From Monitoring to Measures: Historical Contaminated Sediments in the Elbe River Basin

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5th International SedNet Conference, Oslo 27th-29th May 2008
Day 3: River Basin Management – Aspects of Sediment Quality
“Compliance monitoring for sediment is not appropriate because of lack of definition of valid Environmental Quality Standards (EQS) in a European context” (AMPS 2004)

“EQS should only be regarded as high-level screening values as a start of diagnostics, using different lines of evidence, and linking sediment state to impacts” (SedNet 2007)

Screening of generic sources that can result in releases of PS/PHS (WFD Article 16) will include the specific source/pathway historical pollution from sediments (EAF 2004)

“For certain measures (such as source control) target values and a good understanding of the system (different in the upstream and downstream parts) are necessary” (SedNet 2007)
Monitoring Historical Pollution from Sediments

The Rhine Basin

From Monitoring to Measures – Elbe River Basin

3-Step Approach
Heise et al. 2004

1) S.o.C.
2) A.o.C.
3) A.o.R.

SPM/Pollutant – Full Flood Cycles
Target Values – CTT Threshold V.
Critical Pollutant in Main Stream
Tracers, Models and Experiments

(commissioned by the Port of Rotterdam, 2004)

185,000 km²

149,000 km²

(commissioned by HPA and FGG, 2005, 2008)
Analysis of Flood Events, e.g. in 1999

Resuspension of HCB in Iffezheim
(Upper Rhine Barrage)

Distance: ca. 500 km
Time delay: ca. 5 days
Decrease (HCB): 350 µg/kg → ca. 70 µg/kg

HCB-concentrations in Lobith
(Dutch-German-Border)

20 µg/kg limit value for POR for relocation at sea (CTT-Value)

Data: Landesumweltamt Baden-Württemberg
Monitoring Historical Pollution from Sediments

The Rhine Basin

The Elbe Basin

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SPM/Pollutant – Full Flood Cycles
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Heterogenous Data: BfG, IKSE,…
Lack of Target Values for Dioxin
Floodplains as Intermediate Sinks

Proposals for Measures (2008)
Dioxin: from Spittelwasser to the Elbe River

Monitoring of PCDD/F in Sediments of the Elbe River Basin:
++ Congeneric Patterns, - - No Target Values for Relocation
Remedial Option A: Monitored Natural Recovery

The Role of Natural Recovery in Sediment Remediation

1. Contaminant burial – vertical contaminant profiles
2. Mechanical/chemical stabilisation – erosion/elution data
3. Chemical/biological transformation – prognosis/evidence
4. Dilution by dispersion – increase risk to downstream areas

Magar & Wenning, IEAM 2006

Spittelwasser floodplain (60 km², fluvisols + sediments):

1. No clean sediment cover;
2. Easily erodible old sediment (0.5 Pa in the upper 15 cm);
3. Degradation of critical Bitterfeld chemicals – HCH, DDT, PCDD/F – is low, due to toxic effects (Bunge et al., 2007)
From Monitoring to Measures – Elbe River Basin

Option B: Environmental Dredging/Excavation …

Estimate: 5,000 m³ Spittelwasser sediment containing 20,000 ng TE/kg could pollute 10 Mio. m³ Elbe sediment to 10 ng TE/kg

Report ”Feasibility Study on Sediment Remediation of the Spittelwasser in the Bitterfeld District, July 1993“,
UBS Schwerin, IGB-VT Hamburg on Behalf of the Bitterfeld District Office
..... Excavation, Structural Isolation, and Capping

Example: Möbius Press and Hauling System (MPF)

Planning of a Pilot Study on Sediment Excavation/Capping at Hitzacker (Elbe)
# Bitterfeld Mulde Reservoir as a Sink for Metals

Zerling et al. 
SAW (2001)

<table>
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<th>Pb</th>
<th>Cd</th>
<th>Hg</th>
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<tbody>
<tr>
<td><strong>Inflow (tons/yr)</strong></td>
<td>42</td>
<td>5.6</td>
<td>0.12</td>
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<tr>
<td><strong>Outflow (tons/yr)</strong></td>
<td>7</td>
<td>1.6</td>
<td>0.02</td>
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<tr>
<td><strong>Retention</strong></td>
<td>84 %</td>
<td>72 %</td>
<td>86 %</td>
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</table>
From Monitoring to Measures - Conclusions

**Monitoring Risks from Downstream Propagation …..**

- SPM/pollutant concentrations and loads in flood cycles
- Target values in a well-defined decision-making process
- Propagation concept: Hydrology and erosion potential

*RBM requires different levels of sediment monitoring*

Measures on Contaminated Sediments in River Basins
Sediment Monitoring Schemes (JEM 2007 p. 947)

**Screening Monitoring**
- Sampling
- Dry Sample
- Bulk Analysis
- Grain Size Normalization

**In-Situ Sediment Chemistry**
- Wet Sediment Sample
- Measurement of pH and Eh
  - CEC
  - Sub-sampling
  - AVS
  - Sub-sampling (anaerobic)
  - Porewater Extraction
  - Sequential Leaching

**Predicting Propagation**
- Chemical Stability
  - Redox Processes
  - Buffer Capacity
  - Ageing Effects
- Hydraulic Stability
  - Erosion Processes
  - Transport Models
  - Physical Effects

**Basic Characterization**

"Standard"

"Dynamics"
From Monitoring to Measures - Conclusions

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Measures on Contaminated Sediments in River Basins

- Understanding the system – difference up-/downstream
- Diffuse contamination, e.g., in floodplains: ”soft” options
- One-approach for monitoring, measures and aftercare

*Basin-wide cooperation based on technical expertise*
Acknowledgements

Hamburg Port Authority
Thanks for (co-)funding BIS-Elbe-studies; problems with dioxin and Ch. 6 ”Measures“

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Council asked for removal of the FGG-Logo:
“Too much science, little practical statements”.
from: k.& k., Central Office of Hydrology, Prague (1907)

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