



# Sediment management and Source Control

The Port of Rotterdam case

Tiedo Vellinga  
Professor Ports and Waterways  
Delft University of Technology &  
Rotterdam Port Authority

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- In the seventies ... increasing problem
- Introduction regulation on contaminated sediments in The Netherlands
- Extensive research (incl. treatment techniques)
- In the early eighties ... Strategic plan
- Primarily source control (Rhine Research Project / Cooperation with Ministry of Infrastructure and the Environment / Rhine Action Plan)
- The Slufter as intermediate solution



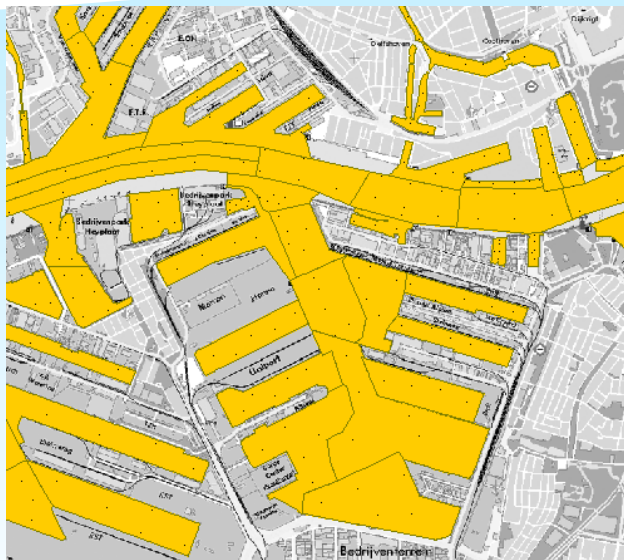
# Dredged Material Management

- Monitoring and classification
- Maintenance dredging
- Sustainable relocation in the North Sea
- Confined disposal (Slufter)
- Source control

# Monitoring and classification

- River (Ministry of Infrastructure and the Environment)
- Port Basins (Port of Rotterdam Authority)
- Substances analysed:
  - Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)
  - Mineral oil
  - PAHs
  - PCBs
  - OCBs
  - TBT

# Annual sampling campaign for classification



- approx. 250 sections
- each sampled at 6 locations
- 6 samples are mixed and analysed at the laboratory



# National Action Levels for relocation in the sea

Substance name	Group	Units	Action level <sup>1</sup>
Tributyltin (TBT) <sup>3</sup>	Organometal	µg Sn/kg d.w.	115
Copper (Cu) <sup>2</sup>	Metal	mg/kg d.w.	60
Arsenic (As) <sup>2</sup>	Metal	mg/kg d.w.	29
Cadmium (Cd) <sup>3</sup>	Metal	mg/kg d.w.	4
Mercury (Hg) <sup>3</sup>	Metal	mg/kg d.w.	1.2
Chromium (Cr) <sup>2</sup>	Metal	mg/kg d.w.	120
Zinc (Zn) <sup>2</sup>	Metal	mg/kg d.w.	365
Nickel (Ni) <sup>3</sup>	Metal	mg/kg d.w.	45
Lead (Pb) <sup>3</sup>	Metal	mg/kg d.w.	110
Sum 10 PAHs <sup>3</sup>	Organic micropollutant	mg/kg d.w.	8
Hexachlorobenzene <sup>3</sup>	Organic micropollutant	µg/kg d.w.	20
Sum DDT/DDD/DDE <sup>3</sup>	Organic micropollutant	µg/kg d.w.	20
Mineral oil C10-40 <sup>2</sup>	Oil	mg/kg d.w.	1250
Sum 7 PCBs <sup>3</sup>	Organic micropollutant	µg/kg d.w.	100

