
SAMEN MAKEN WE
MORGEN MOOIER
VAM

Overview of soil surveys and remediation

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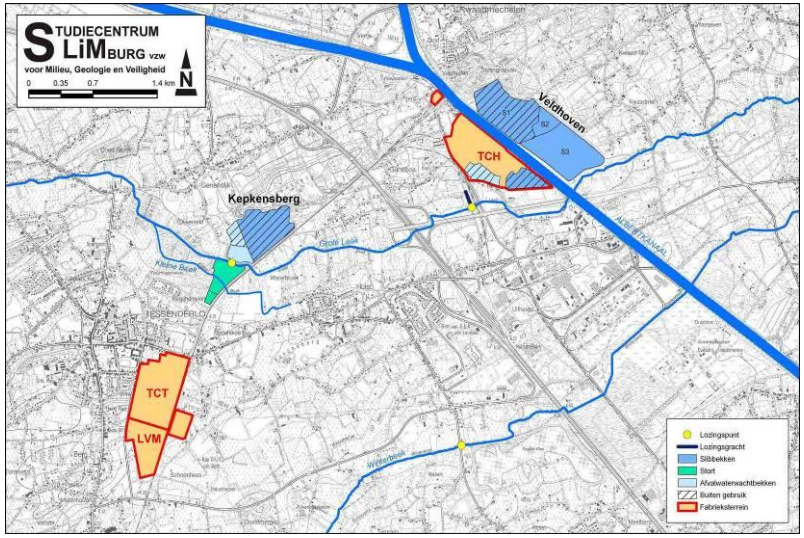
OVAM

5 octobre 2011

Summary

- OVAM
- Soil legislation
- Soil investigations and remediation at industrial sites
  - Tessenderlo Chemie at Tessenderlo
  - LVM at Tessenderlo
  - Kepkensberg sludge pond
  - Tessenderlo Chemie at Ham
  - Veldhoven sludge pond
- Soil investigations at the streams
  - 'Laak'
  - 'Winterbeek'



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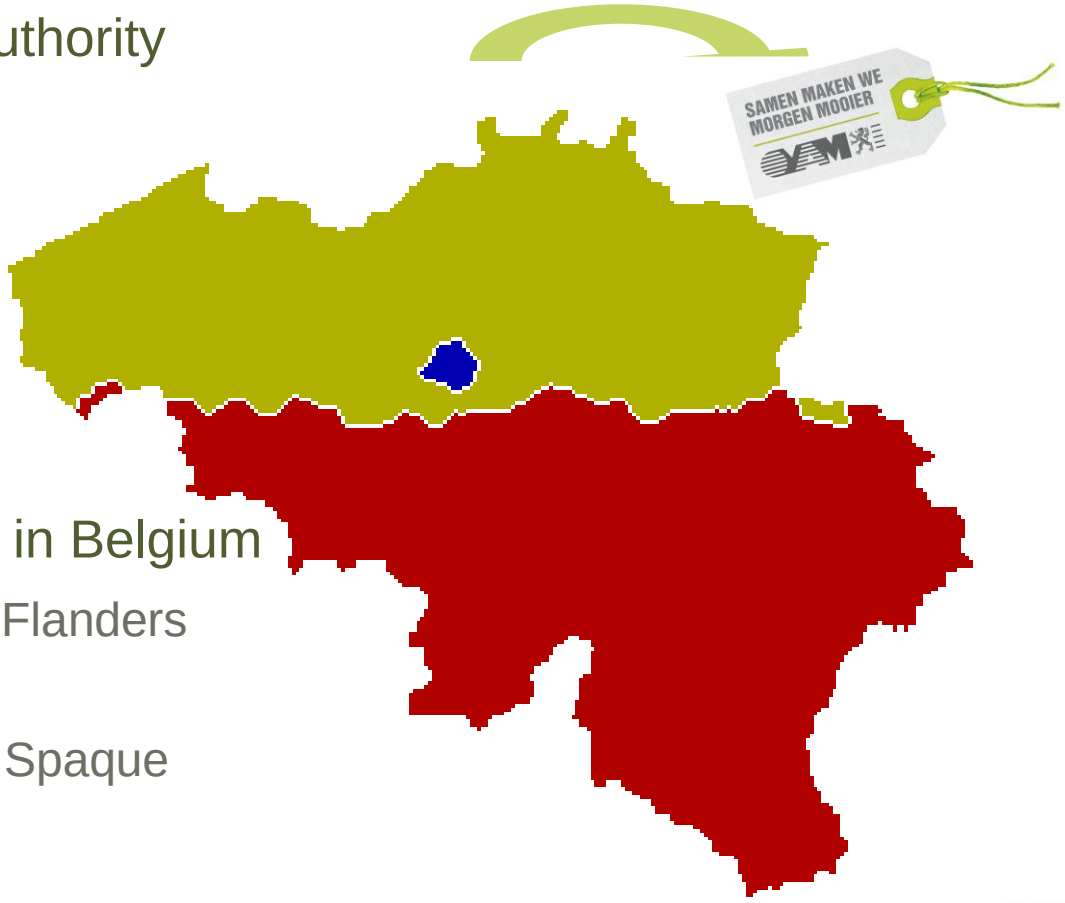
- Radiation = federal authority = FANC
- Environment = regional authority



- Soil legislation authorities in Belgium
  - Public Waste agency of Flanders
  - Brussels region : BIM
  - Walloon region : OWD / Spaque

OVAM

- Since 1981
- Aim
  - **Waste**
    - working out and implementing waste policy.
    - focus on prevention
    - recently more focus on reuse of materials
  - **Soil**
    - Prevent new soil contamination
    - Remediate all historical soil pollution in case of risk by 2036

Soil legislation

- Decree on Soil Remediation (since ‘95) → Soil Decree (2008)
  & Implementation order (VLAREBO)

- Aim:
  - to prevent new (°after 1995) soil pollution or remediate immediately
  - to identify and remediate historically (°before 1995) polluted sites

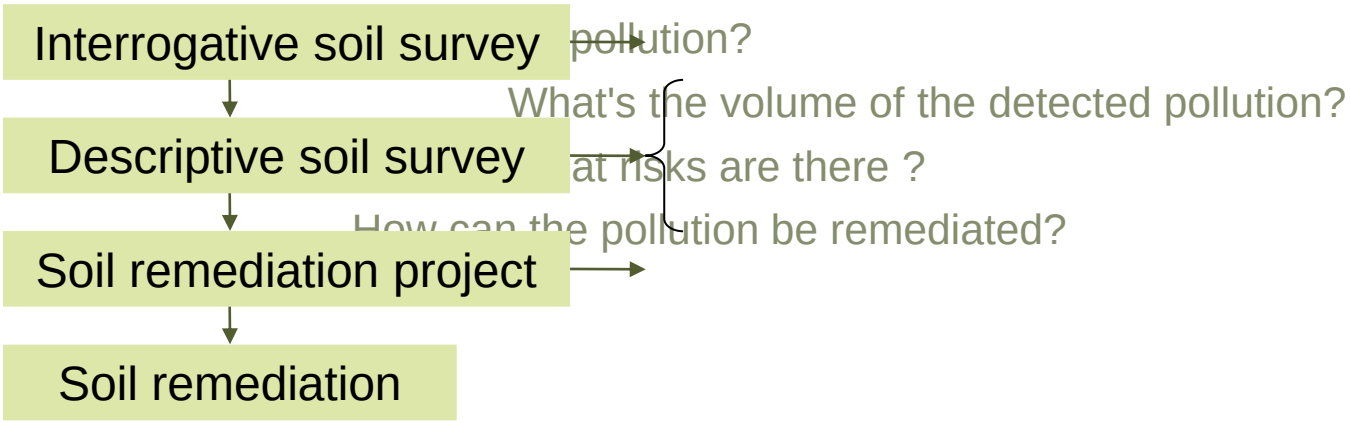
- Principles:
  - ‘polluter pays’
  - protection of the buyer of land

Soil legislation

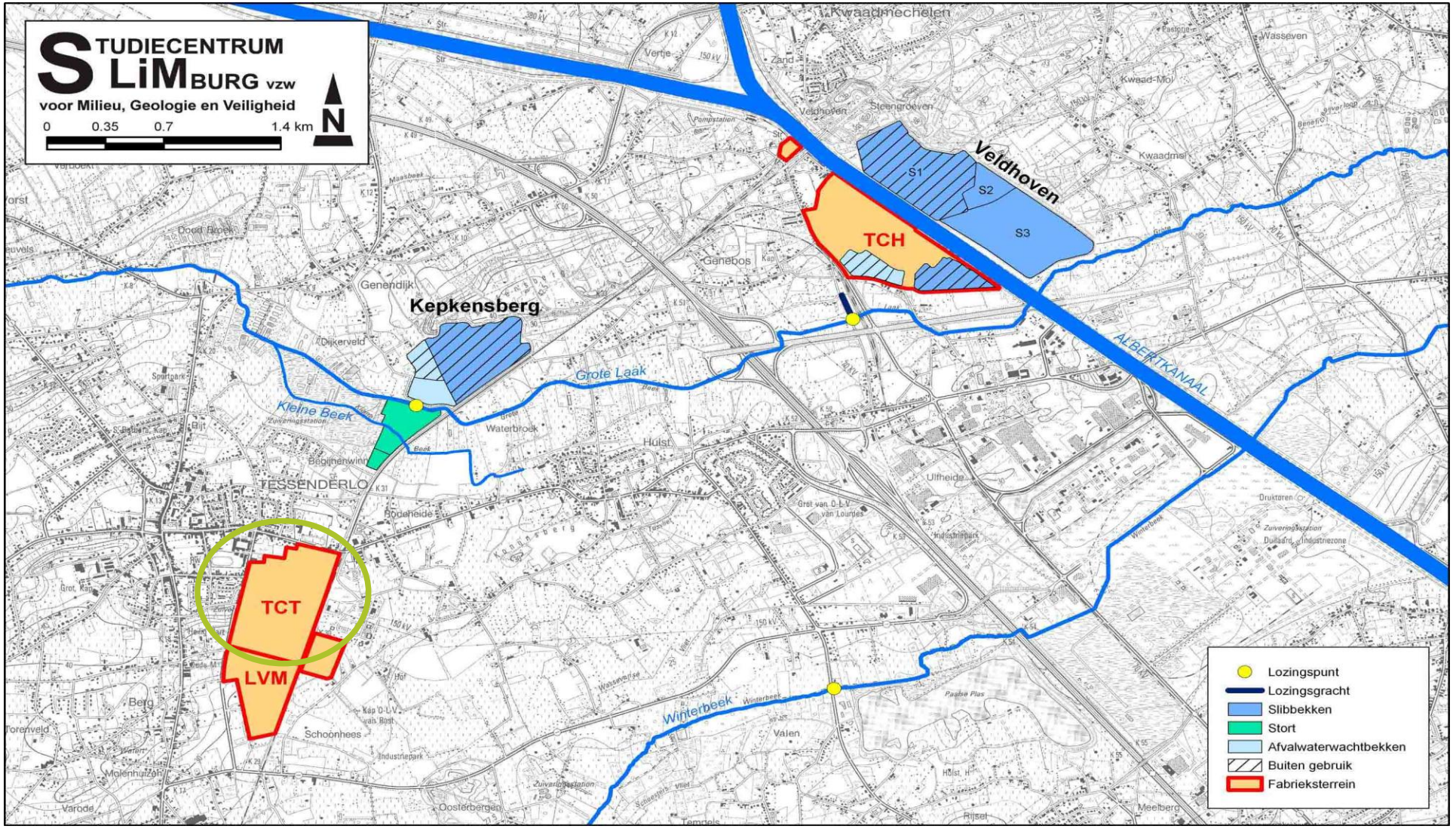
- Triggers for soil investigation :
  - Transfer of risk-sites
  - Periodically for risk-activity
  - Termination of risk-activity*

Risk activity : activity that can cause soil polluition,
Risk-site : a parcel with a risk activity on

- Procedure :

