SedNet

Report on the SedNet Round Table Discussion

Sediment Management – an essential element of River Basin Management Plans

Venice, 22-23 November 2006

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Introduction, overview and conclusions of the SedNet Round Table Discussion

SedNet

SedNet started in 2002 as a Thematic Network with funding from the European Commission DG-Research under the 5th RTD Framework Programme. It was aimed at setting up a European network in the field of "assessment of fate and impact of contaminants in sediment and dredged material and at sustainable solutions for their management and treatment".

Since 2005 SedNet has run independently from the EC. It brings together experts from science, administration and industry. It interacts with the various networks in Europe that operate at the national or international level and that focus on specific fields such as science, policy making, sediment management, industry and education.

SedNet is now the European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management. The focus is on all sediment quality and quantity issues on a river basin scale, ranging from freshwater to estuarine and marine sediments. More information can be found on www.SedNet.org.

Objective of the Round Table Discussion

Sediment is an essential, integral and dynamic part of our river basins. Where human activities interfere with sediment quantity or quality, sediment management becomes necessary. One of SedNet's main recommendations is to integrate sustainable sediment management into the European Water Framework Directive (WFD) related policy, legislation, and implementation process. This is to achieve good ecological status, or potential, and at the same time to support the well-being of the European economy.

Central to the EU WFD are River Basin Management Plans, which have to be produced and published by 2009. Until now sediment related quantity and quality issues have played a relatively minor role in the Common Implementation Strategy (CIS) process. SedNet aims at providing scientific and user oriented input into the WFD implementation phase.

On the basis of this background, SedNet organised a 2-day Round Table Discussion under the title "Sediment management – an essential element of River Basin Management Plans". The objective was to derive generic and specific recommendations for sediment management based on experiences in selected key river basins taking into account legal requirements, needs of users and scientific advice.

The Round Table Discussion brought together delegates from European river commissions, user groups, and scientists. The river basins represented were the Danube, Douro, Elbe and Humber. The ongoing work on the River Rhine sediment management plan was presented by the chairman of the ad hoc-working group on sediments of the International Commission for the Protection of the Rhine (ICPR).

The sediment-related uses that were discussed included:

- Aggregate dredging for the construction industry;
- Agricultural use of floodplains;
- Dredging for navigation purposes;
- Drinking water supply;
- Hydropower generation;
- Nature conservation; and
- Flood protection.

Delegates were asked to prepare written statements before the meeting. The discussion followed the structure: interests; challenges; and expectations. It was facilitated by members of the SedNet Steering Group. An overview of participants and organisations that were present can be found at the end of this document. The outcome of the Round Table is presented here. It is intended to inform River Basin Managers, key players and users, and the European Commission for the further implementation process of the WFD.

Similarities and differences in the river basins

A recurring theme in discussions of the different case studies was that each case was unique, for natural, socio-economic and political reasons. At the same time, sediments are an issue of importance in all of the river basins that were discussed. Different uses and ecological targets are connected through sediments. While sediment challenges become evident in defined areas they may have to be tackled on a broader scale, from water bodies to regions to whole catchment areas.

Some discussion focused on issues of sediment balance. Often in the same river basin, different areas had contrasting sediment quantity issues. Too much sediment makes dredging or reservoir flushing necessary, which may cause ecological impacts like smothering of habitats or even habitat loss. Downstream sediment loss due to sand and gravel extraction, for example, may cause erosion or loss of wetlands and create problems for habitat or coastal protection. At the same, time human interventions such as dredging or hydropower generation have to be acknowledged in order to support economic activities. In all case studies, there was recognition that this would require intense communication and collaboration between various sectors. Solutions need to be both ecologically and economically sustainable. Although not all objectives may be achievable, win-win situations should be sought. Beneficial use of the dredged sediment should be sought, e.g. for conservation purposes etc.

Sediment quality due to contaminants and nutrients was a focus of concern in three of the case studies. There was recognition of the need for better understanding and control of current and historical sources of contaminants, which may involve international and cross-regional cooperation. Approaches for risk identification are being used.

Not only are there differences between the rivers, but also within river basins different regions often need to be identified because they have special characteristics that need to be evaluated. For example, sediment delivery, erosion, contaminant and nutrient emission in mountainous regions have to be differentiated from lowland river stretches.

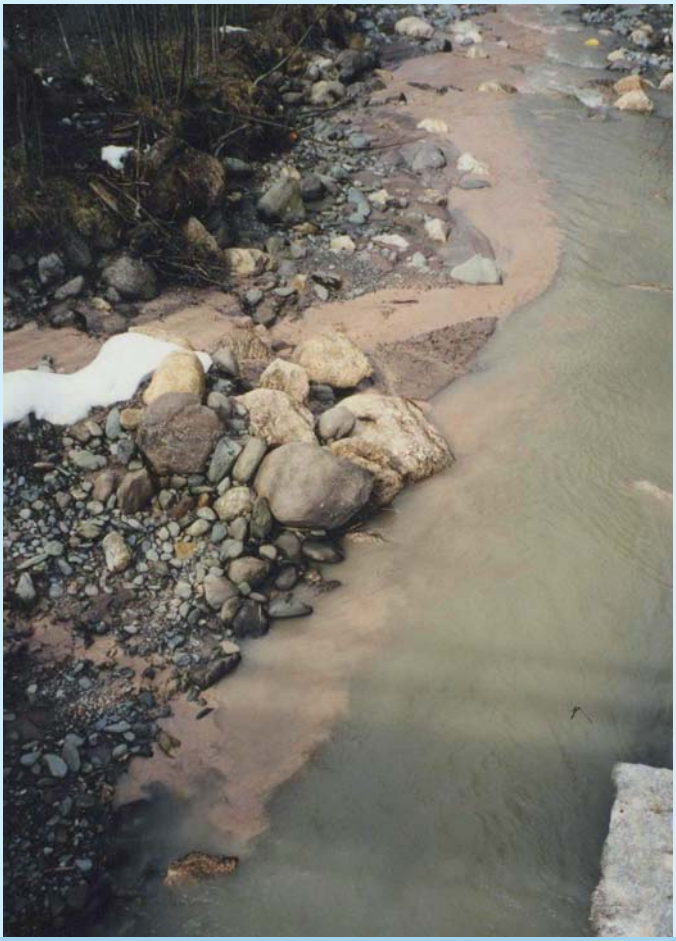
It is important to note that estuaries are substantially different in their characteristics from fluvial reaches. Here we see natural hydromorphological changes connected to sediment movements, and in places very high sediment transport rates coming from and/or going to the sea. Morphological changes may occur over very short time scales. In the coastal zone there is a special link of sediment management to climate change issues in situations where a large amount of dredged sediments can be used for shoreline protection etc.

Looking at the differences between the four rivers the following issues were raised:

- Sediment management has to consider the natural and artificial variations in a river basin.
- The areas within basins with the most important issues differ between river basins. In the Humber basin, the estuary is perhaps the most important region to consider, whereas in the Elbe basin the estuary is also important but to solve contamination problems the whole river basin has to be considered.
- In some river basins quality issues appear to be the most important, whereas in others the focus is more on the quantity issue or a mixture of both. Quality often becomes an issue through the need of quantity management (e.g. maintenance dredging). Quantity management often means sediment transport management[•] (supply and transfer) and also aspects such as river bed stabilisation.

Better system understanding

A general conclusion that was reached is a need to respect wide variation in sediment processes. Because of the highly dynamic nature of most river basins, both quantity and quality issues require a good understanding of the basin system to support management actions and plans. There is a clear need to better understand sediment sources and dynamics and their



[•] See also the WFD CIS Hydro-morphological pressures Policy Paper "Focus on hydropower, navigation and flood defence activities / Recommendations for better policy integration" (2006)

interactions with both human management and ecosystem functioning and services. It is necessary to collate all available data and information to enhance understanding and to identify knowledge gaps.

To manage sediment from a quantitative point of view, it is essential to have data on morphological and sedimentological change. This could be an element of the WFD monitoring programme. Data on aggregate extraction and dredging could be supplied in the characterisation of the river basin.

