“Advancements in assessment of contaminated sediment remobilization risks in unnavigable watercourses in Flanders, Belgium ”

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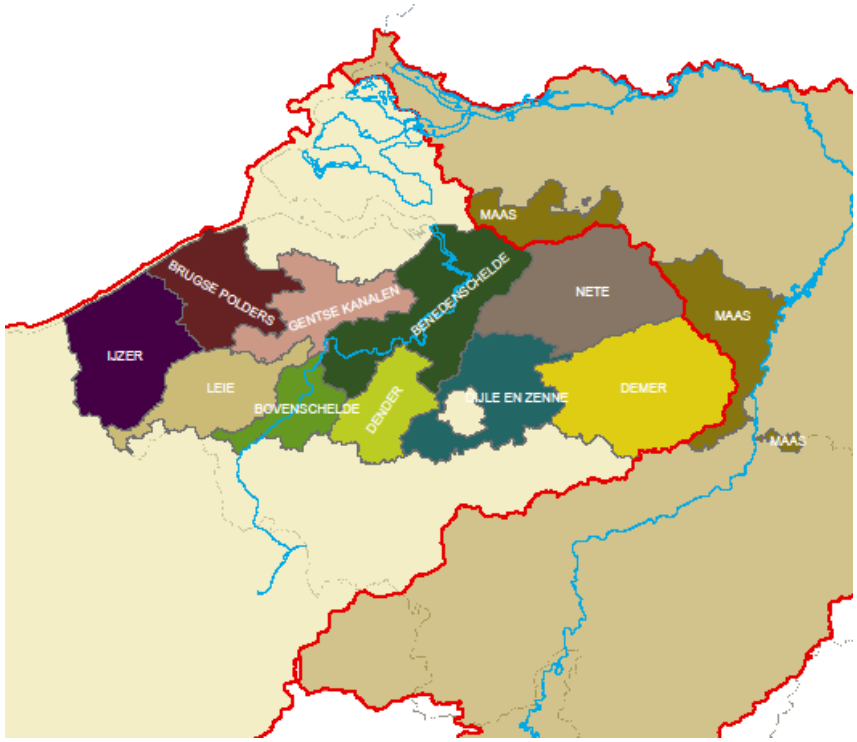
I Policy in Flanders

In Flanders fields



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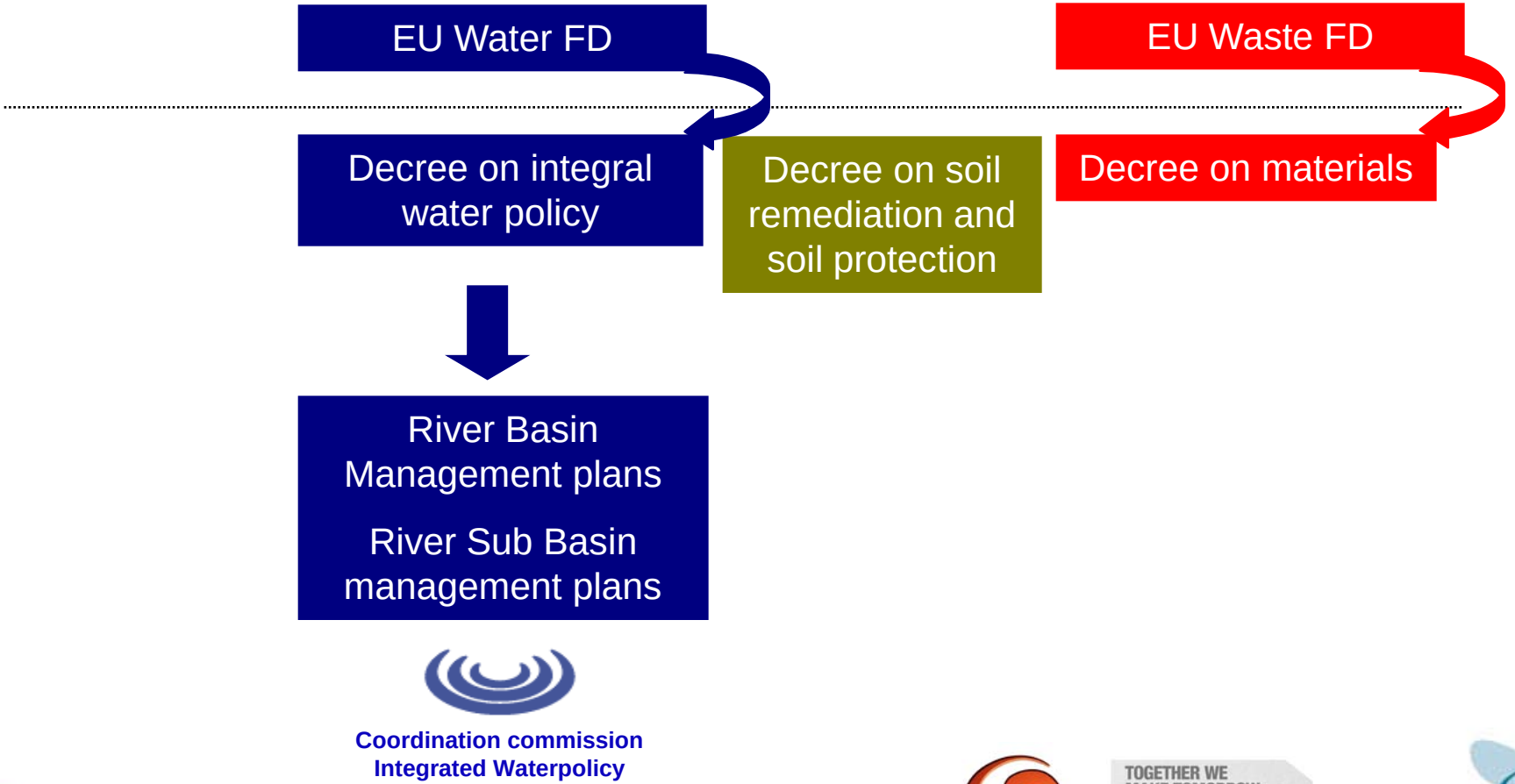
I Policy in Flanders