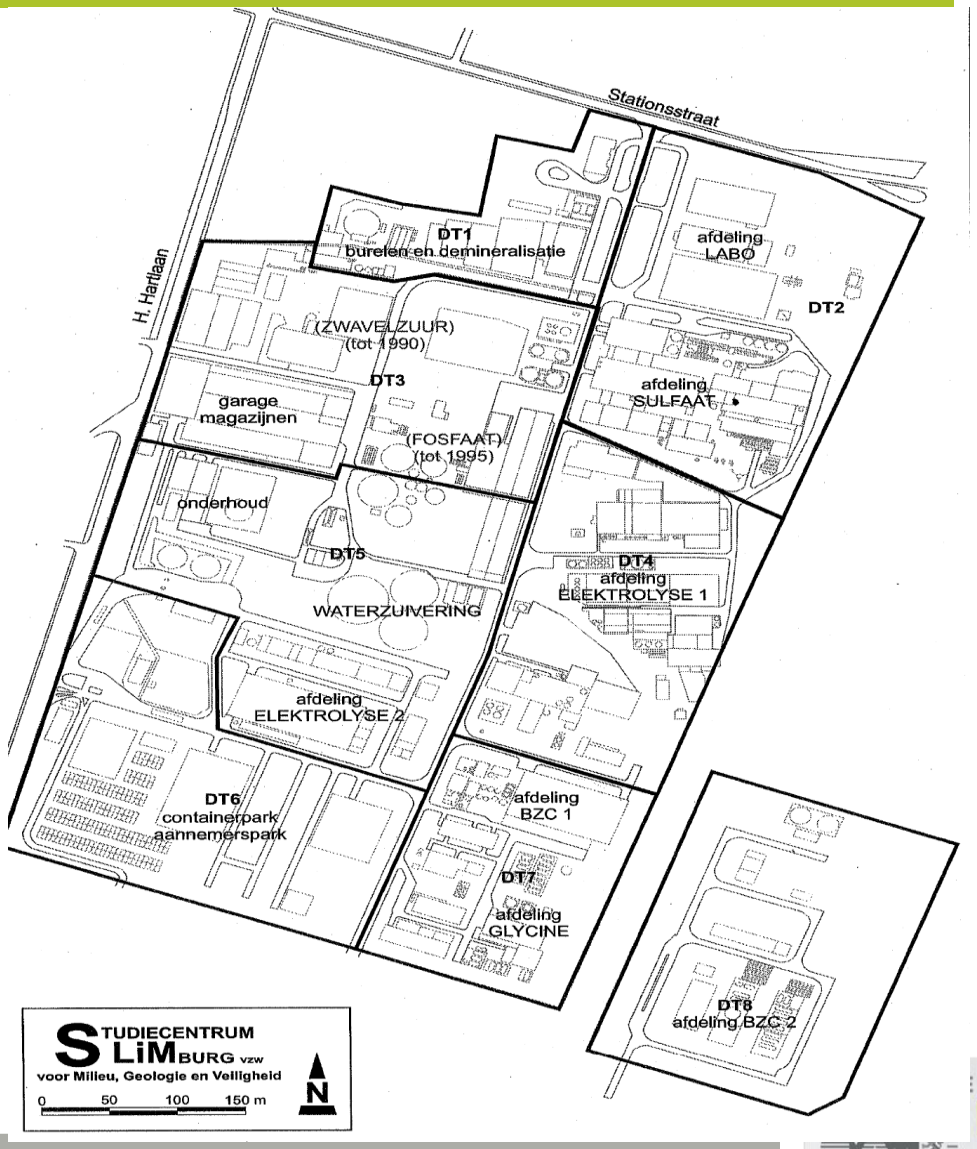


The sites of Tessenderlo Chemie: TCT



Tessenderlo Chemie Tessenderlo (TCT): Interrogative soil survey

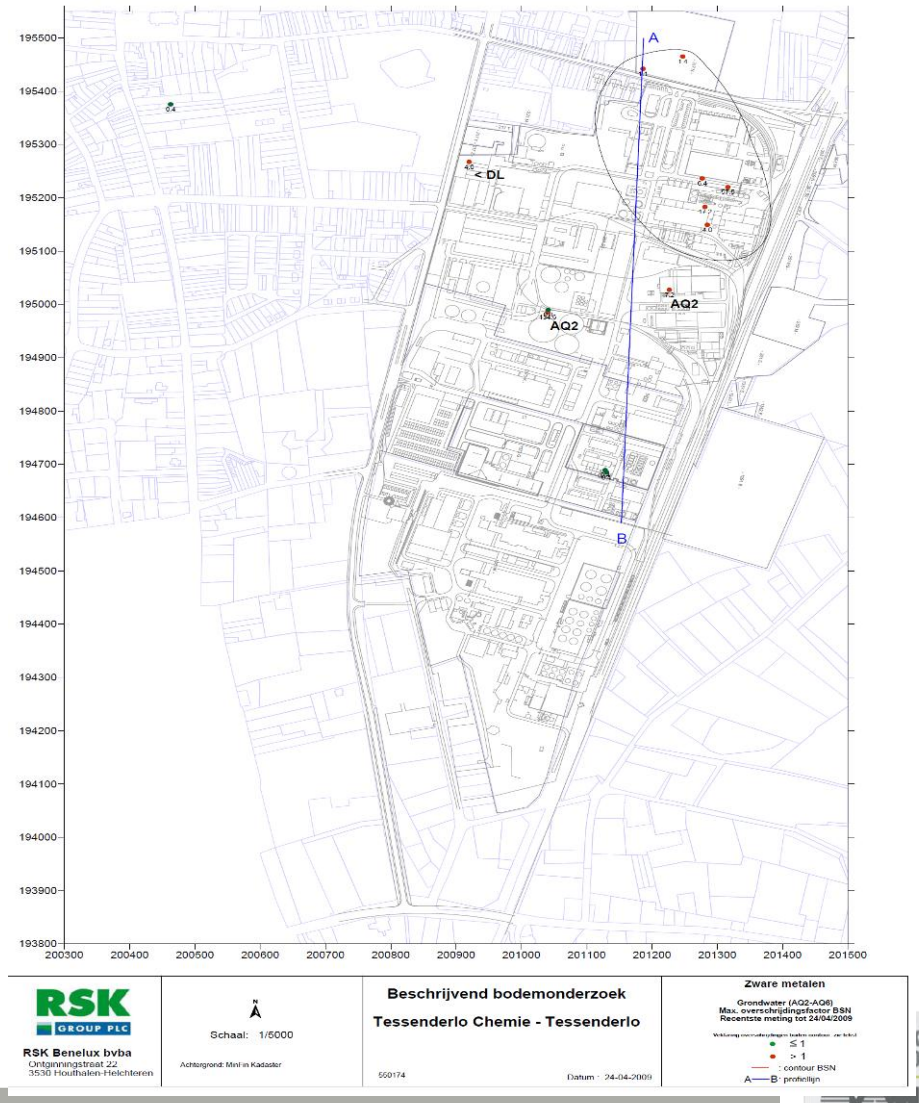
- Different risk activities: tanks, production sites, ...
- Suspected parameters:
  - Soil: standard analysis package
    - Mineral oil, heavy metals, PAHs, EOX
    - Clay and OM content, pH
    - BTEX
  - Groundwater: standard analysis package
    - Mineral oil, heavy metals, BTEX, VOCls
    - MTBE
    - Chlorides and sulphates



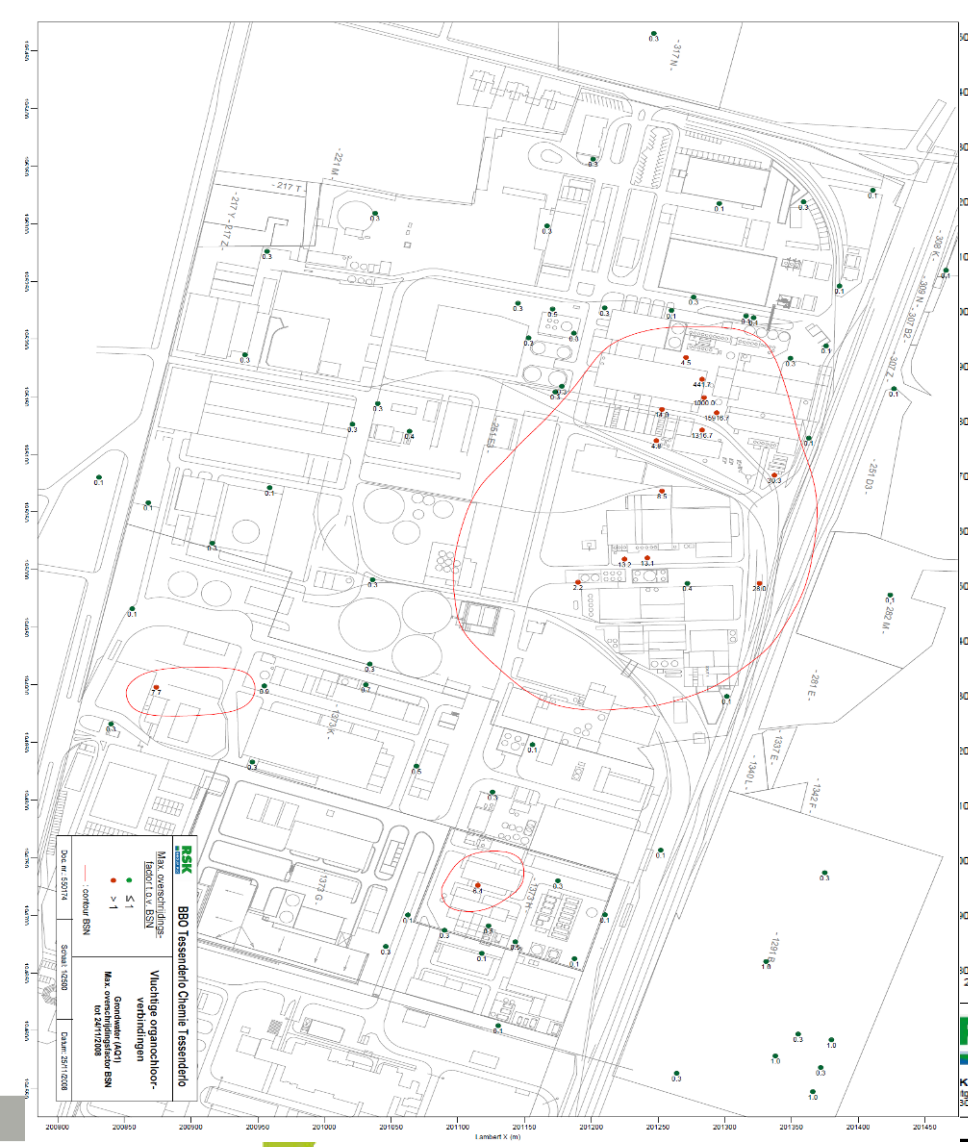
TCT: Descriptive soil survey

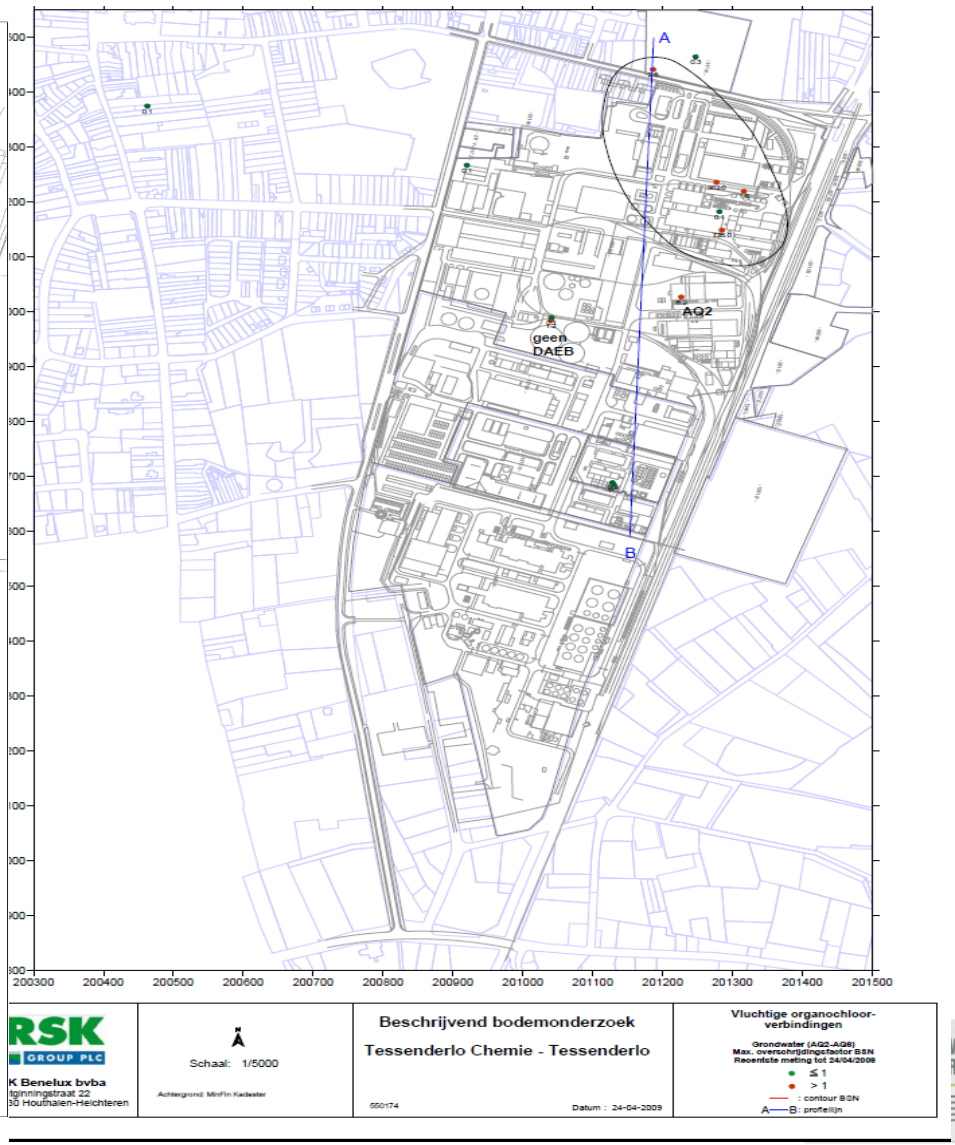
- Characterisation of soil pollution
  - Horizontally identified
  - Vertically identified
- Risks for humans, ecosystems and possibility of spreading
  - Some pollutions: no remediation needed
  - Remediation needed for:
    - Tanks: mineral oil, benzene, crust of oil
    - Productionsite Ely 1: Hg
    - Different sources (e.g. Productionsite BZC1): VOCl
    - Different sources (e.g. Stockage of salt): chlorides and sulphates
    - Production site BZC1: benzene and toluene
    - ...