Hydromorphological alterations - like dams, river deepening, etc. - are often linked to sediment management, which may be necessary to maintain the functioning of the alterations. It may be not only an issue of sediment transport (quantity), because if sediments are contaminated it may become a quality issue as well. Quantity and quality issues often cannot, and should not, be separated.

Flood protection and sediment management are interrelated as well. Giving more room to rivers means extended inundation areas (such as floodplains), which generally are also sedimentation areas. This may mean areas which are subject to sedimentation of contaminants, which may impact on agriculture in these areas.

Need for guidance

Sediment management is an issue which should be considered in the context of WFD river basin management. Because each river basin has its specific characteristics and challenges, then river basin sediment management will have different focal points. A systematic approach which can be used throughout Europe is very much needed.

There is a need for scientific and practical guidance on how to consider sediment management issues at a river basin scale which should draw on existing information and guidance and experience from other places. Available scientifically based approaches and practical experience in Europe should be shared.

Sediments are subject to different European policies and regulations. A European approach should also clarify existing uncertainties in legislation otherwise integration of the requirements of different directives will be difficult for river basin managers and users. Such integration is essential if the objectives are to be met. Even conflicting objectives and activities may arise when EU policies are implemented independently. An integration of requirements of different European directives is thus a challenge for river basin managers and users, including:

- Water Framework Directive;
- Birds and Habitats Directives;
- Marine Strategy and draft directive;
- Waste Directive and other related directives;
- Soil Strategy and draft directive;
- Environmental Liability Directive;
- EU legislation on food quality.

It has to be emphasized that a “one size fits all” approach would not be an adequate management solution. Development and delivery of guidance and frameworks have to allow for variability.

Management plans

Sediment management is needed to secure human activities and environmental objectives, and will be subject to different legal requirements. To balance all this Sediment Management Plans should be developed. The institutional provisions of the Water Framework Directive, like River Basin Management Plans, can provide the necessary platform and instruments.

Management plans have to consider the high natural variability of sediment dynamics and should not compromise the ability of the system to respond. An adaptive, site specific management approach will be needed which allows for variations within a given range. It has to be acknowledged that acting in highly dynamic systems will contain an element of uncertainty.

Plans for integrating requirements of flood protection, navigation, and nature conservation are extant for estuaries like the Elbe, Scheldt, Seine and others. In the UK, a maintenance dredging protocol has been developed for dredging under the Birds and Habitats Directives, which has support from both ports and environmental NGOs. It can be seen as part of the solution for environmental problems in coastal areas and estuaries. Such a protocol could also be developed for WFD requirements.

To enable specific uses and/or to protect the aquatic environment, especially the marine environment, from sediment contamination a special programme of measures may be necessary. For contaminated sediments a three-step strategy has been developed to identify areas of risk and to classify them according to their potential impact at the river basin scale. This methodology is currently being applied to the Rhine and Elbe rivers. More information is given in the Elbe chapter below.

For rivers with a long pollution history, resulting in river basin wide contamination problems, flexibility in management may be needed, allowing transition to a longer term objective. This would account for long-lasting impacts, e.g. with respect to the agricultural use of floodplains or dredging. These exemptions

should be linked to clearly set remediation measures (in the context of the Programme of Measures).

The WFD foresees economic instruments, which may be needed in sediment management. It may be important to have information on the economic aspects of sediment uses (e.g. see the Douro case).

To solve contamination problems, cost-sharing in the river basin may help as a financial instrument. Because of the possible immense costs involved and community-wide importance of the issues, financial support from the EU Commission may be needed.

Environmental Quality Standards for sediments

A discussion focussed on the development and use of sediment environmental quality standards (EQS). The difference between EQS for water and those for sediment is that various types of sediment matrices and different contaminant levels act very differently in river basins. Therefore EQS should only be regarded as high-level screening values and be used accordingly:

- as a start of diagnostics (using tiered approaches);
- using different lines of evidence, and linking sediment state to impacts;
- for certain measures (such as source control) then target values and a good understanding of the system are necessary;
- the role of EQS is different in upstream parts of the river basin compared to that in downstream parts (estuaries);
- EQS may not be appropriate for sediments in highly variable situations where measurable state-impact links are not well understood.

The four river basins case studies have been prepared by the specific rapporteur in collaboration with the group representatives. They reflect the specific group discussion and are different in their content and structure.

Recommendations

Sediment management in terms of quality and quantity should receive due attention in River Basin Management Plans (RBMP). Exceptions from including sediment management into the RBMP should be justified.

There is a need for wide recognition that the current “at risk” classification within the WFD is a screening level, which should trigger spatial discrimination, further study of effects and tests of the significance of impacts. This requires an evidence-based approach to link sediment state to impacts, and integrated thinking about rivers and transitional waters.

Those involved in transitional/marine water management need better engagement with those involved with river management, and vice versa.

Future research will be necessary. There is a need to collate available data to identify knowledge gaps and enhance understanding, linking sediment management to environmental and climate change issues.

An adaptive management approach is required; there is not a one-size-fits-all solution, it has to be tailor-made to the specific situation. At the same time it is important to make use of experience from other river basins and to develop common basic approaches.

The Round Table concluded that achieving good ecological status requires a proper attention to sediment issues, with an awareness of natural variation and differences between river basins.

It was felt that the EU should not only fund problem identification, but also problem solving processes. Sediment issues should be discussed between different Directorate Generals in Brussels, like for instance DG Environment, DG Transport and DG Health.

The Danube case

The discussion in Venice was also based on a workshop which took place in Budapest on 24 and 25 March 2006. The Budapest meeting was jointly organised by SedNet and the European Commission 6th Framework Programme project AquaTerra (www.eu-AquaTerra.de) in cooperation with the Danube countries International Hydrological Programme (IHP) sediments expert group, the International Commission for Protection of the Danube River (ICPDR), UNESCO IHP/International Sediment Initiative (ISI) and the Hungarian Environmental Protection and Water Management Research Institute VITUKI. The workshop was sponsored by UNESCO-BRESCE (Regional Bureau for Science and Culture in Europe).

The full report of the Budapest workshop is publicly available through the AquaTerra website at:
www.attempto-projects.de/aquaterra/59.0.html#92
("BASIN 5.14: Evaluation of the Danube workshop").

The Danube river basin

The Danube River Basin is the second largest river basin in Europe covering 801,463 km^2 and territories of – to date – 19 states including EU-Member States, Accession Countries and other states that have not applied for EU membership. It lies to the west of the Black Sea in Central and South-eastern Europe (see Figure 1). To the west and northwest the Danube River Basin borders on the Rhine River Basin, in the north on the Weser, Elbe, Odra and Vistula River Basins, in the north-east on the Dnjestr, and in the south on the catchments of the rivers flowing into the Adriatic Sea and the Aegean Sea.

Due to its geologic and geographic conditions the Danube River Basin can be divided into 3 main parts:

- The Upper Danube Basin reaches from the sources in the Black Forest Mountains to the Gate of Devín, to the east of Vienna, where the foothills of the Alps, the Small Carpathians and the Leitha Mountains meet.
- The Middle Danube Basin covers a large area reaching from the Gate of Devín to the impressive gorge of the Danube at the Iron Gate, which divides the Southern Carpathian Mountains in the north and the Balkan Mountains in the south.
- The Lower Danube Basin covers the Romanian-Bulgarian Danube sub-basin downstream of Cazane Gorge and the sub-basins of the Siret and Prut River.

Due to this richness in landscape the Danube River Basin shows a tremendous diversity of habitats through which rivers and streams flow including glaciated high-gradient mountains, forested midland mountains and hills, upland plateaus and plains and wet lowlands near sea level.

Management issues

As presented in Figure 2, the achievement of the Water Framework Directive environmental objectives in the Danube basin is at risk due to hydro-morphological alterations, nutrients, hazardous substances and organic pollutants.[•]

Figure 1 The Danube river basin (courtesy of ICPDR)

• ICPDR. 2005. Danube Basin Analysis (WFD Roof Report 2004). Technical Report. International Commission for the Protection of the Danube River. Vienna, Austria.

