



# REHABILITATION CASE FROM BELGIUM: APPROACH OF A REGIONAL HEAVY METAL POLLUTION CAUSED BY NON-FERROUS INDUSTRY

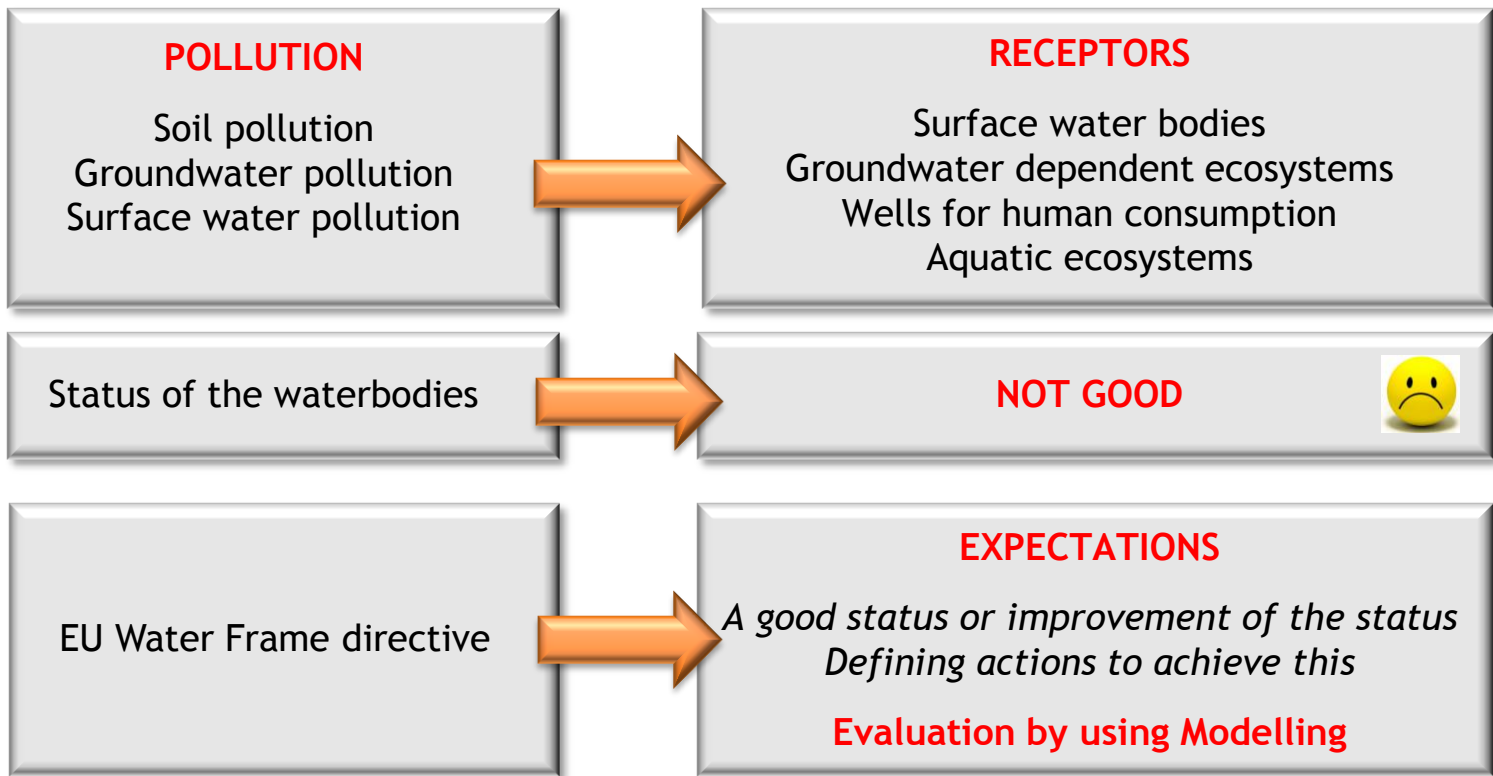
# HEAVY METALS IN THE CAMPINE AREA

Zink / Cadm

The image displays four interactive periodic table cards for heavy metals, arranged in a 2x2 grid. Each card features a small periodic table in the top left corner, a key for electronic configuration, and buttons for history, physical properties, and chemical properties. The background image shows an industrial facility with smokestacks and a body of water, with yellow flowers in the foreground.

Element	Atomic Number	Symbol	Atomic Mass
Zinc	30	Zn	65.38
Cadmium	48	Cd	112.41
Lead	82	Pb	207.2
Arsenic	33	As	74.922

# PROBLEMS

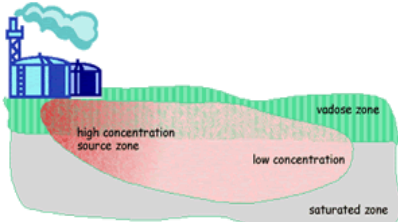


## GOALS OF THE MODEL

*To create a tool helping to understand the transport processes of heavy metals in the studied region allowing a better soil and water management by calculating:*

