European Sediment Research Network

Acronym: SedNet

EC contract No. EVK1-CT-2001-20002

Key action 1.4.1 *Abatement of water pollution from contaminated land, landfills and sediments*

WORK PACKAGE 2
SEDIMENT MANAGEMENT AT THE RIVER BASIN SCALE

Minutes of River Dommel case study

SedNet Second Annual Conference, 29th to 30th September 2003, Venice, Italy

AUTHOR Philip N. Owens & Theo Edelman	**CHECKED BY** SedNet coordinator	**CONTRACTOR** National Soil Resources Institute Cranfield University North Wyke Okehampton Devon EX20 2SB UK Contact: Dr Phil Owens (philip.owens@bbsrc.ac.uk)
APPROVED BY	**DATE** December 2003	
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1. Introduction and rationale

There is clearly a need for SedNet to engage with stakeholders and those responsible for managing sediment within river catchments. SedNet is successfully attempting to do this through its networking activities, workshops and conferences. Not only is there a demand for SedNet to help provide advice and solutions to those who need it most, but there is also a need for SedNet to ensure that it has both the participants and expertise to be able to provide this information and advice. With this in mind, the second annual SedNet conference in Venice in September 2003 focussed on the issue of "river basin case studies". The aim of this exercise was for key stakeholders to present to the SedNet participants at the conference, river basins with contrasting sediment problems and issues. Working/discussion groups of SedNet participants would then address each case study within a detailed discussion period and then present to the stakeholder advice and recommendations. This would provide the stakeholders with expert advice and would also enable SedNet to assess its role and mission within the wider sediment and river basin community.

2. Identification of the problem and presentation of the case

The example of the River Dommel was presented by Mr Theo Edelman, Project Director of "The Active Soil Management De Kempen - ABDK" (which also incorporates the River Dommel). Theo produced an overview document prior to the SedNet conference, which described the main problems and issues relating to sediment within the Dommel catchment. This document is contained within this report as Appendix 1.

At the SedNet conference, Theo Edelman gave a Powerpoint presentation of the River Dommel to the discussion group. The main issues relating to sediment within the River Dommel are:

- The sediment in the river system is polluted with heavy metals.
- Despite turning off some of the main sources, pollution is still continuing because the groundwater at industrial hotspots is contaminated and feeding into the river. Thus the groundwater source of the pollution is still not under control.
- The pollution is present across large areas of the catchment, which covers parts of Belgium and the Netherlands. Thus there are important issues related to trans-boundary pollution.
- Sediment pollution interferes with current and future land use and functions.
- It is difficult to explain the situation to all relevant stakeholders.

3. Discussion

After a clear presentation of the situation in the River Dommel, there followed a question-and-answer session during which the group asked Theo Edelman specific questions. This was followed by a lengthy discussion period, where both stakeholder and participants identified key issues and possible solutions. These were then grouped under key themes to form the basis for Section 4

(solutions and advice). The following list contains many of the questions, issues and solutions identified during the discussion period. In general they tend to fall into distinct themes.

System identification and understanding

- There is a need to identify the various sources of the sediment and contaminants and how much they contribute to the system.
- There is a need to identify the key issues of concern.
- Make initial estimates of mass balances and fluxes, and sediment and contaminant budgets.
- What is a level of contamination that is acceptable and can that level be reached?
- Work out the relation between risk minimisation and costs in each area of competence.
- Prioritise risks to formulate the restoration/remediation plan.
- Is atmospheric deposition still an important source?
- How long does it take for the contaminants to go through the system?
- A potential problem is, if the channel migrates it may result in the erosion of contaminated bank and floodplain sediments, and introduce these back into the channel.
- Map the pollution sources to identify where contamination is still going on.
- Make a conceptual model of the system, which in turn may require monitoring and further investigations.
- There should be a detailed catchment monitoring/measurement programme of sediments and contaminants to understand the system.
- Find financial solutions outside the budgets for environment and water (such as the EU fund for regional development).
- Make an inventory of all planned activities in the area, taking into account the conceptual model of the basin
- Make an inventory of the barriers that exist for the realisation of the plans. Barriers may be legal, or due to organisation of the stakeholders and authorities.
- What does the foodweb look like in the Dommel?
- Establish a database with information on sediment quality in the Dommel, sediment transport, erosion from the land etc.
- Is there a way that monitoring could assist with informing the decision process?