Interface of different policy frameworks



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Actors in Flanders

VLAAMSE MILIEUMAATSCHAPPIJ

WATER

WASTE

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contaminated sediments

SOIL

lne. Departement Leefmilieu, Natuur en Energie

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I Policy in Flanders

OVAM - Public waste agency of Flanders:

waste management / soil remediation

LNE - Environment, Nature and Energy Dept:

soil protection eg. erosion

VMM - Flemish environment agency:

preventing, limiting and eliminating the harmfull effects to water systems and the atmosphere

CIW - Coordination integrated water policy Flanders:

platform for environmental agencies and water course managers

I Policy in Flanders

History ~ development of legislation

1981: start of waste (and soil) policy

- Decree on Waste Management of 2nd Juli 1981

1995: start of contaminated soil policy

- Decree on Soil Remediation 22nd August 1995

2006: after 10 years, re-evaluation of decree on soil remediation - Sediments explicitly included

- Decree on Soil Remediation and Protection 27th of October 2006 (into force since 1th of June 2008)

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Decree on soil remediation and soil protection

Flemish governement indicates on regional scale which contaminated sediments need to be investigated

⇩

Use of **guideline for investigation of contaminated sediments**

⇩

Serious contamination of sediments ?

⇩ **yes**

Flemisch gov. indicates sediments to be remediated

⇩

Remediation

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Specific guideline ‘Sediment Investigation Unnavigable watercourses'

Objective

- First: Serious soil contamination present?
- Secondly: Risk evaluation
  - ✓ Possible **remobilization** of contamination to ground- or surface water?
  - ✓ Exposion to human/plant/animal?

Structure of investigation

- Historical-site investigation
- Development of a sampling strategy
- Defining contamination
- Risk evaluation incl. remobilization

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- Start at source
- only when **sustainable** remediation
- 2008 – 2012: pilot investigations OVAM-VMM

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II Tools for risk evaluation

- **Project 'assessment of remobilization risk'**
  - ? Best evaluation procedure to assess the stability of the contaminated sediment volumes?
  - 2011-2012
  - Team: Antea Group, Arcadis
  - Client: OVAM

- **Project 'Modelling sediment supply towards, and sedimentation processes in unnavigable watercourses in Flanders'**
  - = 1D-Modelling deposition and resuspension in all unnavigable rivers in Flanders?
  - 2013-2016
  - Team: Antea Group, KULeuven
  - Client: VMM & ALBON