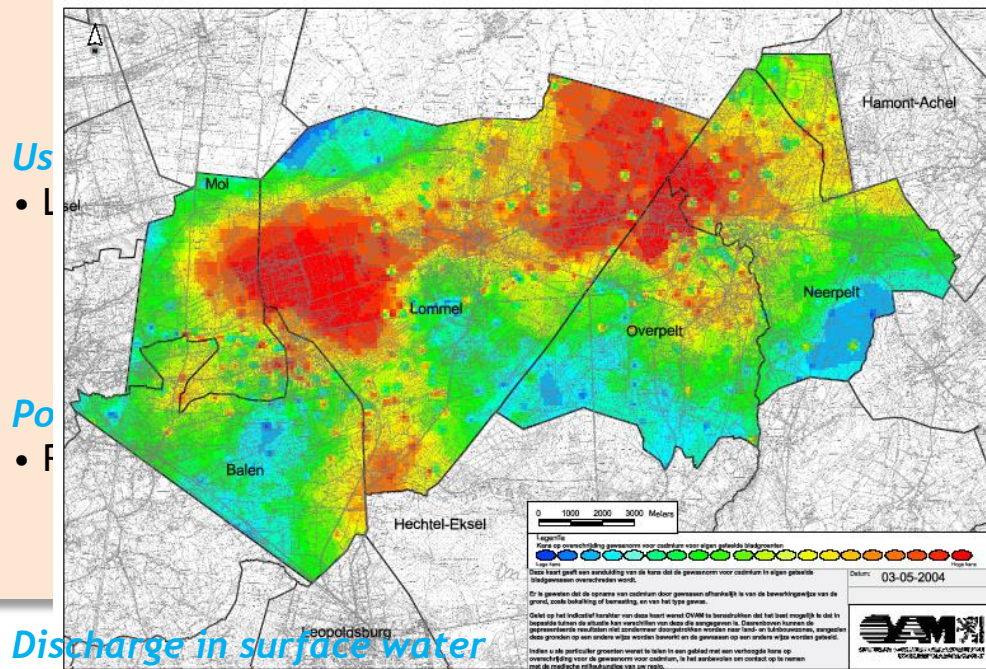
- » Leaching of heavy metals from the soil to the groundwater
- » Movement of Cd and Zn in shallow and deep groundwater
- » Fluxes of heavy metals discharging in surface waters
- » Estimating the status of groundwater bodies as function of time