Technological solutions

- Dredge the contaminated sediments in the upstream sections.
- Concentrate on activities where the benefit is the biggest in the system.
- It is important to recognise that sometimes taking the contaminated sediment out of the river does more harm than leaving it in situ. Removal is expensive and should only be done if it is clear that this will improve the situation.
- Trap the sediment, separate into fine (contaminated) and coarse (clean) sediment, and then remove and deal with the fine fraction.
- It may be possible to use the trapped sediment to make bricks and other building materials.
- Use phytostabilisation techniques on the floodplains.
- Use phytoremediation techniques to soak-up the contaminants.
- Is it possible to remediate the groundwater pollution problem in certain areas?
- Find synergetic measures to improve the situation in the system.
- Try to stop the downward leaching of the contaminants at the worst sites.
- Try to use chemicals to fix the contaminants within the soil.
- Is there a way to absorb the contaminants to soil particles?
- It may be possible to artificially increase the pH of the soil, thus offering better buffering capacity.
- What is the impact of the metals on biogeochemical cycles in soils and sediments?

Stakeholder participation

- A website may be a good way to reach people and stakeholders.
- Exchange experiences with similar complex situations in the EU (and elsewhere?).
- Given the trans-boundary nature of the problem in the Dommel, who will administer the WFD for the Dommel – are they the enforcers?
- Create awareness of the whole problem and bring in people/stakeholders with responsibility.
- Involve politicians. Many decisions that are necessary are beyond the mandate of the authorities involved at present.
- Use surveys to understand what the public perception is of the problem. An increased awareness could improve the willingness to pay for a solution.
- In the case of polluted sediments in rivers, one cannot usually identify who is responsible for the pollution. So a difficult issue is always: who pays?
- Establish a Dommel Basin Action Group, which includes all key stakeholders.

4. Solutions and advice

Some of the key recommendations to come out of the discussion between the stakeholder (Theo Edelman) and the SedNet discussion group are listed below.

Understand the river system:

- There is a need for more monitoring of the system, which at the moment is lacking
- There is a need to develop a conceptual model of the river basin

Stakeholder participation must be comprehensive:

- One solution may be to set up a joint fund for the Netherlands and Belgium
- Need to increase the awareness of public and local administration

When and where to act:

- Intervene as close to the source as possible
- Implement both immediate and longer-term measures

Treatment options include:

- Phytoremediation techniques
- Construction of sediment traps at key locations within the catchment

A possible framework is:

- Formulate a vision with objectives
- Consult stakeholders
- Understand the (sub)system functioning and management options
- Identify risks, both human and ecosystem
- Identify where and when to interact
- Determine treatment and solutions
- Revise the vision and the objectives if necessary

It is important to recognise that there are important feedbacks and loops within this framework. Thus consultations with stakeholders and understanding of the system may well result in a revision of the vision and objectives.

5. How SedNet can help

In addition to the information, advice and solutions described above, SedNet can also help in the following ways:

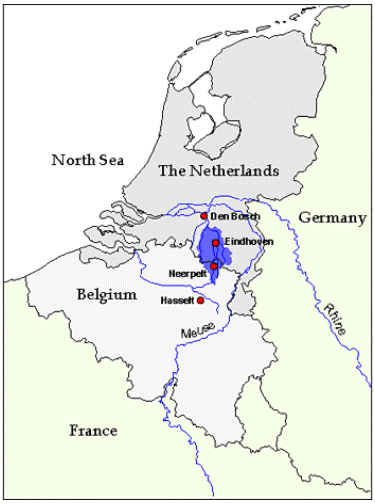
- Share conceptual frameworks
- Act as a forum for brainstorming, in order to share ideas, information and experiences
- Make a database of case studies in Europe
- Establish discussion groups (chat rooms) on the SedNet website
- Establish a "who-is-who"

