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LIMITING MEASURES

TO PREVENT METAL SPREADING

FROM MILITARY SHOOTING FIELDS AND WOOD IMPREGNATION FACILITIES

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Introduction

- Two field “studies” two different filters for run-off water

- Two different sites
  - one contaminated by shooting activity (lead), study for the swedish Armed forces
  - one contaminated by wood impregnating activity (arsenic), study for the National Rail Administration

- A passive (lead) and a pumped (arsenic) filter

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Why a study of filter technique?

- No efficient technique available to remediate the soil from lead spread by shooting (excavated soil - landfill)

- No risk for direct human exposure

- Low land demand

- Unexploded ammunition

⟹ The aim was to find measures that limit the spreading of metal contaminants to the surrounding environment without removing the contaminated soil

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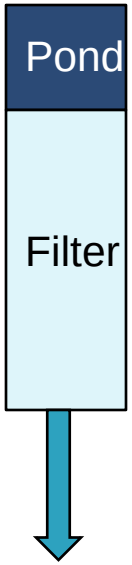
Material and methods

Run-off area - Former target area



Recipient:
The small river
Smestadbäcken

- The run-off area is a slope about 150 m broad and 100 m high (15 000 m^2) with dug ditches
- The pond is 1 m deep, 5 m wide and 5 m long
- The filter is 20 m long, 5 m wide and 1,2 m deep inclusively cover (100 m^3)
- The gradient is 0,2%
- A pre-lab study lead to the recommendation of sand (2-4 mm) mixed with 2,5 % $CaCO_3$ (powder) and 1% $Ca(OH)_2$ (powder) as filter material

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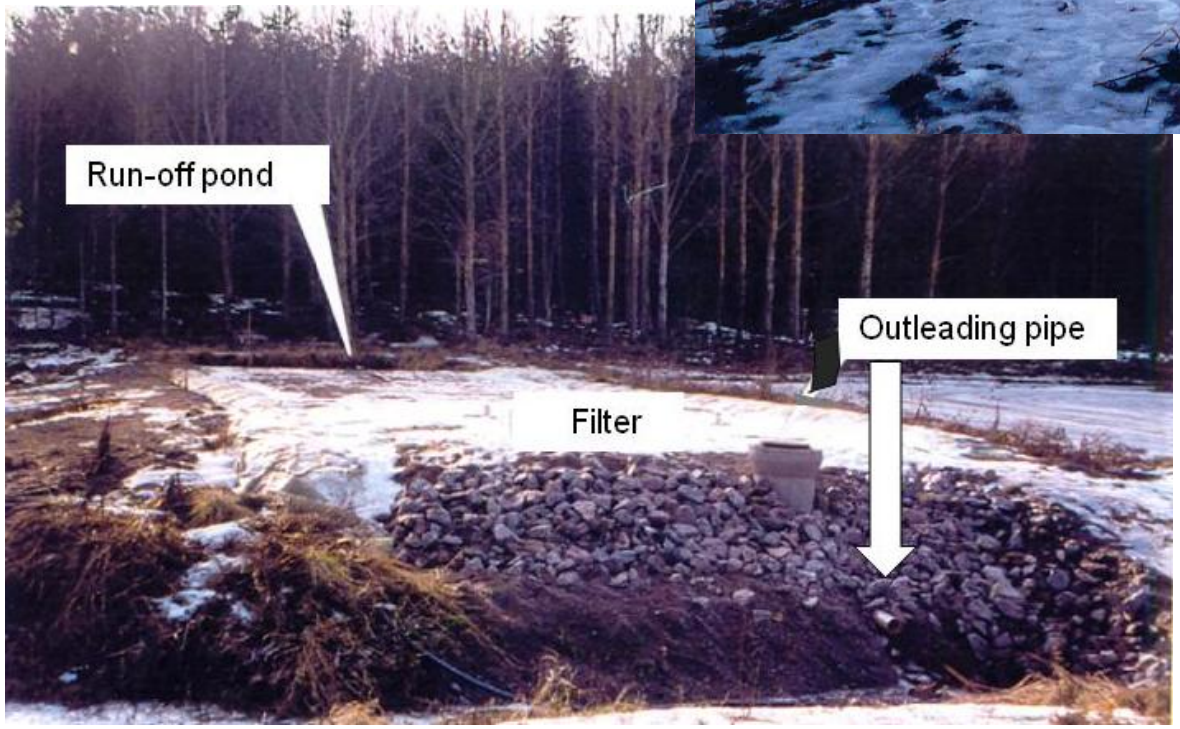