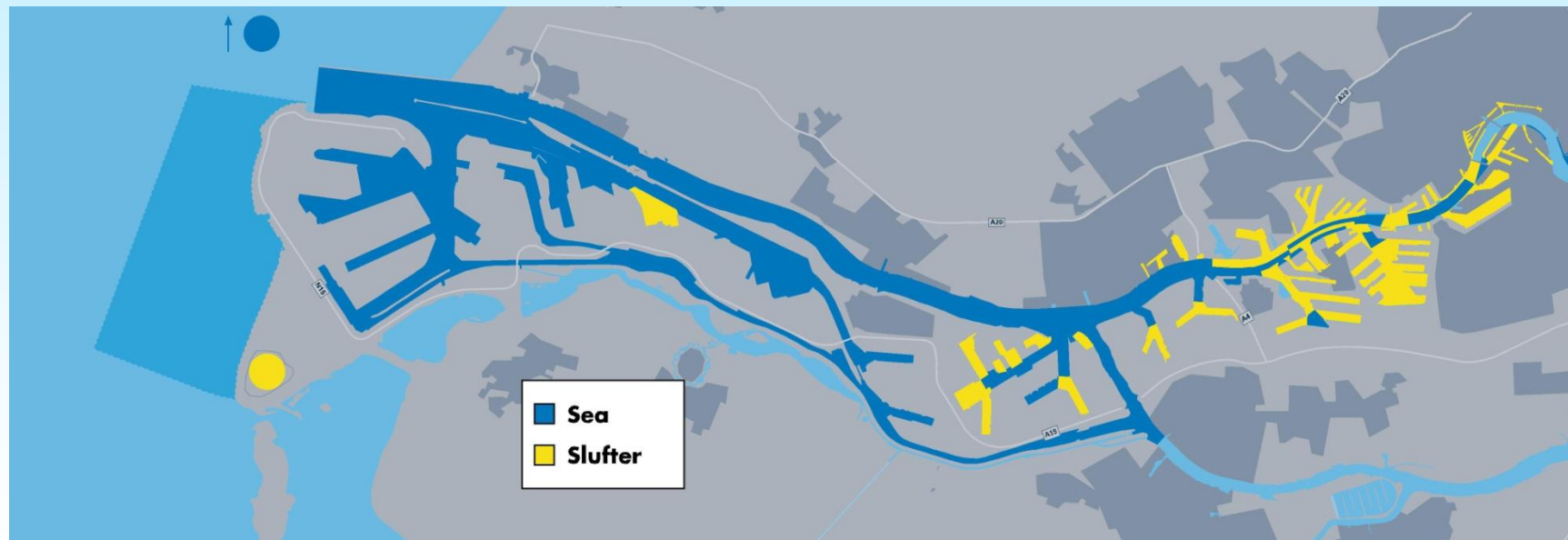
1. Without standard soil correction

2. 50% test rule: no more than two non-priority substances are allowed to exceed the action level with no more than 50% per substance

3. Priority substances (TBT, Cd, Hg, Ni, Pb, sum 10 PAHs, sum 7 PCBs, sum DDT/DDD/DDE, Hexachlorobenzene): action level is a strict upper level  
d.w. dry weight



# Dredged material classification



# Sedimentation originating from sea & river





# Sustainable relocation in the sea

- Around 15 million m<sup>3</sup> annually
- Clean sediment
- Transport distance optimisation
- Relocation also in off-shore pits with sand mining in combination



# Confined disposal: The Slufter

- Around 0.5 million m<sup>3</sup> annually (maintenance dredging)
- Contaminated sediment
- Capacity 150 million m<sup>3</sup> (100 large football stadiums)
- Height dyke walls 24m, depth 28m below sea level
- Surface diameter 1.5 km