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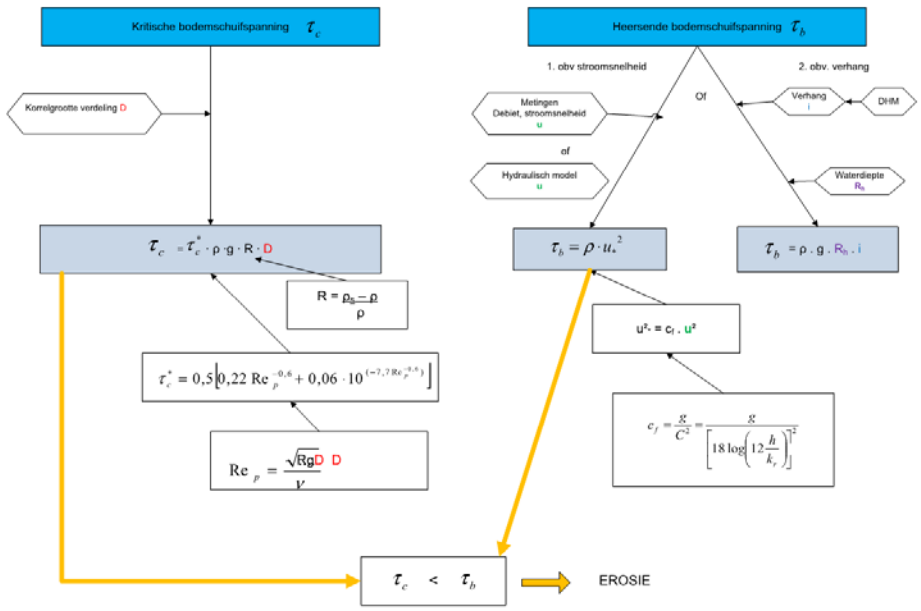
III Project 'assessment of remobilization risk'

Scope

- Physical risk!
- Now: risk if v > 0.3 m/s, v > 0.8 m/s (consolidated)
- Improvement: **shear stress** as risk parameter

Critical shear stress t_c	<	**Current shear stress t_b**	→ **Erosion**
(Resistive force)		*(Attacking force)*	
Sediment properties		Flow properties	
Grain size distribution Density Compaction Water content Organic material		Current velocity Discharge Slope Water depth	

Measurements



III Project 'assessment of remobilization risk'

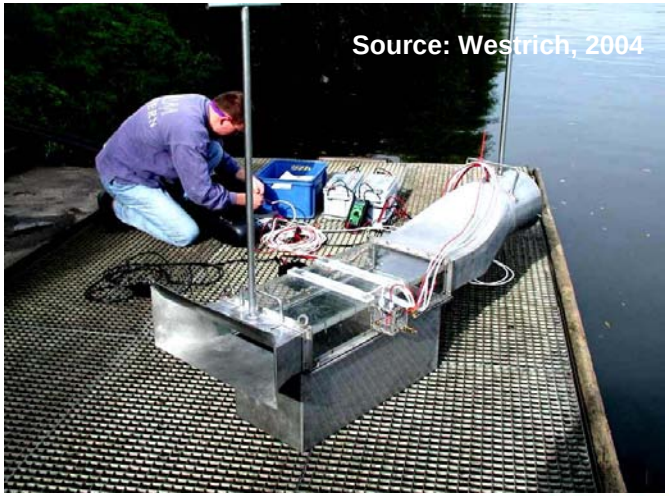
Measurement method

- In situ
- Large scale approach → quick analysis
- Possible methods: CSM, JET, MAF, EROMES, EROMOB, AMF, Graviprobe…
  → CSM selected
- ICBR, Rhine study: "CSM only to use for comparison"