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Results

Totally 21 corresponding water samples were taken of in- and outgoing water

Reduction of lead:

- 2000-2002 reduction rate 83% in average (ingoing 95 µg/l and outgoing 14 µg/l)
- 2003-2005 reduction rate 54% in average
- 2000-2005 reduction rate 76 % in average (ingoing 81 µg/l, outgoing 15 µg/l)
- The pre-lab study showed a filter capacity of up to 99%

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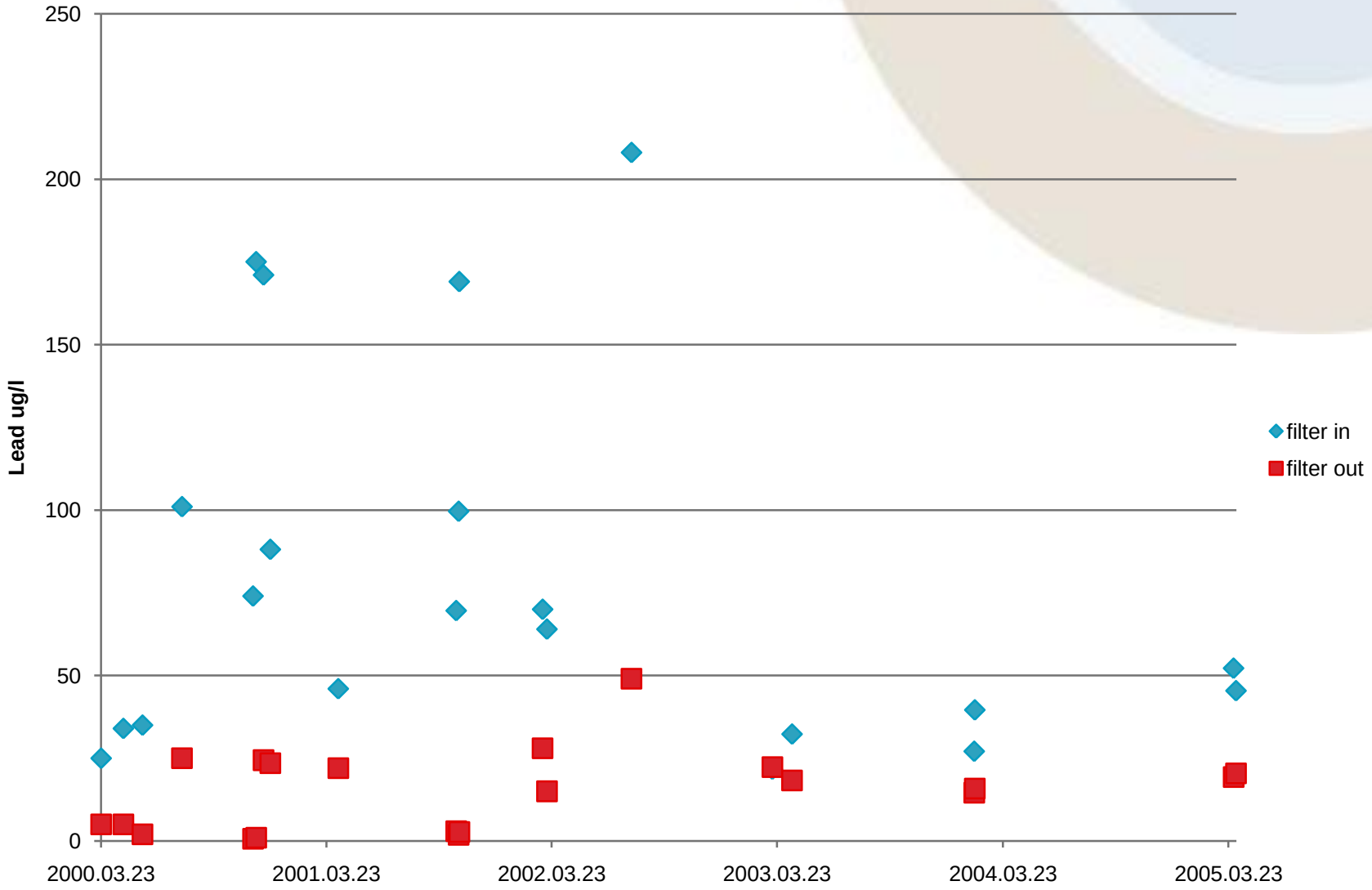
Concentration of lead in- and outgoing water



