapes, which also have an important nature and social role.

It is therefore necessary to review the possibilities for defining the water management within the framework of: the Environmental protection legislation, the Water Act and their associated regulations;

- the development of planning practice, in which sectoral planning should be integrated into strategic spatial and landscape planning. The main alignments of water treatment should be defined at the level of strategic landscape and spatial plans, because of necessity to consider overall factors related to the water in divers landscapes. However, the implementation of water protection measurements is only possible at the level of urban regulation plans, and therefore at this level is necessary to develop the instruments and techniques for their integration with other aspects of the urban infrastructure;
- the importance of integrated environmental protection based on the development of environmental assessment studies, especially for water corridors and hydro-technical construction projects, as well as working at the level of local communities; and finally
- the introduction of the standards and definitions for water as an essential infrastructural component of the urban areas.

It is expected that new directives coming from the European Union level provide chances for the development of new planning paradigms. In this context it is significant to mention, the influence of European Water Frame Directive, according to which has been developed certain management plans (for river catchments area of Tisa, etc.). In the future, therefore, the hope that new European regulations and new landscape planning perspectives will influence on to better understanding of the importance of water issue, in particular with regard to the urban landscape, as most important areas for human settlement in Serbia. Those conditions implicate and force the preparation of assessment methods for urban water that should build the basis for planning arena in the future.

### Conclusions

In order to increased the understanding of urban waters, as well as to produce the sustainable protection, within planning system in Serbia and beyond, it is necessary to find a strategy for improving and mobilizing existing knowledge and experience in the field. Existing of European Water Frame Directive, as well as new coming directions, like European Landscape Convention, together with other European directives and regulations represents a possible way to achieve this. It must, however, also by accompanied by the parallel development of planning instruments at the level of communities, accompanied with a general raising of awareness about importance of the urban landscape. There is also a need for further research, in order to support and strengthen the development of planning methodology.

The development of sustainable living conditions is to be seen as necessary for the effective implementation of the concept of sustainability at the level of the urban landscape. Ecologically orientated planning approaches call for an understanding both of different social groups and their needs, but also for equal importance to be afforded to integrated water protection and development. It is considered that only through a comprehensive assessment of water in urban areas (including underground and surface water) can be developed the set of various rehabilitation water measurements and on that way achieved the long lasting sustainability of water use. In that context particularly important are EU legislations and possibilities of their implementation and integration into actual planning system of Serbia. The new assessment tools for investigation of present and potential role of water developed within the research present the technique for the implementation of European policy of water management, particularly for urban area. Further on, it is believed that investigated research issues can enhance the integration of water issue into landscape planning in Serbia, but also in other countries of Europe.

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## The Role of the European Water Directive on Reconstructing Liesing, Vienna

1. European water directive – Overview
2. Liesing Vienna
3. The influence of the European water directive on reconstructing river Liesing
4. Conclusions

### **1. European water directive – Overview**

1988 – Conclusions on the Community water Policy Ministerial Seminar in Frankfurt: Need for Community Legislation covering ecological quality

1991 – Ministerial Seminar on groundwater, The Hague:

Need for action to avoid long term deterioration of freshwater quality and quantity; programme of actions to be implemented by 2000 for sustainable management and protection of freshwater resources

1992, 1995 – Council requested action programme for groundwater protection

1995 – European Environment Agency confirmed need for action to protect community waters

1995 – Council established basic principles of sustainable water policy in the EU

1996 – European Commission set out principles for community water policy in communication with European parliament and Council of Europe

1996 – European Council: Need to establish procedures for the regulation of abstraction of freshwater and for the monitoring of freshwater quality and quantity

1996 – Committee of Regions, Economic and Social Committee and European parliament requested European Commission to come forward with a proposal for a European water Policy

23 October 2000 European Water Directive establishing a framework for Community action in the field of water policy

The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

- (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- (b) promotes sustainable water use based on a long-term protection of available water resources;
- (c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;
- (d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and
- (e) contributes to mitigating the effects of floods and droughts 1

Government bodies of the EC member states are requested to implement the directive into national law and to identify river basin districts and responsible authorities (Art. 23, Art. 3) until 2003. The basic units of the directive have to be defined until end of 2004 (Art. 5). A monitoring network has to be established and accompanied by public relations work until 2006. In 2008 draft river management plans have to be in a form to be presented to the public. For 2009, the finalised river management plans should include milestones and an implementation plan to achieve the specific objectives (Art. 13, Art 11). Following this timetable it is expected that member states of the European Union will meet the environmental objectives in 2015.

## 2. Liesing, Vienna

### Geology: <sup>2</sup>

The river Liesing has two sources, the "Dürre Liesing" and the "Reiche Liesing". While the Dürre Liesing arises from a limestone area, the Reiche Liesing arises from the flysch limestone area of the Wienerwald, which makes the river grow rapidly in case of heavy rainfall.

In Vienna river Liesing has shaped the landscape through meanders, deposition of sediments and erosion.



Figure 1 Geology influencing river Liesing

### Situation of River Liesing Banks before the reconstruction

River Liesing has been subject to major building activities due to flood protection activities from the 50ies to the 70ies leading to a concrete channel and concrete banks on both sides. Aspects of water quality or ecological aspects were not considered. Still, in 1998 and 2000 after heavy rainfall river Liesing burst its banks.

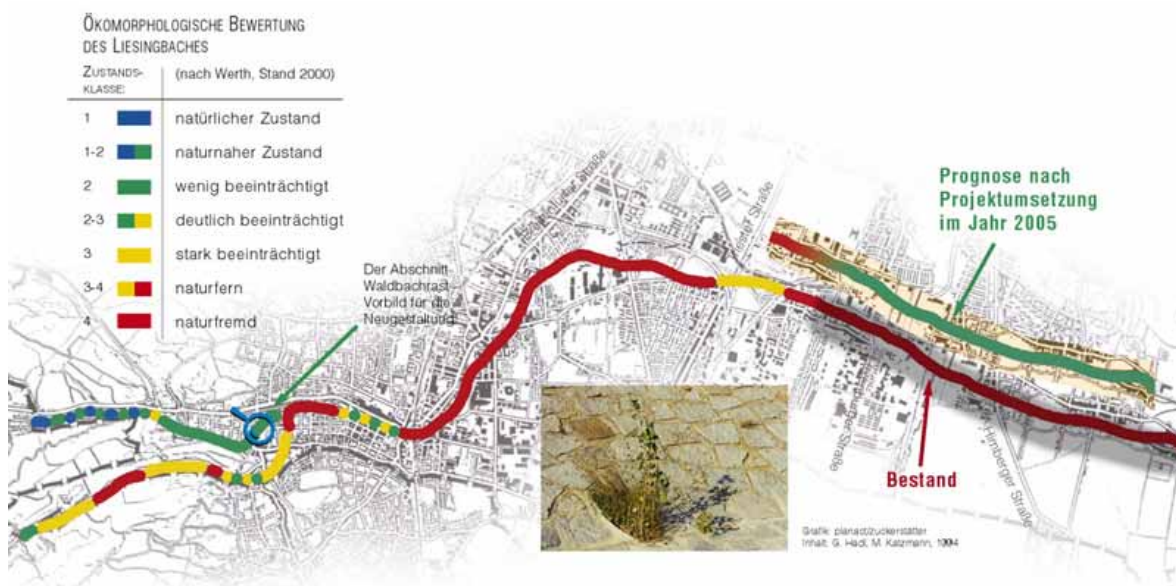


Figure 2 Ecological Valuation of River Liesing, 2000

The area next to the river has recently been subject to construction activities, numerous flats and terraced houses were built near the river on former agricultural areas. A cycle track constructed in 1990 and small playgrounds accompanied this development. The area next to river Liesing is a residential area much in demand today.

### 3. The influence of the European Water directive in reconstructing Liesing

#### 3.1 Life programme of the European Union:3

The specific objective of LIFE-Environment is to contribute to the development of innovative techniques and methods by co-financing projects. 5 areas are eligible for funding through the European Union:

- land-use development and planning;
- water management;
- reduction of the environmental impact of economic activities;
- waste management;
- reduction of the environmental impact of products through an integrated product policy.