CSM

JET

EROMOB



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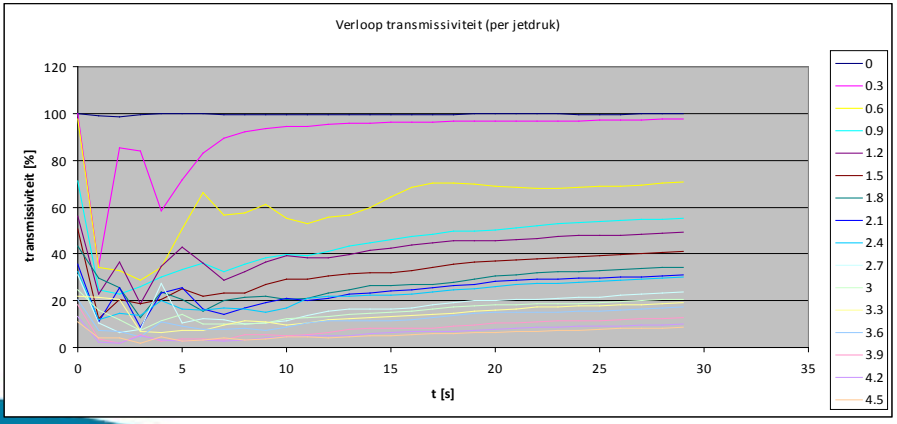
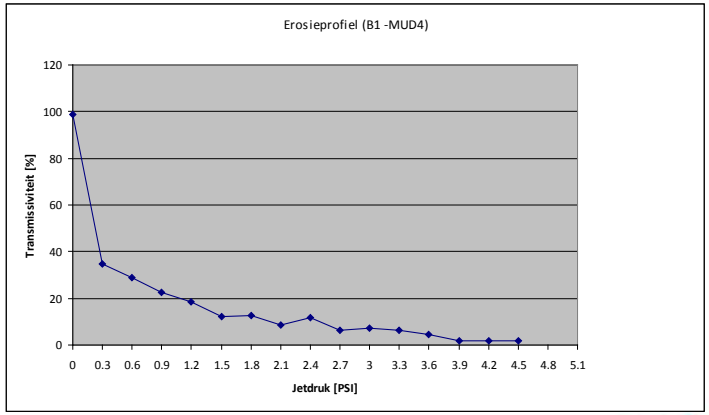
III Project 'assessment of remobilization risk'

Results





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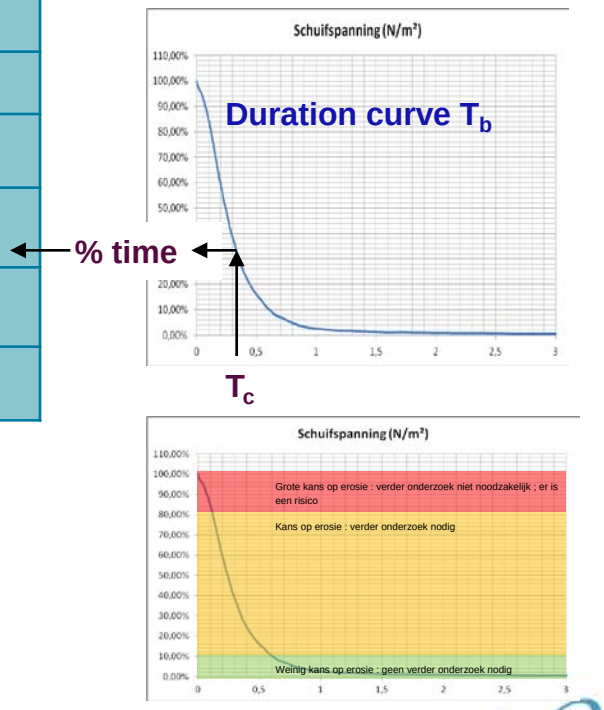
III Project 'assessment of remobilization risk'

Results

- Positive correlations CSM-values with density, water content, grain size
- Comparison with bed shear stress

	% Time $T_b > T_c$	
To, crit	Location 1	Location 2
CSM	40 %	5 %
Shield	90 %	86 %
Lick et al., 2004	95 %	73 %
Chepil, 1959	10 %	10 %



Advancements

- Shear Stress better estimate then velocity
- CSM: Easy to use on larger scale
- Timespan? ICBR: $T_{b,\ 10y} > T_c$