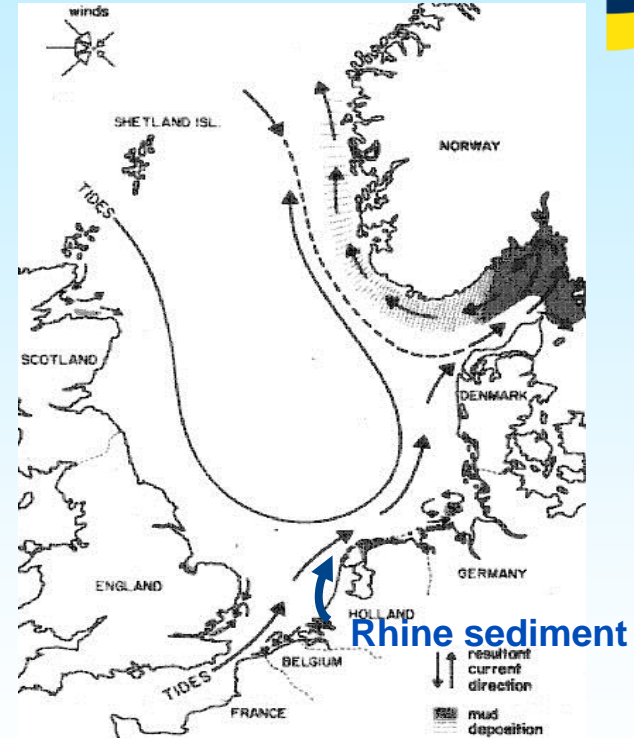


# Transport of sediments in the North Sea

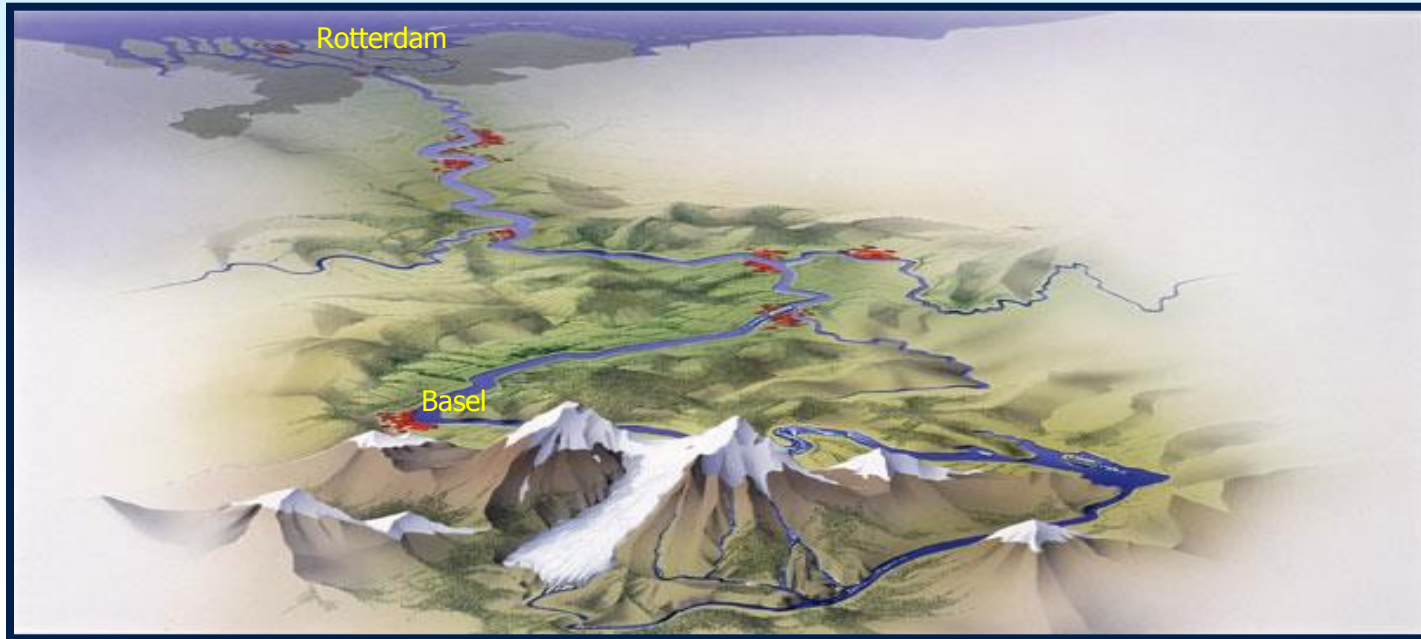
Sediment transport:

approx. 50% of the Rhine sediment flows directly with the river into the sea

Final destination: deposition areas at sea

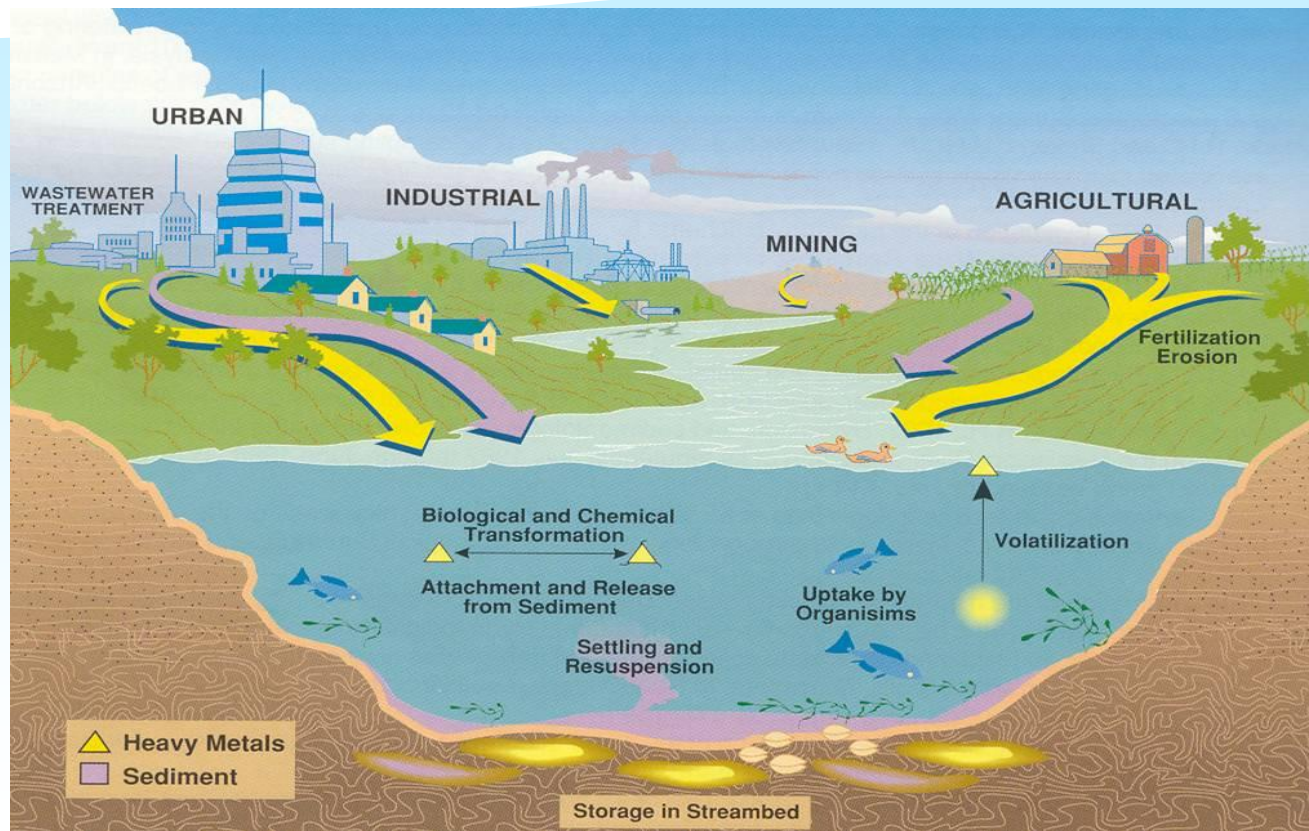


# The Rhine river and Port of Rotterdam





# Sources of contamination and sediment

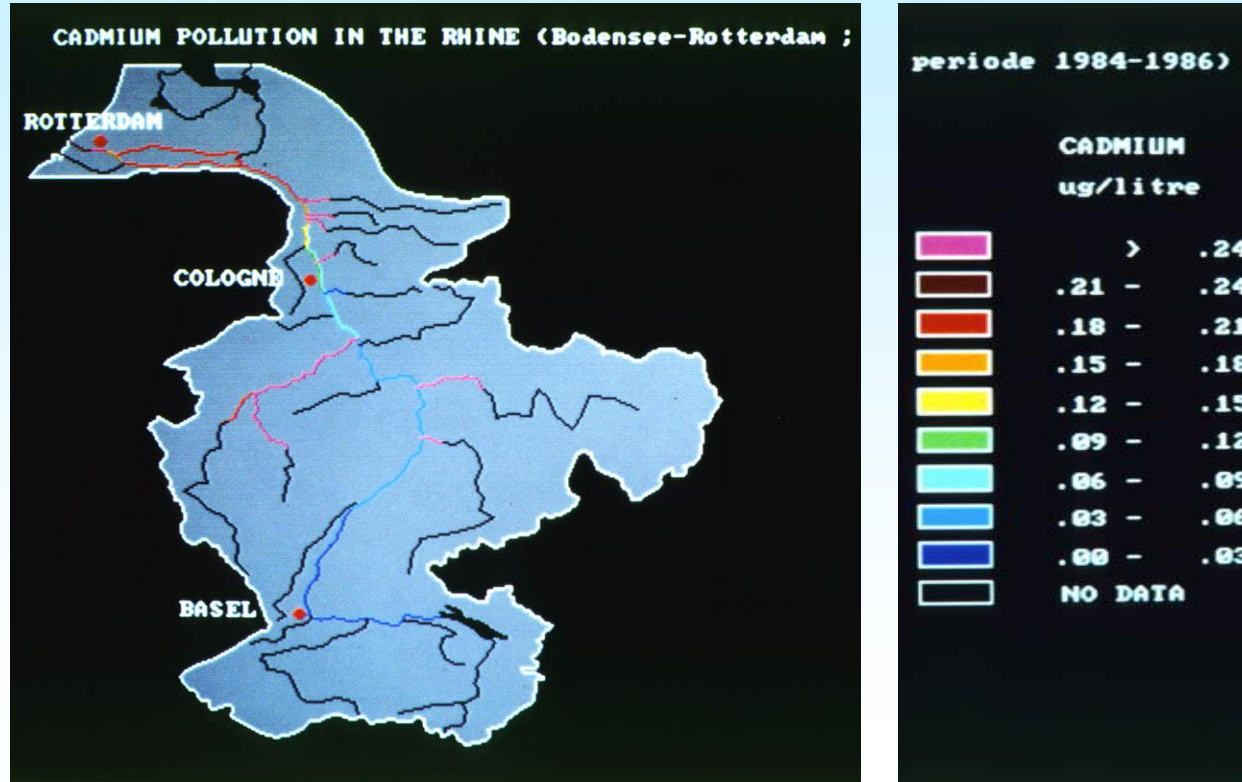


# Rhine Research Project part 1 (1984-1994)

- Source identification and load assessment
- Contaminant balances
- Legal research
- Information campaigns
- Dialogues and agreements