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Discussion

- Spring (feb-april): reduction rate in average 56% (in 42 µg/l out 17 µg/l)
- Rest of the year: reduction rate in average 90% (in 119 µg/l out 13 µg/l)
- Very low water flow
  - Water flow = unknown, theoretically 4000 - 5000 m^3/year
  - Low monitoring frequency

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Conclusions

- Reduction of lead
  - 81 µg/l = very serious condition (swe EPA)
  - 15 µg/l= serious condition (swe EPA)
- High concentration in pond sediment
  - Particularly bound
- A sorption of lead in the filter
  - The processes not exactly known

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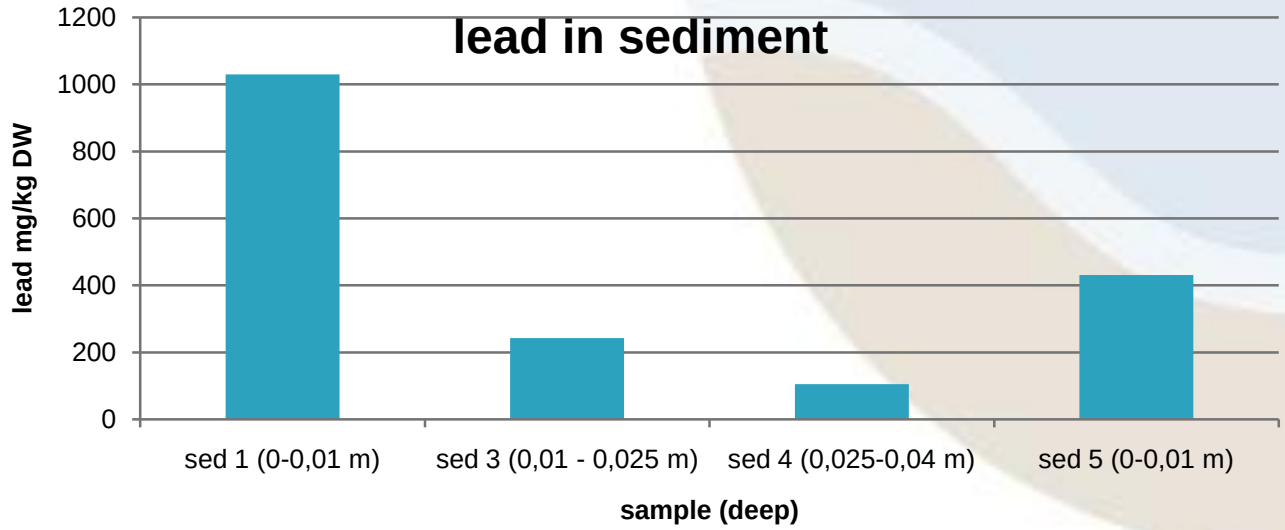