# SOURCES OF POLLUTION



## Atmospheric emissions and depositions 1880 - 1975

- Regional soil contamination
- Leaching of metals to groundwater



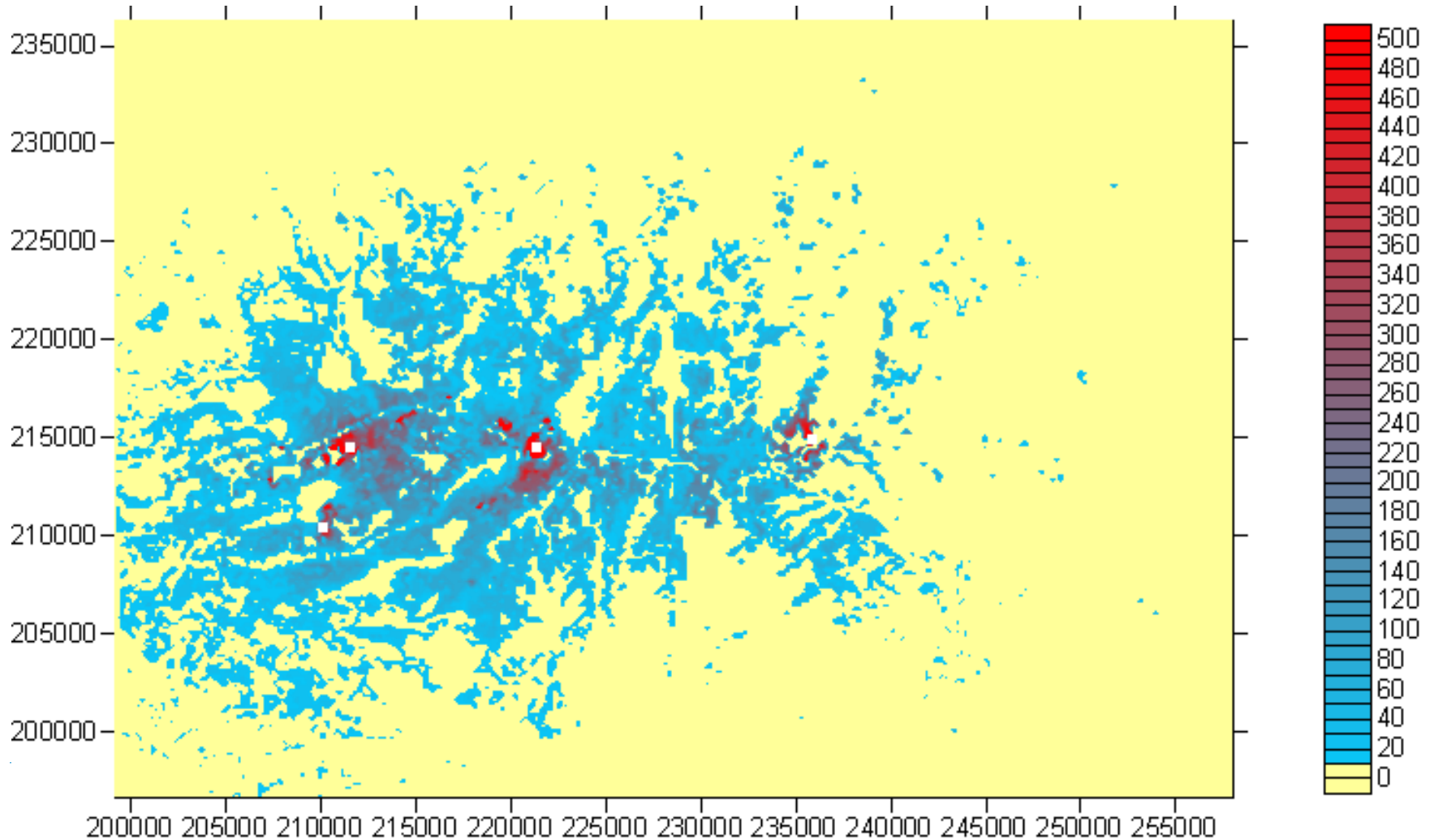
## Discharge in surface water

- Direct risk of surface water pollution

evaluation

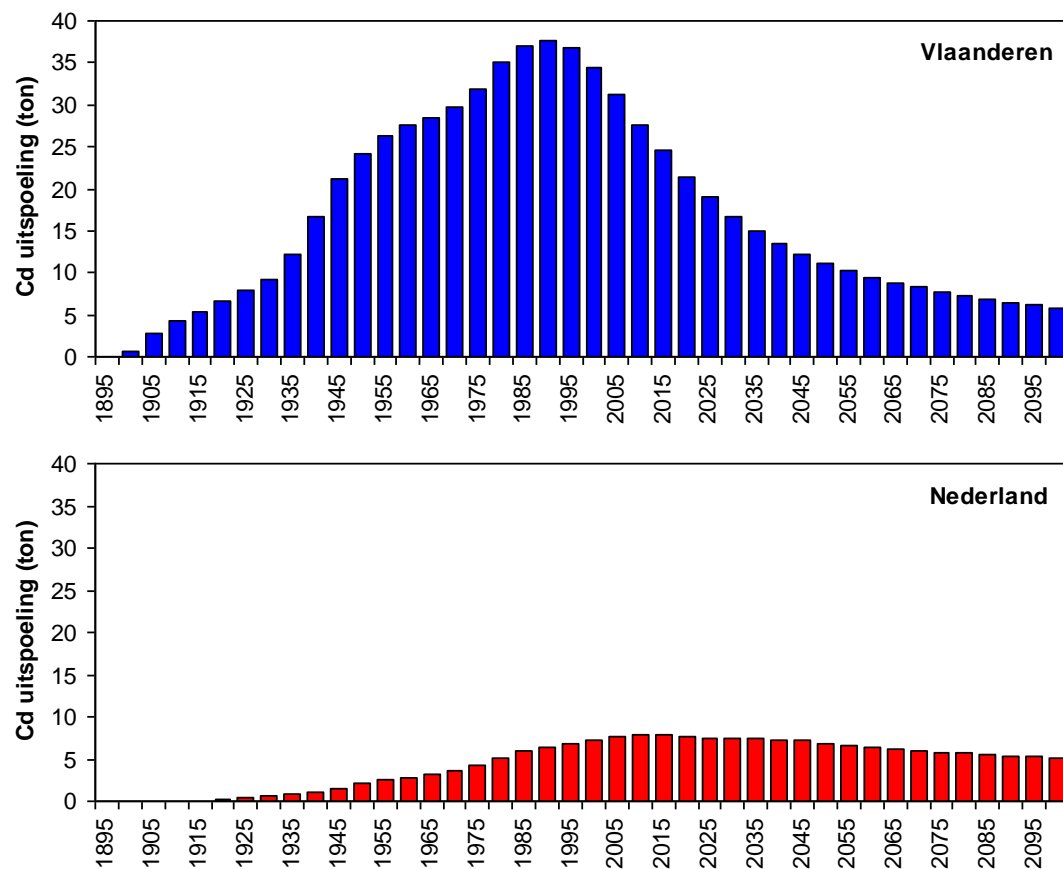
## LEACHING OF CADMIUM

*Leaching of Cd (calculated) to the groundwater taking into account the different sources*