# Contamination Cadmium Rhine river 1984-1986

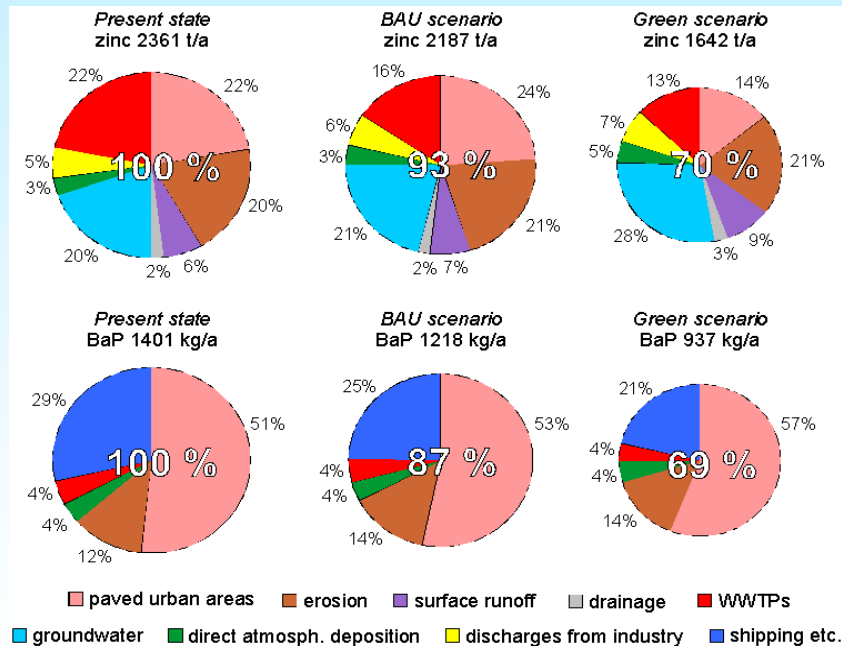
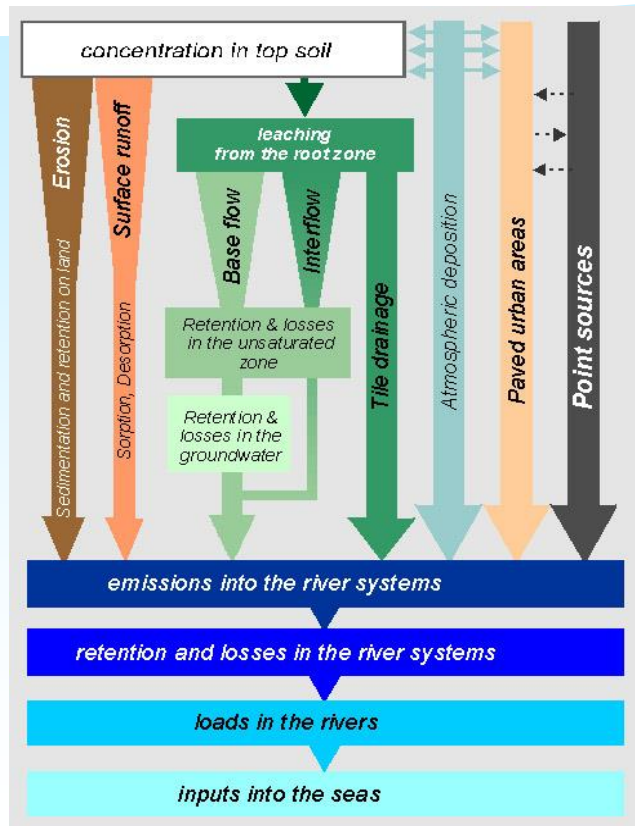


# Results agreement VCI - Rotterdam

Compound	Discharges 1984 (t)	2000	2005*	Red.% '84-'05
Zinc	450	100	65	86%
Chromium	150	20	10	93%
Copper	80	25	16	80%
Cadmium	1.2	0.5	0.15	88%
Mercury	0.6	0.14	0.10	83%
AOX	1500	300	150	90%

**\* in 2006 agreement extended until 2027**

# Rhine Research Project part 2 (1997-2007)



# Inventory of historical contaminated sediment in Rhine Basin and its tributaries



(Foto: BfG)

## Final report

October 2004

Technical University Hamburg Harburg  
in Cooperation with the University Stuttgart