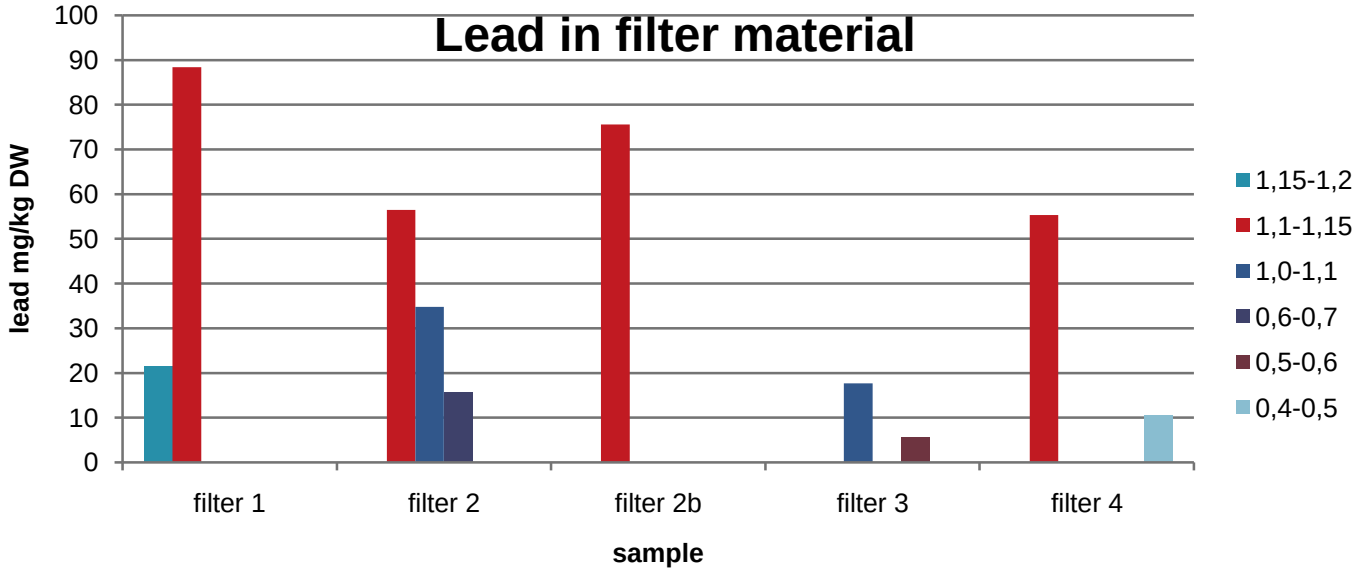

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In the future

- Sequential leaching is performed to find out more about the processes of sorption
- Other future potential risk metals (antimony)

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Why a study of filter technique?

- Located next to a river (difficult to excavate)
- No risk for direct human exposure
- Size of the former impregnation facility almost 21 000 m^2
- Due to the nature of the site – no exploitation

The aim is to find measures that limit the spreading of metal contaminants to the surrounding environment without removing the contaminated soil

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Material and methods

- The filter construction is approximately 20 meters long, 10 meters wide and 3 meters high and built up of several different layers
- A laboratory study showed that iron rich sand (podsol) was the best suited material for use in the filter for arsenic contaminated water
- The run-off water from the impregnation area run through a system of ditches to an aggregation well
- The water is pumped up to the top of the filter and distributed over the whole filter area
- The central filter consists of 1,2 meter of sand from a iron rich podsol.

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Results

- 76% reduction during the first three years (1998-2001)
- 89% reduction of arsenic during period (2001-2007)
- The magnitude of the variation of arsenic concentration differs (in 0,057– 1,49 mg/l) and (out 0,02 – 0,143 mg/l)
- Mean concentration in during 1998-2007 is 0,5 mg/l
- Mean concentration out during 1998-2007 is 0,038 mg/l
- The average reduction of arsenic in the passed water during the entire monitoring period, 1998-2007, is 85 %.