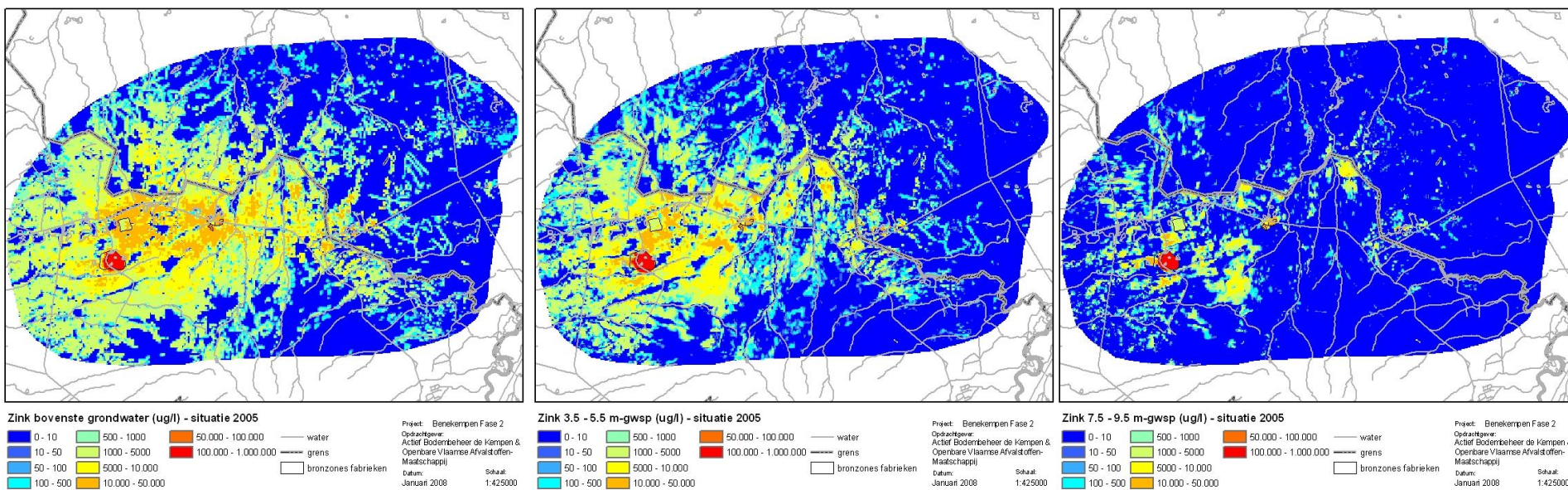
## REFERENCE SITUATION

*Calculated leaching of Cd and Zn  
(in the Dutch and Belgian part of the study area)*



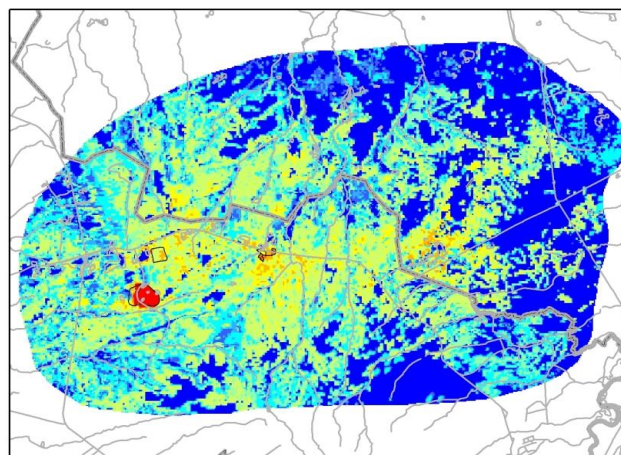
# CONCENTRATIONS IN GROUNDWATER 2005

## Calculated Zn concentration - groundwater 2005



# CONCENTRATIONS IN GROUNDWATER 2060

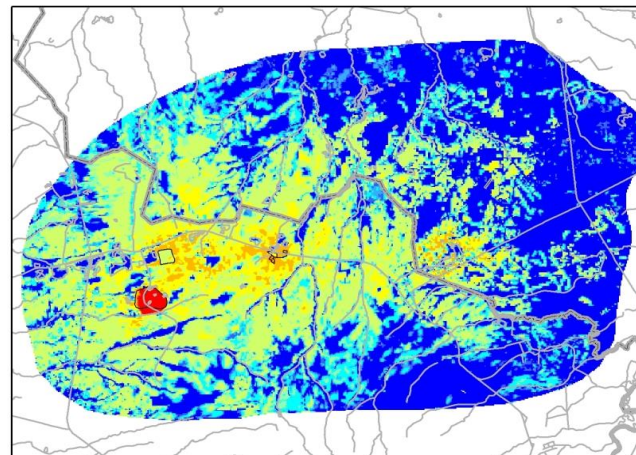
## Calculated Zn concentration - groundwater 2060



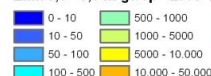
Zink bovenste grondwater - 2060 (µg/l)



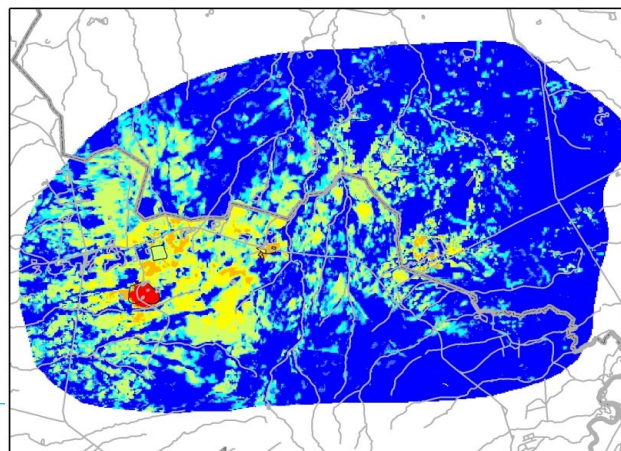
Project: Beneluxen Fase 2  
Opdrachtgever: Actief Bodembeheer de Kempen & Openbare Vlaamse Afvalstoffen-Maatschappij  
Datum: Januari 2008  
Schaal: 1:425000



Zink 3,5 - 5,5 m-gwsp - 2060 (µg/l)



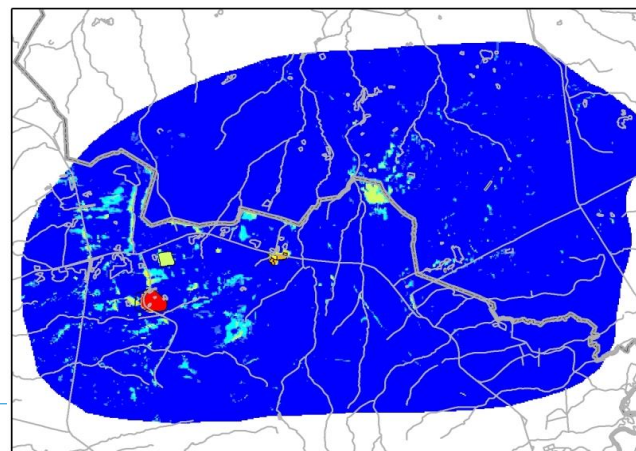
Project: Beneluxen Fase 2  
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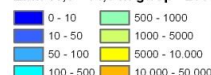
Zink 7,5 - 9,5 m-gwsp - 2060 (µg/l)