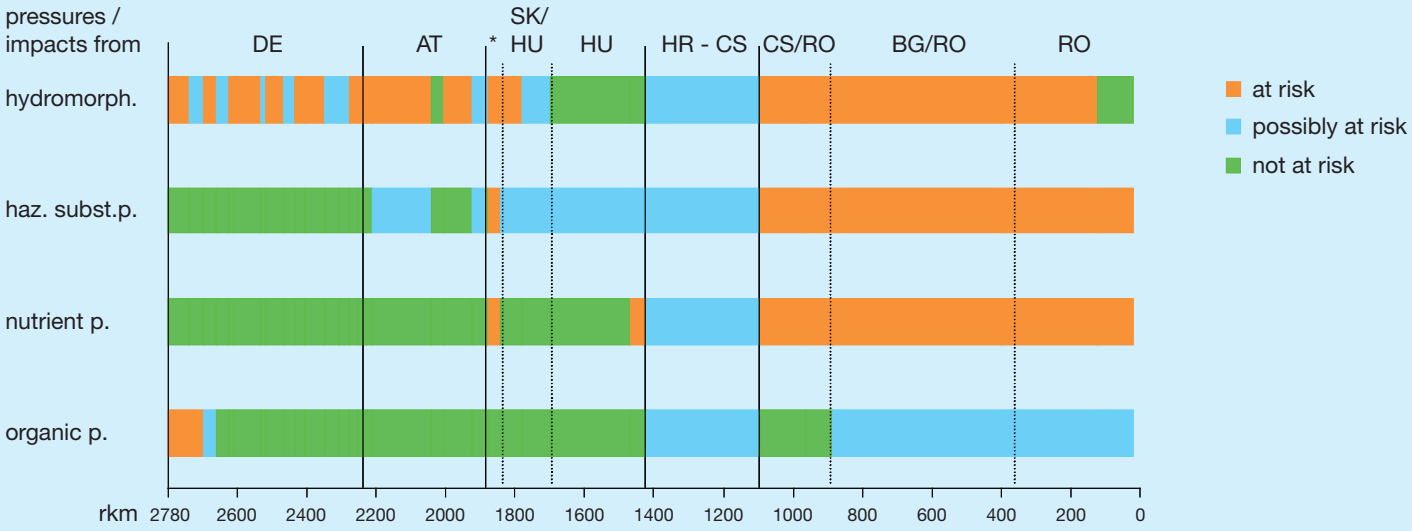


Figure 2 Causes of risk of failure to meet the WFD objectives in the Danube basin (from ICPDR, 2005)

Although it may be clear that each of these key-issues is also linked to sediment, based on the available information to date it is not yet possible to estimate whether there is also a risk of failure to meet the WFD objectives due to sediment issues. This was kept in mind in the Budapest workshop as well as during the Round Table Discussion.

Outcome of discussions

The participants of the Budapest workshop perceived the following two sediment management related issues as most important in the Danube basin:

- The improvement of the understanding of the role of sediment in the functioning of the natural sediment-soil-water system in the Danube and of the impact of changes (hydro-morphological, land use, climate/flooding etc.) on that functioning. This touches upon sub-issues like the relation between sediment quantity and quality, its relation to achieving the WFD environmental objectives (good status), options for management of sediment, e.g. for mitigation of possible impacts to the WFD objectives, sediment-associated mass transfer and sedimentation of contaminants, awareness/communication of sediment (related) issues etc.
- The current status in quantity and quality of sediment in the Danube river-basin. This touches upon sub-issues like harmonisation of sediment sampling and sediment analysis, data availability (national > trans-national > basin scale), data comparability, (central) handling/storage of data, etc. and the related political/trans-boundary bottlenecks to overcome and, eventually, deriving of a sediment balance (quantity and quality) for the Danube.

All participants of the Round Table Discussion in Venice endorsed the outcome of the Budapest workshop. However, some complementary issues related to sediment management were also raised, especially the perspectives of hydropower generation, drinking water production and of the World Wide Fund for Nature (WWF) were taken into account.

Hydropower generation

Sediment management is perceived as an issue in the upper part of the Danube. Here sediment needs to be flushed from reservoirs to keep them functioning and to increase flood protection capacity. The aim of hydropower producers is to find sustainable solutions to this issue as it is realised that the flushing results in high downstream sediment loads, thus increasing turbidity which may impact on fish breeding. An important question, however, is: how to differentiate natural variability in sediment loads and related turbidity from anthropogenic influence? Furthermore it should be noted that each case is different. Hence, a case-by-case approach is needed.

Drinking water production

Sediment management is indirectly perceived as an issue by drinking water producers. Their primary aim is to protect the quality of the surface and ground water resources, i.e. the resources for drinking water production. It is realised that the resource quality is related to, and hence may be impacted by, the quality of suspended particulate matter (SPM) and/or the quality of sediment. Maintaining or improving of the water phase/water quality and sediment will help to avoid using costly techniques (e.g. ozonation) to produce safe drinking water.

WWF perspective

According to the WWF sediment management is an issue of concern in the Danube. River training works, barrages and dams,

and also sediment extraction cause riverbed incision especially in upstream sections of Danube. Incisions from 1 to 4 m over the last 100 years have often irreversible effects on river training structures, bridges and also groundwater dependent ecosystems.

Common perspective

Related to possible sediment management issues, there was consensus among the Round Table participants on the following:

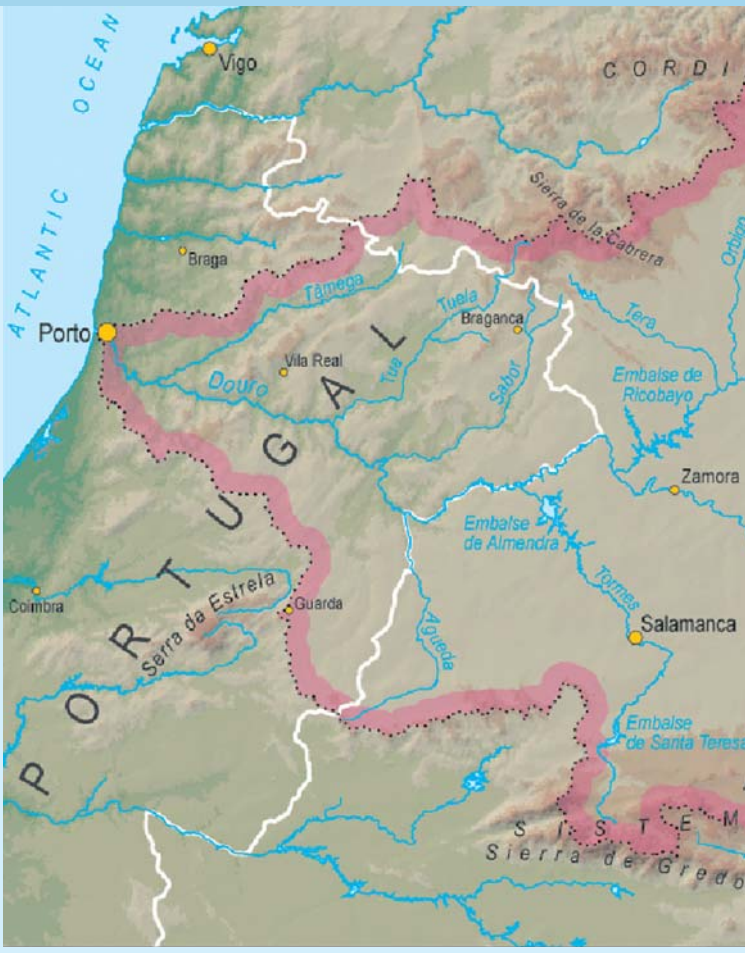
- Issues differ in the different stretches of the Danube, which are: Upper; Middle; Lower; delta; tributaries and reservoirs;
- Measures supporting navigation (river training works & dredging) are pressures which can conflict with natural/dynamic rivers, demanding adaptive management;
- Sediment (fine material) deficit/river bed degradation is mainly perceived as an issue in the lower part (Romania) and some sections of the upper part (bed load/bed incision) of the Danube. However, over the longer term the average sediment load has remained the same due to flushing (upstream), but the temporal variability has increased;
- In general sediment quantity is perceived as the main issue, however in the main channel/lower part of the Danube there are also quality related issues (DDT and other persistent pollutants). Furthermore there are indications that sediment quality in (some) tributaries is much worse than in the Danube main channel. This may pose a risk of secondary poisoning/food chain effects;
- Agriculture in the Danube has more impact on ground water quality than (contaminated) sediment in the flood plains. In general the flood plains have good ground water quality;
- Nutrient loading is perceived as an up-down stream issue. However, the nutrient load is quickly diluted by rain. But in general a significant load comes from upstream countries.