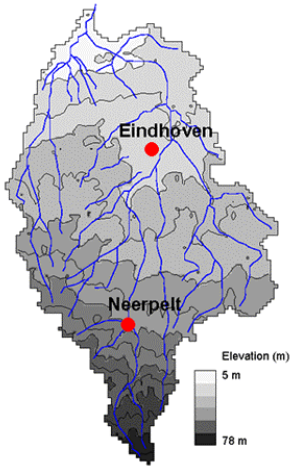
6. Concluding comments by Mr Theo Edelman

It was very useful for me to share my sediment issues and problems with colleagues from abroad. From the discussions, I realise that our ideas to remediate the Dommel are good. The recommendations of my SedNet colleagues sharpened my mind however, especially in relation to actions that should be taken by our Belgian neighbours. The Belgian authorities have promised to tackle the polluted sites, including the polluted groundwater (at the costs of the companies), and to construct a sediment trap to keep the polluted sediment in their own country. The Dutch and Belgians made a joint proposal for the EU to monitor the complete system including soil, groundwater, surface water and sediments.

Appendix 1 – The River Dommel case study document (prepared by Theo Edelman)

River:	**Dommel (tributary of the river Meuse)**
Key- issue:	Sustainable management of trans-boundary, sediment/suspended particle bound and also groundwater transported zinc and cadmium contamination. Contamination originating from a not yet sanitised, industrial contaminated site (zinc smelter)
Key-stakeholder:	Name: Mr. Theo Edelman Function: Project director 'Active Soil management De Kempen - ABDK' (also covering the Dommel) E-mail: tedelman@abdk.nl; Tel.: + 31 40 232 92 77
Generic description:	(Figures extracted from: http://mk.frw.ruu.nl/ research/Dommelproject/ dommel.htm) The Dommel is a small tributary of the river Meuse, its size is 1350 km^2 and the lat-long of the centre of the catchment is 4ºE, 52ºN (see figure). It origins in Belgium, crosses the border in the south of the Netherlands (Kempen region) and confluences with the Meuse near the city of Den Bosch. The annual water transport is 420 million m^3 rainwater and 90 million m^3 industrial and public waste water. The river drains an intensive agricultural and heavily populated area (approx. 593000 people). In the Belgium part of the Kempen, just before crossing border (Neerpelt), it also drains an area where several zinc factories are located. Also in the Dutch part of the Kempen a zinc factory is located. Especially in this trans-boundary region the Dommel is valuated as an important nature reserve.