Project: Beneluxen Fase 2  
Opdrachtgever: Actief Bodembeheer de Kempen & Openbare Vlaamse Afvalstoffen-Maatschappij  
Datum: Januari 2008  
Schaal: 1:425000



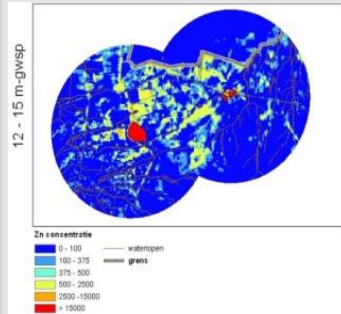
Zink 11,5 - 14,5 m-gwsp - 2060 (µg/l)



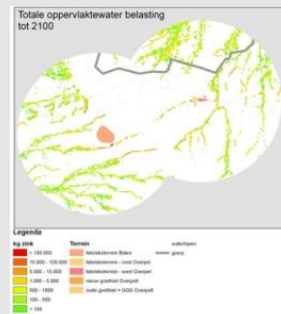
Project: Beneluxen Fase 2  
Opdrachtgever: Actief Bodembeheer de Kempen & Openbare Vlaamse Afvalstoffen-Maatschappij  
Datum: Januari 2008  
Schaal: 1:425000

# EVALUATION OF DIFFERENT POTENTIAL REMEDIAL ACTIONS

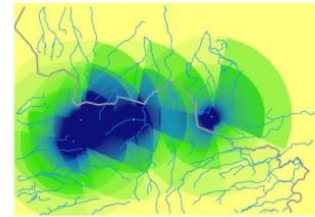
## Pumping



## Drains



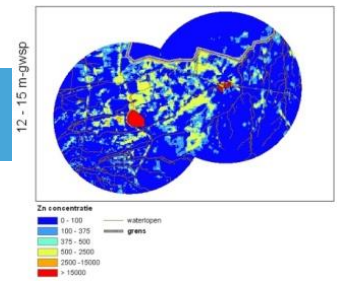
## Removing soil



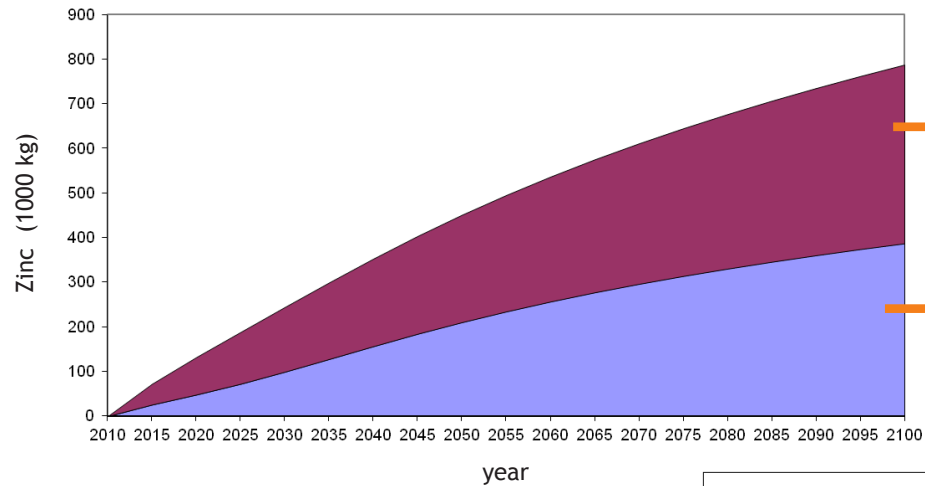
## Combination



## REMOVAL EFFICIENCY: DRAIN - PUMP



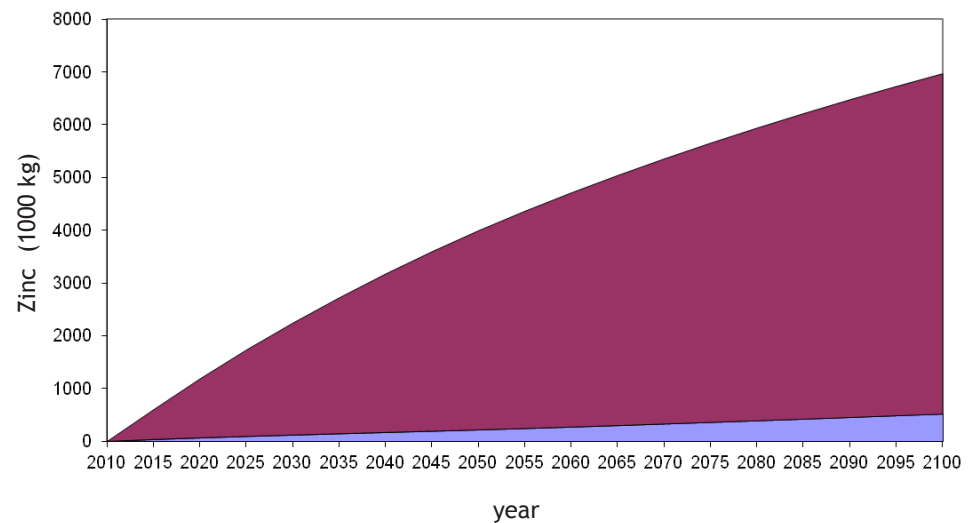
Zinc removal using drainage



From groundwater pollutant plumes

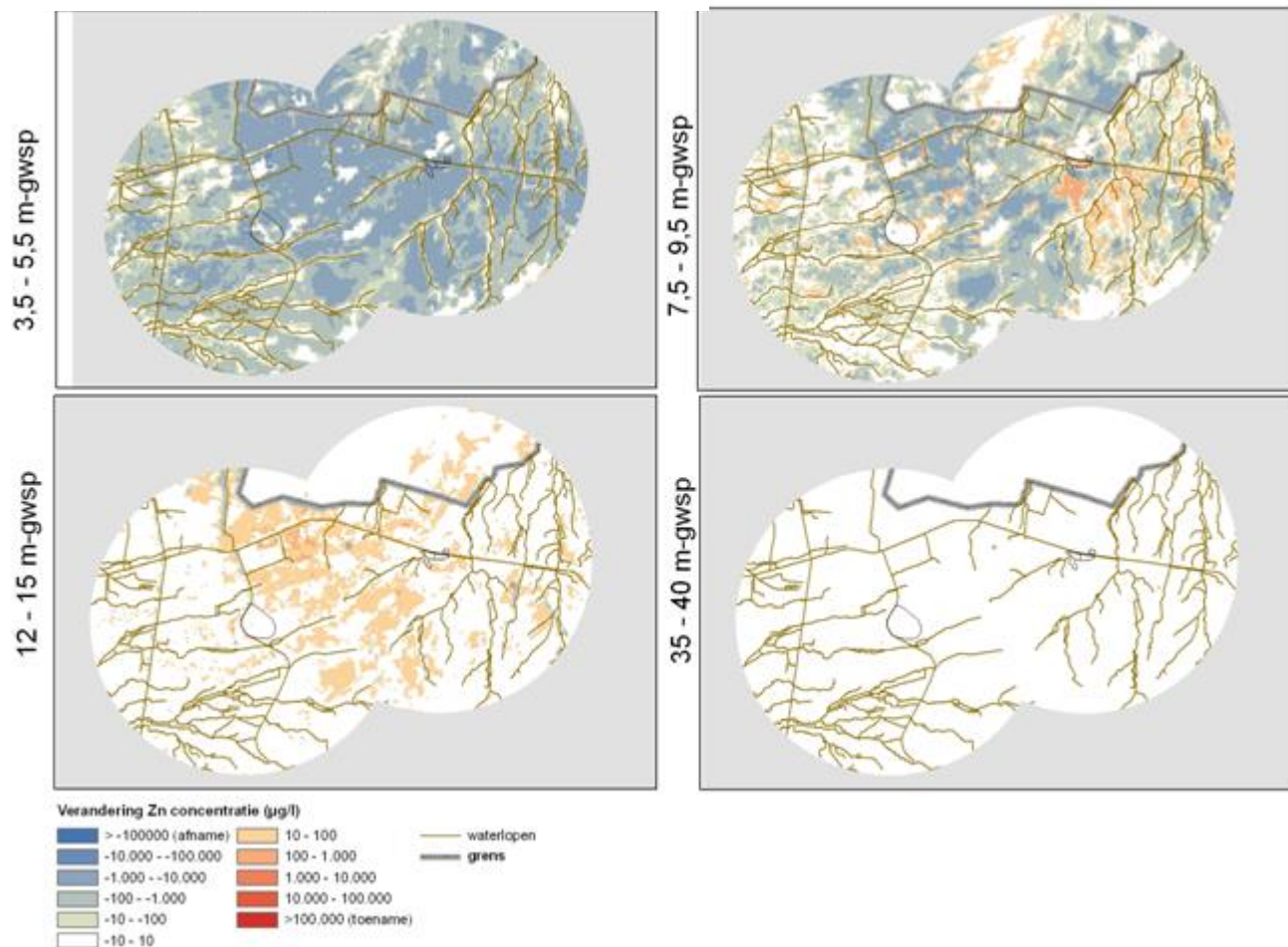
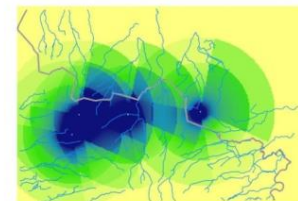
From leaching