This report was written on behalf of the Port of Rotterdam

by

Dr. Susanne Heise,  
Consulting Centre for Integrated Sediment Management at the TUHH  
(BIS)  
Hamburg, Germany

Prof. Ulrich Förstner,  
Technical University Hamburg-Harburg (TUHH)  
Hamburg, Germany

in Cooperation with

Prof. Bernhard Westrich,  
Thomas Jancke  
Joachim Karnahl  
from the „Institut für Wasserbau“  
University of Stuttgart, Germany

Prof. Wim Salomons,  
University Amsterdam  
The Netherlands

Dr. Harald Schönberger,  
Regierungspräsidium Freiburg  
Germany

# Areas of risk

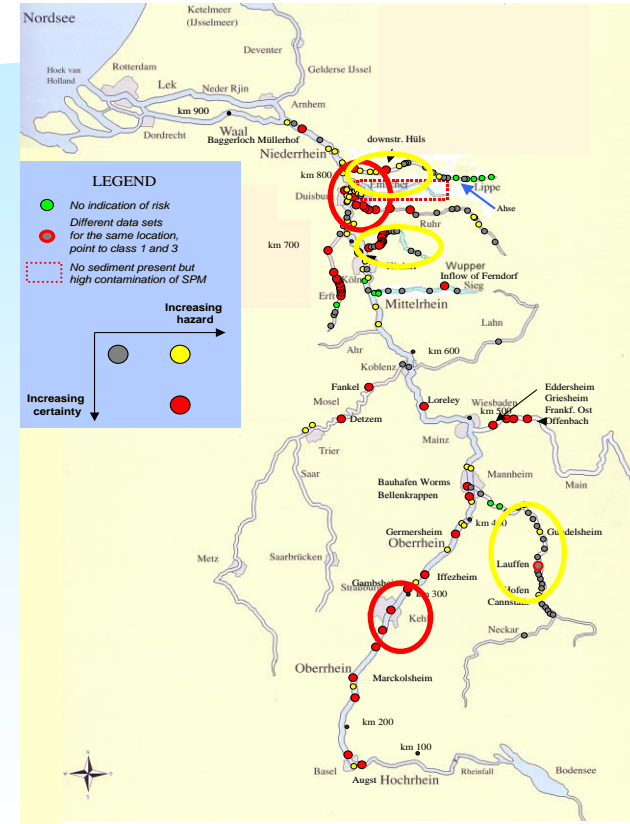
classification of

- substances of concern (WFD)
- areas of concern
- areas of risk

under uncertainty consideration

 evidence for high risk

 evidence for risk



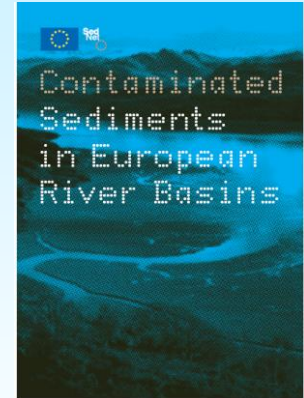
# Conclusions and results Rhine Research Project

- Significant quality improvement since 1984 (successful emission control industrial sources)
- Emission control still essential in improving quality: programmes of measures Rhine (Water Framework Directive)
- Balanced action in level of protection (sea – river)
- Sediment Management Plan now incorporated at river basin scale (International Commission for the Protection of the Rhine)
- Sediments more in focus of EU (SedNet)



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

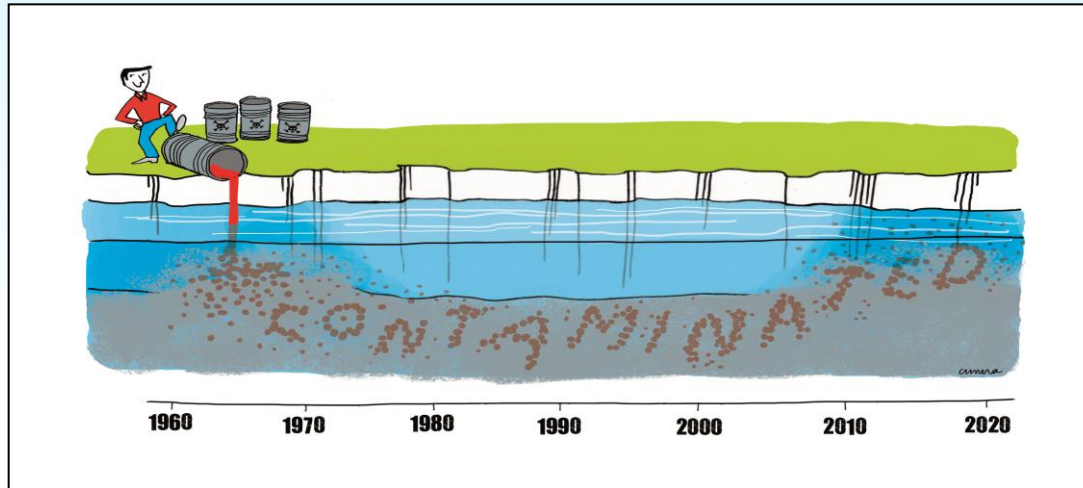
Focus is on all sediment quality and quantity issues on a river basin scale, ranging from freshwater to estuarine and marine sediments.