TCT: Descriptive soil survey: heavy metals

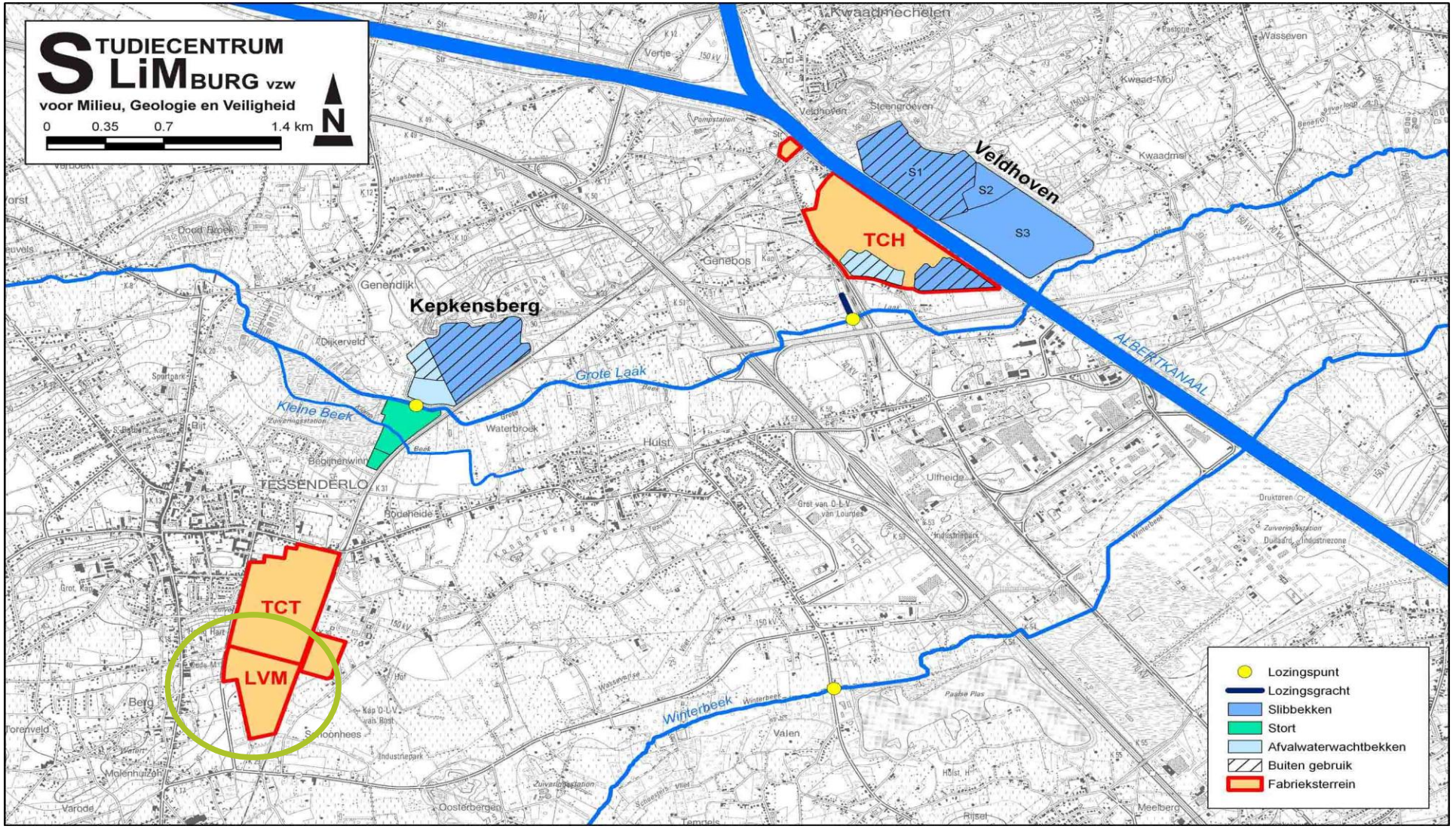


TCT: descriptive soil survey: VOCl





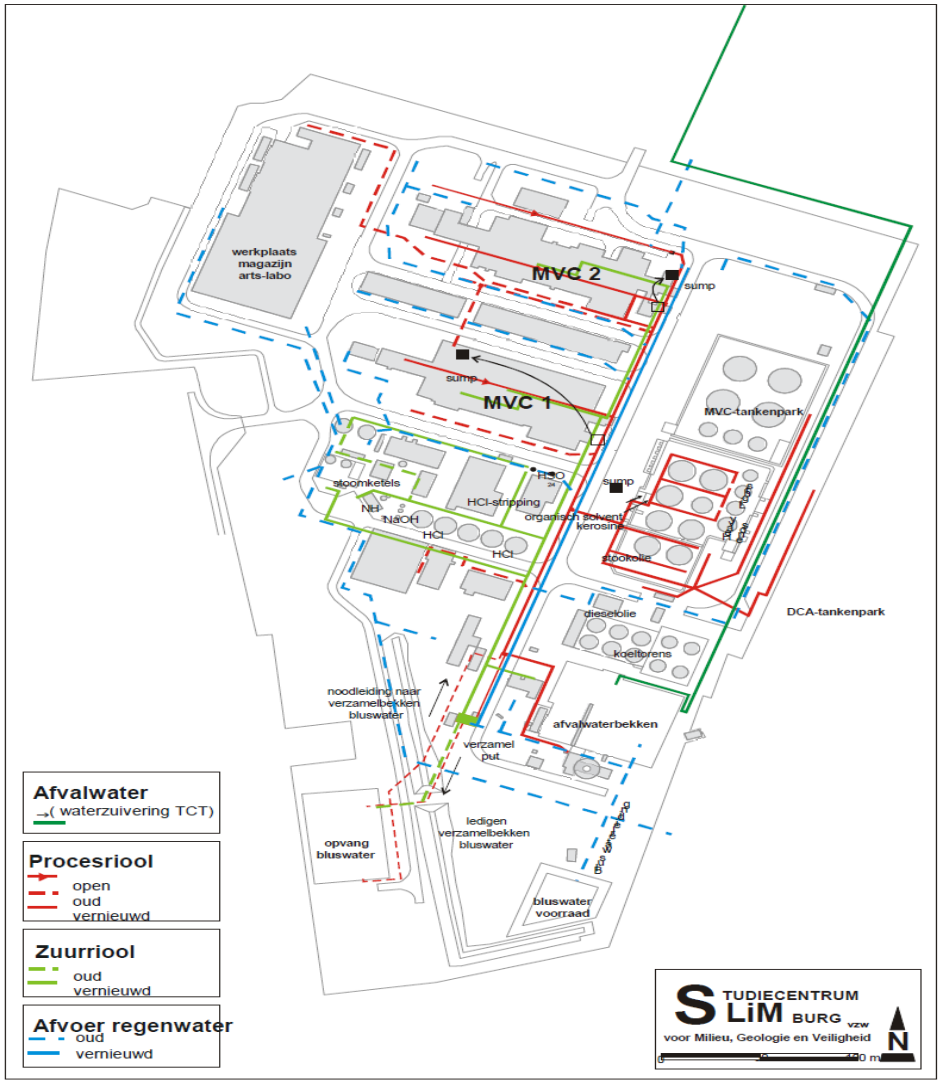
The sites of Tessenderlo Chemie: LVM



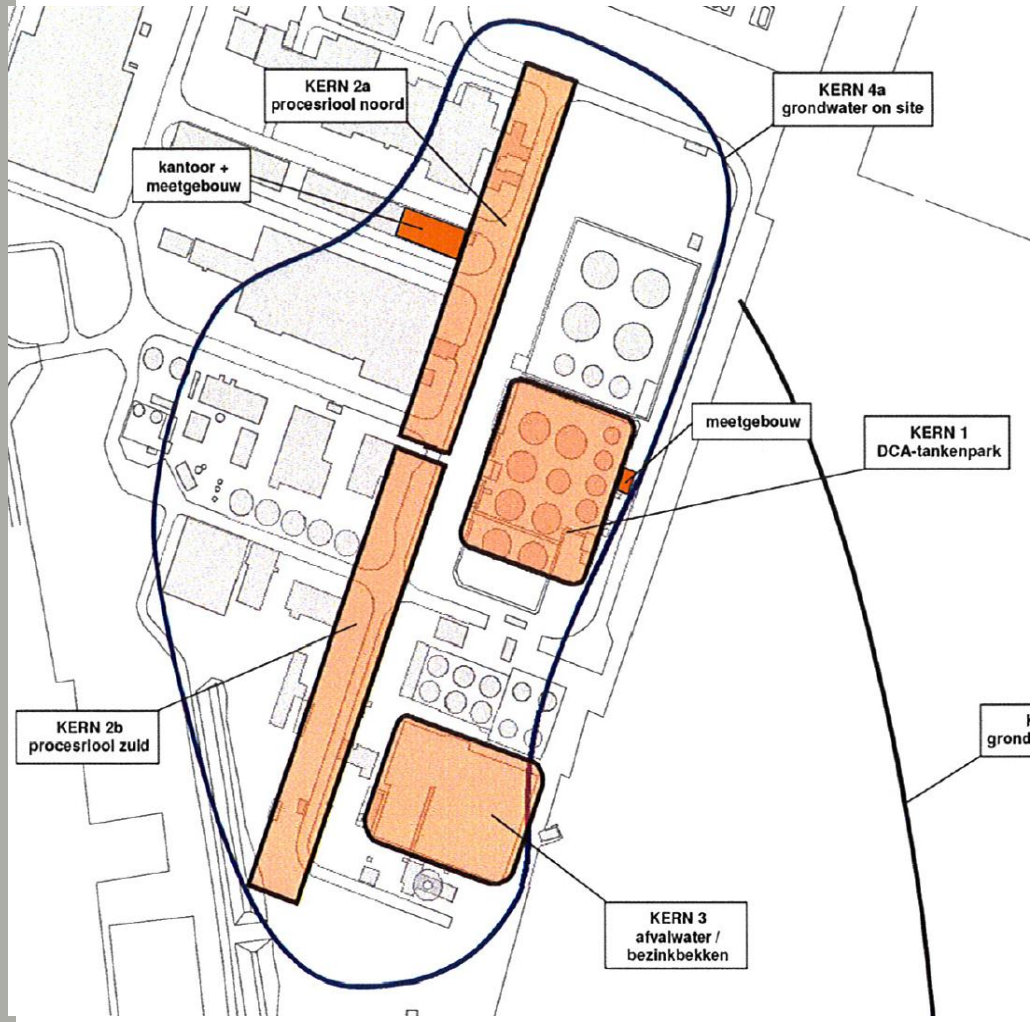
Limburgse Vinylmaatschappij (LVM): Interrogative and descriptive soil survey

- Different risk activities: MVC and DCA tanks, production sites, waste water basin,...
- Suspected parameters:
  - Soil: SAP
  - Groundwater: SAP and clorides and sulphates
- Soil pollution: VOCl, mineral oil, BTEX
  - Identified horizontally and vertically
  - Risk analysis

→ remediation needed

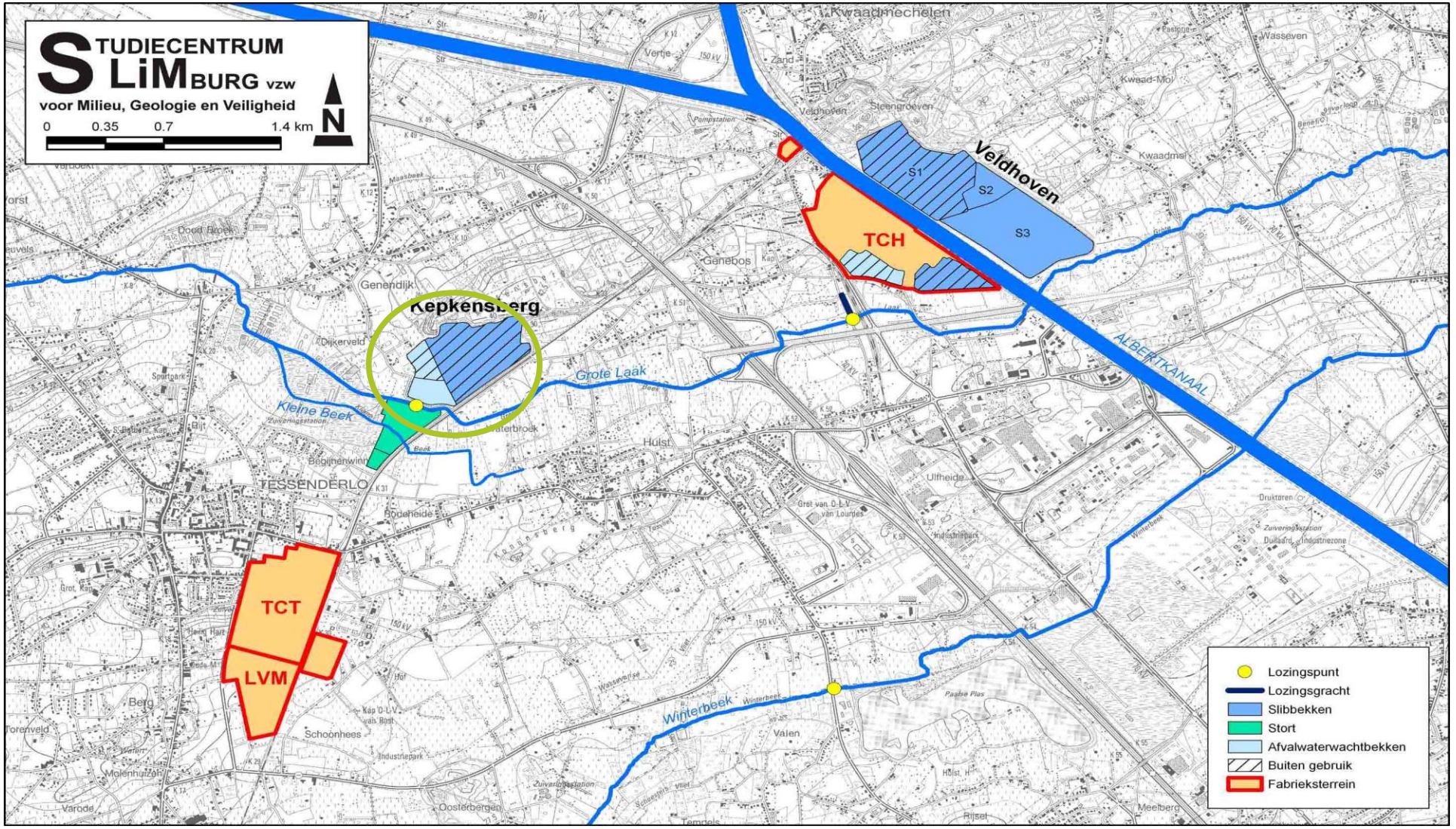


LVM: Descriptive soil survey – and remediation

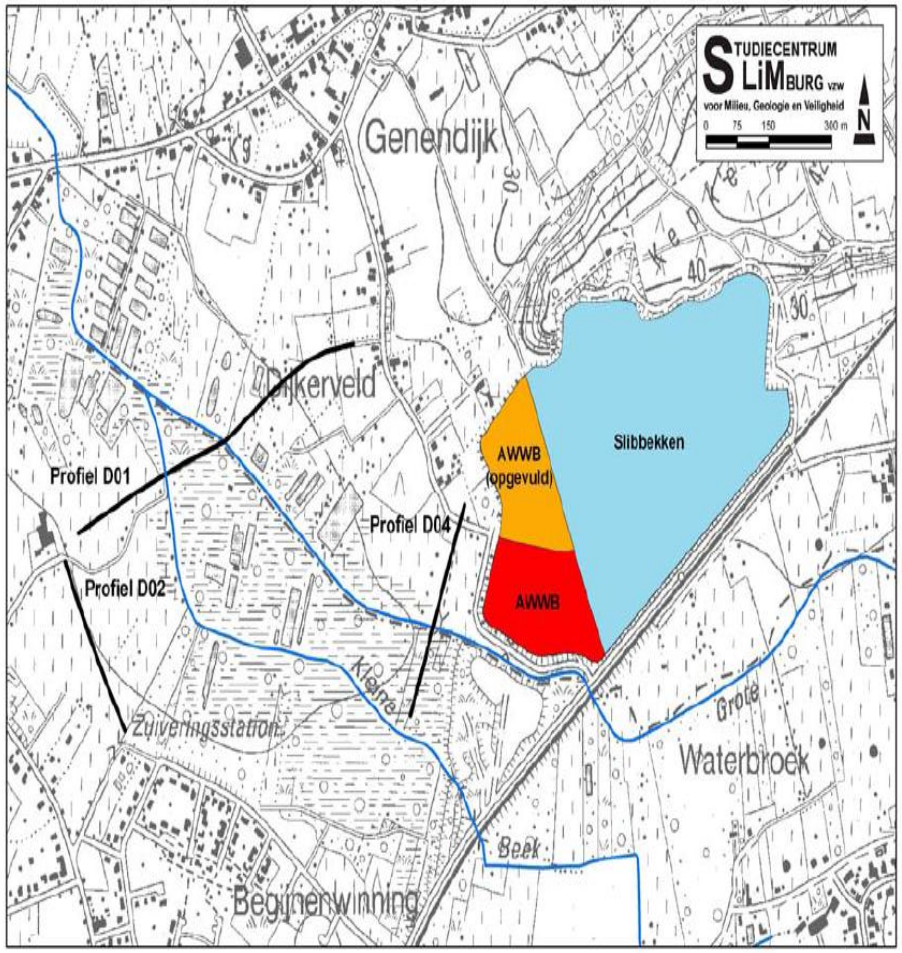


- VOCl (12 DCA) in soil and groundwater
- Southern plume with lower concentrations
- Sources:
  - Drain of proceswater
  - Waste water basin
  - Tanks
- Remediation:
  - In situ biological degradation by isolated bacteria
  - Circulation of the groundwater by ‘Hydrogeobiocells’

The sites of Tessenderlo Chemie: Kepkensberg



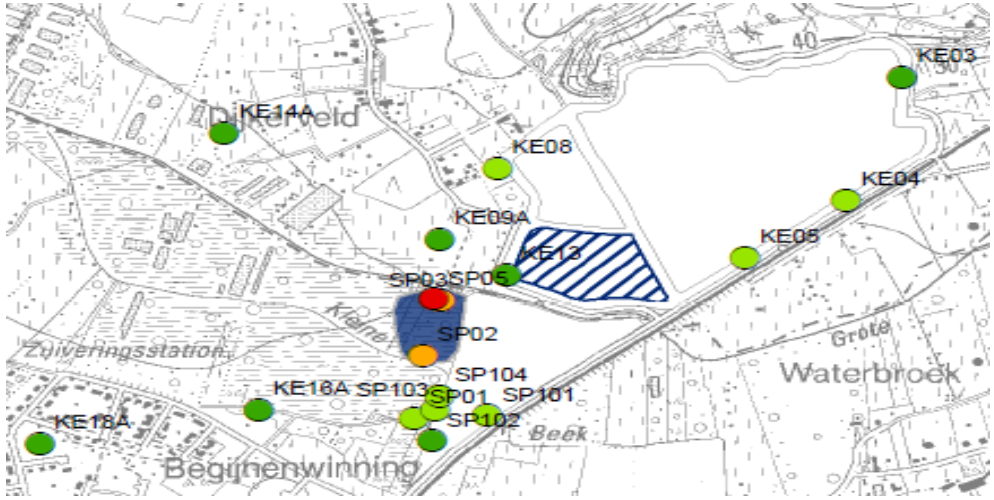
Waste water and sludge (CaF2) basin Kepkensberg: soil survey

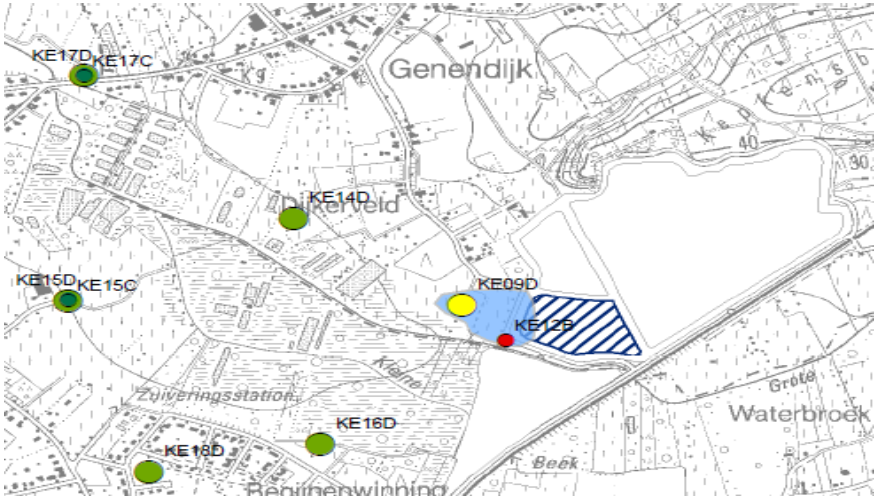


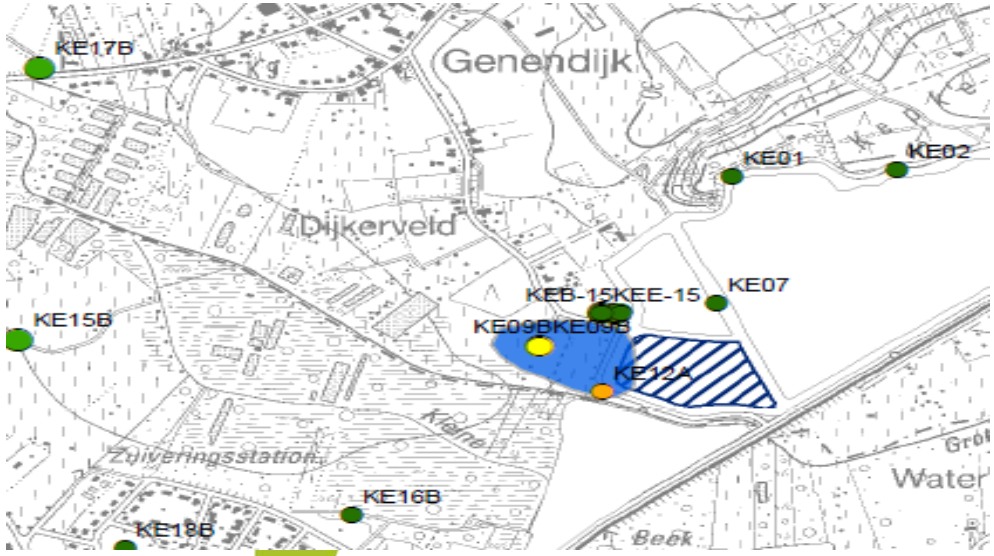
- Aim: impact of the basin to the environment
  - Samples from soil under the sludge and soil and groundwater around basin
- Suspected parameters:
  - Soil: SAP and radium
  - Groundwater: SAP and chlorides and sulphates
- Soil pollution: VOCl in gw and heavy metals in soil
  - Horizontally and vertically identified
  - Risk analysis