Zinc removal using pumping



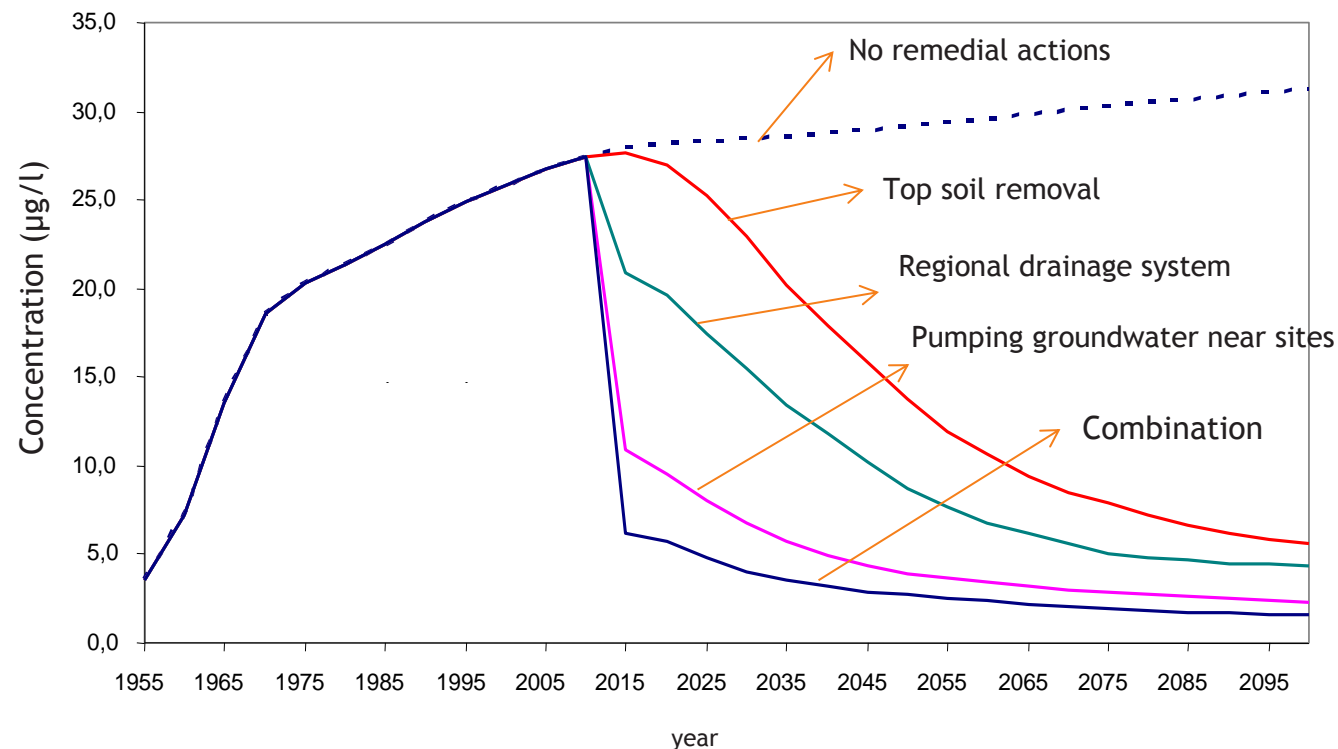
# CALCULATED REMOVAL EFFICIENCY: TOP SOIL REMOVAL

*Removal effect on Zn concentration in 2050*



# CALCULATED REMOVAL EFFICIENCY

## Surface water evolution in the river Molse Nete



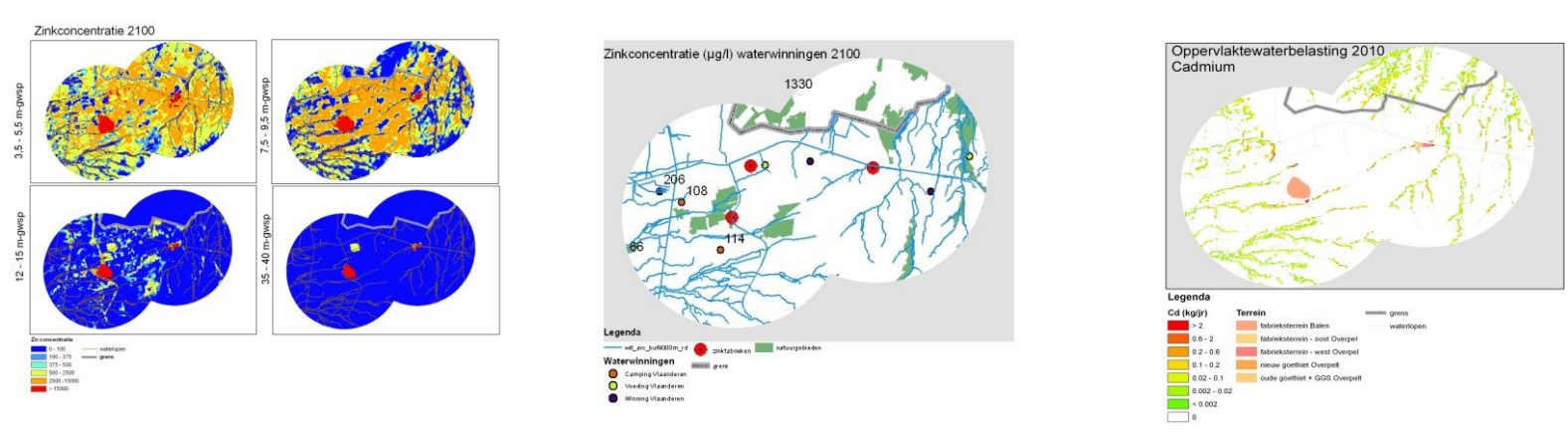
# EFFECTS OF REMEDIAL ACTIONS ON GROUNDWATER BODIES

## *WFD evaluation*

- » Pumping or draining: low impact on the status of WB's
- » Removal of top soil: impact after 2050, good status from 2100
- » Combinations of actions: low impact (except combination including top soil removal)