Last but not least the participants to the discussion indicated that they would like to see solutions for existing problems before focusing on new issues.

Towards the integration of sediment management in the Danube RBMP

The participants of the two discussions agreed on actions that are needed to move towards advice on the implementation of sediment management in the Danube River Basin Management Plan (RBMP):

- *Define the sediment balance*: i.e. actions undertaken to collate and synthesise the available information related to the current status in quality and quantity of sediment in the Danube river-basin. The actions are aimed at coming to a (preliminary) estimation of the sediment balance for the Danube and its main tributaries.
  UNESCO will most probably financially support a related activity. However, the Budapest workshop and Round Table participants call for further/additional support from the riparian states in order to be able to successfully complete this activity.
- *Improve the system understanding*: i.e. actions undertaken to address (to be further defined) knowledge gaps and hence improve the understanding of the role of sediment in the functioning of the natural sediment-soil-water system in the Danube. The actions should be aimed at assessment of the combined impact of sediment quantity and quality on the ecological status.
  Regarding system understanding, the Budapest workshop and Round Table participants call to exploit any opportunities under EC Framework Programme 7 (FP7), or opportunities under other research funding programmes. The participants call also upon the research programme developers (FP7 and others) to further tune their programmes to the need to improve system understanding. SedNet could be very helpful in this perspective by collation and synthesising of the existing experience and knowledge on the combined impact of sediment quantity and quality on the ecological status. It was suggested that this could e.g. be a theme of one of the next SedNet conferences.



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The Douro case

Participants in the discussion on the Portuguese part of the River Douro came from the following institutions:

- Instituto da Água (Institute for Water), which is the institution responsible for the WFD and the RBMPs in Portugal;
- Port Authority of Douro and Leixões (Administração dos Portos do Douro e Leixões), which has jurisdiction over the lower part of the estuary and is responsible for maintenance, bank protection and small harbour management;
- University of Porto, Head of the Working Group on ICZM appointed by the Ministry of the Environment;
- Laboratório Nacional de Engenharia Civil LNEC (Hydraulics and Environment Department);
- INIAP-IPIMAR (Institute for Fisheries and Sea Research).

Figure 3 Catchment area of the Rio Douro (Map: UNEP)

Figure 4 The Portuguese section of the Rio Douro, depicting the extensive mountainous character of the catchment. (courtesy of F. Veloso Gomes)

Description of the situation

The Douro catchment area of 97,000 km^2 is shared between Spain (80%) and Portugal (20%). Of a total 850 km river length, 525 km are in Spain, 112 km along the Spanish-Portuguese border, and 213 km in Portugal, where the Douro reaches the North Atlantic (Figure 3).

Over most of its length, the river is confined to a narrow river channel, flowing through mountainous regions (Figure 4). Hence, sediment consists almost exclusively of sand and gravel with minor silt components.

39 multipurpose dams (mostly for hydropower generation) with a total capacity of 1080 hm^3 disrupt the flow of the river in Portugal, smoothing the current velocity and reducing the sediment load that is transported downstream. Sediments that accumulate in reservoirs are extracted as aggregate for construction.

The Douro shows extreme annual flow variability: river flow can range from a few hundred m^3/s during summertime (or occasionally zero as a result of water management) to about 16,500 m^3/s during a 50-year return period flood. Due to their relatively low capacity, flood control by reservoirs works effectively only with small to medium floods, while the impact of extreme floods is scarcely controlled. In these cases a lot of material becomes resuspended and is flushed downstream towards the estuary (Figure 5).

Sand and gravel is extracted along the river for the construction industry. Until recently, around 2 million tonnes of sand and gravel were extracted each year from the Douro riverbed, representing an estimated 4% of the total (land-based and aquatic) aggregate production in Portugal. In the past 5 years, due to the observed morphological changes (i.e. depth increase) and the collapse of a century-old bridge, restrictions were

Figure 5 Carrapatelo dam during average hydrological conditions (left) and during the flood event of 1978 (courtesy of F. Veloso Gomes)

Figure 6 Hydrological processes at the mouth of the Douro (courtesy of F. Veloso Gomes)

• Ramalhosa E, Pereira E, Vale C, Válega M, Monterroso P, Duarte AC (2005): Mercury distribution in Douro estuary (Portugal). Marine Pollution Bulletin 50: 1218-1222

imposed on the activity. Aggregate extraction has been reduced to about 0.3 million tonnes annually.

The Douro estuary has a length of 22 km. It is a highly energetic zone due to tides, waves and river discharge. At its mouth, a sand spit protects the inner zone, with its river banks and beaches, against incoming waves. Dredging to maintain the nautical depth is only carried out in the estuary. The dredged material is partly relocated in the estuary and partly used for construction purposes.

In the inner zone of the sand spit finer sediments settle (circled in Figure 6). Samples from this area have shown slight mercury contamination[•], while on the north bank of the estuary, substantial anthropogenic metal contamination was found, which probably derived from emissions from the city of Porto.[••]

Sediment being transported by the Douro towards the coast is assumed to be responsible for a large percentage of the total sediment budget of the coast. The dominant littoral drift is south towards an area of extensive coastal urban settlement, protected by groynes and other works.

Challenges in the Douro catchment

In the Round Table discussion[•••] the main sediment challenges have been identified to be quantity related and driven by extensive changes which have been noted over the last decades:

- The river depth has increased by several metres, which may have led to the collapse of a century old bridge;
- The sand spit has retreated inwards by 750 m since 1854. Subsequently the estuary banks have been increasingly affected by waves;
- While the former long shore sediment transport along the coast was assessed to have been 1–2 million m^3/year, depending on the annual wave climate, the current long shore sediment transport has been estimated to be 0.1–0.2 million m^3/year due to lack of fluvial sediment sources.

Statement 1

Sediment deficiency in the river system worsens erosion at the coast. There is strong evidence that commercial sediment extraction activities are largely responsible for this deficiency.

The Douro is the largest supplier of sediment to the coastal system. The reduction in supply by the Douro over recent years, probably caused to a large extent by gravel and sand extraction, adversely affects coastal sediment dynamics. The coast south of the river mouth, to where the main current flows, is subject to strong erosion. The efficiency of protective groynes is low due to small amounts of accumulating sediments.

Recommendation

A recommendation given by the group is for a strong reduction in aggregate extraction for construction purposes. Material that needs to be dredged from the estuary for maintaining the nautical depth should remain in the system according to a dredging plan. While it is nowadays also used for construction purposes, it should in future be exclusively relocated in areas that are strongly eroded, e.g. in the estuary and at the coast, in order to decrease the negative annual sediment balance. There are a number of challenges involved in this. Even though these measures need to be taken up as soon as possible, it is recognized that time will be needed to achieve this recommendation due to the social and economic implications.

Statement 2

The extraction of sand and gravel has a negative impact on the morphology of the river bed. Information on volumes of extracted and dredged material is often unavailable.

The information on sediment dynamics in this system is not sufficient. Publicly available information on sediment extraction is suspected to be incorrect, and detailed information is often not available. This makes the estimation of the sediment budget and the impact of extraction procedures difficult. Additionally extraction is often done by digging deep holes in the river bed, disturbing the river bottom and the morphological stability.

Recommendation

Periodic surveys of the river bed are needed in order to monitor changes in bottom depth and hence to identify erosion/aggradation zones. While extraction is still going on, more environmentally friendly extraction methods should be used. At the same time, extraction needs to be properly supervised in order to ensure the right amounts and practices. It was suggested that an already existing data base for water information could be extended to include sediment data. The continuously updated data base should be publicly available.