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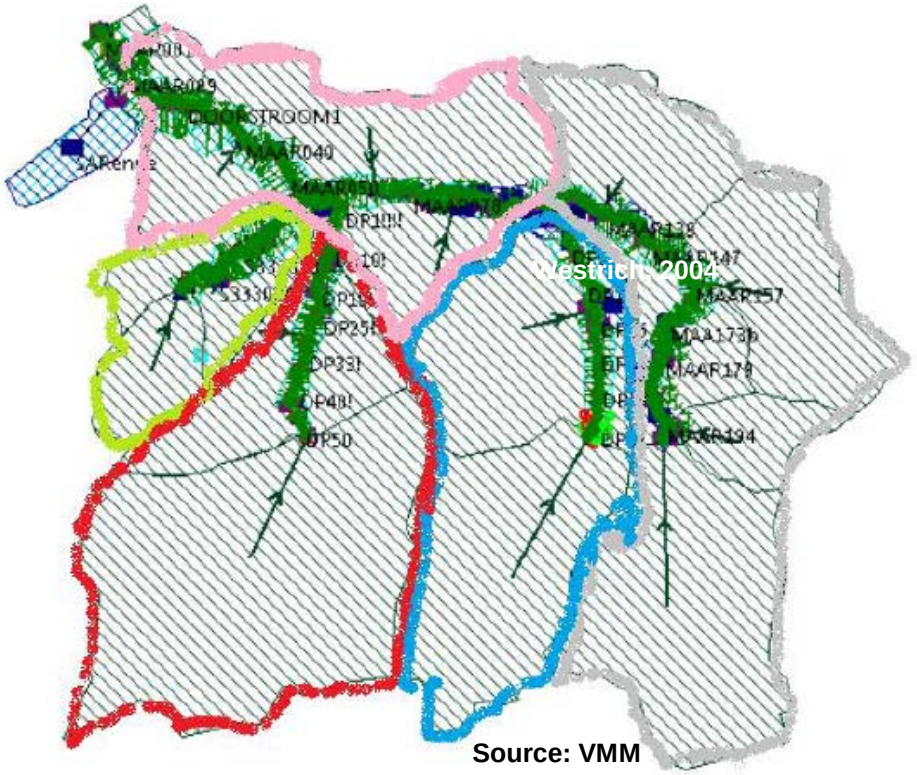
IV Project 'Erosion & sedimentation modelling'

Scope

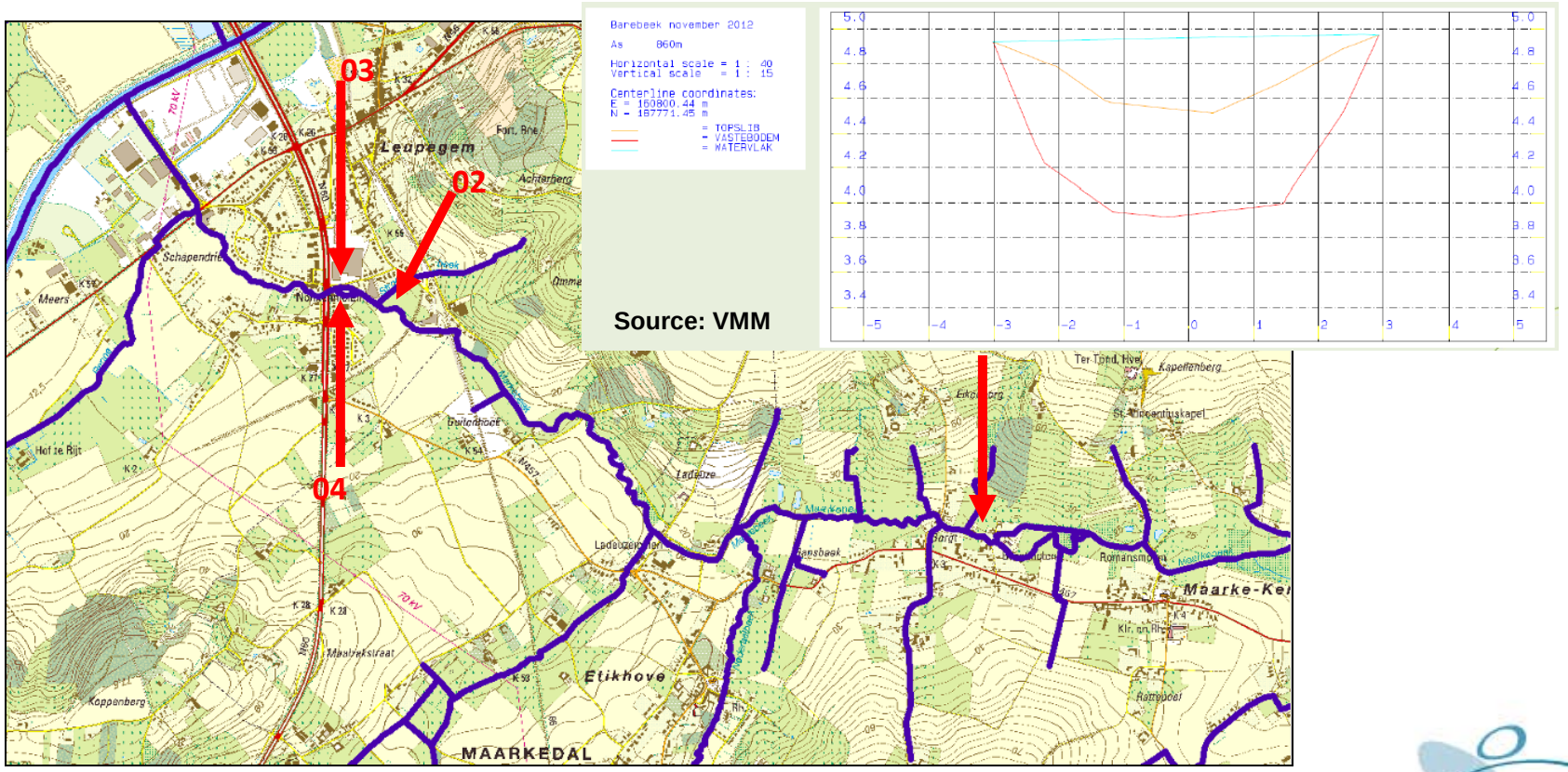
- Modelling sediment supply towards, and sedimentation processes in unnavigable watercourses in Flanders
- Hydraulic modelling: Infoworks RS or ICM
- Maarkebeek as test area → Infoworks RS is only option