LIFE is divided into LIFE-Nature, LIFE-Environment and LIFE-Third Countries. 47% of the total budget of the LIFE programme (€ 640 million) is spent for LIFE-environment.

The successful proposal for co-funding by the LIFE programme was an important basis for the project to ensure the financial basis for reconstructing the river according to the European Water Directive.

#### 3.2 Aims and structure of the Project Living River Liesing

The aim of the project was to improve the situation at the river Liesing according to the EU Water Directive in order to archive "maximum ecological potential" of a heavily modified water body.

The specific aims of the projects were:

- Improvement of the water quality to quality class II according to the saprobic system.
- Re-introduction of a diverse macrozoobenthos and river-specific fish species into the relevant river section.
- Establishment of a string of aquatic ecosystems with restored ecosystem function and structure which may function as aquatic ecological corridor extending far into the urban area.
- Creation of new habitats for priority species (council directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).
- International exchange of project results.

After valuation of the actual state, a project structure has been developed by the landscape architecture office Knoll and the City of Vienna, Departments 30 and 45.

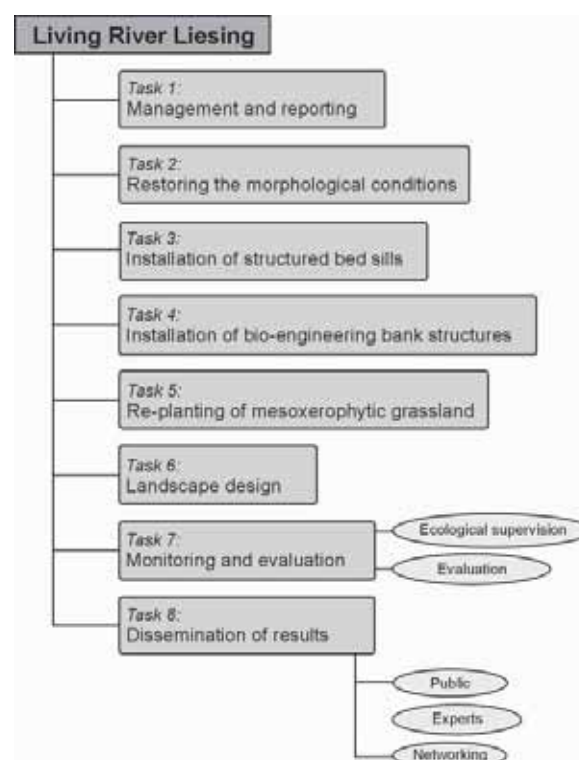


Figure 3 Project Structure Living River Liesing

#### 4. Conclusions

The interdisciplinary project has turned the river and its banks into the longest near-natural rivulet of Vienna and has so considerably extended the green belt of the city.

For a length of 5.5 km, the canal-like concrete channel has been re-designed into a semi-natural type-specific river which meets the relevant flood protection requirements. The revitalisation activities included construction measures to restore the river continuity by re-building bed drops, the restoration of semi-natural morphological conditions by integrating bays and shallow water zones, the restoration of former meanders, the construction of a semi-natural river bed with a gravel substrate, and the restoration of the river's natural transport capacity.

The steep banks were flattened and partly enlarged and so protected by bioengineering measures (willow fascines, wattle fence). Existing valuable grassland has been preserved by storing it during the construction works and re-planting it afterwards. Trees and bushes which are not native or suited for this location were replaced by species which are typical of floodplains.<sup>4</sup>

During this process not only participation of citizens has played a major role but also public relations work to keep persons interested up to date. The project web site: [www.life-liesingbach.at](http://www.life-liesingbach.at) and the public information centre situated near the construction area have played crucial roles in this public relations work as well as a film about the project and various leaflets, articles and information booklets.

The Liesing recreation area as a whole is today not only a better habitat, it offers more opportunities for its use as well. The long paths next to the river do not look all the same any more for kilometres, but have different attributes at different sections. Playing facilities for children have been improved.

Unfortunately the space between the river and the accompanying street and buildings is still rather small, which gives neither the user much space nor does it offer a habitat without disturbance for animals like birds. More space for the river in case of high water would have improved flood protection as well.



**Figure 4 River Liesing banks before and after reconstruction**

<sup>1</sup> DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000, Establishing a framework for Community action in the field of water policy

<sup>2</sup> <http://www.life-liesingbach.at>

<sup>3</sup> <http://europa.eu.int/comm/environment/life/life/environment.htm>

<sup>4</sup> <http://www.aquamedia.at/templates/index.cfm/id/1156>

## **Genesis and typology of riparian and fluvial landforms of the Kopački Rit within the Danube floodplain corridor in Croatia and Serbia**

**An example for understanding the linkage between the WFD and the protection of large riparian wetlands**

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### **Abstract**

Wetlands and floodplains with their ecological function as well as their flood mitigation capabilities are not exclusively mentioned in the WFD. Only inventories of protected areas for habitats and species under Article 6, Annex IV and the description of groundwater dependant habitats are required. Basically the WFD focus on those areas, where the maintenance or improvement of the status of water is an important factor in their protection. The second sensible and important issue covers the hydromorphology with its important role for the reference conditions for water bodies and the quality assessment.

The following list indicates the step-wise approach of the WFD with some implications for the wetlands and floodplains:

1. Assessment of the status (Art. 4)
2. River and lake typology (Art. 5, Anh. II,1)
3. Definition of water dependant terrestrial habitats (Anh. II,2)
4. Inventories of protected areas (based on the FFH, and Birds Directives, Art. 6)
5. Description of reference conditions (Anh. II,1.3)
6. Preparation of programmes of measures (Art. 11) and river basin management plans (Art. 13)
7. Surveillance, monitoring (Art. 8)

In a first step the ICPDR designated 55 protected areas of basin wide importance including the Kopački Rit complex. Before the detailed characterization of this unique floodplain the following figure 1 shows the selection process how to designate WFD relevant protected areas (Natura2000 sites; similar approaches were used in Germany and Austria). Based on the entire set of areas and species the selection approach considers the typical life conditions and requirements of selected water related habitats and water dependant species:

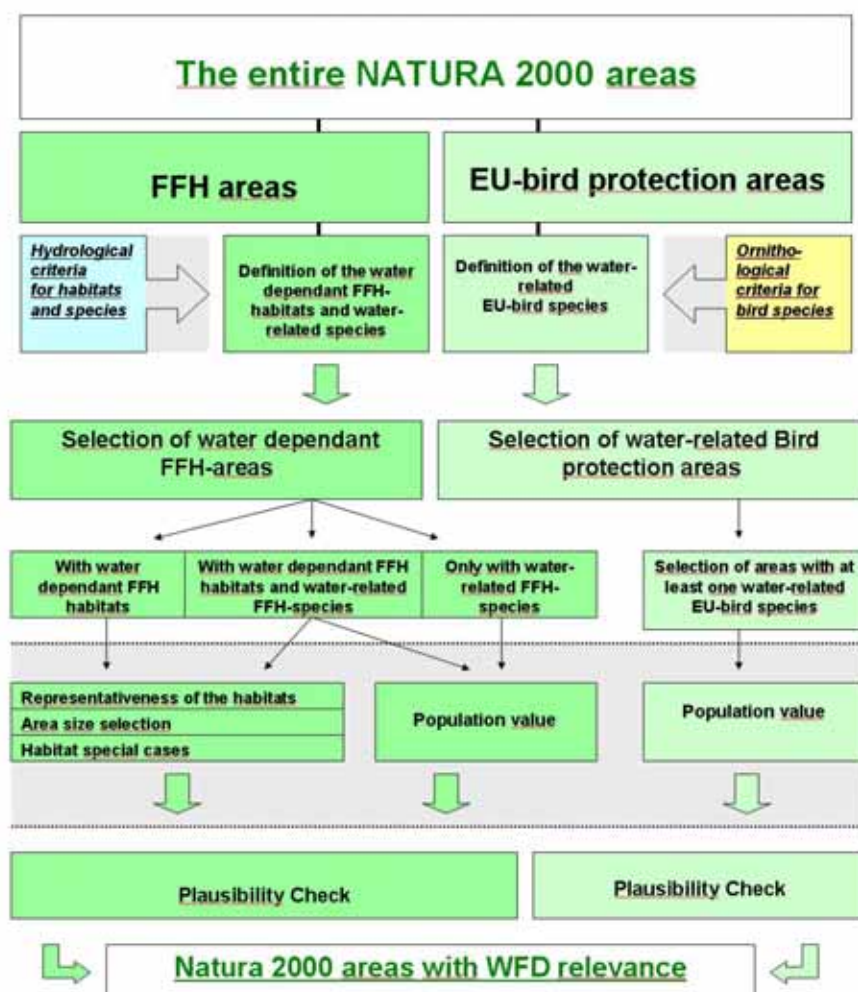
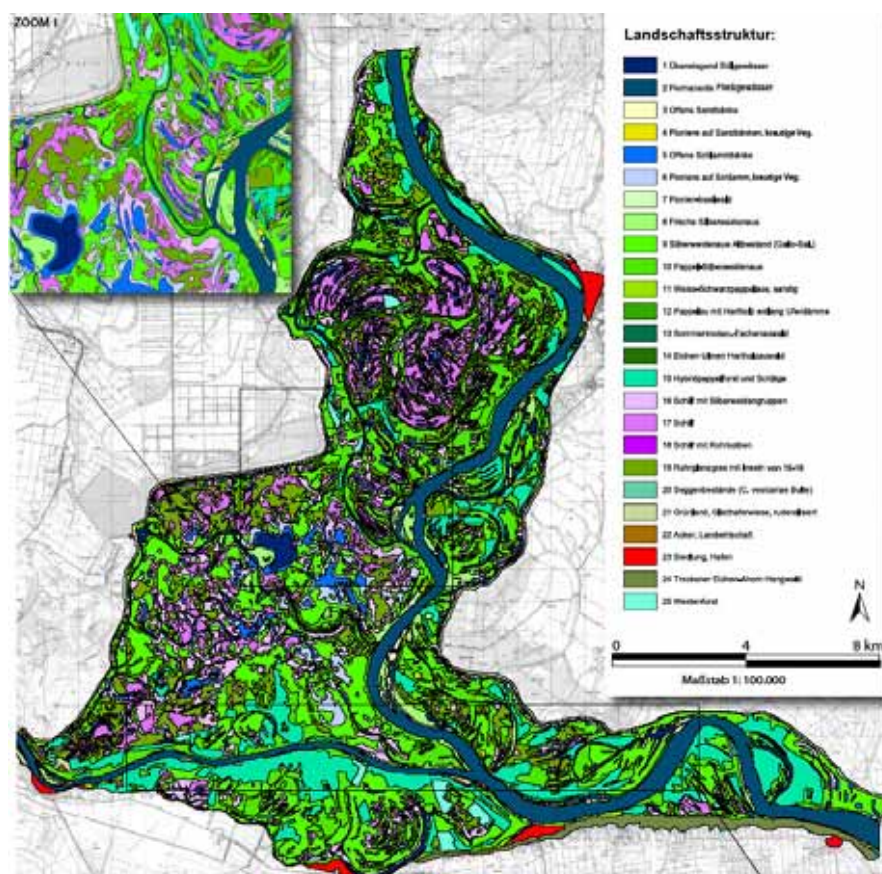


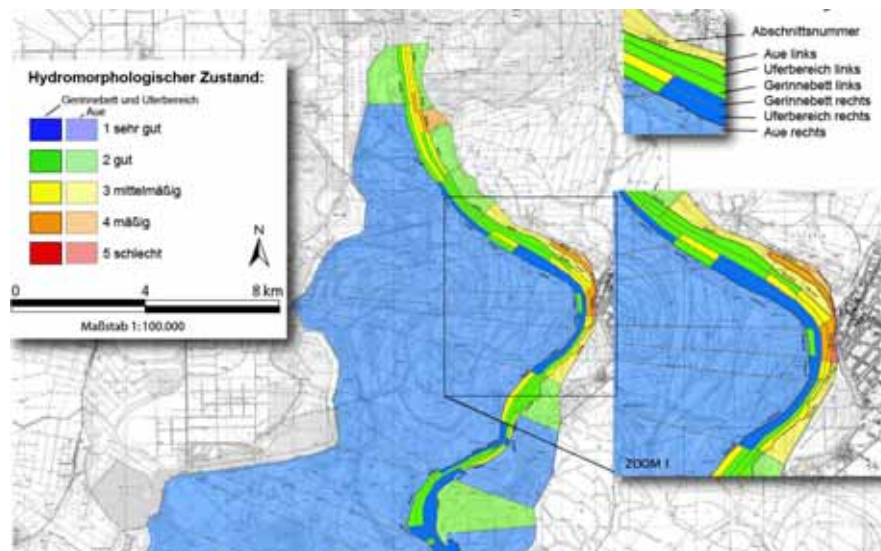
Figure 1: Selection of WFD relevant Natura2000 sites

The Kopački Rit at the confluence of the Drava into the Danube river and the adjacent floodplain areas along the middle course of the Danube build a recent floodplain corridor of more than 100.000 ha only in Croatia and Serbia & Montenegro. The Kopački Rit in particular is characterized by long enduring flood events during the early summer months, extensive soft woods and swampy vegetation patterns which form a mosaic of high dynamic shallow floodplain lakes, muddy pioneer stands, a typical floodplain relief with flood channels, oxbows and bank ridges as well as large reed stands and succession areas. Next to the Danube Delta the area is the second most important spawning ground along the entire Danube and hosts over 290 bird species over the year.



Map 1: Landscape structure inventory

In a first step a landscape structure analysis (habitat mapping, compare map 1) based on multispectral and multisensorial remote sensing data and field surveys with following historical comparisons and a hydromorphological inventory (compare map 2) of the Danube and Drava were carried out. The developed methodology based on German approaches for large rivers, but is also inline with the new European CEN-standard.