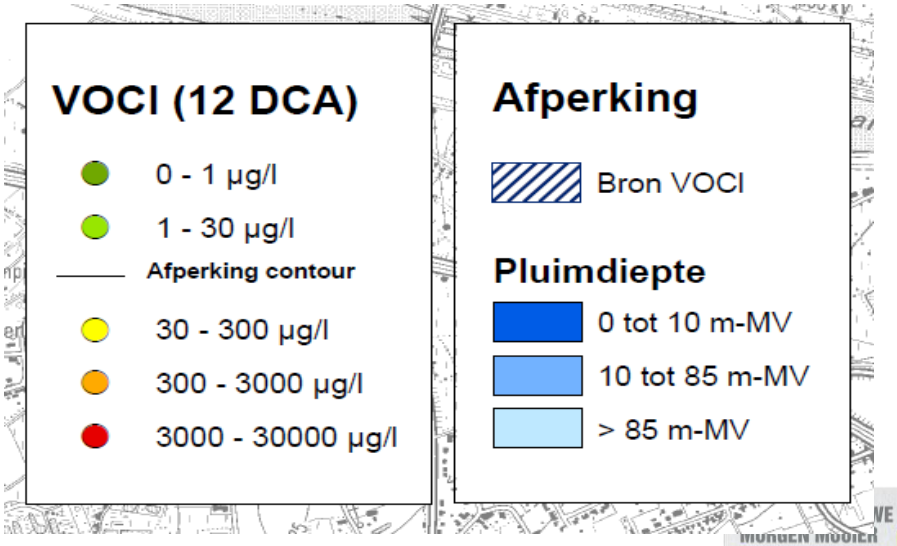
→ remediation needed

Kepkensberg: descriptive soil survey: VOCl







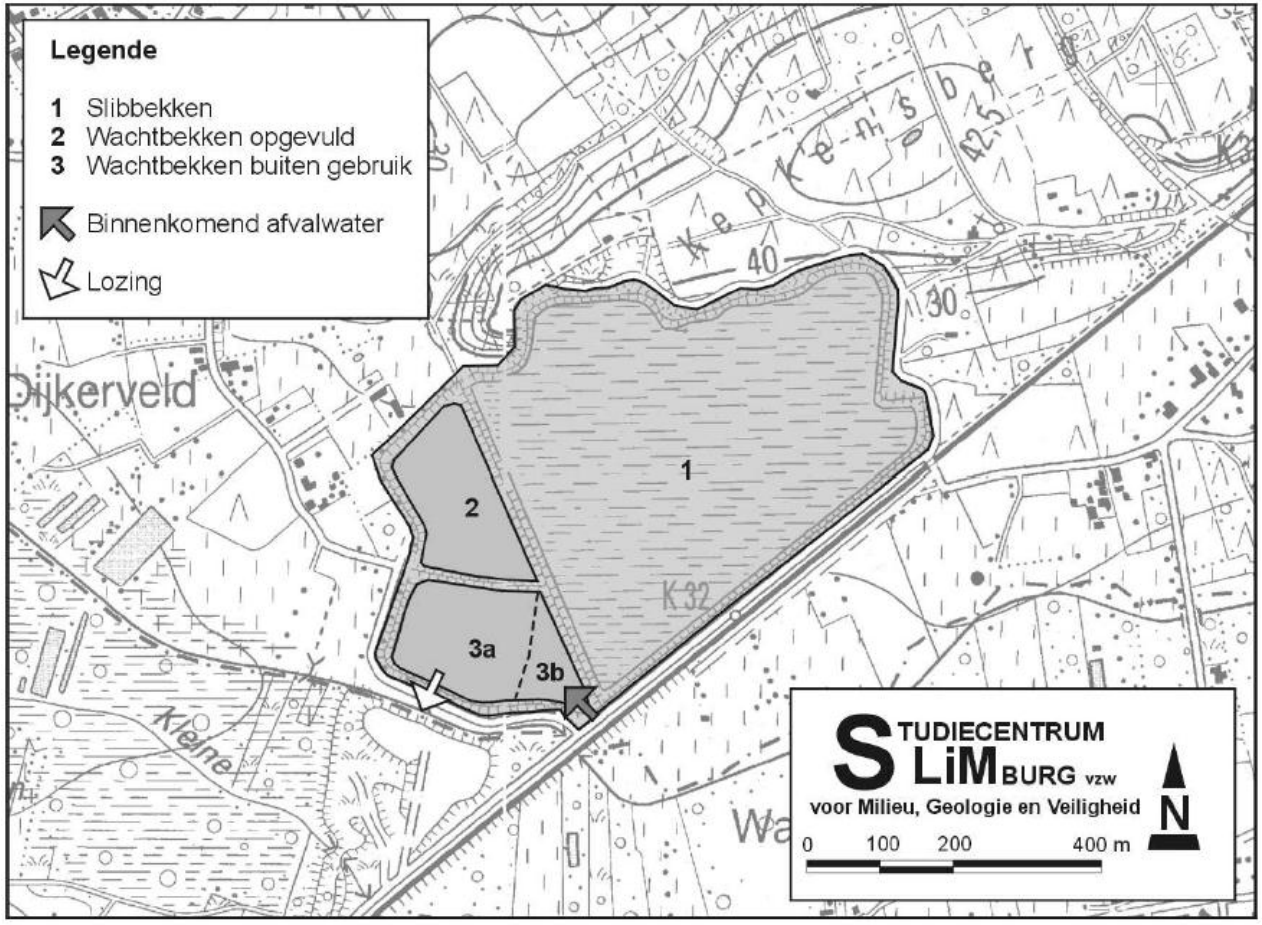


Kepkensberg: descriptive soil survey: salts

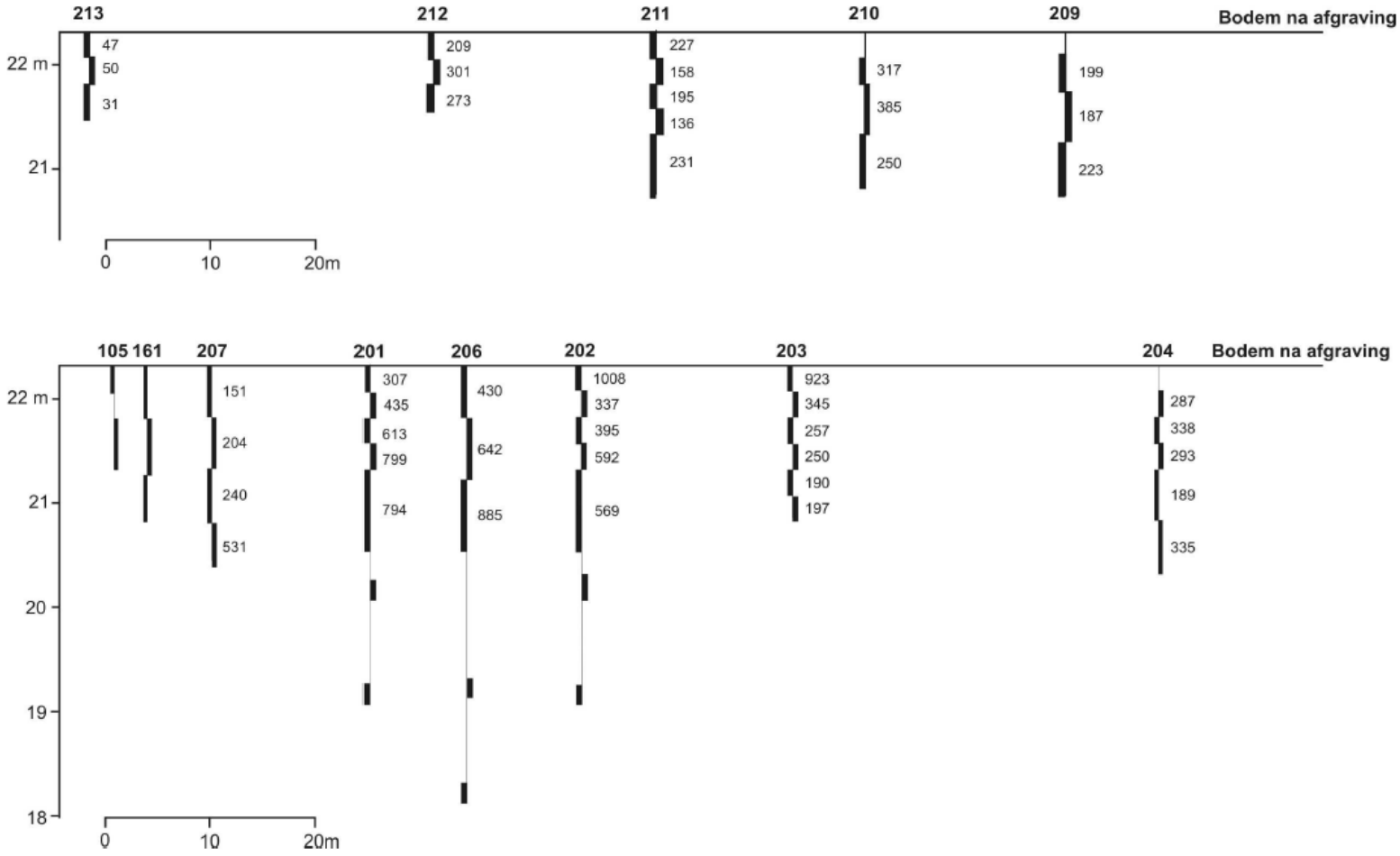
- Pollution with salts
  - Identified in horizontal and vertical direction
  - Risk assesment in progress

Kepkensberg: remediation of a part of the waste water basin

- Part of the waste water bassin (3b)
- Excavation of the sludge and natural soil
- Transport to sludge basin Veldhoven
- Placing of a membrane in the new waste water bassin
- Terminated august 2011



Kepkensberg: initial radium concentration of the natural soil of the waste water basin (after removal of the sludge)



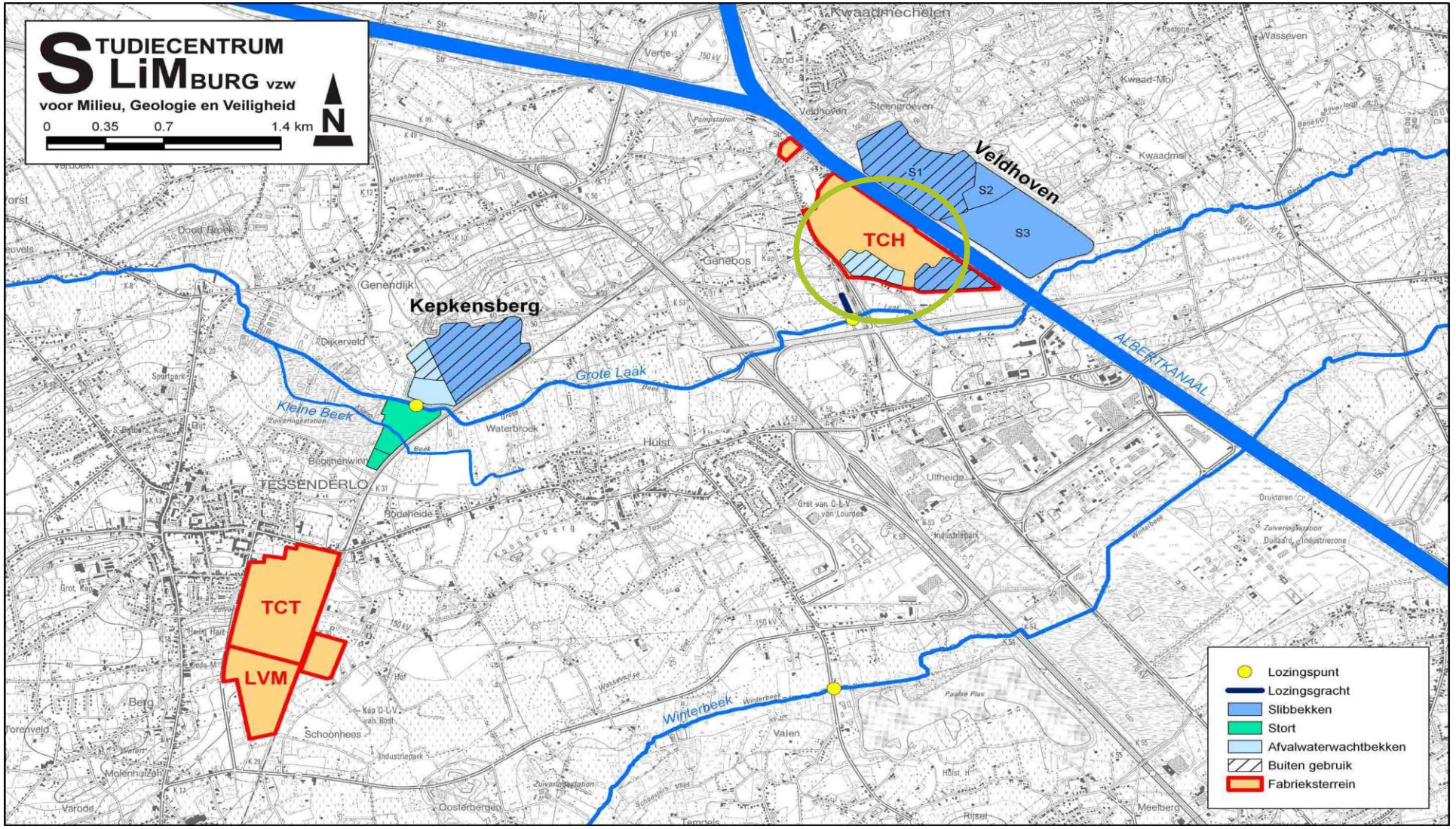
Figuur 10 Concentraties radium (Bq/kg) in de natuurlijke bodem onder het afgegraven slib (zonder hoogtecorrectie) (Milieulabo TC, Dr. P. Luts)

Kepkensberg: radium in the waste water basin

- Receiving landfill: licensed for radioactive compounds
- After excavation:
  - Radium concentrations expected to be between 200 – 500 Bq/kg ds
  - Take into account the use as a waste water bassin : no risk for radiation
- OVAM can not impose TC to take actions about radiational aspects
  - not our authority
  - inform FANC

Kepkensberg: remediation

The sites of Tessenderlo Chemie: TCH



Tessenderlo Chemie Ham (TCH): Interrogative and descriptive soil survey

- Different risk activities: tanks, production sites, sludge basin, old swamp, ...
- Suspected parameters:
  - Soil: SAP, radium
  - Groundwater: SAP and chlorides and sulphates
- Soil pollution: VOCl, heavy metals
  - Horizontally and vertically identified
  - Risk analysis

→ remediation needed

TCH: descriptive soil survey: heavy metals

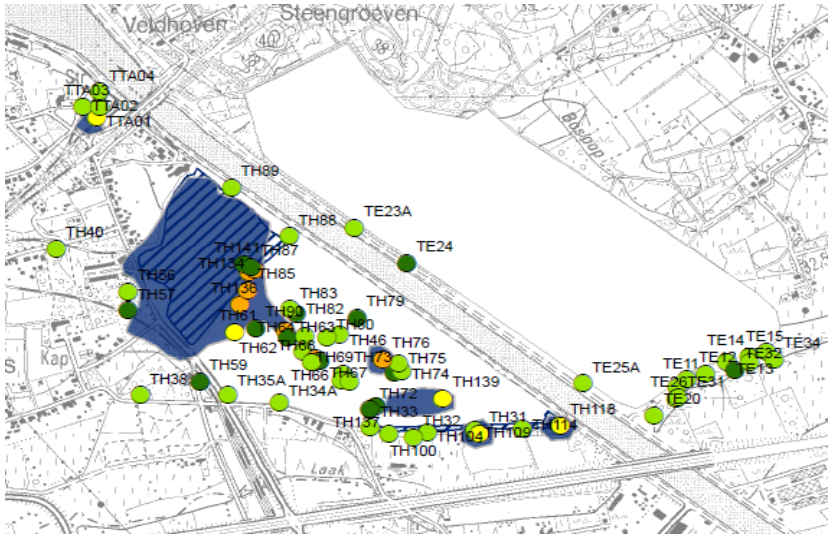
Source of pollution:

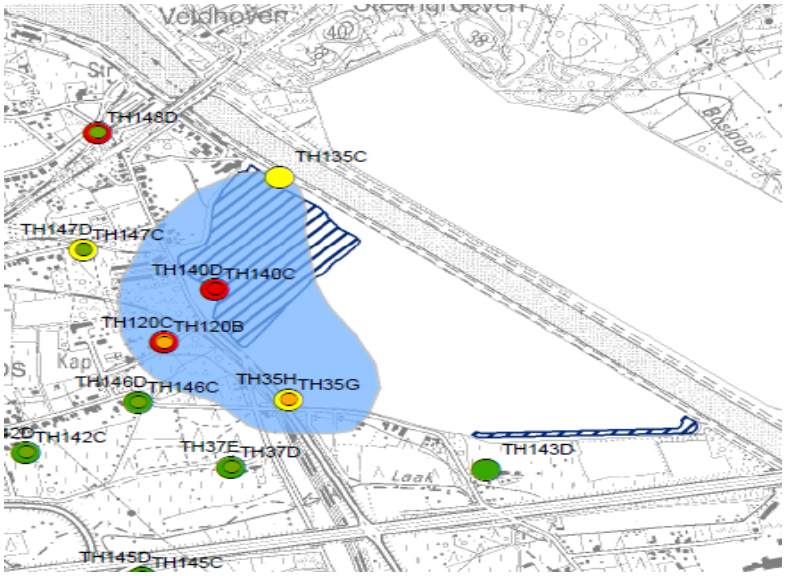
- Construction of an embankement on the place of an old swamp with dust materials between 1935 and 1985
- Construction of an embankement with dust materials for elavating the site
- Waste water basin
- Sludge basin

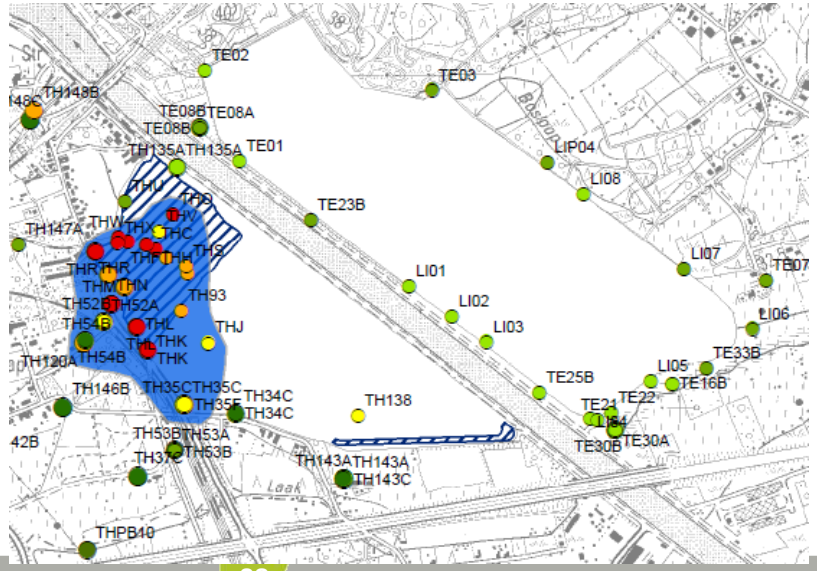
- Pollution was identified
- Risk analysis

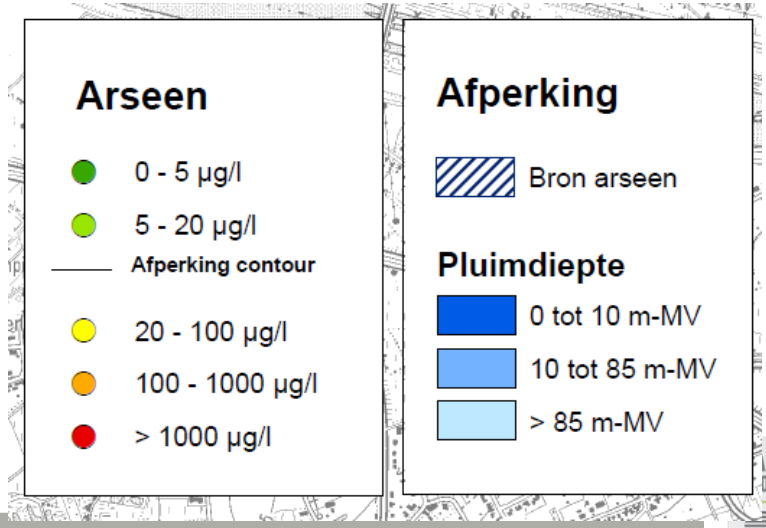
- Remediation needed

TCH: descriptive soil survey: As







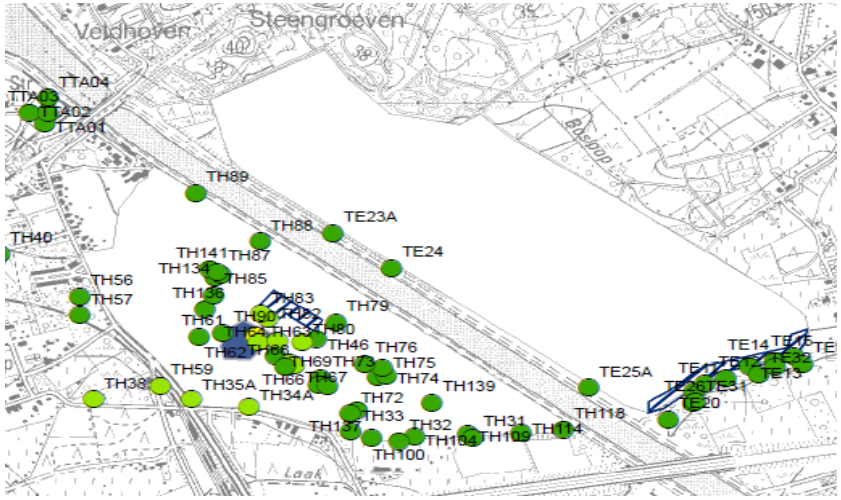


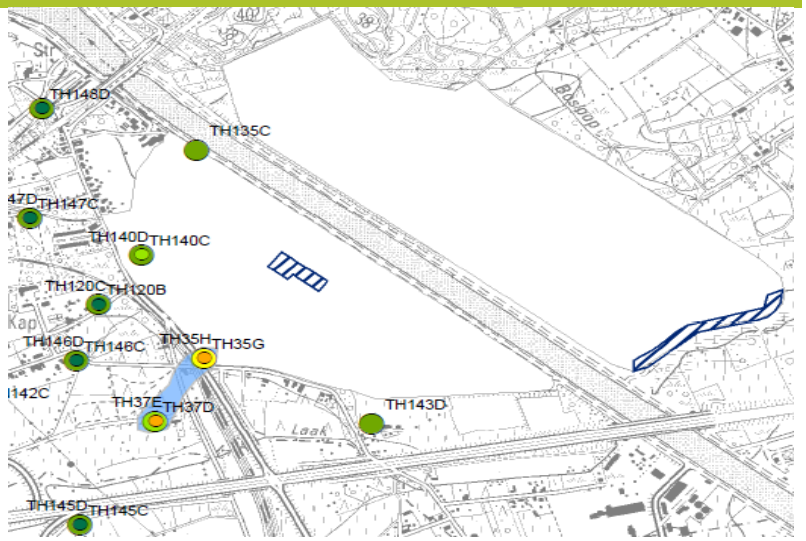
TCH: descriptive soil survey: VOCl

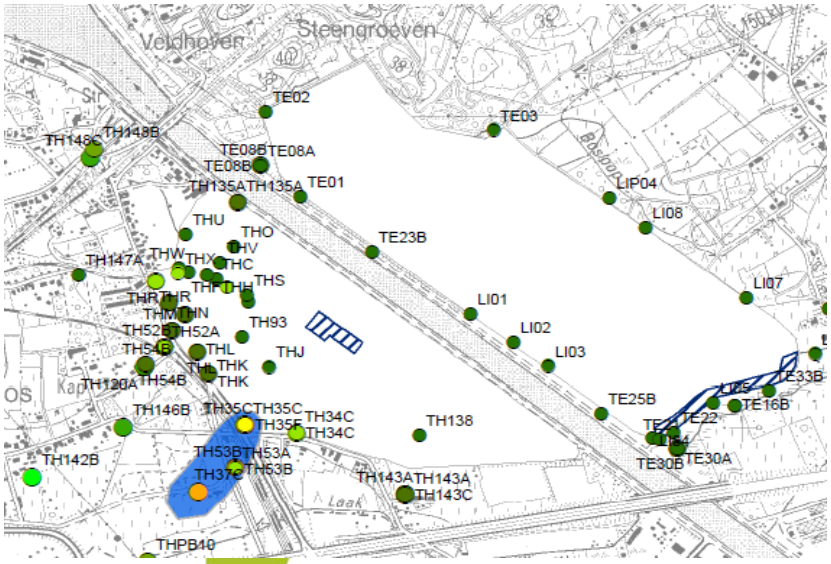
- Source
  - Use of restproducts from LVM as fuel in the '90's
- Identified
- Risc analysis

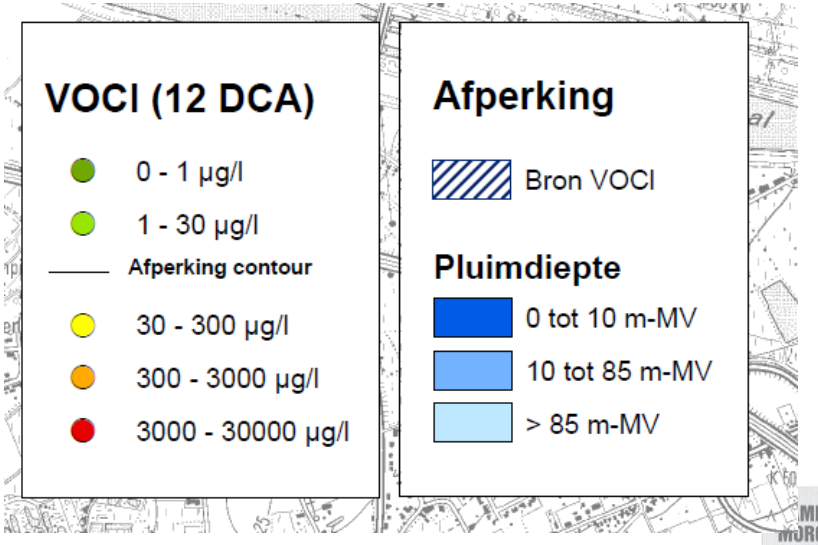
- Remediation needed

TCH: descriptive soil survey: VOCl

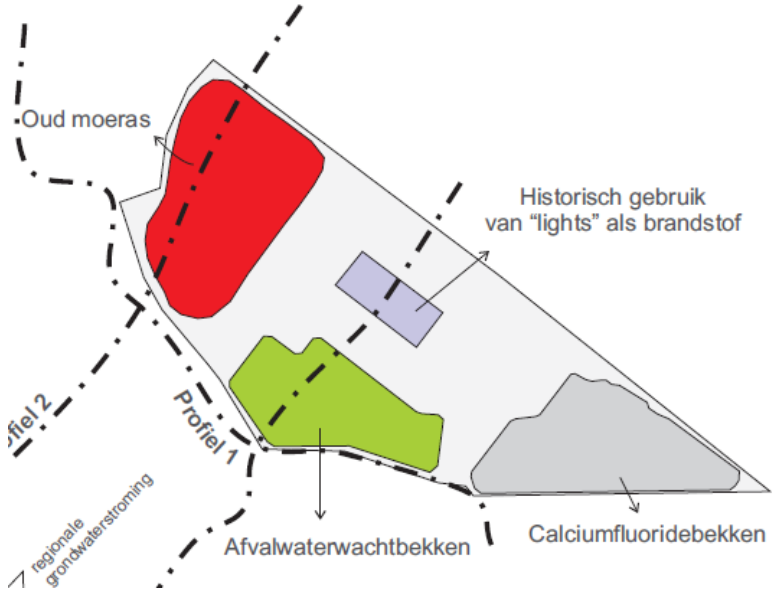


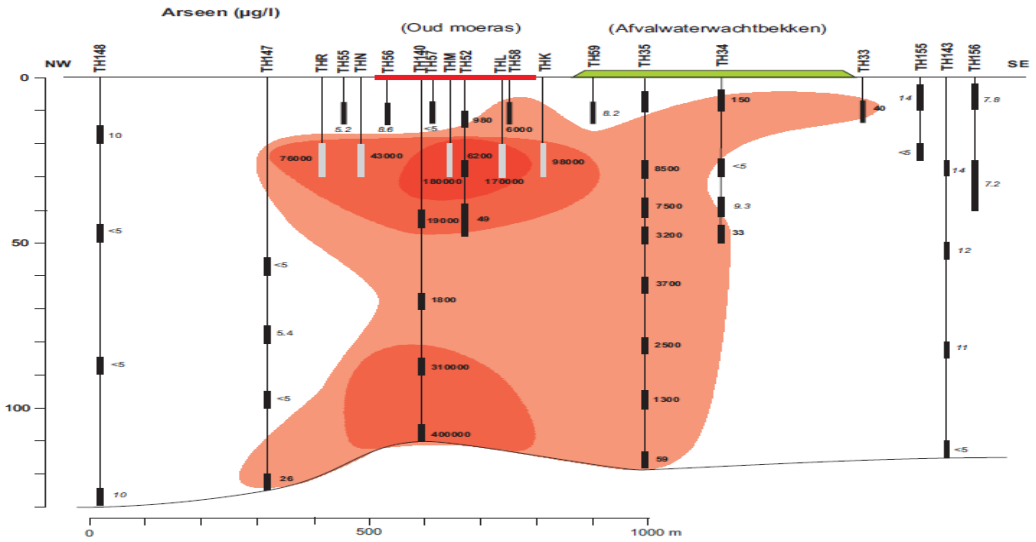


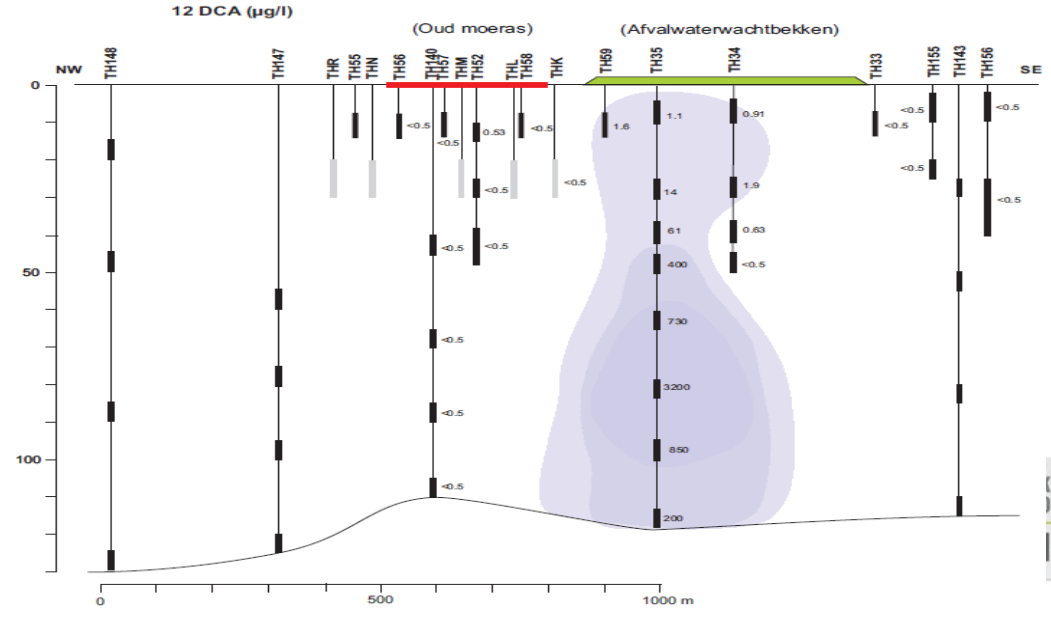




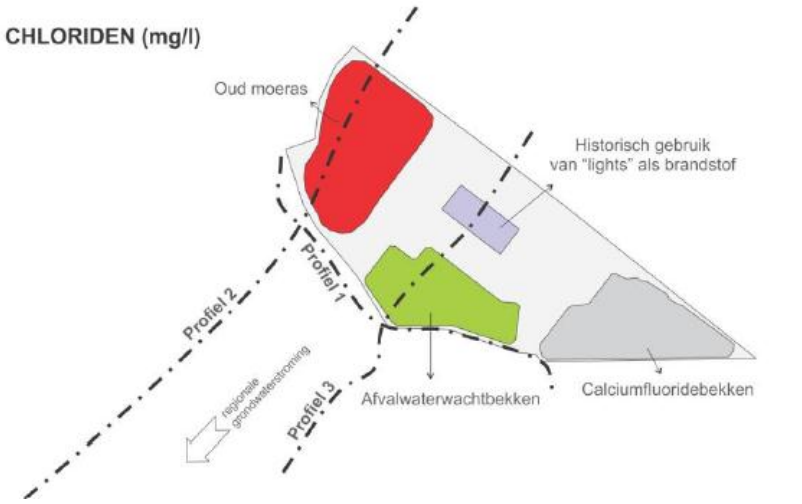
TCH: descriptive soil survey: As and VOCl