Statement 3

Sediment quality is not a priority with regard to sediment management and water quality in the Douro but needs to be addressed.

Pollution from agriculture and urban sources impacts the water quality of the Douro. While in the course of the river, sediment consists mostly of sand and gravel, but fine sediments accumulate near the mouth of the river and may be impacted by the contaminants in the water. Relatively little, however, is known about the contamination of sediments here.

[••] Mucha AP, Bordalo AA, Vasconcelos MTSD (2004): Sediment quality in the Douro river estuary based on trace metal contents, macrobenthic community and elutriate sediment toxicity test (ESTT). J. Environ. Monit. 6: 585-592

[•••] Opinions of the participants do not necessarily reflect the views of their institutions

Recommendation

A more coherent monitoring of particle-bound contaminants is necessary where the specific focus should be on suspended sediments, as these may affect the estuary and coastal area. Surveys that need to be carried out will have to be harmonised between the different institutions and should be based on environmental objectives.

Statement 4

There are a number of current management plans which partly already address sediment issues but which are regionally based.

Currently existing management plans comprise coastal, river basin and reservoir management plans. Measures address different interests, like e.g. the protection of the river mouth and the protection of communities along the southern coastal stretch: breakwaters are under construction with the aim of reducing the impact of high energy waves, to reduce the volume of dredged material, and to direct the transport of material towards the Southern coast. The River Basin Plan from 2001 already mentions erosion, sediment transport and sedimentation, and envisions specific plans for sediment management, e.g. strict restrictions on aggregate extraction in future.

Recommendation

The existing river, coastal, reservoir and harbour management plans need to be integrated into one new River Basin Plan, prepared according to the WFD. Necessary measures will need to address sediment management issues and should be realized in river-basin oriented spatial planning. This, however, can only be done by recognizing the interests of river and land users. Their participation in the decision process is regarded as essential.

Expectations of the participants

- There is a need for further information on sediment dynamics in the river and estuary. Periodic surveys and measurements at different discharge situations are needed in order to determine sediment loads and to understand processes and impacts. The Regional River Administration, which is responsible for the implementation of the Water Framework Directive, should give a mandate to experts to carry out these surveys. Harbour authorities and national and regional water authorities are expected to cover the costs.
- The data base of the Water Authority should be extended by collected sediment data.
- Aggregate extraction in the river should be banned. The material dredged inside the estuary should be relocated purposefully with regard to quantity and quality.
- A specific sediment management plan, integrating sediment quality, quantity, water, soil, and land use is needed and should be developed in a participatory process, and implemented. A programme should be set up to evaluate and assess the realization of the plan, for which institutional cooperation will be necessary.

The Elbe case

In preparation for the Round Table on the Elbe case study, written contributions were submitted by the German River Basin Community (FGG Elbe), the Ministry of Agriculture of Lower Saxony (MA LS), the Waterways and Shipping Directorate East (WSD Ost), and the Hamburg Port Authority (HPA). A profound scientific analysis particularly with regard to sediment quality was given by U. Förstner, Hamburg. An email comment was received from WWF Germany, Freshwater Unit.

The Elbe basin

The Elbe is the third largest river of Central Europe, both in terms of length (1,091 km) and catchment area (148,268 km^2). The German part of the basin encompasses two thirds of the entire area, one third lies in the Czech Republic, and less than 1% in both Austria and Poland.

The Elbe stands out among Central European rivers for its natural resources, such as its wetland and floodplain forest habitats.[•]
The Elbe represents a densely populated European region with a very long industrial history and mining tradition. Around 56% of the entire catchment area is used intensively for agriculture.

For decades prior to the fall of the "iron curtain" the Elbe had been the recipient of insufficiently treated wastewater. For example, the chemical complex at Bitterfeld used to release 200,000 m^3 of untreated industrial sewage into the Elbe each day. After the collapse of the communist regimes, the remaining and the newly built industries and farms became generally equipped with modern pollution-control technologies. In the time span from 1990 – 1999, 181 municipal wastewater treatment facilities were newly built, extended or reconstructed.[••] However, the concentrations of several contaminants in sediments are still far from being safe for the freshwater community, the marine environment, and agricultural use.[•••] The most critical parameters in that respect are Cd, Hg, As, Zn, HCB, PCBs, and dioxins/furans.[••••]

For centuries, the flow conditions and the morphology of the river have been fundamentally controlled for the benefit of flood protection, navigation, hydropower generation, and land reclamation. Floodplain and tidal-marsh areas have been reduced by about 80% since mediaeval times. The river-engineering works have severely influenced the sediment budget.

In the inland Elbe, on the one hand, narrowing of the floodplain and river training by groynes have increased the sediment transport capacity of the free-flowing river. On the other hand, impounding of the upper course and of major tributaries has drastically reduced the natural bedload supply from upstream. The resulting bed degradation causes lowering of water levels not only in the river channel itself, but also in the groundwater bodies of the adjacent floodplains.

For the tidal Elbe too, scientific results indicate an unfavourable hydromorphological development. Man-made changes along with natural evolutionary processes have reduced the ability of the system to dampen the tidal energy. The naturally highly variable morphology of the Elbe estuary has become more and more uniform. The flood tide thrusts into the estuary with more energy, leading to an altered sediment-transport regime with siltation in shallow water zones and increased up-river transport of sediment (tidal pumping).

Figure 7 The Elbe catchment basin

• Anonymous (2005): Die Elbe und ihr Einzugsgebiet. Ein geographisch-hydrologischer und wasserwirtschaftlicher Überblick. Internationale Kommission zum Schutz der Elbe. Magdeburg

•• Netzband A, Reincke H, Bergemann M (2002): The river Elbe – a case study for the ecological and economical chain of sediments. J Soils & Sediments 2 (3), 112-116

••• Heininger P, Pelzer J, Claus E, Pfitzner S (2003): Results of long-term sediment quality studies on the river Elbe. Acta hydrochim. hydrobiol. 31 (4-5), 356-367

•••• Heise S, Claus E, Heininger P, Krämer Th, Krüger F, Schwartz R, Förstner U (2005) Studie zur Schadstoffbelastung der Sedimente im Elbeeinzugsgebiet – Ursachen und Trends. Im Auftrag von Hamburg Port Authority. Abschlussbericht Dezember 2005. 169 S

Interests and management challenges

First status report pursuant to Article 5 WFD [•] (FGG Elbe)

The River Elbe status report 2005 estimates that about two thirds of the surface waters in the Elbe basin are at risk of failing to meet good ecological status. Analysis of the anthropogenic impacts on surface waters and groundwater resources pursuant to Article 5 of the WFD enabled the FGG Elbe to identify both morphological/hydromorphological changes and pollution from diffuse and point sources as key issues of water-resources management which have to be considered in the programmes of measures and the management plans.

Nature conservation (WWF Germany)

River training, barrages and dams have changed the sediment budget of large parts of the Elbe. As a consequence, significant riverbed incision occurred over the last 100 years, which resulted in a persistent drop of surface-water and groundwater levels in large parts of the Middle Elbe. Riverbed degradation adversely affects not only the stability of river-training structures and bridges but also the functioning of groundwater-dependent ecosystems like floodplains by causing irreversible losses of alluvial forest with its specific vegetation and fauna. With regard to contamination, the Spittelwasser as one of the key regions of concern has to be specially addressed.

Agricultural use of floodplains (MA LS)

The European Union developed a concept to steadily reduce the exposure of the European population to dioxins and furans via the foodstuff pathway. One measure to reach this goal was to set maximum levels for dioxins and furans in foodstuffs.[••] Dioxins, like many other contaminants in rivers preferentially attach to sediment particles and may be deposited with them during floods onto floodplain areas that are often used for farming. Agricultural use of riparian floodplain areas exposed to intensive sediment deposition may not be safe in this situation. The viability of farms with a high portion of their land in floodplains is thus threatened. This was just the case after the Elbe River flood of 2002, when high quantities of sediment were mobilised and deposited on floodplains. In consequence, the dioxin levels in feed and food measured in Lower Saxony were sometimes significantly above the permissible maximum concentrations.