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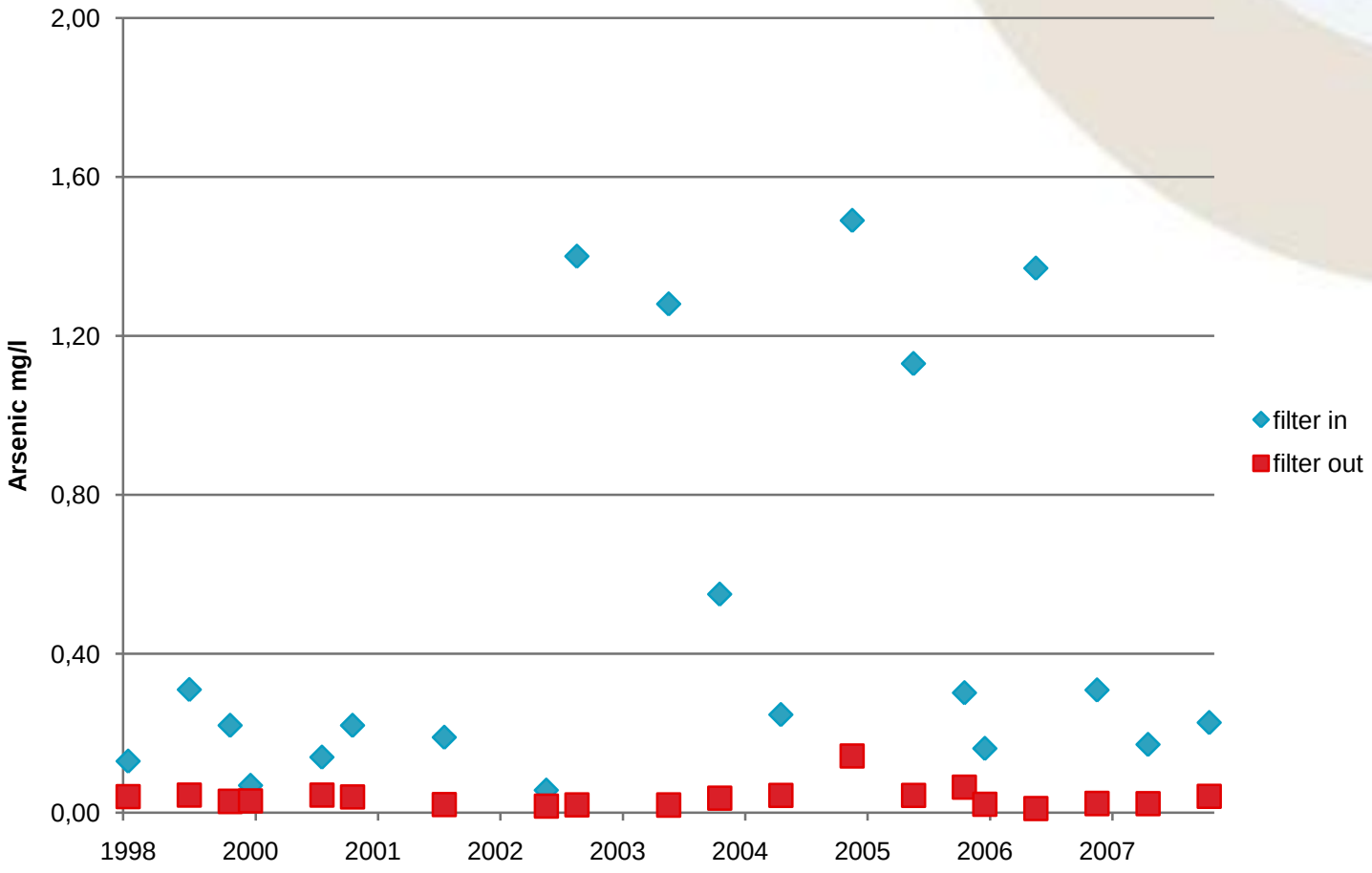
Concentration of Arsenic in- and outgoing water



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Conclusions

- 0,038 mg/l (out) = moderate serious condition (Swedish EPA)
- The reduction of arsenic seems to extend to approximately the same level no matter the arsenic concentration in the ingoing water
- It would be of interest to investigate if a longer time of contact between the contaminated water and the active filter influences the rate of arsenic reduction.

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Comparison

- Both filter constructions works satisfactory
- The pumped filter demands electricity and more frequent supervision
- The passive filter demands clearing of ditches/pond
- The prospect for a long-term function – good for both filters (saturation rate, clogging of filter)
- The natural conditions at the site decided wich technique to choose
- Bigger risk for overflow with the pumped filter construction

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Questions?

and thank You for listening!