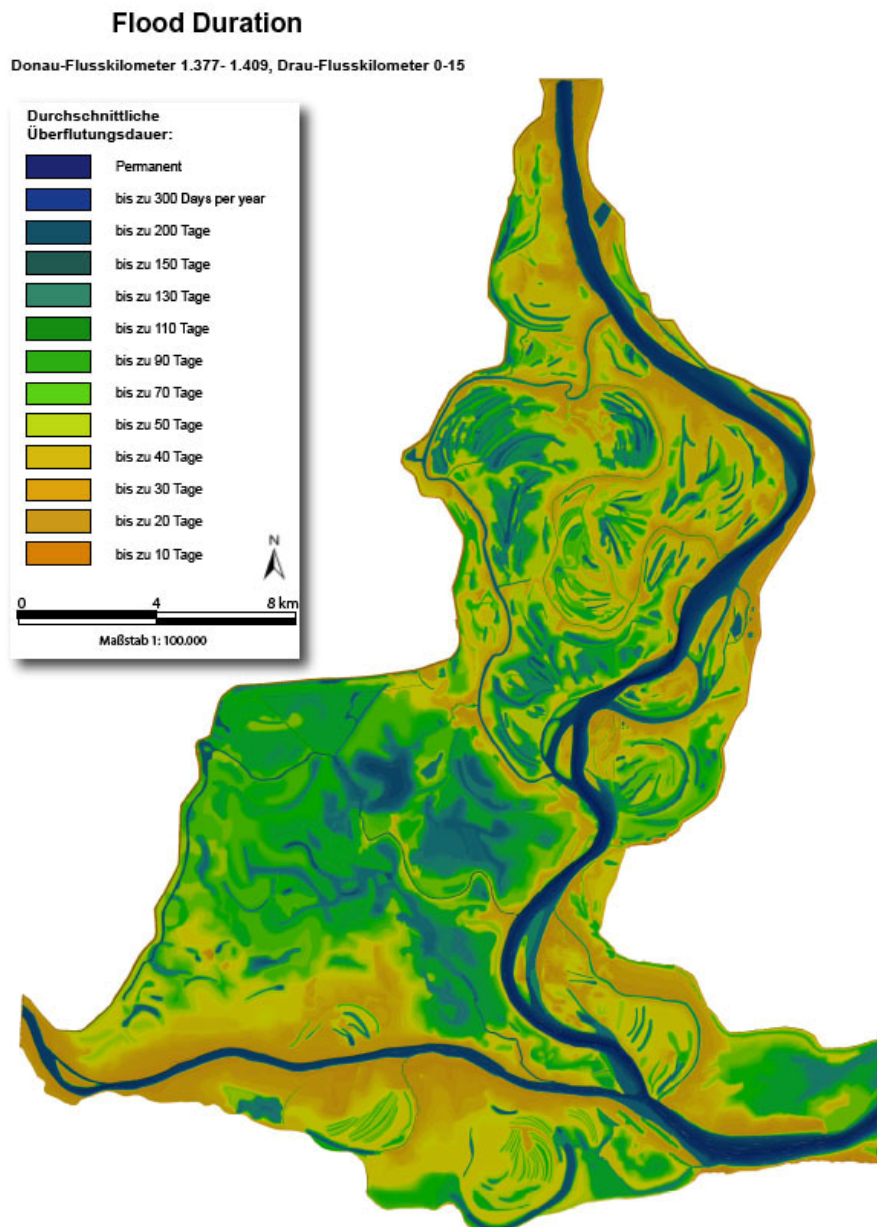


Map 2: Hydromorphological inventory

In a second step a digital elevation model was used to calculate the flood levels and to determinate the flooded area for different water stages and flood events (compare map 3). The importance of large floodplains along lowland rivers for the retention and wave peak reduction is much more effective than for headwater streams in mountainous areas.

In a third step all visible riparian and fluvial landforms based on the structural inventory in combination with the additional invisible floodplain relief information of the DEM were surveyed. In a natural floodplain many different landforms (such as oxbows, riffles and swales) exist in close neighbourhood and time frequency and in many different succession stadiums.

The final analysis try to order the collected landforms along a flooding gradient including additional parameters such as vegetation, size and planform to propose a fluvial landforms typology for the research area. Parallel to the development of the typology, attention was given to the development and genesis of selected typical landforms in particularly all forms depending on the meander morphology of this area and depending of the natural levees along the main rivers. The understanding and genesis of the unique shallow floodplain lakes of the Kopački Rit which still exist only in a small number on the lower Danube in Romania is one of the most challenging tasks.



Map 3: Flood duration map

Summarizing, the Kopački Rit (protected since 1964) hosts still a great number of different fluvial and riparian landforms and as opposed to comparable sites in Western and Central Europe the structure and vitality of those forms are still under near-natural conditions.

Concerning the WFD and the management of the area under WFD purposes “target is the good ecological quality of all parameters”, the study highlights the importance of a near-natural flood regime as well as an intact sediment and morphological regime for the existence of such lowland floodplain areas. The description and analysis of the fluvial landforms in the recent floodplain, covering numerous small and larger water bodies (different oxbows and floodplain lakes, pools) allow the assessment of possible reference conditions for large rivers beside the ecological (water) quality in the main channel. The hydromorphological approach offers a great opportunity to survey also large rivers in the Danube River basin.

## **Living River Liesing – A LIFE-project on rehabilitation of a heavily modified waterbody in Vienna’s urban environment**

Author(s): Dr. Ulrike Goldschmid, Dipl. Ing. Jochen Schmid

### **1. Objective**

The objective of the innovative pilot project funded by LIFE-environment, is to achieve “maximum ecological potential” for the Liesing River, as demanded by the Water Framework Directive with regard to “heavily modified water bodies”. For a length of 5.5 km, a concrete channel located in an urban area was re-designed into a semi-natural type-specific river, which also meets the relevant flood protection requirements. The River Liesing is Vienna’s third largest river after Danube and Wienfluss. Its catchment basin is 115 km<sup>2</sup>; the whole riverlength is 30 km, with 52 km<sup>2</sup> and 18 km of it in Vienna. The names of her two headstreams “Rich-” and “Dry Liesing” characterise the geology of the area. The “Rich Liesing” comes out of a Flysch area, and the “Dry Liesing” has her origin in limestone.

The Liesing is famous for her fast rising, heavy floods, of the Flysch area, where heavy showers cannot be soaked up well. Heavy flood events in the past led to a regulation system such as lowering and stretching of the riverbed. Meanders have been cut off and refilled and high bed drops interrupted the flow. Loss of wildlife, disturbance of the ecosystem and bad waterquality in the new channel were of no interest at that time.



Figure 1. Heavy flood events in 1954



Figure 2. After the flood in 1954 the Liesing was pressed into a u-shaped concrete bed.

## 2. Actions and measures taken

Revitalisation activities include construction measures to restore the river continuity by re-building bed drops, restoration of semi-natural morphological conditions by integrating bays and shallow water zones, restoration of former meanders, construction of a semi-natural river bed with a gravel substrate, and the restoration of the river's natural transport capacity. Steep banks are flattened and partly enlarged and are now protected by bioengineering measures (willow fascines, wattle fences). Existing valuable mesoxerophytic grassland has been preserved by storing it during the construction works and was re-planted afterwards. Only indigenous trees and bushes were used. An accompanying pathway and a riverside playground for children have been constructed and opened to the public for recreational purposes. The project is accompanied by intensive PR activities involving neighbouring residents.

### 2.1. Restoration of the morphological conditions of the river

The hard concrete, u - shaped riverbed was totally removed and stones for hydraulic engineering have been installed to protect the river bed. A gravel layer consisting of grain sizes typical for this kind of river was applied in order to provide sufficient gaps in the sand to be populated by macrozoobenthos. The river profile will be enlarged, shallow water zones created, and the bank line will be extended by integrating

bays and eddy zones. These measures are changing the roughness, will result in different flow velocities, and the river will be able to create different depth variances in a certain amplitude.

This constitutes a significant ecological improvement, since it leads to the development of a multitude of microhabitats, which may be populated by faunal and floral communities typical of this kind of water which contain a large number of different species. Particularly in times of low water flow, the scouring zones are important for the survival of a large fish community. During floods, the bays and eddy zones provide a place of refuge for fish and macrozoobenthos. The shallow water zones may be populated by plant communities typical of the transitional zone between water and land (reeds), which are essential for the hatching process of insects whose larval development takes place in the water (Odonata, Plecoptera etc.). Moreover, such reed zones contribute essentially to improving the quality of the water.



Figure 3. re –construction of the new riverbed

## 2.2. Installation of structured bed sills

The restoration of the river continuity is a significant requirement of the Water Framework Directive. Bed drops which constitute an unsurmountable obstacle for fish restrict their natural range especially with regard to migratory species. Hence, particularly rheophile species of fish are severely threatened by extinction. In the Liesing River, such bed drops were removed and replaced by flat bed sills with a maximum height of 15 - 20 cm, which create a variety of different current velocities. These bed sills were installed in various combinations, so that the difference in bed levels of about 75 cm currently existing in some places were re-shaped into softly sloping bed structures of up to 100 metres. This will restore the possibility of longitudinal migration even for microorganisms, and the rich native fish fauna still existing in the semi-natural upper reach of the Liesing River may spread further. The aim is to create suitable habitats not only for adult fish but also for juvenile fish hoping that stable populations will develop. The stock of non-native salmonids is to be strongly reduced as a management measure implemented in agreement with representatives of the fishery lobby.