Inland navigation (WSD Ost)

Besides the maintenance and repair of river-engineering works, the active management of sediments, both by dredging/relocation and artificial bedload supply, is also part of the maintenance of the 600-km freshwater reach that serves as a Federal waterway.

The bed material that is dredged at sites of insufficient navigable depth is returned to the riverbed at places where the water is deep enough. The relocated material (~ 200,000 m^3 per year) consists exclusively of coarser sediment fractions without contaminants.

Figure 8 Alluvial forest along the Middle Elbe

[•] Anonymous (2005): Internationale Flussgebietseinheit Elbe. Bericht an die Europäische Kommission gemäß Art. 15 Abs. 2 der Richtlinie 2000/60/EG. Dresden, 3. März 2005

[••] Commission Regulations No 466/2001 and No 2375/2001

Excessive erosion prevails in the Elbe reach between river-km 120 and 230, and artificial bedload supply is practised there by regular dumping of borrow material from gravel pits (~ 85,000 t/a). There is an urgent need to stop bed degradation that impairs navigation during low-flow periods.
Finally, about 15,000 m^3 of dredged material from inland harbours and from impoundments on the Saale tributary have to be managed annually. The relocation of these fine-grained sediments usually has to be ruled out because of their contamination. Thus, they have to be safely disposed of on land.

Port of Hamburg and navigation in the tidal Elbe (HPA)

The Port of Hamburg is situated at a distance of about 100 km from the North Sea in the upper part of the Elbe estuary. Regular maintenance dredging is necessary to ensure the required depths for navigation.
Today, sediment and dredged material is managed in three ways:

- Relocation in the upper part of the estuary has been the main pillar of the management concept since the mid-1990s. The relocation regime and conditions were agreed between the Hamburg Department for the Environment and the HPA. For instance, the relocated material has to meet certain contamination thresholds for sediments. Open water disposal is banned in the summer season.
- Sediment amounts have been increasing significantly since the year 2000. Besides natural variation, factors like loss of side branches and inundation areas as well as fairway deepening led to this effect. Furthermore, a substantial portion of the material relocated near the port in the upper part of the estuary is transported back into the port together with marine sediments due to tidal pumping. As an interim solution to interrupt this perpetual cycle of material, dredged sediments are transported out to the North Sea into the ebb tide dominated area. Again, environmental aspects are thoroughly observed.
- For that portion of the material that is still too contaminated for relocation in the Elbe or in the North Sea, the HPA operates a land-treatment plant (METHA) with a capacity of 1.2 million m^3 annually and corresponding landfills with costs of around €35 million per year. Over the last 25 years, Hamburg spent nearly 1 billion Euros for this purpose. Regular calculations show that these measures remove about one third of the upstream contaminant load reaching Hamburg from the system, thus relieving pressures on the North Sea and the Elbe.

Together with the Federal Waterways Administration and the other Federal States a comprehensive sediment management concept for the tidal Elbe River is under development.

Figure 9 The METHA treatment plant for contaminated sediments

Quality aspects in river basin sediment management (U. Förstner)

A three-step strategy should be used to assess the risk posed by contaminated sediments on the river-basin scale, involving the identification of

- substances of concern;
- areas of concern;
- areas of risk with regard to the probability of polluting the sediments in downstream reaches.[•,••] The final assessment of such “areas of risk” has to take into account sediment erosion thresholds and the hydrological exceedance probability.

On the basis of this approach the BIS of the Technical University of Hamburg-Harburg prepared a study “Inventory of historic contaminated sediments in the Rhine Basin and its tributaries” which can be downloaded (http://bis.tutech.de).

With respect to sediment-associated contaminants, questions that should be asked during selection of management options include:[•••]

- Is the site erosive or depositional?
- Will management options change this; will there be impacts downstream?
- Can the natural sedimentation process solve the problem through burial and mixing?
- Does incoming sediment bring new contaminants?

• Heise S, Förstner U, Westrich B, Jancke T, Karnahl J, Salomons W (2004) Inventory of Historical Contaminated Sediment in Rhine Basin and its Tributaries. On behalf of the Port of Rotterdam. October 2004, Hamburg, 225 p

•• Heise S, Claus E, Heininger P, Krämer Th, Krüger F, Schwartz R, Förstner U (2005) Studie zur Schadstoffbelastung der Sedimente im Elbeeinzugsgebiet – Ursachen und Trends. Im Auftrag von Hamburg Port Authority. Abschlussbericht Dezember 2005. 169 S

••• Apitz SE, White S (2003) A conceptual framework for river-basin-scale sediment management. J Soils Sediments 3: 132-138; see also Apitz et al. (2005) Integr Environ Assess Manag 1 (1): 2-8

Major practical improvements could be gained by applying an approach[•] that shifts the emphasis towards the use of multiple, consistently used lines-of-evidence, rather than placing undue focus on one or two separate aspects. The effective communication of such results and of associated uncertainties is also extremely important. In this way, the crucial, potential impacts of severe events with low-probability or combinations of probabilities (like the 100-y flood and the probability of erosion to a specific depth) on the exposure and the risk along with the associated uncertainties can be considered.

Expectations regarding management plans and programmes of measures

For the compilation of river-basin management plans and the respective programmes of measures, general and specific conclusions were drawn.

General conclusions are:

- Sediment is an important issue in the Elbe basin. Sediment management should be included in the river basin management plans. Comprehensive sediment management on the river basin scale should be recognised as a common task of politics, administration, society, and the economy. All interests should be mutually accepted as legitimate.
- Scientifically based approaches are available and should be used to set priorities in solving problems related to, or originating from, sediments.
- A considerable part of the contamination problem is supra-regional and cannot be attributed to individual polluters. Consequently, the costs for problem solving should be shared at the supra-regional level where they occur.
- Sediment and dredged-material issues are subject to different kinds of EU legislation, e.g. that for water, soil, or waste. A clarification and harmonisation is needed through the European Commission.

Specific expectations are:

- Contaminated sediments pose a risk to downstream regions, both in terms of ecology (e.g. North Sea) and uses (e.g., dredged-material management in inland and tidal waterways; agricultural use of floodplains). In the short run, transitional concepts and regulations (i.e. achievable and realistic) should be agreed on at the river-basin community level, e.g. for the management of dredged material. At the same time, medium-term measures on the river-basin scale should be agreed, to move towards a durable reduction of the risks originating from contaminated sediments. In order to allocate the scarce financial resources to those sites where the investment can yield the best results for the river basin, the above-described progressive approach to risk assessment should be followed. The treatment capacity in the City of Hamburg could be one option in an overall integrated scheme for contaminated sediments in the Elbe basin.
- The problems faced by agricultural enterprises, which are restricted in their usual farming practices due to contaminated sediments, should receive due attention. Financial support should be granted also by the EU to adapt the agricultural management, and the regulations should be moderated for a transitional period.
- Coordinated effort is necessary in order to remediate the Spittelwasser creek. In the discussion the dioxin/furan problem was identified as one of the key issues of sediment quality. The origin of this largely lies in the Spittelwasser in the River Mulde region. This small tributary to the Mulde has been used as a channel for industrial effluents for decades. For example, dioxin concentrations up to 23,000 ng/kg TEQ were found. As demonstrated by detailed investigations,[••] a clear source-sink-relationship exists between the Spittelwasser and the downstream Elbe regions. The remediation of this creek could be a highly effective step towards good ecological status of the Elbe, the protection of the North Sea, and the future unrestricted agricultural use of the floodplains downstream.
- Quantitative sediment management practice for the inland sections of the Elbe should be based on a common concept at regional and river-basin community levels. The concept should be agreed upon for a medium term horizon within the river basin management plans by considering all legitimate interests. Thus, it should find an optimum between the upkeep and repair of river-engineering works, the active management of sediments, and ecology. To avoid further ecological and economic damage, the riverbed and the water level should be stabilized. In an ecological sense, stabilization should be achieved by methods which do not change the characteristics of the free-flowing river. Sediment management like artificial bedload feeding appears to be an ecologically compatible and economically effective approach to achieve a dynamic stabilization of the riverbed. To improve the hydraulic conditions and to equalize sediment transport, additional training measures like groyne adaptation and lowering of levees should be considered where necessary.
- In the Elbe estuary an integrated and overarching concept is needed. It has to meet the legal requirements of different regulations as well as the needs of navigation, nature protection, flood defence, tourism, etc. This concept has to be worked out at regional and river-basin community levels with all stakeholders involved. Sediment management considering the whole system will form one of the main objectives of a future programme to achieve sustainable development for the tidal Elbe River region. This will be a medium to long-term challenge.

