High Resolution Site Characterisation en PAK verontreiniging

Interreg
EUROPESE UNIE
Vlaanderen-Nederland
Europees Fonds voor Regionale Ontwikkeling

resanat
Natuurlijk saneren we de bodem

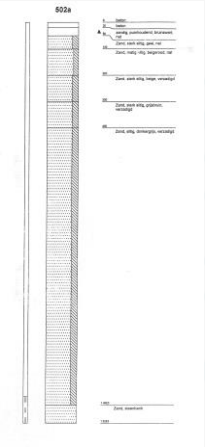
7/11/2022

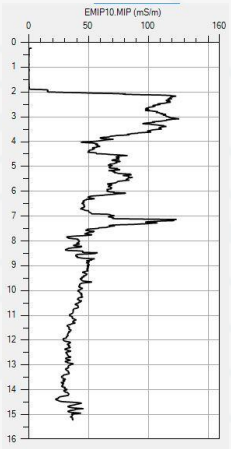
Onzekerheid in het Conceptuele Site Model

Heterogeniteit van ondergrond

Beperkte beschikbare informatie

Bodemonderzoek/sanering is omgaan met onzekerheid





Goede bemonstering is niet eenvoudig en intensief werk

Dataproductie per dag veldteam?

Bvb diepe peilbuizen € / meetpunt ?

datadichtheid

karakteristieken variëren op cm/dm schaal eerder dan op m schaal

Onzekerheid in het Conceptuele Site Model

Dealing with DNAPL's….

Dichtheid> water

Kan tot grote diepte verspreiden ➔ zaklaag

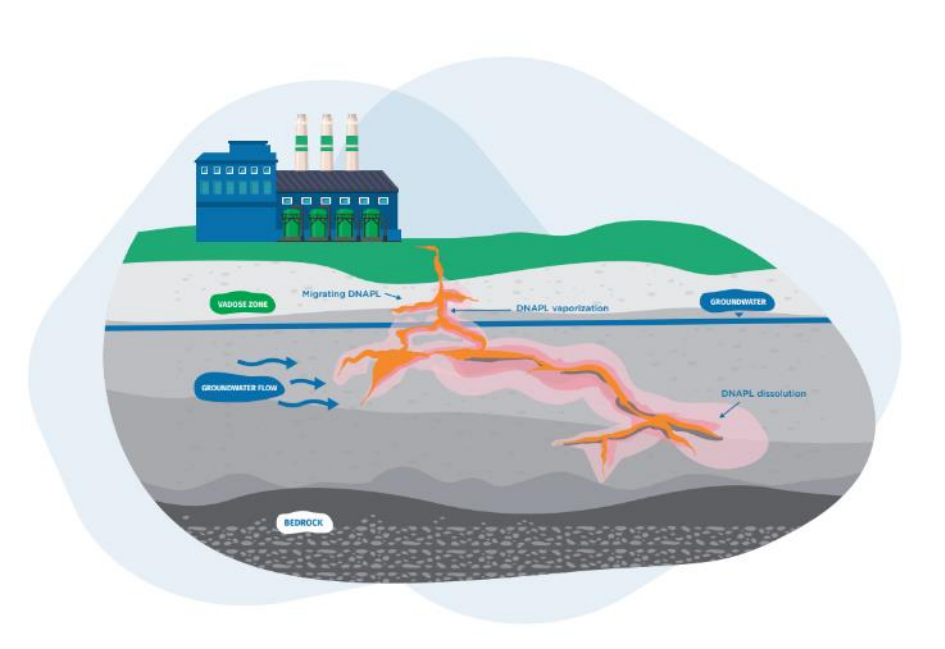
DNAPL verspreiding is sterk afhankelijk van verschillen in bodemkarakteristieken

fijnere bodemopbouw vormt een capillaire barrière

➔ DNAPL pooling & laterale verspreiding (evt tegen GW stromingsrichting in!)

Diffusie : DNAPL opslag in smalle poriën.