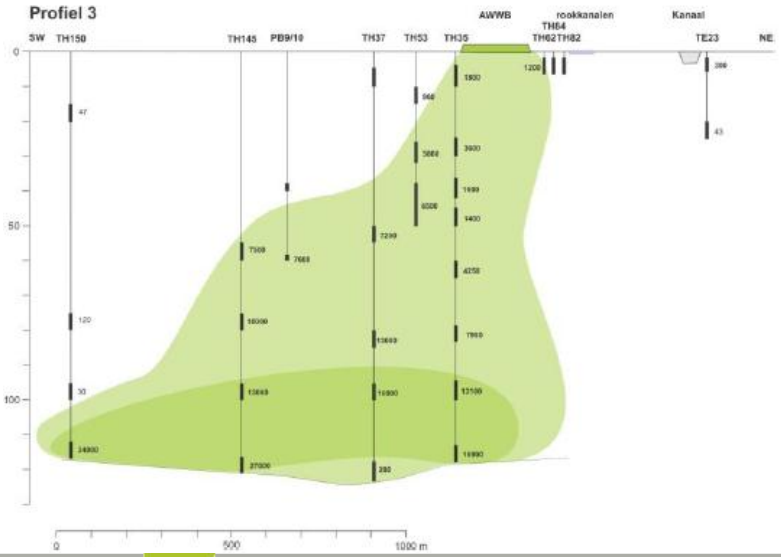






TCH: salts





- Source:
  - Construction of an embankement on the place of an old swamp with dust materials between 1935 and 1985;
  - Construction of an embankement with dust materials for elavating the site
  - Waste water bassin
  - Mud bassin
- Identified
- Risc analysis in progress
- Expect to be completed in december 2011

TCH: remediation of the sludge basin

Foto 12 OB 1-3 uitsteken PVC buis met slibmonster.

TCH: remediation of the sludge basin

- Soil remediation plan: 2011
  - Excavation of sludge and polluted 'natural' soil
  - Transport to sludge basin Veldhoven
  - Way of transport was still not decided
    - By boat
    - By trucks

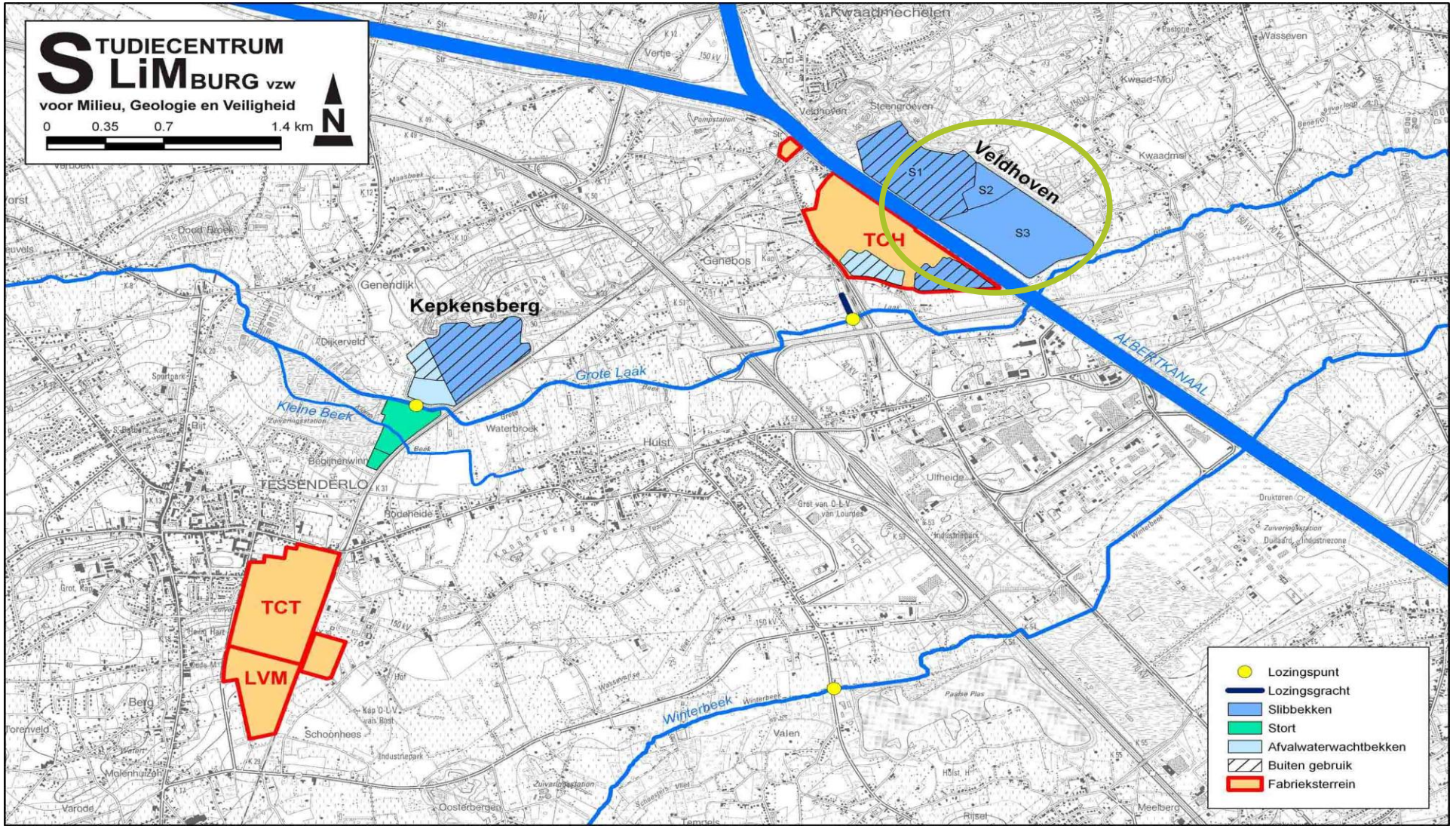
TCH: sludge basin: radioactivity

- Sludge: heavy metals, chlorides, sulfates and radium
- Initial radium concentrations:
  - sludge: 3000 à 4000 Bq/kg
  - Natural soil: 24 Bq/kg
  - Gw: 0,05 – 0,0075 Bq/l
- Receiving landfill: licensed for radioactive compounds

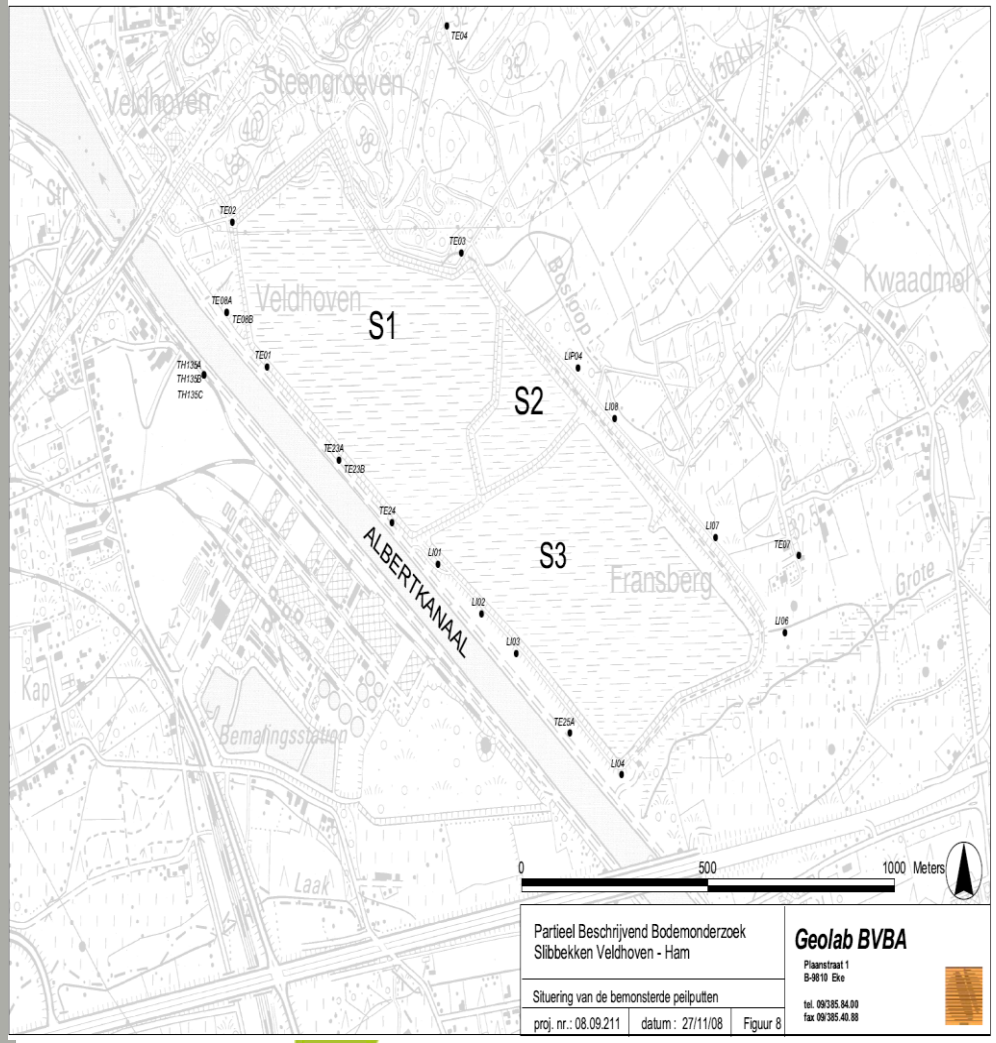
TCH: Sludge basin: remediation

- Advice FANC
  - Necessary protection for workers
  - Special attention for the protection against radiation during the removal of the sludge cable in the southern dam
  - Soil which can be used for the construction of an embankment: only if the radium concentration < 200 Bq/kg
  - After remediation: check up of natural soil for radium concentrations
    - Radium concentrations < 200 Bq/kg
- OVAM can not impose:
  - not our authority
  - advises TC in the approval of the remediaton project

The sites of Tessenderlo Chemie: Veldhoven



Sludge (CaF2) basin Veldhoven: soil survey

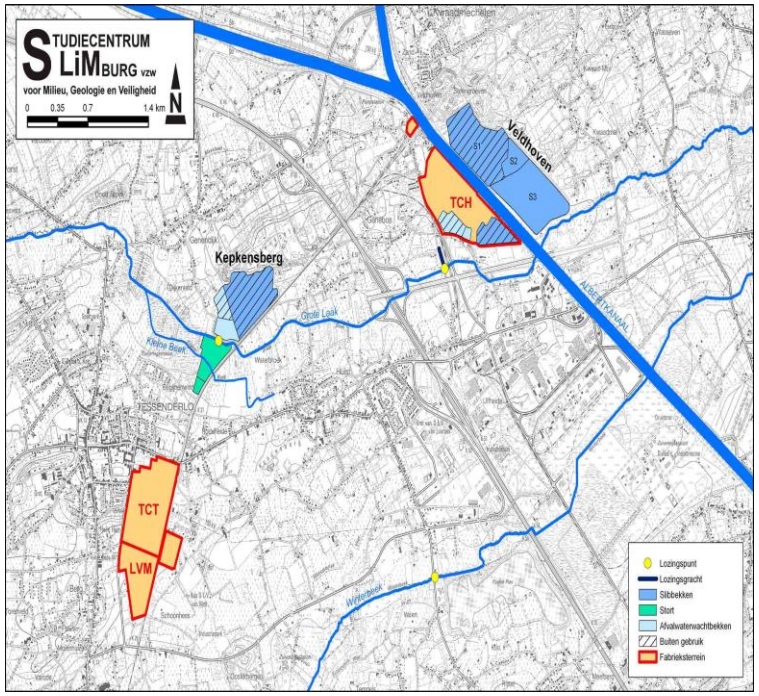


- Aim: impact of the basin to the environment
  - Samples from soil and groundwater around basin
- Suspected parameters:
  - Soil: SAP and radium
  - Groundwater: SAP, chlorides and sulphates
- Soil pollution: chlorides and sulfates
  - Horizontally and vertically identified
  - Risk analysis

→ no remediation needed

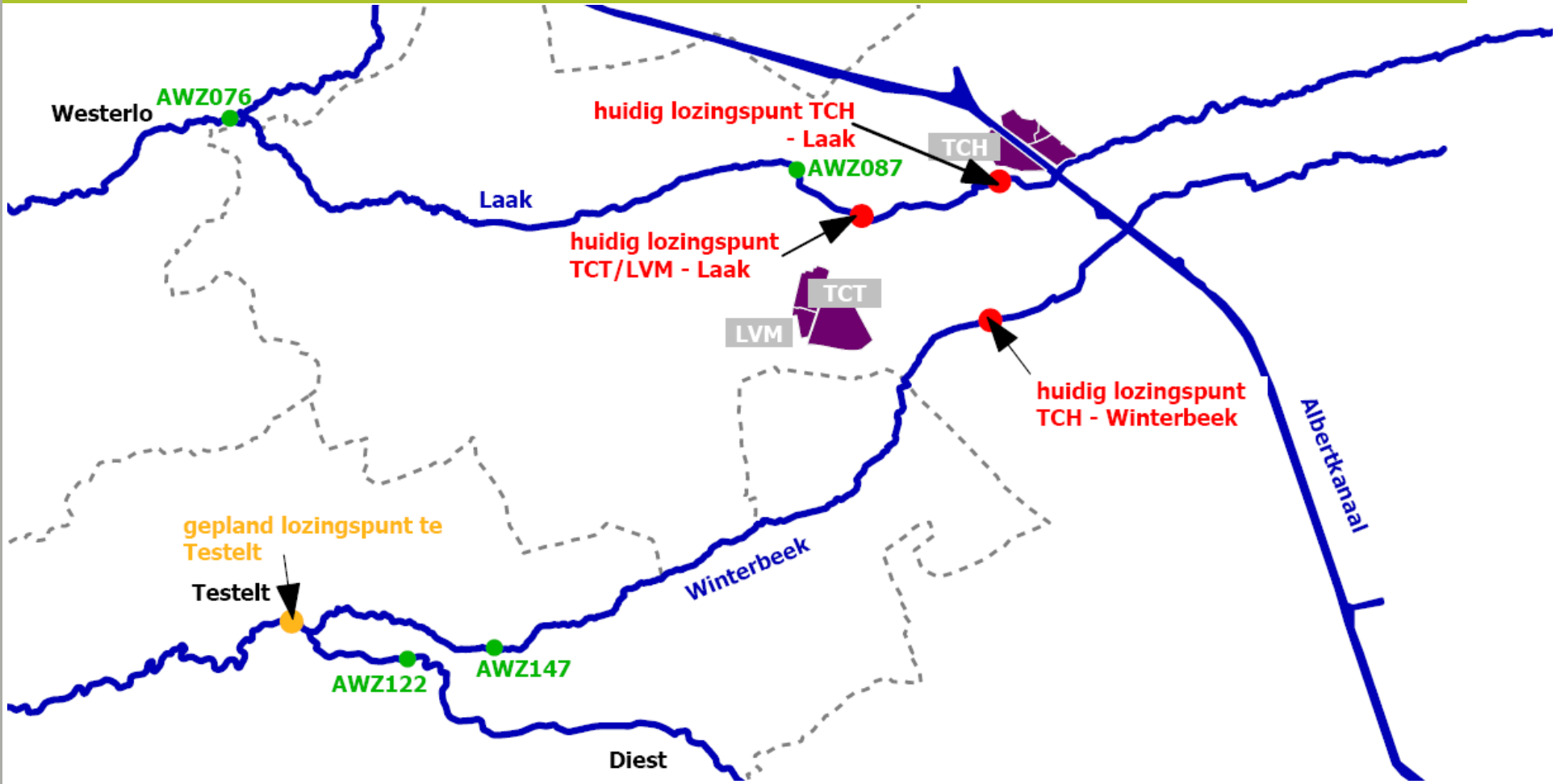
summary

- Kepkensberg
  - remediation terminated for part of the waste water basin
  - further remediation needed
  - descriptive soil survey salts: in progress
- TCT
  - soil surveys accepted
  - descriptive soil survey salts: in progress
  - remediation needed
- LVM
  - Remediational project accepted