Figure 4. Series of new bed sills allow migration of fish and other river inhabitants again



Figure 5. flat bed sill in detail

### 2.3. Installation of soil-bioengineering bank protection structures

In context of practical construction training of the Institute of Soil Bioengineering and Landscape Construction of the University of Natural Resources and Applied Life Sciences Vienna students built bank protection structures made of willows, such as fascines, wattle fences, brush mattresses and willow cuttings to protect the riverbank in a close-to-natural manner. Various willow species suitable for this location (*Salix purpurea*, *Salix viminalis* etc.) have great root formation capacity, which means that their branches, twigs, and trunks quickly develop a dense network of roots at the cut surfaces. Therefore, they are very well suited for building ecological bank protection structures. Willows with a trunk diameter of up to 15 cm were freshly cut and processed within a few days. The branches and trunks were bound together to form long fascines and fastened with pegs and wire in the spillage area of the slopes or are partly dug in. They also may be interlaced to form vertical fences or may be placed and secured as brush mattresses flatly onto softly sloping embankments. After a short time, most of these willow branches start to root, grow further and swiftly protect the embankment against erosion by waves, currents or rain. They

quickly form a woody border, which is typical of floodplains. This woody border runs parallel with the river and is essential for its shading. The gaps between the root structures, fascines and wattle fences serve as hiding-place for juvenile fish and for various mammals such as Soricidae (shrews) and as nesting area for waterfowl and valuable food resource for beavers (*Castor fiber*).

The building of such bank structures constitutes an important element of the students' practical training. In consequence, they also develop a rather personal relationship with the river.



Figure 6. The vegetated crib-wall 5 month after construction.

#### **2.4. Removal and re-planting of mesoxerophytic grassland**

An analysis of the ecological status quo conducted in 1999 revealed that ecologically valuable populations of dry oat-grass (*Festuco-Brometea*) have locally settled on low-nutrient slopes with southern exposure. In some places the oat-grass was interrupted by low-nutrient meadows of higher altitudes (*Triseteta*) which are rich in herbs. In areas where these communities could not be preserved during the construction works, the oat-grass was taken off in layers of about 20 cm, temporarily stored in the vicinity of the building site, and re-applied to a low-nutrient, water-permeable soil substrate. For this purpose, the plant sods were distributed on the relevant area leaving gaps in between them and the quickly growing sods spread into these gaps. This measure was supported by the manual collection of seeds which were then sown into the gaps on the new slope areas. The re-location of ecologically valuable plant communities guarantees the conservation of an interesting biodiversity as a result of the close vicinity of aquatic, semi-aquatic and extremely low-nutrient, dry zones.

#### **2.5. Landscape design**

The measures to design the river area and the surroundings include the following:

**Re-planting of solitary trees and bushes:** There are a few relicts of the original riparian woods, though most trees currently growing near the Liesing River belong to a planted wood stand, which is not suited and untypical for this location. In areas where trees had to be cut for construction work, they were replaced by species typical for the relevant location. In addition to solitary trees, and various native bush groups were planted in places of the embankment. Their blossoms and seeds will not only be pleasing to the eyes of visitors but also of ecological value providing food for insects and birds in the winter.

**Construction of accompanying pathways:** On both banks of the Liesing River, pathways running parallel with the river have been constructed and are open to the public as cycleway and trail (urban walkway). In some places this pathways run close to the river and are more distant from the river in other places, creating interesting views. Moreover, the pathways link public transport stops, nursery schools, schools, supermarkets, etc. They are accompanied by tables and public benches integrated into a public open space system. The pathways surface consist of a water permeable surface (water-bound surface).



Figure 7. Pathway and resting place close to the river

Riverside playground: A special attraction is the “riverside playground”. In this context, safe access to the water was the first imperative. Children love the possibility to play in and near water, to build small dams, to divert water, to build small boats and let them float. Children, growing up in an urban environment rarely have the opportunity to experience nature creatively, though this is crucial for their environmental education. This opportunity will now be safely provided in this section of the Liesing river.

### 3. Expected results

A prerequisite for the project was the construction of a new wastewater-line parallel to the riverbed. This is expected to improve the water quality to quality class II of the saprobic system.

The most important outcome is an aquatic ecological corridor through the urban area with new habitats for priority species and recreation opportunities for the urban population. The challenge of the project was to relate specific situations to the interacting fields of urban planning and water engineering. The goal was to achieve the “maximal possible ecological potential” in “heavily modified waterbodies” called for by the Water Framework Directive for

#### 3.1. Evaluation and monitoring

Ecological supervision of construction: An ecologist as well as makrozoobenthos specialist and a landscaper were members of the interdisciplinary planning team. During the whole project period, an ecologist was supervising construction directly at the site.

Evaluation: Constructed measures will be evaluated through a three-year ecological monitoring process which started in 2004. . During the planning phase in 1999, an analysis of the ecological status quo had already been conducted and now serves as benchmark for the monitoring. Indicators for the ecological function of the biological communities in the river include macrozoobenthos, fish, dragonflies, and ciliates, as well as ecological examinations of the aquatic and terrestrial flora. The group of indicators for terrestrial areas consists of ground beetles (Carabidae). Samples are taken three times a year at 6 sampling points, in order to examine the status in spring, summer and autumn. In addition, hydromorphological and sedimentological examinations are carried out in accordance with the Austrian standard (ÖNORM M 6232).

A video film documents not only the reconstruction work on the river, but also the methodology and results of the monitoring. Furthermore, a bacteriological and chemical monitoring process is carried out which will analyse the parameters: carbon, ammonium, nitrite, nitrate, phosphate, chloride, sulphate, calcium, magnesium, overall phosphor level, hardness, oxygen, temperature, conductivity and surface tension.

In order to monitor the hydrological discharge level, which changed by the removal of sewage plant discharge and thermal waters, two additional gauges will complement the existing permanent hydrological water gauge. .

#### **4. Project status**

Reconstruction work started in autumn 2002 and will be finished in the winter of 2005. Planning of reconstruction of an additional 2.8 km upstream has already been started.

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# Stakeholders in the Danube River Basin

Janja Zlatic-Jugovic

**EU Water Framework Directive (WFD) that came into force in 2000, obliges the EU countries to implement it and to put it into practice. WFD considers the river basin as the basic unit for any water planning and management activity. Thus administrative, national and political boundaries are prevailed by natural hydrological boundaries.**

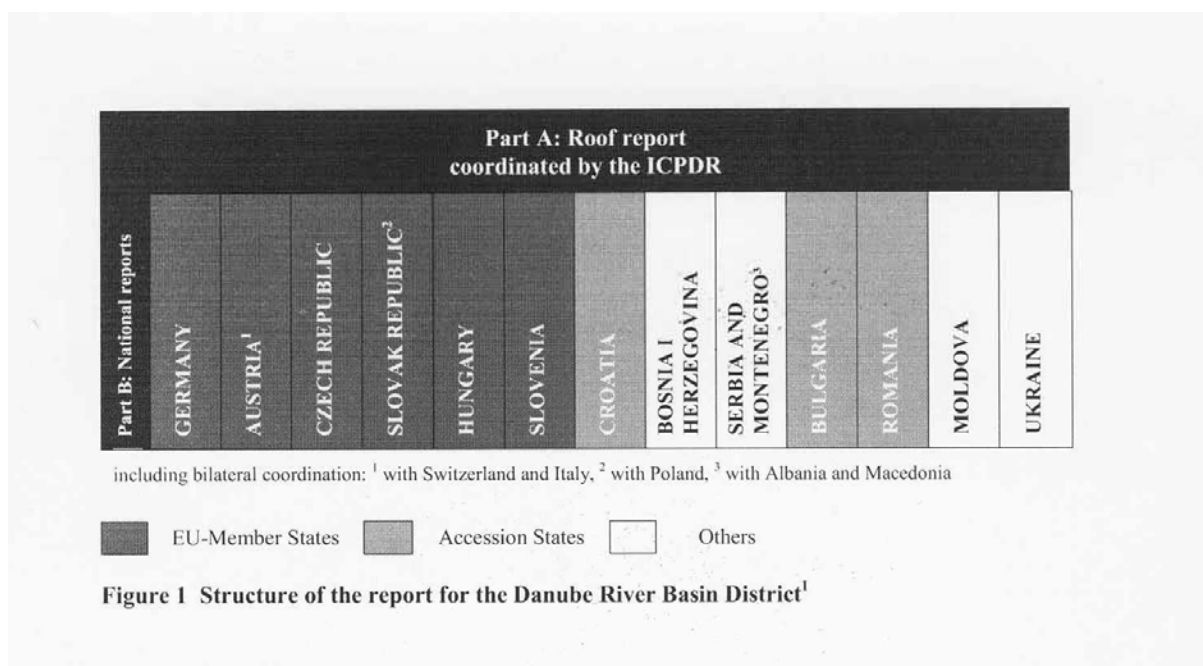
**The aim of the WFD is to achieve a “good ecological and chemical status” of all water bodies by the year 2015. The implementation of the directive is binding for the countries, the steps are precisely determined. The result of this process is a river basin management plan to be published by the year 2009.**

**Besides competent authorities, the stakeholders are included in the effort to achieve the compromise between the water use and water protection. They range from individual consumers, major water-using sectors like industry or agriculture to water supply and water treatment companies, nature conservationists and scientists. They should take part in every planning process of water use at local, national and international level.**

According to WFD (Article 14), public has to be informed of definitions of the basin characteristics, and to be actively involved in drafting the river basin management plans and subsequent programmes for the implementation. Aarhus convention, signed in 1998 by the Governments of the UN ECE region and the European Community, is a convention on public access to information, public participation in environmental decision-making and public access to justice on environmental issues. The Aarhus Convention entered into force in 2001. In the Danube basin, nearly all the countries have ratified the convention, while Croatia, Serbia and Montenegro as well as Bosnia and Herzegovina are in the process of doing it.