# SedNet messages (1)

## Sediment quality and remobilisation

Contaminated sediments can have adverse effects on people, the environment and the economy. Because sediment is moved through the river basin to the sea, such effects can occur not only locally but far from the source of contamination. Remediation and protection measures therefore need to be integrated into river basin management plans.

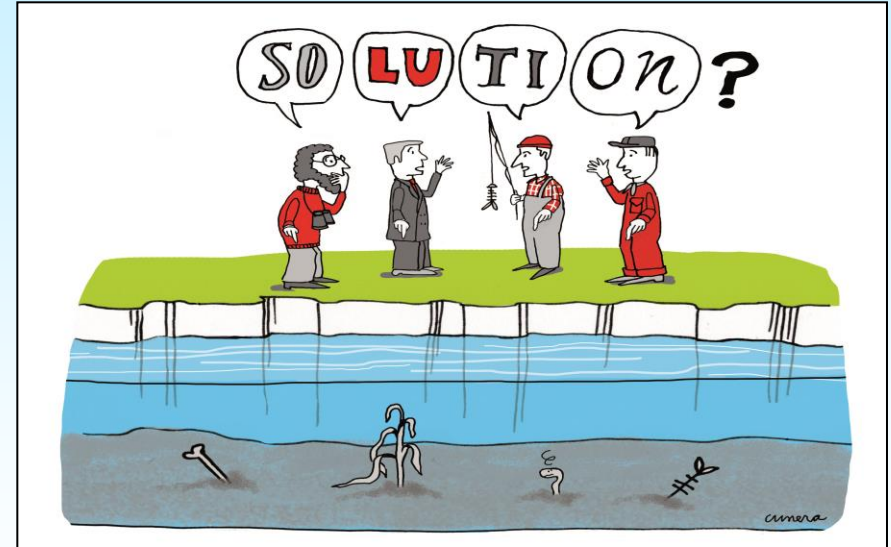


# SedNet messages (2)

## Sediment and river ecology

Sediment is a fundamentally important component of aquatic ecosystems.

Achieving a sustainable balance between the development of waterways and meeting ecosystem objectives will depend on both constructive dialogue between various stakeholders, policy coordination and effective transboundary cooperation.



# SedNet messages (3)

## Sediment quantity and hydro-morphology

Sediment transport is a vital element of the natural hydro-morphological regime..

We need better understanding of both current status and potential impacts to ensure that hydro-morphological assessments are reliable and measures are appropriate.



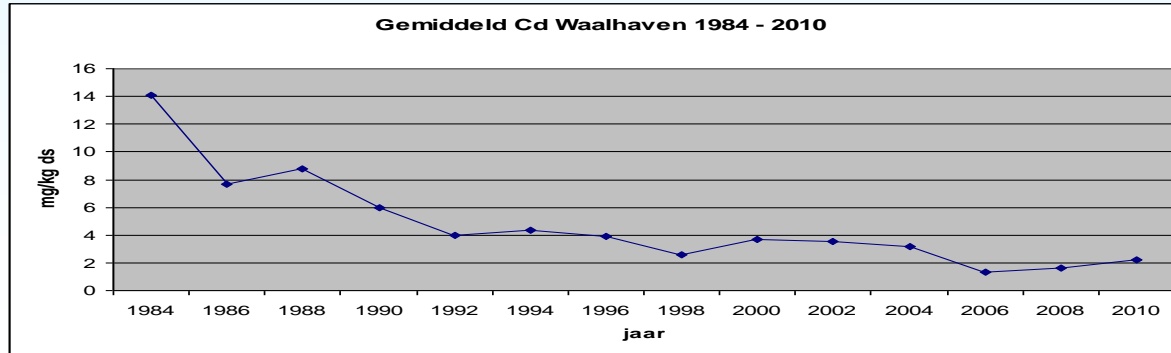
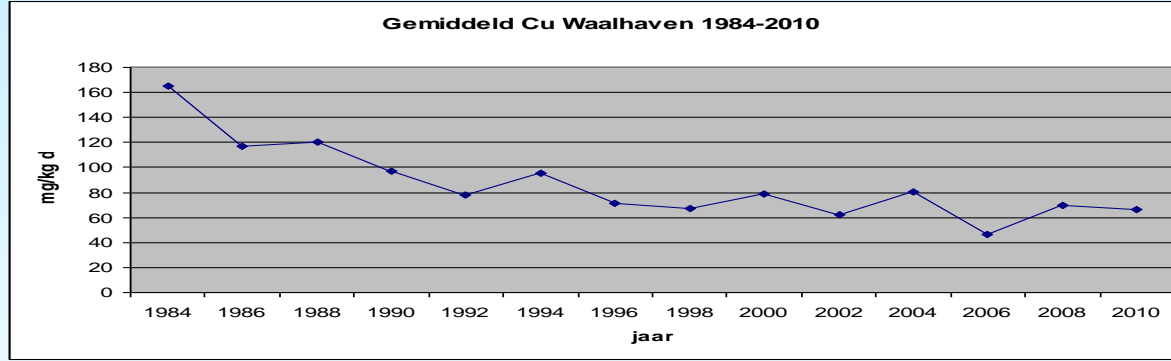
# SedNet messages (4)