DPSIR analysis:	Drivers: Operational zinc factories near Neerpelt (Belgium) and in Budel-Dorplein (Netherlands) make use of zinc ore, containing zinc and cadmium as major contaminant. Since the seventies of the last century clean production processes have been introduced, but during 70-80 years cadmium and zinc has polluted the natural environment by air, by discharge of waste water at the surface water system and by free distribution of zinc-ashes. Polluted groundwater starts to seep into the surface water and water sediments system. This process will continue for decades unless specific tailor made measures are taken. Pressures: The soil of an industrial site near Neerpelt is heavily polluted with cadmium since the start of zinc smelting (100 years ago). Due to leaching the groundwater is also heavily polluted. Annually at least 30.000 kg zinc and 1000 kg cadmium enters the Dommel, via run-off & leaching originating from this unsanitised site and via contaminated groundwater. Cadmium adheres to suspended particles and sediment. Annually 980 ha of the Dommel floodplain is inundated for approximately 14 d/year, thus cadmium contaminated sediment is deposited at floodplains. Cadmium leaches from floodplain soils and is transported to and via the groundwater. Contaminated seepage water re-enters, amongst others, the Dommel. State: Cadmium concentrations in watersediments are measured as 85 –300 mg/kg (in a tributary of the Dommel near to the site, the Eindergatloop) and as 10-40 mg/kg in de Dommel, showing the increase of concentrations upstream in the system in the direction of the source. In total it is estimated that about 61 km^2 of (water)sediments of the Dommel system contain more than 5 mg/kg cadmium. Cadmium and zinc in the surface water have the following range: Cadmium 1 – 80 µg/l (highest values also in the Eindergatloop), zinc 30 – 2.100 µg/l (highest values in the Eindergatloop). In groundwater 1 – 300 µg/l cadmium and 10 µg/l – 50.000 µg/l zinc has been observed. Near and at the site even higher values can be expected. Impacts: Several impacts to benthic species (decreased abundance, Cd adapted species, methum deformities midge larvae etc.); decreased or completely stopped litter mineralization; cadmium accumulation in several organisms, from plants to birds of prey. Decreased public 'valuation/appreciation' of the area as a nature reserve. Responses: *Technical*: a sediment trap has been installed in the Netherlands, near Eindhoven, in order to keep the Dommel in Eindhoven free of sand. The trap has been filled with polluted sediment, which need to be removed. After sanitation the trap shall be rearranged as a smart trap where sand which can be reused and the remainder of the sediment settle down separately. This sediment trap can be regarded as an end-of-pipe measure. To minimize the effects of the pollution a "begin-of-pipe" measure is neccesary however. Flanders and the Netherlands jointly study the optimal location and layout for such a measure. High attention is given to the environmental efficiency with respect to the cleaning of the cadmium and zinc pollution. *Institutional*: amongst others stimulated by the Water Framework Directive, at 22 November 2002 the Belgian and Dutch government signed a memory of understanding in which they declared to cooperate in finding solutions for the trans-boundary cadmium contamination in the Kempen. Furthermore, the project office 'Active soil management De Kempen' was founded, in which several, Dutch institutions cooperate in order to solve the Dutch part of the issue: the national and regional governments, 48 municipalities and 2 regional water quality boards. In Flanders governmental agencies and industries have committed themselves to the cleaning of the area. The pollution of the Dommel system is a key factor.
Possible solutions:	*Technical*: Sediment traps can contribute to solving the problem, but are not enough. Reason is that a substantial part of the pollution is not bound to sediment but solved in the water. It will not be stopped by a sediment trap therefore. A complete removal of the contaminated sediment by such traps is not wanted as sediment also binds the cadmium of the seepage water (bound = less harmful). With a smart design of the sediment trap these problems may be solved, resulting in a "begin-of-pipe" solution. The contaminated floodplains could perhaps be treated by using plants. *Socio-economic*: several, important stakeholders already cooperate in order to jointly come to solutions (see 'responses'). There is already a substantial budget reservation made by them (40 Million Euro). However, (much) more budget is needed (350 Million Euro), possibly to be achieved by involvement of more co-financing stakeholders (governmental and private) and e.g. by adhering to (inter)national research programmes. Sustainable solutions require trans-boundary approaches as a major source of pollution is located in the Belgium part of the Dommel system, while the threatened part of the system is situated for the greater part in the Netherlands.
Questions to SedNet:	• How to asses whether (necessity), where (site) and when (prioritise) sanitation of the contaminated sediment and/or floodplain is really necessary/urgent for ecological reasons? (WP3) • Are there realistic/feasible cold immobilisation techniques, besides sediment itself, which could be used in this case to bind the seepage water cadmium? (WP3 and WP4) • Is phyto-remediation/extraction a realistic/feasible option for these contaminated floodplains?

	(WP4) • How to manage (treat) the contaminated dredged material (both sediment and plants enriched with metals after fytoremediation) from the sediment traps? (WP4) • How much sediment should remain in the system to enable/ensure/maintain a proper ecological functioning? (WP2) • How much cadmium and zinc will seep from the groundwater into the watersediments in how many years and where (WP3) • How to derive an integrated risk assessment approach for this case? (WP5) • How to involve more stakeholders that are also committed (i.e. willing to co-finance) to solve this issue? (WP1) • How to derive an integrated, sustainable sediment management approach for this case? (WP2)
EU projects:	EU-LIFE project ('94-'98): "Demonstration project for the development of integral management plans for the catchment areas of small trans-border lowland rivers: The river Dommel" (see: http://mk.frw.ruu.nl/research/Dommelproject/dommel.htm)
Stakeholder perspective:	• Water Framework Directive is 'gift from heaven' (i.e. stimulus for trans-boundary cooperation) • A system oriented approach is the way to successful management of this case. Therefore a comprehensive knowledge of the system is needed. Only then it will be possible to come to a coherent set of improvement actions • Set of actions should not conflict with current legislation • Powerful, long lasting management necessary to achieve goals • In favor of setting up a European knowledge platform for exchange of information/experience and for together testing of new treatment techniques • Very interested to look for possibilities to bring in this case/specific research issues into EC (co-)funded projects (FP6, Interreg, SedNet)