The interaction between public and authorities in this democratic context is a must. But how does this work in practice? We are living in an era when sustainable development overrules the traditional economic optimisation and EIA is (at least) nominally involved in every decision-making process. However, despite signatures and the public participation in the negotiation and implementation processes of both; domestic environmental requirements on one side and potentially, of international agreements, the good practices to bring words into deeds are often still missing.

In the Danube River Basin, International Commission for the Protection of the Danube River (ICPDR) implements the Convention for the Protection and Sustainable Use of the Danube River. Further more, after the commitment of the Danube countries to implement the WFD in the Danube River Basin, ICPDR has been designated as the platform for the implementation of the international aspects of the WFD in the Danube River Basin. The main task of the ICPDR is to coordinate the development and establishment of the River Basin Management Plan.



The Expert Groups of the ICPDR are appointed by the governments of the 13 Danube countries. River basin management, WFD implementation, pollution control and monitoring, accident prevention, flood protection, economic analysis, ecological aspects of land use, wetlands and protected areas are the main issues of basin-wide interest.

Nevertheless, ICPDR is also committed to serving as a framework for information and stakeholder participation in Danube-related issues. Thus, currently the following NGOs in the Danube basin have the observer status in the ICPDR: World Wide Fund for Nature - Carpathian Programme (WWF-DCP), International Association for Danube Research (IAD), Danube Environmental Forum (DEF), Global Water Partnership (GWP), Regional Environmental Centre for Central and Eastern Europe (REC), Black Sea Commission, Danube Commission, International Association of Water Supply Companies in the Danube River Catchment Area (IAWD), International Hydrological Programme of the UNESCO (IHP) and RAMSAR Convention on Wetlands. Although starting to cooperate with ICPDR as “pure observers”, with time they could actively join the planning process.

Several NGOs in the Danube basin are also actively participating in the UNDP/GEF Danube Regional Project, but they do act also independently, through their programmes, projects and campaigns on international, national and local level.

International Association for Danube Research (IAD) is the oldest NGO in the Danube region. Since 1956, IAD connects the experts in 13 Danube countries from both sides of “iron curtain” in the field of limnology, water management and water protection. Nowadays it pools the expertise and experience of some 500 scientists in its 13 Expert Groups. The expert studies offer a valuable basis and inventory for

future Danube river management (macrophytes inventory, floodplain ecology, hydromorphology mapping, biomonitoring etc.)

World Wild Fund for Nature – Carpathian Programme (WWF-DCP) is present in the Danube region since early 1990s while engaged in habitat restoration projects, sustainable wetlands management, policy lobbying, education and awareness raising activities and others.

Danube Environmental Forum (DEF) is a network of environmental NGOs working on nature protection in different parts of the DRB. Established in 1999, it represents now 150 NGOs in all 13 Danube countries. DEF is a good route for linking the high policy level discussions on the basin level to local people throughout the DRB.

Danube river basin is the most international river basin in the world. The region has been divided to “East” and “West” since the Roman era by the Roman “limes”, in the last century by the “Iron curtain” until 1989 and the wounds of the recent war are still healing. The discrepancies do not lie only in history and politics, the DRB is a union of countries of huge economic disparities and the recent EU-Enlargement has brought a new dynamics of feelings and attitudes throughout the whole region. It is a great task to unite six EU-Member States, three Accession countries and four Non-EU countries towards a unique harmonized river basin management. In this process public participation plays an important role.

However, as a result of a high degree of cooperation and coordination among the Danube countries, recently, the WFD Roof Report on the status of waters in the Danube region for the year 2004, Basin-wide overview – Part A (Part B consists of national data), has been submitted to the EU commission. It was for the first time, that on the basin level such an immense quantity of data has been collected. This has been a great success, but also an opportunity to detect the gaps and to learn the lessons for future. The Stakeholder conference in Budapest in June 2005 accumulated the stakeholders from the Danube region. It was a great international event to public information and consultation. The WFD Roof Report 2004 has been presented and the feedback information from the stakeholders collected.

Public participation in shaping the river management should be carried out on different levels, depending on the scale of the issues being addressed. In a large transboundary river basin like Danube, the international dimension to public information and consultation is needed.

The EU legislation alone could not be sufficient to safeguard the water resources in the Danube River Basin. Public awareness should be encouraged towards transparency, while developing and spreading examples of good practices. Free access to information and to planning process should be established, communication infrastructures should be developed, public education supported in order to make the public participation and consultation really function.

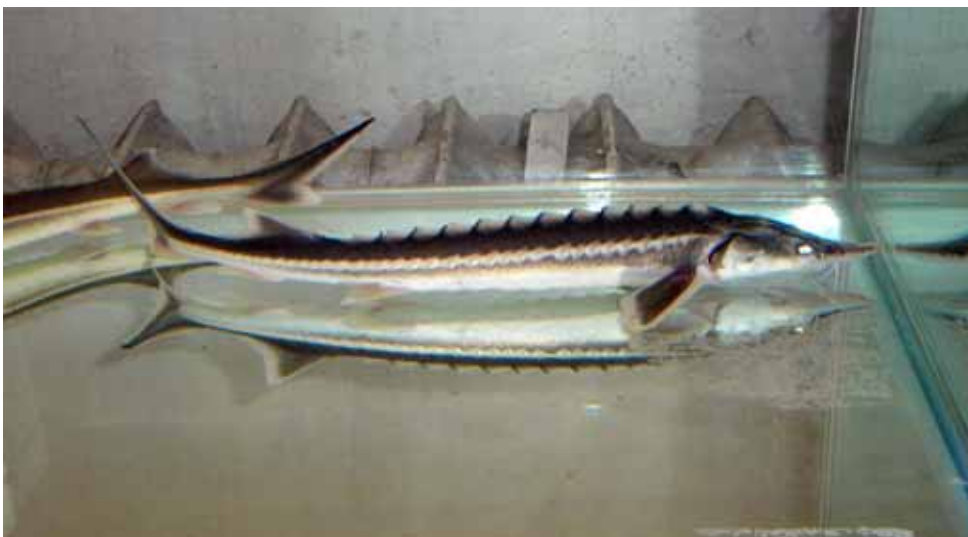
Photo 1: Wild boars in National Park Lonjsko Polje in Sava Catchment



Photo2: The Danube Day, a manifestation of unity for 80 million people living in the basin in 2006 is promoted under the motto "Living space (fish for the Danube)".



Photo 3: Sterlet called Ship sturgeon caught in Bulgaria for the first time after 30 years. Recently, IAD and WWF have initiated the Sturgeon Action Plan that should help to restore the sturgeon population in the Danube and the Black Sea



## The DANUBE Region: Current Role of the European Water Framework Directive and Possible Role of European Landscape Directive.

**Meinhard Breiling**

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### Introduction

The European Union agreed on the Water Framework Directive in 2000 and certain procedures became obligatory for all EU countries. The ecological and chemical states of European rivers have to be described until 2006 with the aim to preserve a good and to improve a bad state by water management plans. Until 2015 a harmonised approach should be on the way. So far, the efforts concentrated to involve the national and provincial authorities into this process. Others should follow later on.