• Bohlen WF, Erickson MJ: Incorporating sediment stability within the management of contaminated sediment sites: A synthesis approach. Integrated Environmental Assessment and Management 2 (1) 24-28 (2006)

•• http://projects.jrc.cec.eu.int/show.gx?Object.object_id=PROJECTS000000000003D17F

The group consisted of practitioners from port authorities, flood protection, nature conservation and applied research. The majority of the Round Table participants had interest and experience in estuarine and coastal issues, and therefore discussions focussed mainly on these issues.

The Humber River Basin

The Humber River Basin District (RBD) is one of 11 RBDs in England and Wales, and is the largest in England with a size of >26,000 km^2, covering a fifth of the area of England (see Figure 10).

The Humber estuary is one of the principal inputs of runoff into the North Sea with a mean annual river flow of 250 m^3 sec^{-1}. The estuary has a true estuarine length of about 62 km, with an average width of 4.3 km. The hydraulic depth along the estuary ranges from over 13 m at the mouth to 2.9 m. The Humber is a dynamic estuary with a spring tidal range of up to 7 m.

Today the estuary area is significantly smaller than its original extent following the deceleration of Holocene sea level rise (circa 6000 years BP), due to the formation of salt marshes and intertidal flats, followed by their later reclamation by man. The catchment includes the major industrial conurbations of the East and West Midlands, and South and West Yorkshire. Many of the rivers in these areas are heavily modified and canalised.

Figure 10 Humber River Basin District

The Humber Catchment

Much of the remainder of the area is either intensive agriculture or upland. There are about 11 million people living in the basin.

The Humber estuary has around 40,000 ship movements annually, visiting the ports of Grimsby, Immingham, Hull and Goole, as well as the riverside berths and wharves. Its ports and wharves handle about 14% of the UK's international maritime trade and must continue to develop facilities to cope with future changes, as has occurred over the last 200 years. The ports support a number of industries alongside the estuary including chemical works, oil refineries and power stations that dominate the shoreline. Between these, there are large areas of agricultural land and areas of nature conservation, a large proportion of which was reclaimed from the estuary over the last circa 400 years.

The long-term sustainable plan for investment in tidal flood defence includes realignment of some embankments to create new intertidal habitat. This will offset loss of protected habitat resulting from engineering works and sea level rise, will lead to greater stability of some defences, and will reduce extreme high water levels in the tidal reaches of the rivers. Realignment to create flood storage areas can also be used in the upper estuary to help manage water levels during extreme events.

Birds are an important feature of the Humber with nine species of international importance using the estuary. Nearly all of the Humber estuary is designated under either the EU Birds and/or Habitats Directives as SPA (Special Protection Area) or SAC (Special Areas of Conservation). Thus all activities related to port development, e.g. navigation, infrastructure development, capital and maintenance dredging and associated disposal, are subject to the procedures and requirements of the EU Habitats Directive.

River basin management and the WFD [•]

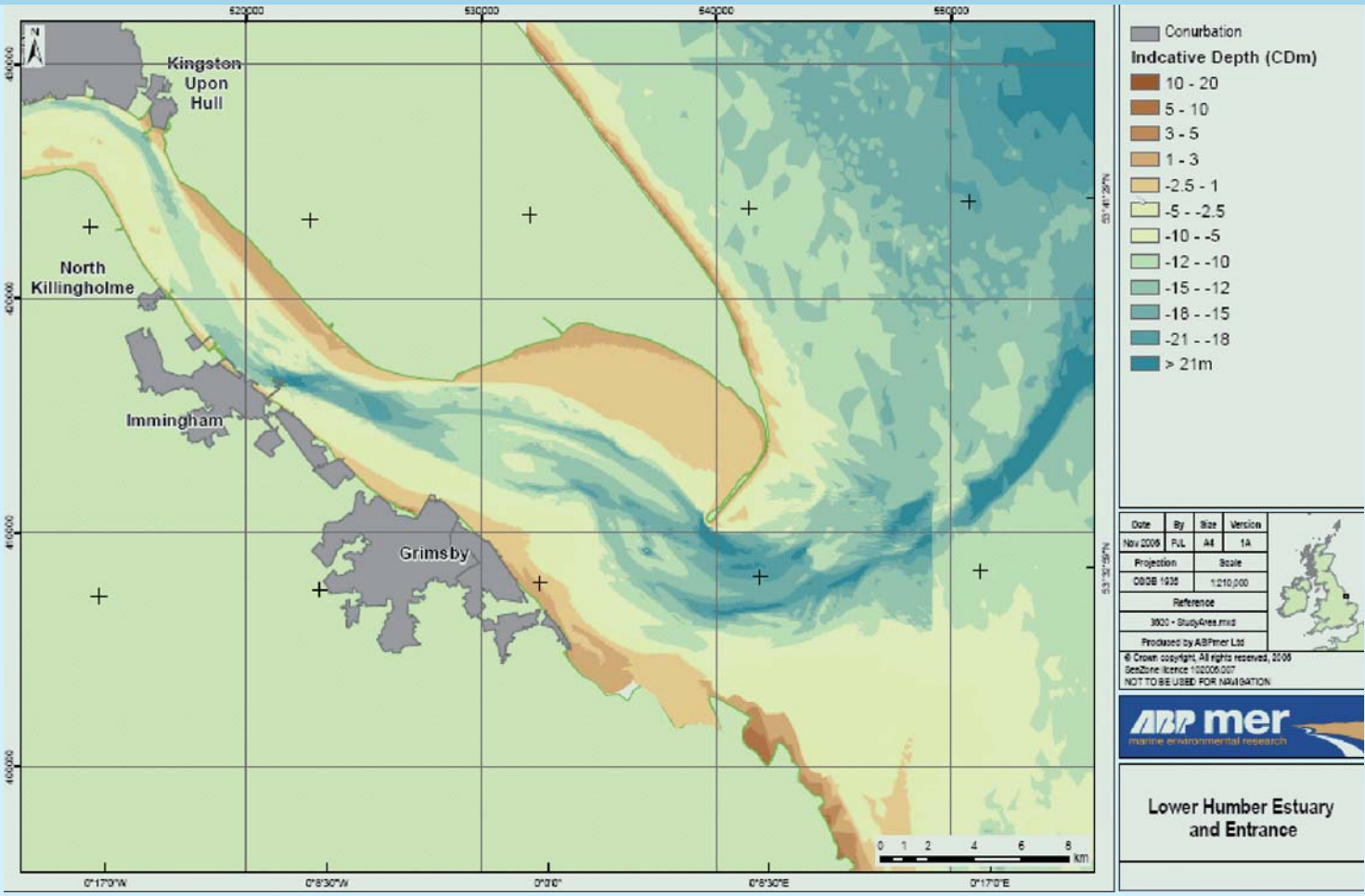
For surface water bodies, the Humber RBD has been divided into 890 river reaches, 93 lakes, 5 transitional water bodies and 1 coastal water body. For the riverine and freshwater parts of the Humber basin, the main issues identified during the IMPRESS analysis of pressures and impacts of the Water Framework Directive (WFD), include:

- sediment delivery;
- morphological change;
- metals and other contaminants;
- nutrients, such as phosphorus which is probabaly sediment-related.

100% of transitional and coastal water bodies are classified as 'at risk' or probably 'at risk' from morphological pressures. 20% are classified 'at risk' from point source pressures.