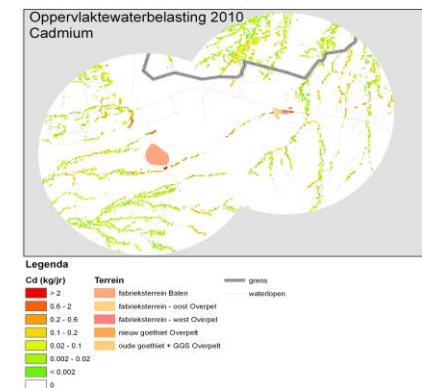
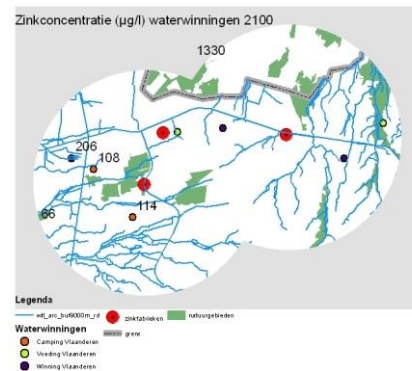
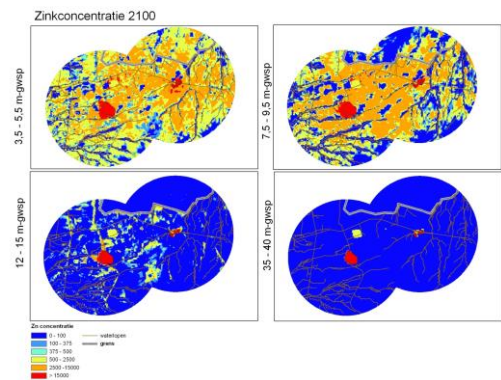
## CONCLUSIONS -1:

- » The groundwater system, in the study area, is severely polluted in such a way that it will impact the surface water system for several decennia.
- » Measures to remove pollution from groundwater (by pumping or draining) on a regional scale seems not to be effective
- » Pollutant removal in the plume areas on and near the plant sites (non-ferro industries) has a significant effect on the local groundwater quality



## CONCLUSIONS -2:

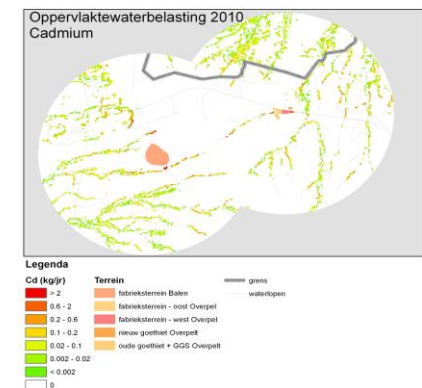
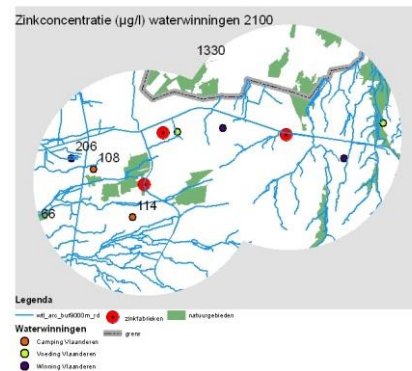
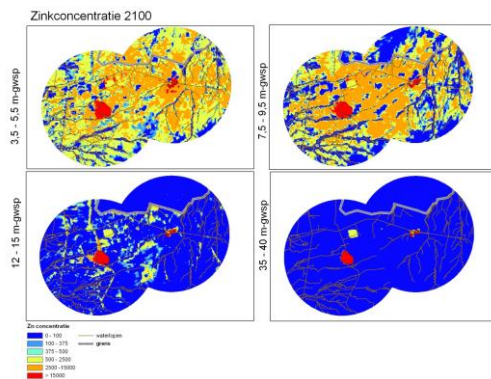
- » Decrease groundwater discharge (into rivers) by using local drains / pumping is effective at some locations
- » Removal of top soil, which is effective after a certain time, is not considered because it is not cost effective.



## CONCLUSIONS -3:

### *Taking into account the modelling results:*

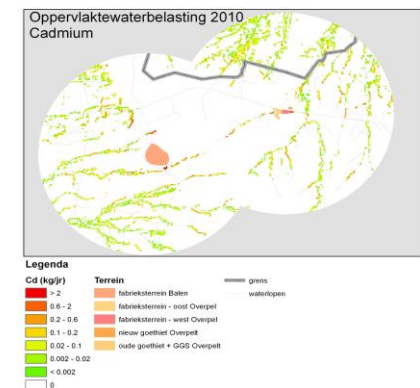
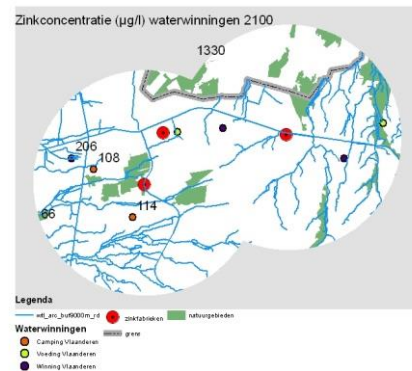
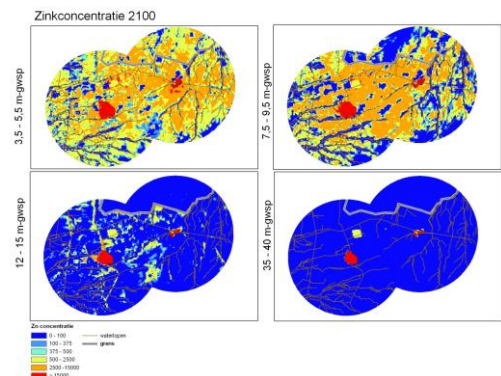
- » The focus of the remedial actions is on / near the plant sites itself
- » Tests to remove heavy metals from surface water using “passive” methods is being studied
- » A monitoring of groundwater and surface water quality, to follow up the status of the water bodies, is started to identify if an improvement of the water quality status is observed (as expected based on the modelling results)



## CONCLUSIONS -4:

*Related to mining issues:*

- » Similar approach can be followed including:
  - » Characterization & source identification
  - » Risk analyses
  - » Receptor based approach (groundwater, surface water)
  - » Scenario's using models
  - » Follow up: monitoring



## CONTACT

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