One of the recent elaborates of the Council of Europe was the European landscape convention, which was signed by 24 Council of Europe member countries in Florence in October 2000. Natural and cultural aspects are equally important. The contextual embedding of several factors is in centre and water is a most important one under them. The landscape convention resembles the local Agenda 21 approaches initiated by several European countries after the World Summit in Rio in 1992. The landscape convention is directed to the smallest public authority scale, the communal councils. Until 2005 more than 10 European countries ratified the European Landscape Charter and thereby the landscape charter became a binding planning instrument of those countries.

### Extension of planning scales and sustainable development over spatial scales.

Since the Stockholm Conference in 1972 and more distinct since the Rio Conference in 1992, sustainable development with economic, social and ecologic sound development is promoted everywhere in the world. The Agenda 21 program became a major concern all over the globe with the basic question: "Under what conditions economic growth is not harmful for the ecosystem?" All recent international agreements of environmental quality are related to sustainable development. In practical terms this means the common definition of environmental thresholds or procedures.

From a planning point of view, sustainable development is a process. It will not end in a steady state. Periodically, there is a need to reformulate the meaning and interests of sustainable development as continuously new issues are entering the debate.

**Figure 1: Extension of planning scales**



Figure1 Global, regional and local planning scales. The bottom line shows diameters of spatial extensions in log km scale. 2 corresponds to a diameter of 100km length or  $10^2$  km, 1 to  $10^1$  km or 10km, 0 to  $10^0$  km or 1km, -1 to  $10^{-1}$  km or 100m and so on. The advantage of this presentation is that we

see global and private scale phenomena on one chart. The Danube region extends approximately at 3 ( $10^3$  or 1000km length) and includes 1 million  $\text{km}^2$  if we anticipate the form of a square. It is situated in an international regional scale, the largest of the regional scales. The atmosphere is global and stretches over 100,000 km. The local scale starts with 1 km in diameter and private scale starts with 100m and goes down to the diameter of 10 cm at the point -4. When I sit on my desk, I am within any scale at the same time.

The interaction of spatial scales, global, regional, and local ones are obvious. Sustainable development on the global scale builds on a sustainable development within regional scales. A sustainable regional development builds on local sustainability. In homogenous parts of the scale there is a higher likelihood to foresee development. In heterogeneous parts there is a higher likelihood to discover surprises, often the reason for major changes and innovations. Gaps should neither become too large nor should they disappear.

Still the actors in planning concentrate on a few scales and integrating larger scale developments into local plans are just at the beginning. The issues of sustainability are mixed and depend on the spatial scale we address.

Reducing greenhouse gases is one interest of a sustainable development on the global scale. The Kyoto protocol to protect the atmosphere with the stabilization and reduction of greenhouse gases is an important international agreement. Despite the recent draw back from obligations by some countries the issue never received so much attention before. This issue pulls all other issues that are in focus on the smaller scales

Water becomes a key interest on the international regional scale. The European water framework directive was established to enforce concerted actions all over Europe. Physical, chemical, zoo- and phytoplankton and bacteriological indicators describe the quantity and the quality of water.

The use and shape of water bodies need adequate attention and for this the smaller regional scale is more appropriate. Landscape and the composition of water as landscape element with diverse water bodies providing habitats for all kind of organism are an interest on a much smaller regional scale related to communities.

We can regard sustainable development as a continuous process to improve planning by enlarging the range of topics from all spatial scales. Any new framework addressed on a particular scale of relevance that is taken seriously by a critical mass of decision makers will contribute to more sustainability. The smooth interaction from global, regional and local scales will lead to more overall sustainability.

**Figure 2. Regional sustainability and the range of the water framework directive and landscape convention.**

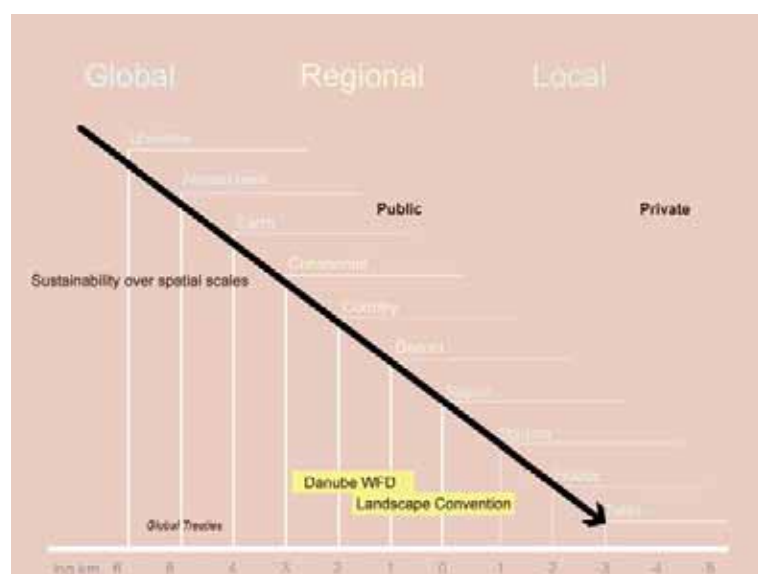


Figure 2 explains the idea of sustainability over many spatial scales. The line from global to local is the ideal that we want: sustainability from large scale to small scale. The water framework directive and the landscape convention support spatial planning efforts of the public sector within regional scales. While the water directive covers the larger scale, the landscape convention covers the smaller regional scale. In combination both frameworks cover what we generally consider as regional and public.

The two European frameworks of water and landscape cover each a particular range, where they intend to get the attention of the relevant actors in scale. In Figure 2, the range of the water framework directive for the Danube basin covers 3 to 2 or an overall area of about 1 million  $\text{km}^2$  including smaller units with an average size of 10,000  $\text{km}^2$ . The landscape convention deals with overall areas of several

10,000 km<sup>2</sup> - the size of nations undersigning it – consisting of smaller scale administrative units with a size of approximately 100 km<sup>2</sup> covering objects of the private scales.

## Regional sustainability in the Danube River Basin

The aim is to assess the question of regional sustainability. The frameworks designed for public scales management collect or stimulate wanted initiatives from the private scales. Best practice approaches from viewpoint of the water and landscape directive get more value in a program. What is considered as sustainable in the local scale can multiply in the regional scale. The framework of the larger scale is the water framework directive. The framework of the smaller scale is the landscape convention.

The issue of regional sustainability started long before in a period of cold war in 1980 with the Bucharest declaration for protecting the Danube River. The situation changed spectacularly after the break down of the communist block in 1989. The Danube Protection Convention was signed in Sofia

in 1994. It led to the establishment of an international agency in 1997, the International Commission for the Protection of the Danube River, ICPDR. The European water framework directive from 2000 gave a legal basis for setting up water management plans. Those plans are expected for 2006.

The second half of the last century was characterised by rapid transformations and accelerated change. Inside the Danube region, we find modifications with land use changes, increase of overbuilt areas for settlements and traffic, construction of large river reservoirs with transformations of river beds, intensified agricultural land management practices with irrigation, drainage systems and multiplication of chemical inputs, growth of urban sewage, increasing demands in water supply in industries and services combined with an increase in waste water.

The Danube river basin contains 0.2% of the Earth surface or 0.5% of the global landscape.

With 817,000 km<sup>2</sup> it is the 22<sup>nd</sup> largest river basin in the world and the second largest in Europe.

With a length of 2857 km it is globally the 27<sup>th</sup> longest river. From the source in Germany up to Budapest, the Danube flows through mountainous and hilly terrain, from

Budapest downwards to the Danube Delta, there are primarily lowlands. The highest point in the Danube basin is in the Swiss Alps with 4047m altitude (Biz Bernina). Beside parts of the Alps, we find fractions of Carpathian and Balkan mountains. The central parts of the Danube river basin consist of fertile planes and the delta.