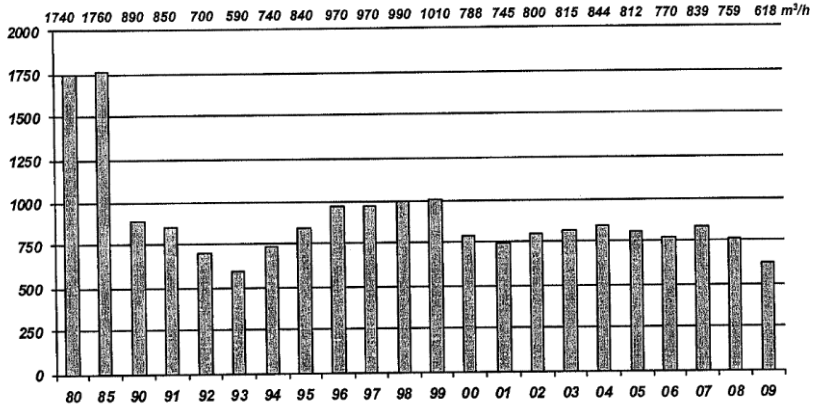
- TCH
  - remediational project accepted for sluge basin
  - remediation needed
  - descriptive soil survey salts: in progress
- Veldhoven:
  - no remediation

Contaminated Streams

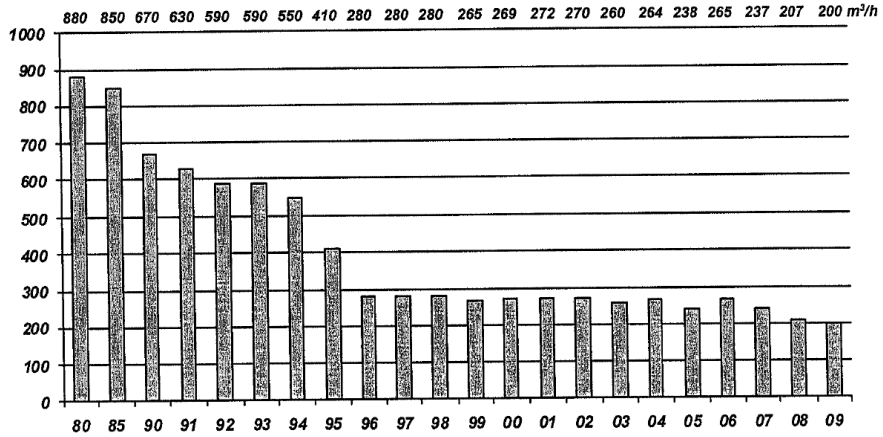


Discharges in streams

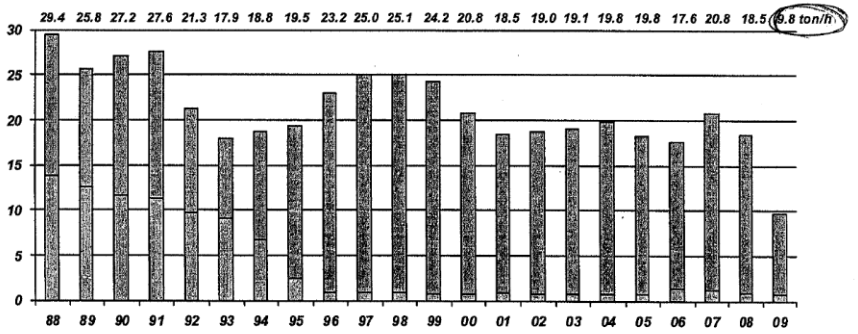
Figuur 1.1. **afvalwaterdebiet, m³/h, jaargemiddelden afvalwater TCH**



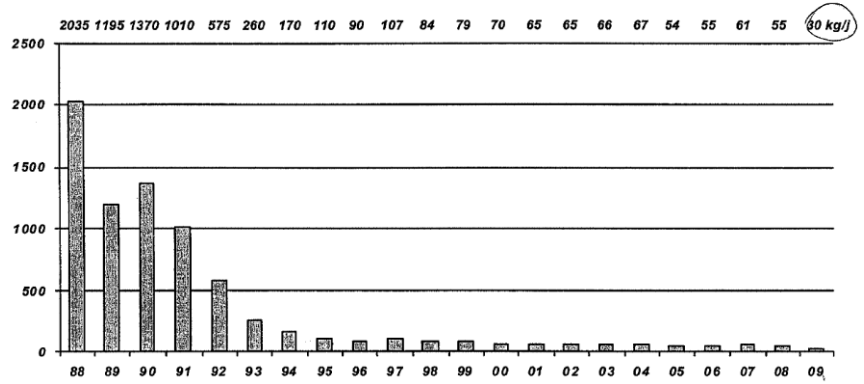
Figuur 1.2. **afvalwaterdebiet, m³/h, jaargemiddelden afvalwater TCT/LVM**



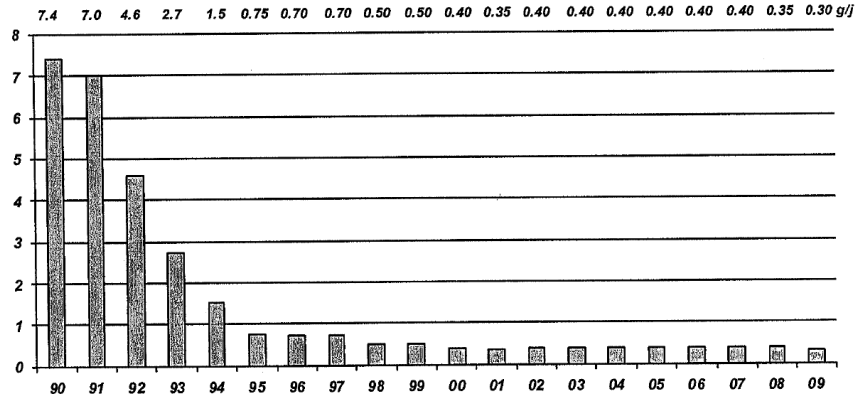
Figuur 1.35. **chloridevrachten, ton/h, jaargemiddelden afvalwater TCH, TCT/LVM**



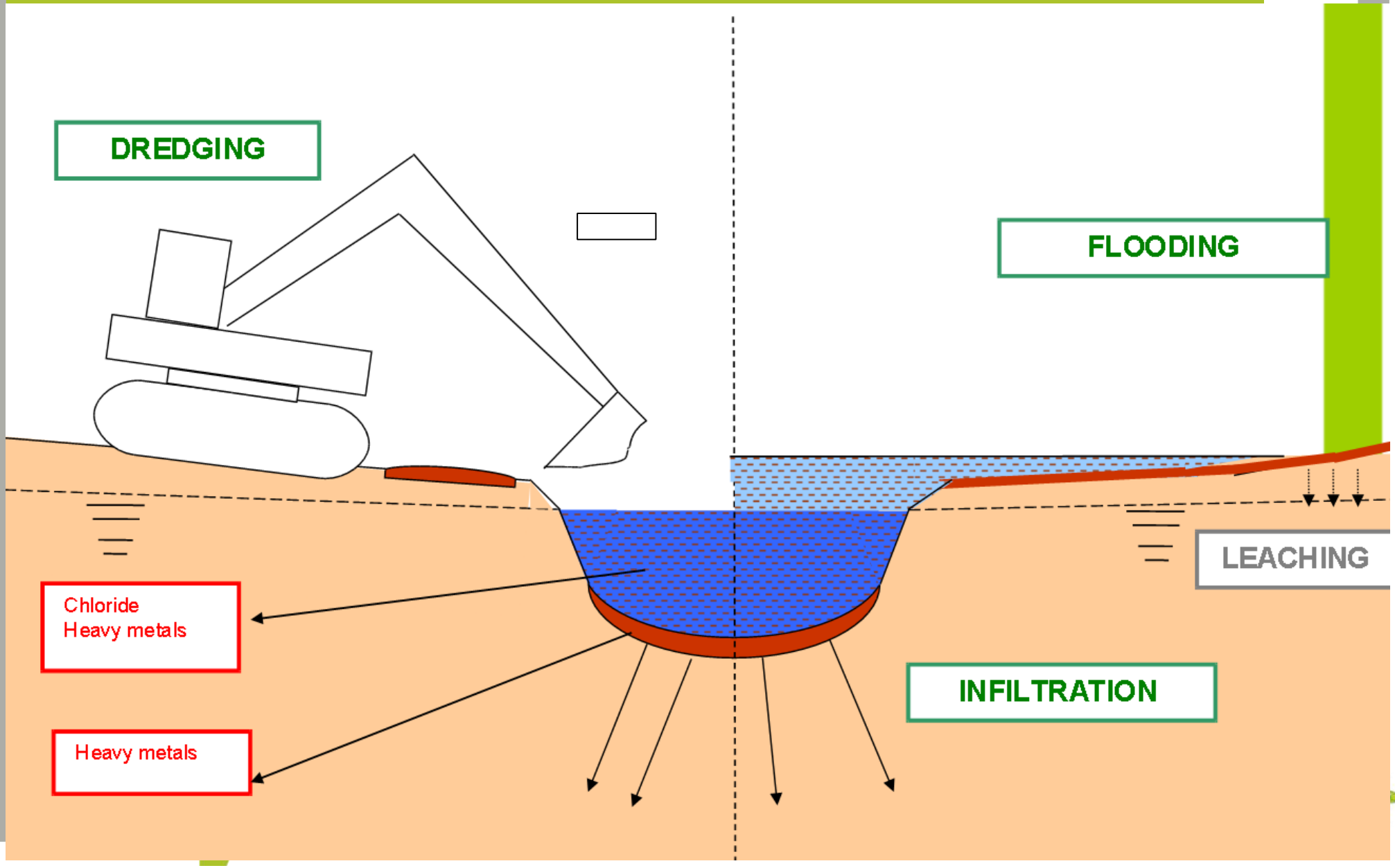
Figuur 1.5. **Cadmiumvrachten, kg/j afvalwater TCH en TCT/LVM**



Figuur 1.15. **radiumvrachten, g/j Afvalwater TCH**



Contaminated Streams



Contaminated Streams – Laak – Situation

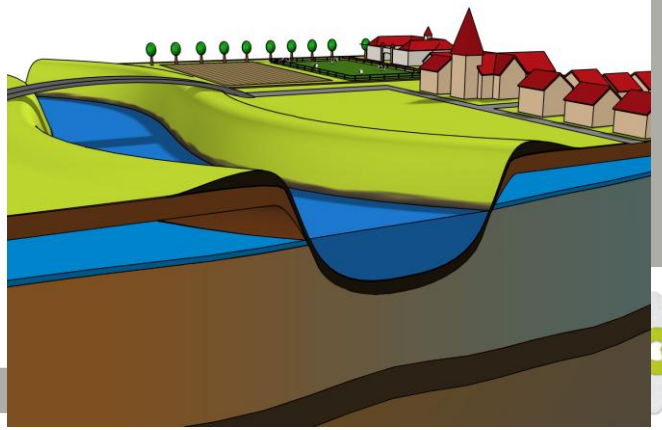
- Stream of 20 km, through different municipalities and provinces
- Mainly rural area
- Geology : sand, at 100 m-mv heavy clay
- 2 discharge points
- Surface of flooding area : 142 ha (350 acres)

Contaminated Stream – Laak

- Official soil investigations
  - Interrogative soil survey in 2003 assigned by Flemish government executed by Soresma-IMDC
  - Descriptive soil survey in 2009 assigned by Tessenderlo Chemie executed by RSK
- Other investigations
  - Research on radium-contamination of the Laak (SCK-CEN, 1999)
  - Analysis of milk, meat, liver and kidneys of cattle

Contaminated Stream – Laak – Interrogative soil survey

- Research activities
  - Soil
    - heavy metals and organic compounds
    - At riverbanks and in flooding area
    - Top layer (#150 – 25 cm) – some deeper (#30 – 2 m-mv)
  - Groundwater
    - Heavy metals, organic compounds and chloride
    - Monitoring wells (#20) + geo-electric profiles (100m-mv)
  - Stream sediment
    - Triad-method (4 locations)



Contaminated Stream – Laak – Interrogative soil survey

- Results
  - Soil : heavy metals
    - Right bank more polluted then left bank
    - Mouth 'Zammels Broek': most polluted
  - Groundwater : chloride
  - Sediment : bad quality

→ Further investigation needed

	Max.	Gemid.	Norm
Metalen [mg/kg d.s.]			
Arseen (As)	**2200**	**1267,5**	41
Cadmium (Cd)	**74,0**	**38,3**	3,2
Chroom (Cr)	**210**	91,5	123
Koper (Cu)	180	88,5	188
Kwik (Hg)	**120**	**46,5**	10
Lood (Pb)	**1200**	**694,5**	325
Nikkel (Ni)	30	18,5	131
Zink (Zn)	**1000**	553	822

Radium (Bq/kg) left bank (mean) : 2836
right bank (mean) : 3772

Contaminated Stream – Laak – Descriptive soil survey

- Research activities
  - Determination of contaminated area
    - Radiometer-measurements in flooding areas
    - Coincidence elevated radiation – heavy metal-contamination
    - Statistics (Kriging)

      6 mg/kg Cd ~ 150 nSv/h
  - Risk assessment
    - Human health risk?
    - Ecological risks?
    - Risk of spreading?

  → Remediation needed

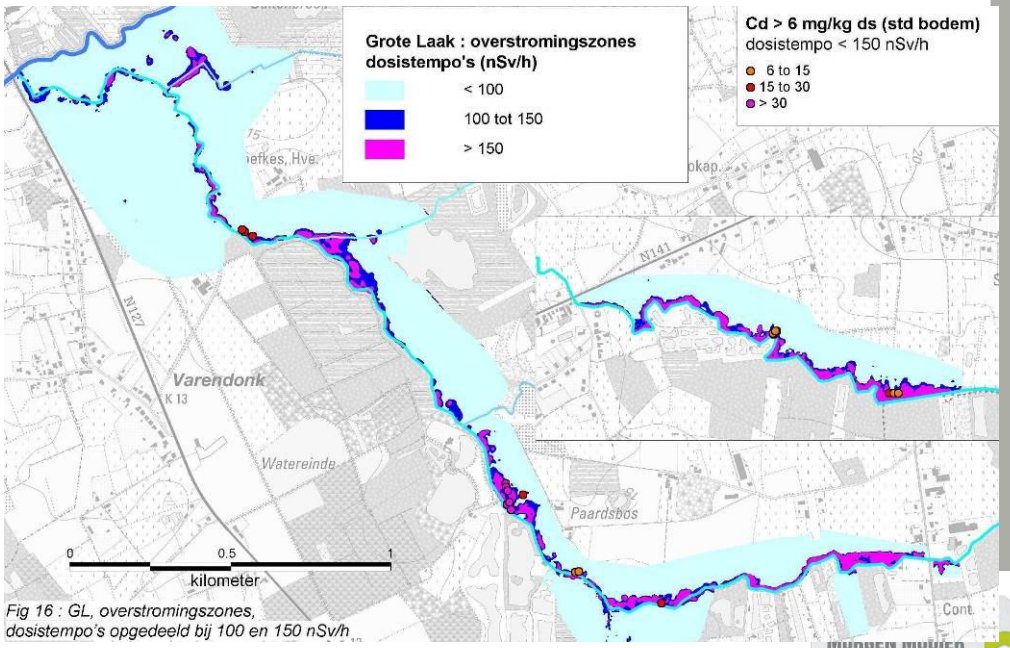
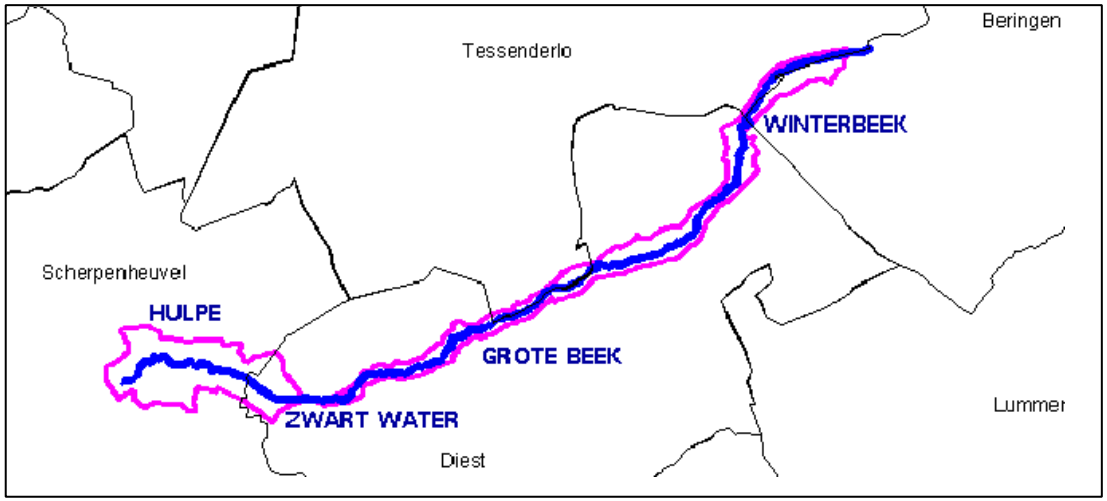