• Water Framework Directive. Humber River Basin District. Summary Report of the Characterisation, Impacts and Economic Analyses Required by Article 5. Environment Agency, England

Figure 11 The Humber estuary



Main sediment-related issues

There have been great improvements in water quality in recent years, but there remain some concerns (particularly from the Environment Agency in the light of the Water Framework Directive) associated with water quality (pollution and eutrophication) in some rivers. There is potential for the remobilization of stored contaminated sediments (such as on floodplains, etc.) - i.e. "legacy of the past" effect - due to management changes in the basin (land use and river use) and due to climate changes.

Sediment transport processes are an important physical characteristic of the Humber estuary. It is estimated that on a given tide up to 1.26 million tonnes of sediment may be in the water column. It is a highly turbid estuary with most of the annual exchange of sediment across the mouth (estimated as 85×10^6 t $year^{-1}$) being sourced from the erosion of glacial cliffs and platforms along the coast and the North Sea, rather than from the rivers, whose input is estimated at only 3%.[••]

Sedimentation within the River Humber/Humber estuary reduces depth, affecting the safe passage of vessels. Dredging is therefore required. Most of the dredging occurs in the lower and middle estuary. Maintenance dredging has taken place in the Humber estuary since about 1778. In 1950, there were about 50 vessels engaged in dredging in the estuary, with all material being deposited back into the estuary system, and this practice persists today. The average rate of dredging for the estuary, calculated over a 35 year period, amounts to about 7.3 million m^3 per annum (including the dock systems) although this is highly variable.

The ongoing review of existing Environment Agency discharge permits has shown that most of the metals found in the Humber water column derive from sediment contamination, which can be attributed to both past and present releases in the catchment. The loads of metals which are permitted to be released today are far less than they were 30 to 40 years ago. Water column and sediment contamination levels are therefore gradually reducing. Sediment re-suspension means that past contaminants continue to appear in the water column, but over a period of time mixing with fresh marine-derived sediments will lead to improved sediment quality and burial of contaminated horizons. Persistent organics such as PCBs continue to be found occasionally in sediments though they are not permitted in discharges.

[••] Townend I, Whitehead P (2003) A preliminary net sediment budget for the Humber Estuary. Science of the Total Environment 314: 755-767.

Sediments in the tidal Ouse contribute to the pronounced summer dissolved oxygen sag, which potentially affects migration of fish species by trapping organic matter which exerts an oxygen demand, particularly when sediments are stirred up by tidal currents. The Humber estuary receives substantial loads of nutrients from discharges and other sources, and is considered hyper-nutrified. However, sediments protect the estuary from the effects of eutrophication, as algal blooms are inhibited by the highly turbid waters.

Outcome of the Round Table discussion

Sediment needs to be recognised as an essential part of healthy functioning systems (rivers, estuaries, coasts). The participants agreed that sediment management in the Humber is a clear need.

There was an agreement by the practitioners to look at issues and challenges on a broader scale and to look for whole system approaches, and to seek win-win solutions that hit multiple targets. Best practical, sustainable, environmental solutions should combine the needs of economically driven projects, like dredging or port extension, with those of nature conservation. The WFD is just one of these requirements. An example is the need for dredging for navigation and the use of dredged sediments for creation of mud flats because of sea level rise or for flood protection.

It was the view of the group that sediment quantity, quality and dynamics are not adequately considered within the WFD risk assessment currently undertaken. The risk assessment is too blunt an instrument to identify the real issues for users of the estuary. Ideally, it should be used as a screening level tool and should trigger spatial discrimination, further study of effects and tests of significance of impacts. For example, the estuary is divided into five areas and it is possible that the whole of one of these areas can be classified “at risk” whereas contaminants may only be found in a few concentrated locations. These issues will emerge with more detailed assessment and understanding of the system, supported by detailed monitoring where necessary. This understanding is required to better determine effects which which may lead to remediation the resolution of detrimental impacts.

It could be argued that the most significant pressures are those resulting on the hydromorphology of the estuary, e.g. the effects of flood protection works, land-claim, and structures within the system. All of these will affect, have affected or are still affecting the natural functioning of the system: initially in a physical sense, changing the morphology, but also affecting the ecology. These impacts can and have been offset by managed realignment which imparts positive pressures upon estuary function. This illustrates that there are other pressures that need to be considered other than water quality and contamination and these are related to the sediment dynamics of the system.

Dredging in the UK is highly regulated, being controlled by Planning Regulations, the Coast Protection Act (CPA), the Habitats Regulations (implementing the EU Habitats Directive) and the Harbour Acts. The disposal and beneficial use of dredged material in the marine environment is controlled by the Food and Environment Protection Act (FEPA), although there is a large degree of overlap between the individual pieces of legislation. For all intents and purposes, the whole estuary is designated for nature conservation importance (Birds and Habitats); therefore, the requirements of the Habitats and Birds Directives must be considered alongside WFD issues.

Although it was felt that European legislation insufficiently deals with sediments there was a general desire not to end up with an EU-generic approach to sediment management in all basins or parts of a basin or in all countries. There is a clear need to recognise and respect a wide variation in sediment processes within and between systems. New guidance and frameworks which are to be developed and delivered should not be too restrictive and should allow for variability. In essence, sediment needs to be considered as a part of a functioning, healthy ecosystem and not managed in isolation.

In estuaries, generic pass/fail sediment quality standards may not be appropriate due to the natural variability of the sediment system. The relationship between sediment availability and morphological evolution is relatively well understood, but relationships between sediment quality and biological responses are more problematic, with tools such as biomarkers under development to better evaluate such impacts.

Figure 12 View of the Humber estuary (courtesy of P. Whitehead)

A good understanding of estuarine processes is essential in determining useful and meaningful measures for the system as a whole. In any one estuary section considerable natural variability occurs over different timescales, e.g. tidally, seasonally and longer periods such as the lunar nodal cycle. This variability includes changes to the bathymetry, sediment type, suspended sediment content and, therefore, turbidity in the estuary which cause an ever-changing biological response.

The Humber case highlights the necessity to improve communication and establish integrated thinking about rivers, transitional waters and coastal waters/sea. Natural processes operate very differently in fluvial and transitional or coastal parts of a system, and therefore the approaches required to assess measures and effects also need to be different.

Sea disposal of dredged material is only permitted for relatively clean sediments, taking account of varying background levels of heavy metals and other potential pollutants in different disposal areas. The high cost of treatment or contained disposal, and the absence of central government funding for ports projects in the UK, has meant that problems with contaminated sediments have often led to the adoption of novel solutions or the project being re-designed to avoid the problem areas. Source control (both point and diffuse source) is essential in maintaining the functioning of the estuary in the long-term, since, if there were no contamination, there would be no need to remove contaminated sediment from the system, assuming sediment itself is not regarded as a contaminant.

Recommendations

It was the conclusion of the Round Table Humber participants that sediment is an important resource within the Humber basin and that sediment management should form part of the overall Humber basin management plan, so as to achieve the required objectives of good ecological status and sustainable environmental functioning. This is likely to hold true for other Member States around the North Sea basin.

It is important to remember the vital beneficial role that sediment plays in tidal waters. These whole ecosystems have evolved with and are dependant on the continuing supply and exchange of large volumes of fine-grained sediments between the foreshore, deep channels and further remote sediment sources.
At present there is a lack of integration of sediment issues and management between different compartments of the “river basin”, such as riverine and estuarine environments. There is a need for more integration of sediment issues within river and estuarine management plans. There is a need for policy and economic instruments to achieve this. There is, however, a need to assess the roles of the EU and national policy-making processes in developing appropriate legislation for specific basin management objectives. There is a need for better financing of appropriate research into sustainable sediment management, from both national and EU sources.

The expectation of the Humber Round Table participants is that future guidance and future solutions must be specific (tailor made to the situation), measurable, achievable and realistic.
A time frame must be set, and measures must be cost effective.
Key messages need to get through to the right people.
An important message that must get through to all those who try to manage water-soil systems is: “Ignore sediment at your peril!”

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SedNet

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SedNet is the European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management.

Its focus is on all sediment quality and quantity issues on a river basin scale, ranging from freshwater to estuarine and marine sediments.

SedNet brings together experts from science, administration and industry. It interacts with the various networks in Europe that operate at national or international level or that focus on specific fields (such as science, policy making, sediment management, industry, education).