IV Project 'Erosion & sedimentation modelling'

Selected sedimentation zones

- Measurements of sediment discharges & sedimentation volumes



lne Departement Leefmilieu, Natuur en Energie

Vmm VLAAMSE MILIEUMAATSCHAPPIJ

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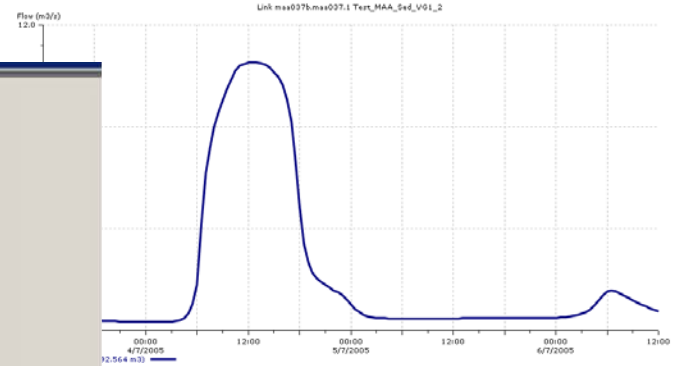
IV Project 'Erosion & sedimentation modelling'

tests on event 4/7/2005



Start Date-Time: 01 januari 2000 00:00:00 #D
Sediment Transport Eqn. Coeff.: 1.000 #D
Depth Change Criteria (m): 0.010 #D
Bed Elevation Distribution: 1.000 #D
Active Layer Thickness Factor: 2.000
Bed Porosity: 0.500
Channel Geometry Update: None
Transport Calculation Method: Composite
Grading
Sediment Size D0 (mm): 0.010
D0 and D100
Sediment Size D100 (mm): 0.250
Hard Bed
Dredging
Dredging Type: Constant Level #D
Dredging Time Unit: Seconds #D

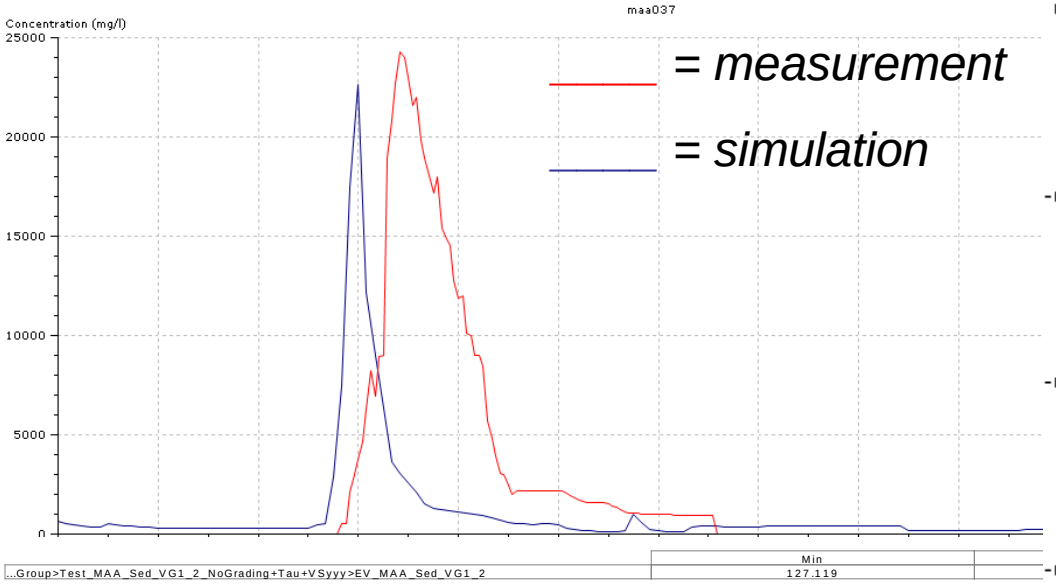
	Diameter (mm)	rho (kg/m3)	Transport equation	Proportion	Cohesive	Cohesive threshold (N/m2)	Cohesive Ws (mm/s)
▶	0.050	2650.0	Westrich & Jurashek	0.900	☒	0.100	1.960
2	0.200	2650.0	Engelund & Hansen	0.100	☐		
✳					☐		