## Dredged material management

A sustainable approach in relation to the management of dredged material requires a change of focus: rather than considering dredged material as a waste, dredged sediments need to be seen as a resource.

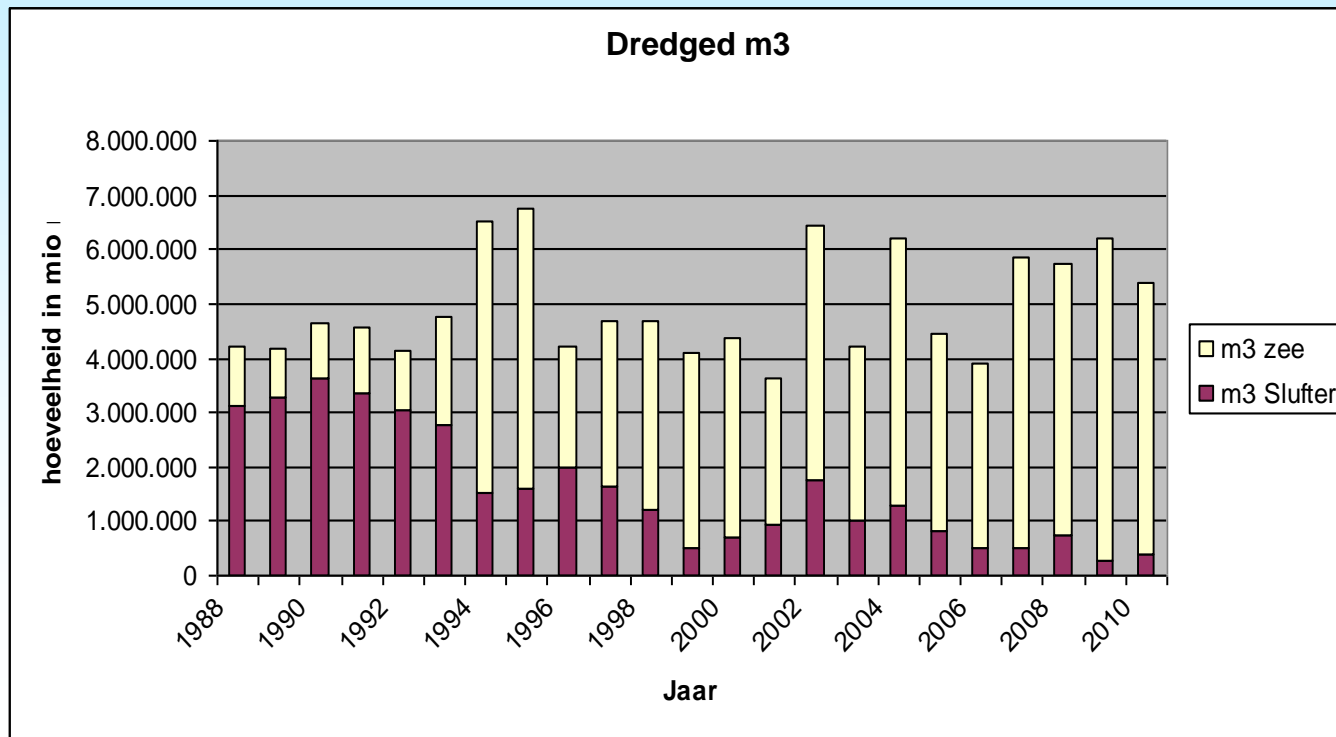


# Dredged material quality improvement





# Reduction dredged material disposal in Slufter



# A message to remember

- In the Rhine catchment peoples behaviour in their backyard is linked to the enjoyment and values they experience in the North Sea
- The link is through the sediment.