A geo-physical division (IHP UNESCO, 1999) divides the Danube into three segments, the upper Danube from the source to the castle of Devin/Bratislava, where the river Morava flows into the Danube, the central Danube from Devin to the Iron Gate at the border Yugoslavia and Romania, and the lower Danube covers the Danube after the Iron Gate until the Danube Delta.

The Danube basin lies in a favourable climate zone of the world. The average annual temperature is about 9° C. The longitudinal range for temperature is  $\pm 1^{\circ}\text{C}$  within the basin and about  $-1^{\circ}\text{C}$  for 200m increase in altitude. Monthly temperature differences stretch over 20° C along the year. Annual precipitation is varying from a maximum of 2000mm in mountainous elevations to a minimum of 300mm in lowlands, in average some 680mm a year.

Some 0.5% of the world precipitation amounting for 550 km<sup>3</sup> water is raining or snowing within the Danube river basin. About 0.7% of global river runoff or 270 km<sup>3</sup> derive from the Danube and 0.4% of the global evaporation or 280 km<sup>3</sup> (own estimate based on global and European estimates of L'vovich and White, 1990) happen over the land cover of the Danube river basin. The Danube has a mean discharge of 6,400 m<sup>3</sup>s<sup>-1</sup>. The estimated mean sediment load is 19 million tons per year and the mean dissolved load is 60 million tons per year (Douglas 1990).

Around 1.5% of the global population with 83 million people (ICPDR 2002) are living in the Danube river basin. With about 100 inhabitants per km<sup>2</sup> the Danube river basin is about three times more populated than the world average. Compared to other European regions, e.g. the Rhine region, the Danube region can still be considered as scarcely populated. The inhabitants have in general good access to water resources. Assuming a high average daily demand of 600l freshwater per inhabitant, some 20 km<sup>3</sup> are annually converted into waste water. While it seems that the quantity of freshwater can easily be supplied, the seasonal availability of water can be a problem. In some years there can be drought, in other flooding.

The recent results in the report of the Joint Danube survey (ICPDR 2002) in particular the phytoplankton and zooplankton measurements demonstrate that general pollution levels of the Upper Danube and Lower Danube countries are generally less than the ones of central Danube countries. We find several and diverse ways of using and managing land and water in the Danube river basin,

primarily based on the economic possibilities of the countries. Austrian and German cities are almost entirely built out with sewage treatment plants, while Budapest and Belgrade do not have yet a satisfying system to treat wastewater at relatively high levels of polluting substances like detergents. The downstream countries have neither a high level of polluting inputs nor sewage treatment plans.

Economic disparity is large. The average person in Switzerland – the leading country in terms of income - has some 30,000 US\$ GNP per person and year, the average income of a person in Moldova – the poorest country - is 500 US\$ GNP per person and year. Based on economic figures we find three sectors: a) the economically rich upstream sector with Austria, Germany, Switzerland, the b) moderate rich in between sector with Czech Republic, Slovakia, Hungary, Slovenia, Croatia and c) the less rich sector with Yugoslavia, Bosnia-Herzegovina, Bulgaria, Romania, Moldova and Ukraine (Fischer Verlag, 2001). In addition we find four more countries, Italy, Poland, Albania and Macedonia with minor shares – less than 1000km<sup>2</sup> - of their countries within the Danube river basin. Former Yugoslavia was reported to have higher income disparities within its borders than the European Union had. A sustainable regional development with so large economic differences is not possible.

The smaller scale of regional sustainability should be promoted by the European landscape convention. The ensemble of the landscape is in focus. The shape, functionality and beauty of water bodies are in particularly important in a landscape perspective. While the large scale of the Danube region is for many inhabitants abstract. Most inhabitants of the Danube region have not visited other parts of the basin. They lack a basic understanding for such different conditions. The small scale of their landscape is their point of understanding and identification.

## Conclusions

A single framework like the water directive caring for harmonised environmental standards throughout the region gives visions for a sustainable regional development. A complementary framework on the smaller scale that considers the particular context of water in the overall environment is needed. We propose the landscape convention, as landscape includes nature and culture with all ecological, economic and social foundations that contribute to sustainability.

So far the development is not comparable throughout the Danube region. Primarily the economic differences are responsible for an unsustainable regional development. The economic and environmental thresholds are different in each country and district of the Danube river basin. A successful implementation of the European frameworks will contribute to a more sustainable development within the Danube region.

## References

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**Program: Contemporary Aspects of Landscape Planning**

**The Implementation of the EU Water Framework Directive from  
International, National and Local Perspectives.**

Place: Seminar Room 32, Operngasse 11, 4<sup>th</sup> floor

Final program version January 18th, 2006

**Block 1: Thursday, January 19<sup>th</sup>, 2006, 9:30 to 12:00**

<b>Block 1</b>	<b>The Implementation Process of the EU Water Framework Directive on International, National and Local Level.</b>
D. Drumea, Deputy Minister of Environment, Rep. of Moldova, Delegate ICPDR presidency	The European Water Framework Directive: the Role of ICPDR and the Influence of National Governments. <a href="http://www.icpdr.org">http://www.icpdr.org</a>
G. Ofenböck, Austrian Ministry of Life	The Austrian Position for the Implementation of the EU WFD. Die österreichische Position bei der Umsetzung der EU Wasserrahmenrichtlinie (in German with English Summary). <a href="http://publikationen.lebensministerium.at/">http://publikationen.lebensministerium.at/</a>
G. Käfel, NOEL, Government of Lower Austria	The Local Implementation of the EU WFD exemplified at Thullnerbach in Lower Austria. Maßnahmenvorschläge zur Erreichung des Zielzustandes gemäß WRRL an der Großen Thulln. (in German with English Summary)
Discussion:	Multilevel Regimes of Implementation of the EU Water Framework Directive.

**Block 2: Thursday, January 19<sup>th</sup>, 2006, 13:30 to 16:00**

<b>Block 2</b>	<b>International and National Projects in Relation to EU Water Framework Directive</b>
M. Zessner- Spitzenberg, TU Wien	Results of the DaNubs project 2001-2005. Link: <a href="http://danubs.tuwien.ac.at">http://danubs.tuwien.ac.at</a>
G. Kuschig, MA 31, Wien	The Interreg IIIB CADSES project KATER II (KArst waTER research programme). Link: <a href="http://www.kater.at">http://www.kater.at</a>
E. Mattanovich, Raum&Umwelt Wien	Water Framework Directive and Environmental Impact Assessment at Large Infrastructure Projects. Wasserrahmenrichtlinie und UVP bei Infrastrukturprojekten. (In German with English summary)
Discussion	Will the EU WFD dominate future local and regional planning?



### Block 3: Thursday, January 19<sup>th</sup>, 2006, 16:20 to 18:30

Block 3	Particular Aspects of EU Water Framework Directive and Situation in Non EU Countries
A. Awadallah, TU Wien	Water management under extreme conditions of conflict in the Gaza Strip.
M. Randers/ J. Svärd, SLU Ultuna	Sweden and the EU Water Framework Directive.
D. Djapa, TU Wien	Water Management in Urban Context: the Case of Belgrade.
B. Birli, TU Wien	The Role of the European Water Directive on Reconstructing Liesing River, Vienna
Discussion	Is the concept of the EU WFD a general concept for the whole world or a particular European one? Is the EU WFD needed in urban areas?

### Block 4: Friday, January 20<sup>th</sup>, 2006, 9:30 to 12:00 a.m.

Block 4	Stakeholders in the Danube River Basin
U. Schwarz, FLUVIUS, Wien	Genesis and typology of riparian and fluvial landforms of the Kopački Rit within the Danube floodplain corridor in Croatia and Serbia. An example for understanding the linkage between the WFD and the protection of large riparian wetlands.
U. Goldschmied, MA 45, Wien	Living River Liesing – A LIFE-Project on Rehabilitation of a heavily modified waterbody in Vienna's urban environment
M. Breiling, TU Wien	The DANUBE Region: Current Role of the European Water Framework Directive and Possible Role of European Landscape Directive
Discussion: Guided by IAD, the oldest NGO in Danube Basin	The Interests and Influence of "Stakeholders" in the Danube River Basin: how it is possible to contribute?



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