Values?

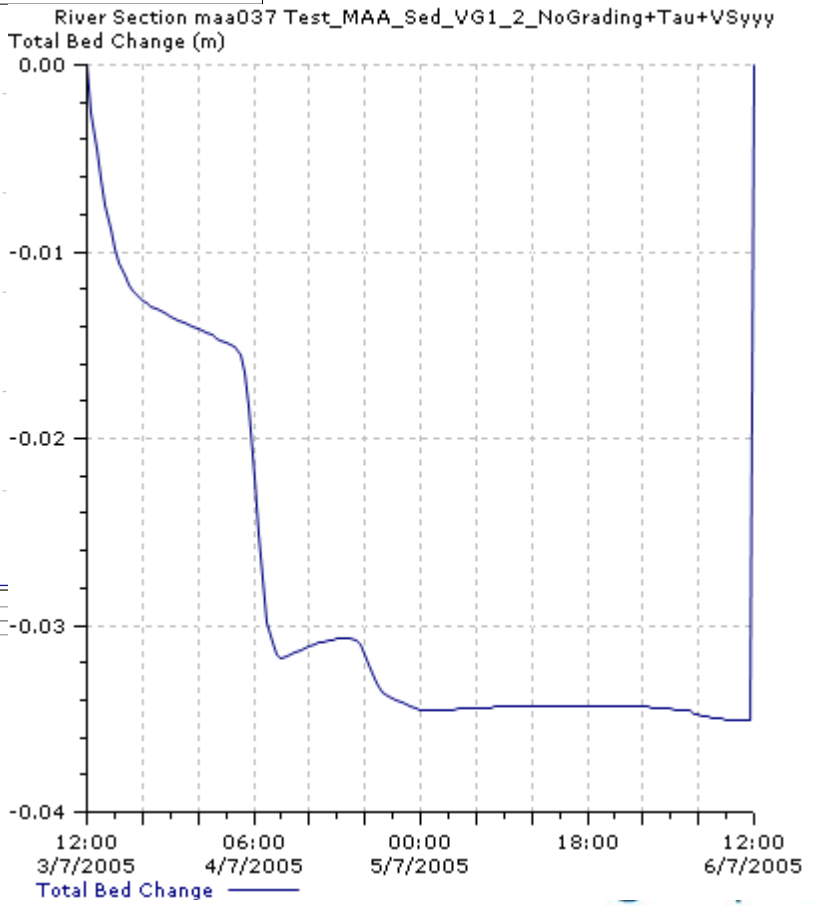
IV Project 'Erosion & sedimentation modelling'

Measurements at downstream section

Simulation Plot Produced by d12235 (26/09/2013 13:49:34) Page 1 of 2
Sim: >Maarkebeek>Run Group>Test_MAA_Sed_VG1_2_NoGrading+Tau+VSyyy>EV_MAA_Sed_VG1_2 (26/09/2013 13:38:41)
Selection List: Custom Selection



	Min
...Group>Test_MAA_Sed_VG1_2_NoGrading+Tau+VSyyy>EV_MAA_Sed_VG1_2	127.119



IV Project 'Erosion & sedimentation modelling'