Fig 16 : GL, overstromingszones, dosistempo's opgedeeld bij 100 en 150 nSv/h

Contaminated Stream – Winterbeek

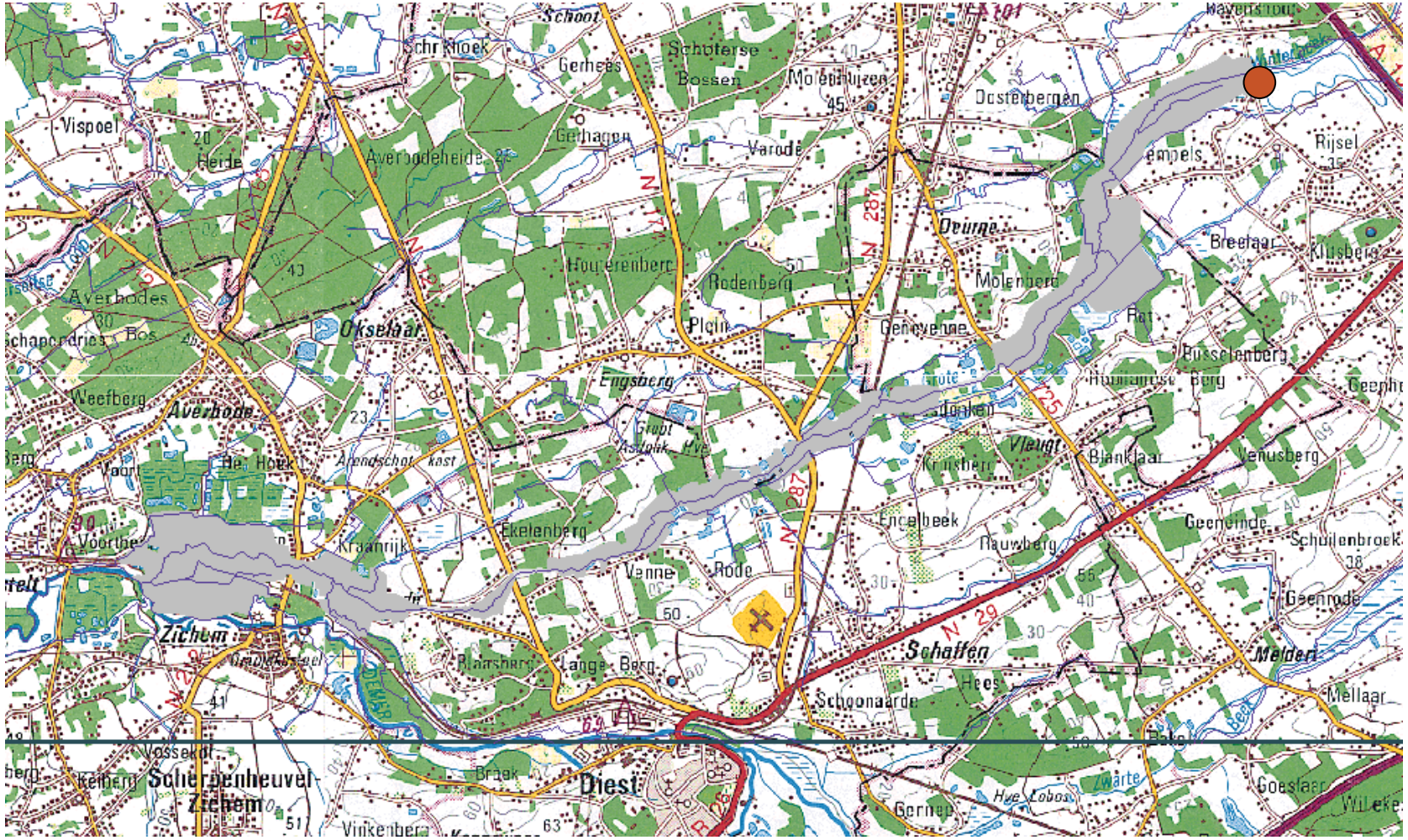
- Situation :
  - Stream of 16 km, through different municipalities and provinces
  - Mainly **natural** area
  - Geology : sand, at 100 m-mv heavy clay
  - 1 discharge point
  - Surface of flooding area : 721 ha (1780 acres)



Contaminated Stream – Winterbeek

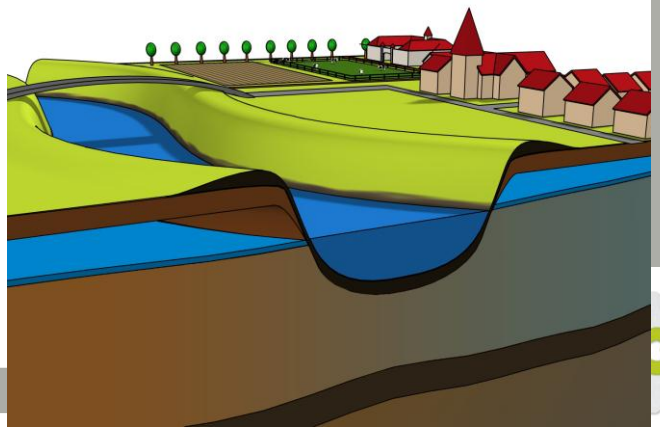
- Official soil investigations
  - Interrogative soil survey in 2003 assigned by Flemish government executed by Ecolas nv
  - Descriptive soil survey in 2009 assigned by Tessenderlo Chemie executed by RSK
- Other investigations
  - Ecological inventarisation and vision – Winterbeek (Haskoning, 2003)
  - Research on radio-activity-contamination in the Valley of the Three streams (FANC, 2003)
  - Aerial measurements on the Winterbeek (FANC, 2004)
  - Valley of the Three Streams : watersystem and ecology (INBO, 2008)

Contaminated Stream - Winterbeek



Contaminated Stream – Winterbeek – Interrogative soil survey

- Research activities
  - Soil
    - heavy metals and organic compounds
    - At riverbanks and in flooding area
    - Top layer (#1208 – 10-30 cm) – deeper (#75 – 1 m-mv)
  - Groundwater
    - Heavy metals, organic compounds and chloride
    - Monitoring wells (#75) + electro-magnetic profiles (30m-mv)
  - Stream sediment
    - Triad-method (25 locations)



Contaminated Stream – Winterbeek – Interrogative soil survey

- Results
  - Soil : heavy metals (Cd, As)
    - Right bank more polluted then left bank
    - Banks: most polluted (dredging)
  - Groundwater :
    - chloride
    - Infiltration after flooding
  - Sediment : bad quality

→ Further investigation needed

BODEM		max	gem	max X BSN
Arseen	mg/kg	740	93	15,7
Cadmium	mg/kg	160	12	60,95
Chroom	mg/kg	480	51	3,32
Koper	mg/kg	790	28	3,12
Kwik	mg/kg	17	1	1,61
Lood	mg/kg	400	49	1,89
Nikkel	mg/kg	94	21	0,66
Zink	mg/kg	3460	245	4,47
EOX	mg/kg	791	2	15,82

GRONDWATER		max	gemiddelde	BSN
Arseen	µg/l	370	34	20
Cadmium	µg/l	11	2	5
Chroom	µg/l	23	4	50
Koper	µg/l	38	3	100
Kwik	µg/l	0,2	0	1
Lood	µg/l	65	11	20
Nikkel	µg/l	100	18	40
Zink	µg/l	1100	43	500
Chloriden	mg/l	2568	323	200 (MTC)
Geleidbaarheid	µS/cm	5470	988	2000 (richtwaarde)

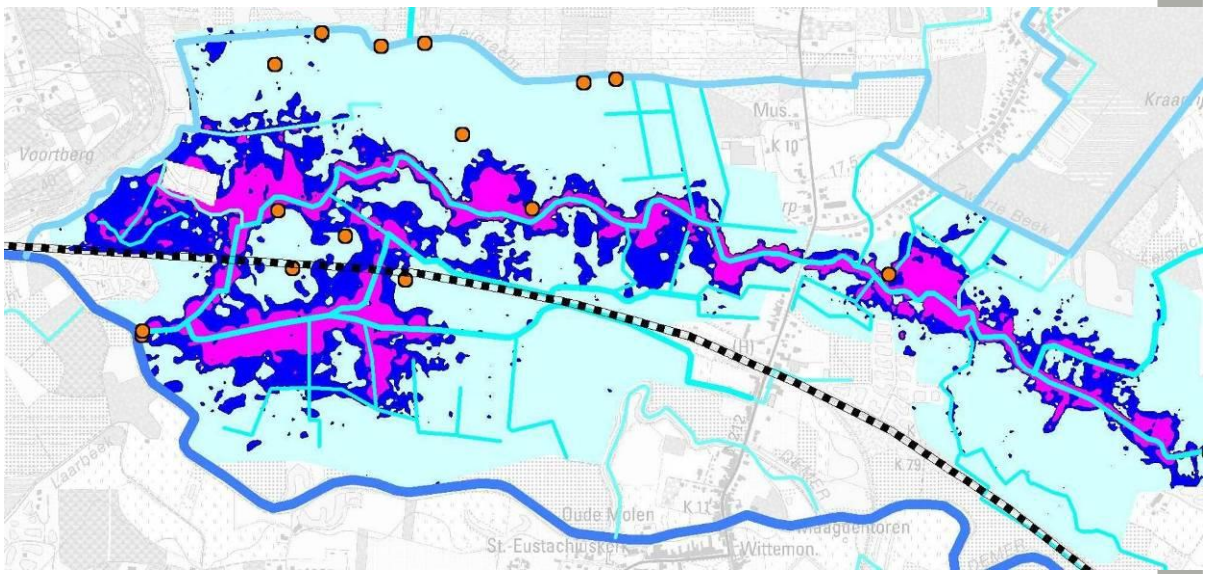
Radium (Bq/kg) left bank (mean) : 3800
right bank (mean) : 2000

Contaminated Stream – Laak – Descriptive soil survey

- Research activities
  - Determination of contaminated area → dose-rate
    - Radiometer-measurements in flooding areas
    - Coincidence elevated radiation – heavy metal-contamination
    - Statistics (Kriging)

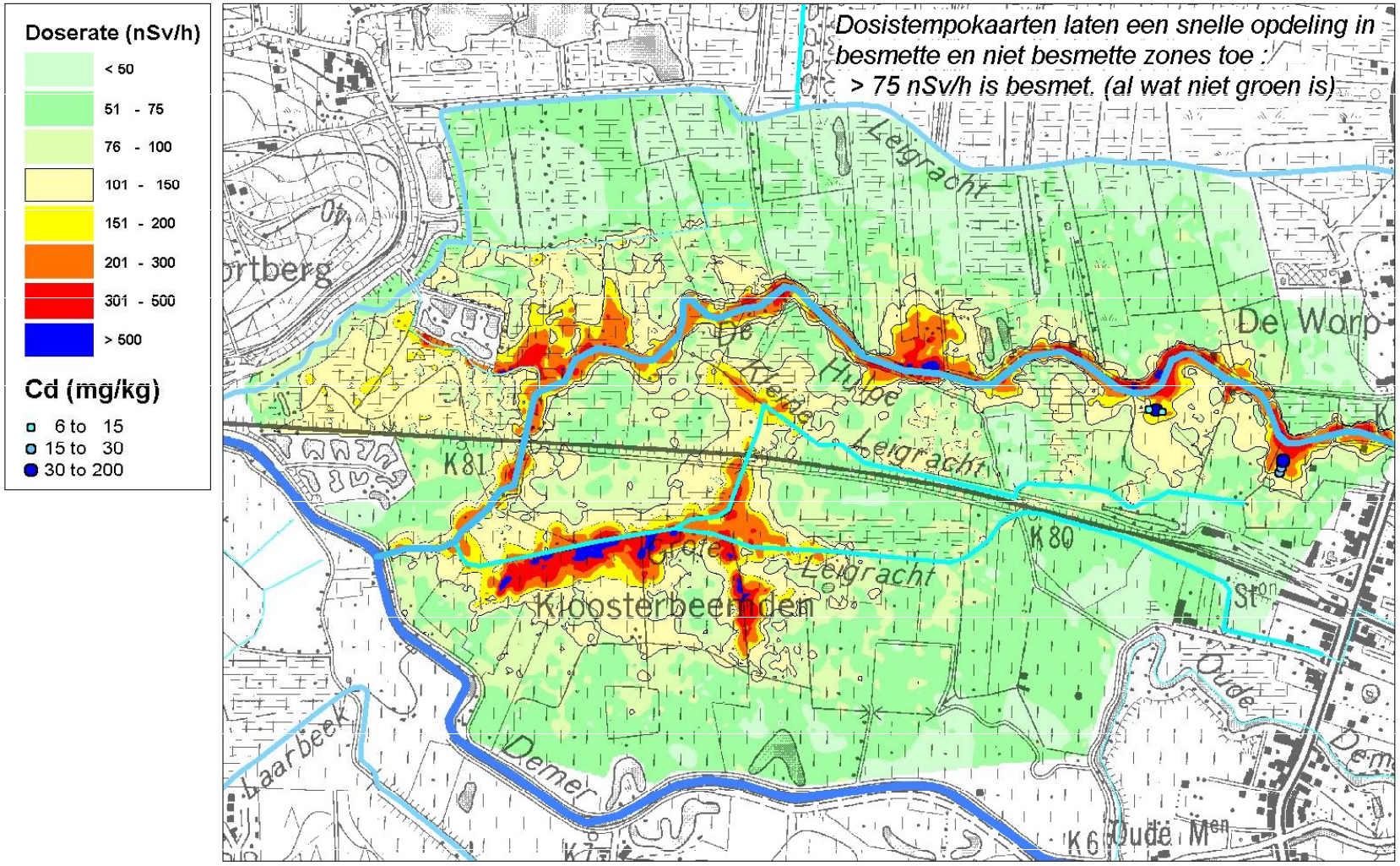
6 mg/kg Cd ~ 150 nSv/h

  - Risk assessment
    - Human health risk?
      - Crop analysis
      - 'Vlier Humaan'
    - Ecological risks?
    - Risk of spreading?



→ Remediation needed

Contaminated Streams - Winterbeek



Contaminated Streams – Further steps?

- Remediation needed
  - Opportunities in future
    - In 2014 : discharge chlorides -90%
    - TC is willing to store 300.000m³ contaminated soil & sludge
  - Obstacles
    - Different stakeholders and persons obligated to remediate
    - Different legislations
    - $$
    - Accessebility

→ Integrated consultation needed

Contaminated Streams – Further steps?

- Integrated consultation started for Winterbeek
  - Added value
    - Gathering of all relevant information (GW-models,...)
    - One vision
  - Members
    - Streammanagers (VMM, provinces)
    - Demer-river-basin-secretary
    - OVAM
    - ANB
    - FANC
  - Aim
    - Start of Soil Remediation project (2012) and start remediation (2014)
    - Noticable better situation by 2015

Conclusions – contaminated streams

- Contaminated streams
  - Contamination known : delineation bij dose-rate

simultaneous discharge Cd – Ra

  - Time for action
  - Integrated consultation is crucial !

Thank you for your attention
Any further questions?

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