

Quantification of mass flux at the groundwater/surface water interface and evaluation of impact on a local stream from an old landfill

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Introduction

Border areas between water bodies are encompassed in the WFD 2000

Old landfills are common in the world (~ 2000 only in Denmark) impacting ground and surface water bodies by their leachate (inorganics, organics and xenobiotics)

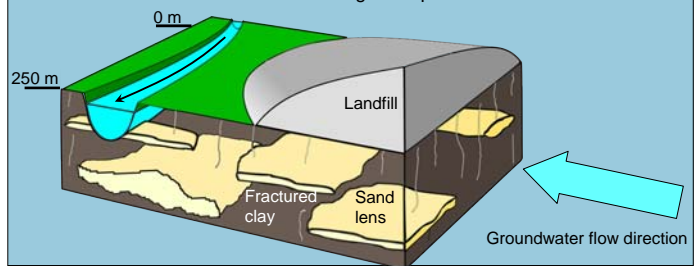
Groundwater / surface water interface (GSI) where leachate can discharge into surface waters extends depending on local hydrogeology

Hypotheses:

1. GSI in heterogeneous geological settings is focused within the groundwater paths, with enhanced leachate concentrations and redox gradients
2. GSI is place of significant attenuation of landfill leachate compounds

Objectives

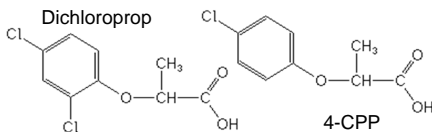
- **Identification** of the GSI
- **Conceptualization** of contaminated site (landfill, fractured clay/sand lenses and recipient waters)
- **Quantification** of contaminant mass fluxes
- **Evaluation** of chemical and ecological impacts on the stream



Results

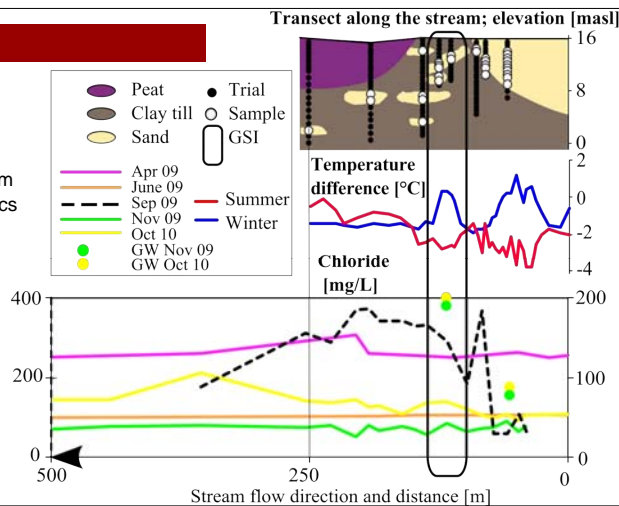
Step 1: retrieving existing information on

- waste: chemical
- geology: fractured clay with sand lenses
- hydrology: groundwater flow towards the stream
- key contaminants: phenoxy acids and inorganics



Step 2: downscaling

- delineation of leachate plume
- temperature identification of the GSI
- characterization of the stream

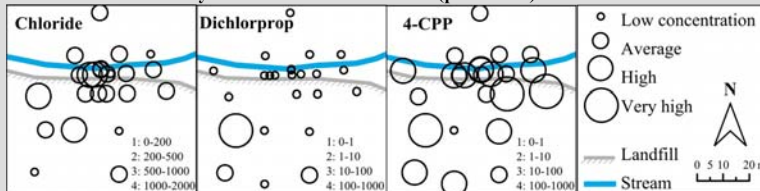


Step 3: evaluation of impact

- quantification of contaminant mass flux by multiple methods
 - 4% of background stream flux at average conditions
 - high in draught periods (Sep 09)
- estimation of ecological status in the stream
 - generally poor, even disregarding the GSI
 - seasonally deteriorated by flux at the GSI

Conclusion

Distribution of key contaminants at the GSI (plan view)



- Contaminants are randomly distributed in the source
- Discharge areas are restricted according to clay/sand setting
- Hydrologic potential for discharge through the GSI is constant

•Leachate was methanogenic with high concentrations of inorganics, phenoxy acid herbicides and their degradation products.

- Identification of the GSI demanded final resolution of 1 meter

- Leachate does not form a classic shaped plume
- Biogeochemical processes are of a higher importance

- Impact varies seasonally, governed by contaminant flux at the GSI and background in the stream
- It is highest for ammonium, chloride and phenoxy acids
- It is lethal for aquatic organisms in the vicinity of the landfill when:
 - leachate accumulates in the low stream
 - contaminants desorb from peat in the low stream
 - surface runoff is higher than stream background
 - streambed gets eroded