Measurements upstream

Simulation Plot Produced by d12235 (26/09/2013 13:49:34) Page 2 of 2
Sim: >Maarkebeek>Run Group>Test_MAA_Sed_VG1_2_NoGrading+Tau+VSyyy>EV_MAA_Sed_VG1_2 (26/09/2013 13:38:41)
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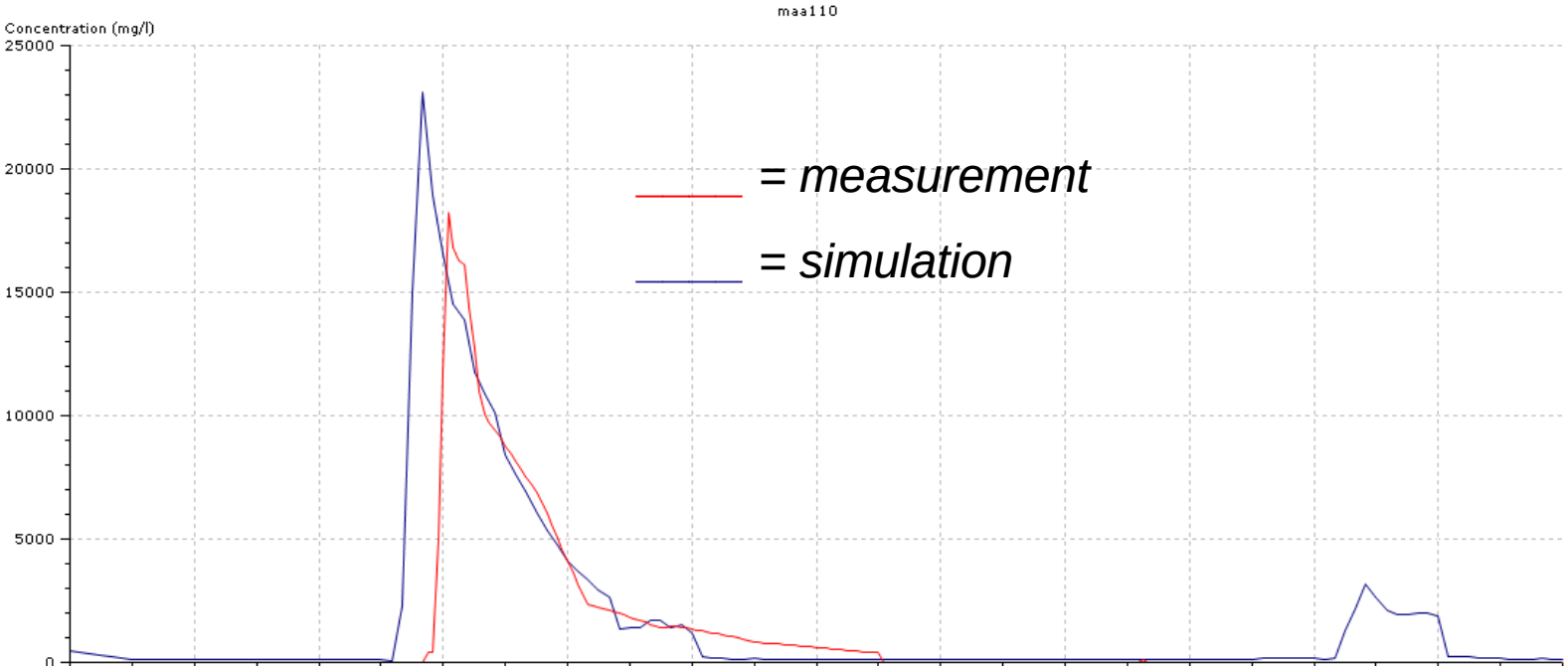

	Min	Max
...Group>Test_MAA_Sed_VG1_2_NoGrading+Tau+VSyyy>EV_MAA_Sed_VG1_2	54.121	23144.049

V Conclusion

Complementarity of both projects

- Project 1: Monitoring campaigns for assessment resuspension risk
  - Goal: Assess risk
  - **But also:** estimation of ciritical model parameter values

- Project 2: Erosion & sediment transport models
  - Goal: Assess erosion/sedimentation
  - **But also:** asses physical risk for resuspension, possibility for capping, …

= MORE WITH LESS

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VI Recommendations/questions

Monitoring

- Standard method for CSM!
- Alternatives for CSM?
- Spatial/depth variation?
- Erosion rate?
- Suspension samples!

Modelling

- Stability issues!
- 1D + 2D (retention basins, flood areas)?
- Scenarios: include capping?