Advectie: vorming van langdurige GW pluimen



….Major challenges

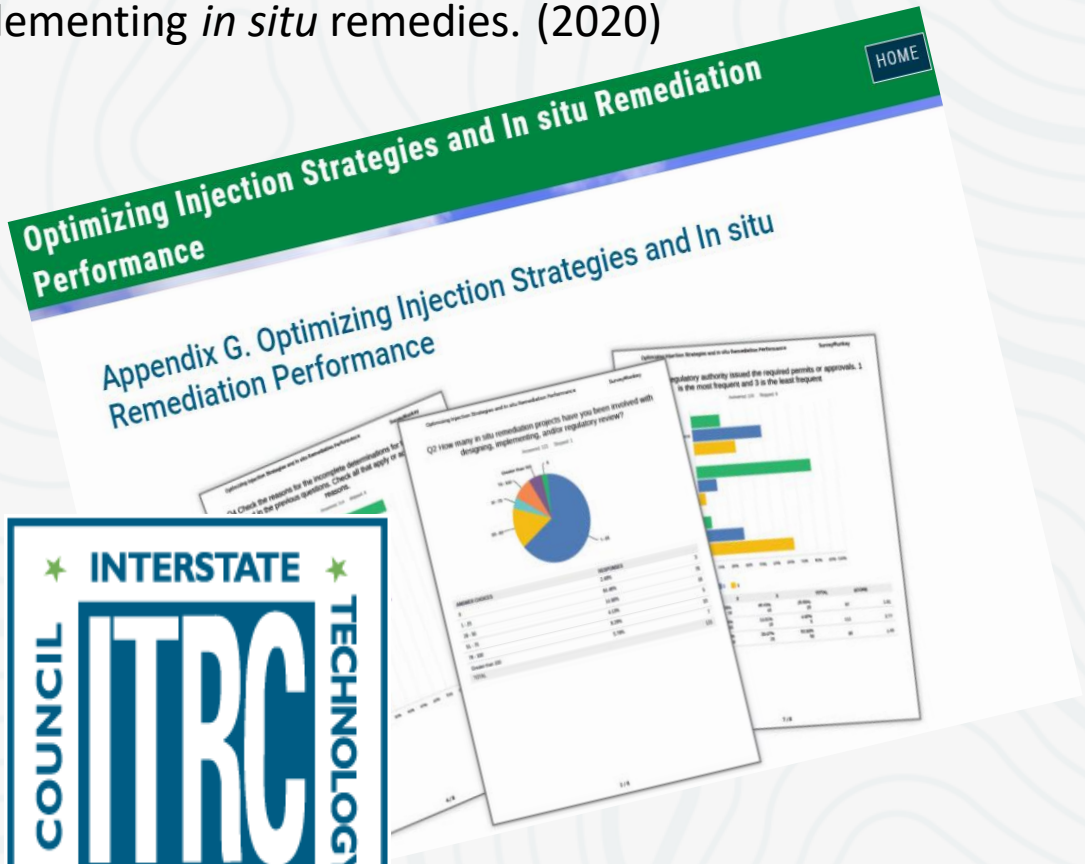
Horizontale en verticale verspreiding wordt bepaald door (subtiele) variaties in de bodem

onvoorspelbare architectuur van pluim en bron

Schaal van variabiliteit !

Onzekerheid in het Conceptueel Site Model

ITRC Survey: Identify regulatory challenges to implementing *in situ* remedies. (2020)



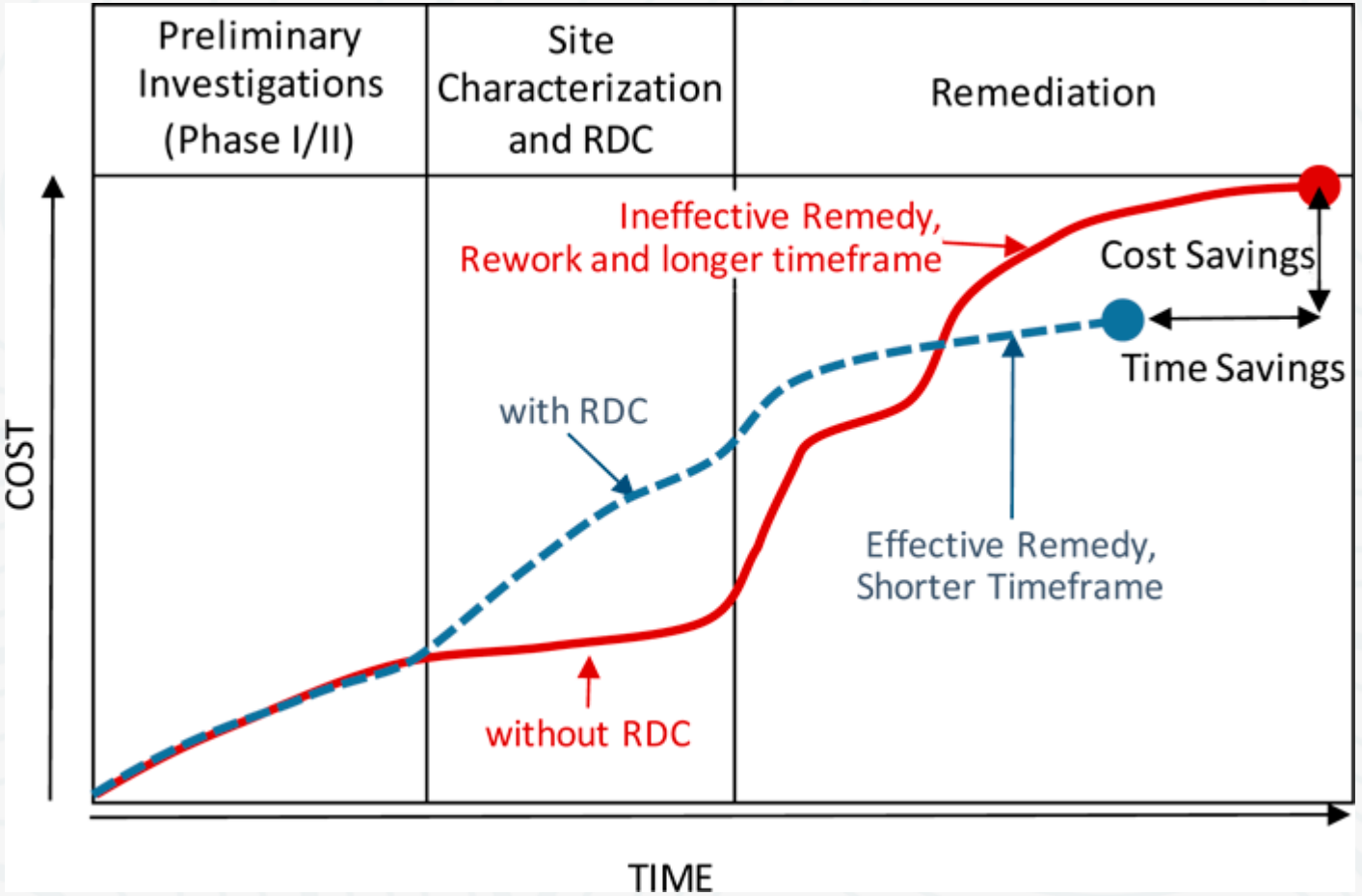
Main reasons *in situ* remediation proposals failed to obtain approval:

- The conceptual site model (CSM) was found to be insufficient (74%)
- Proposed amendment emplacement /delivery was questionable. (55%)
- The proposed *in situ* treatment was questionable (45%)

Root cause(s) for the inadequate information:

- Inadequate source **characterization** (e.g. unknown mass or location of target contaminants are not well defined). (65%)
- Inadequate **placement design** based on the CSM. (49%)

Value of investigation & Remedial Design Characterisation (RDC)



Conceptual project lifecycle costs with and without RDC.
Source: Modified from (ITRC 2015)

Typische aanpak:

Snel overstap naar sanering zonder veel bijkomend onderzoek

Value of Investigation:

Voorafgaand bijkomend onderzoek

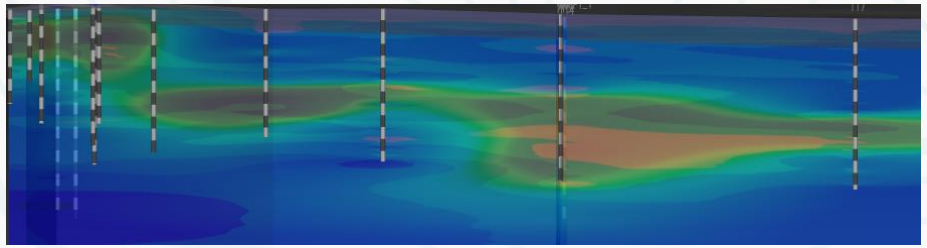
→ Effectievere sanering

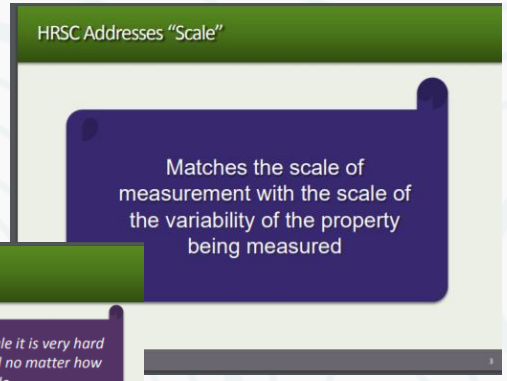
→ Tijd en kosten bespareknd

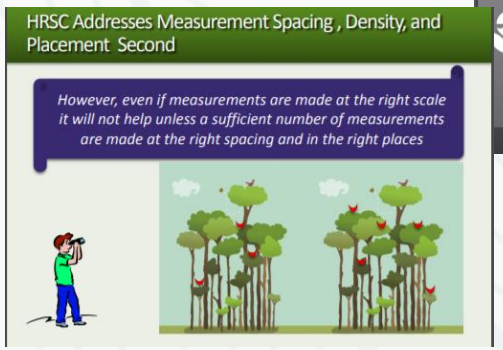
Reduceren van onzekerheid :HRSC

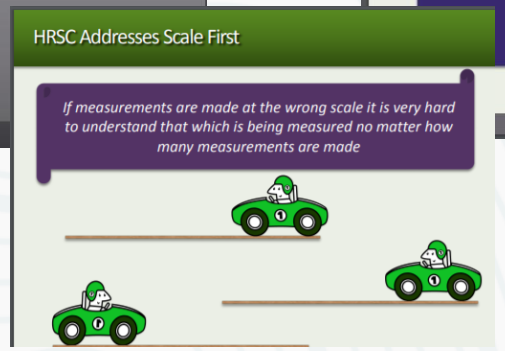
High Resolution Site Characterization

- Meetmethoden met geschikte schaal
- Kosteneffectieve gegevensverzameling
- Dynamische bemonsteringsaanpak & kortere onderzoekscycli
- Minder onzekerheden & betere inzichten

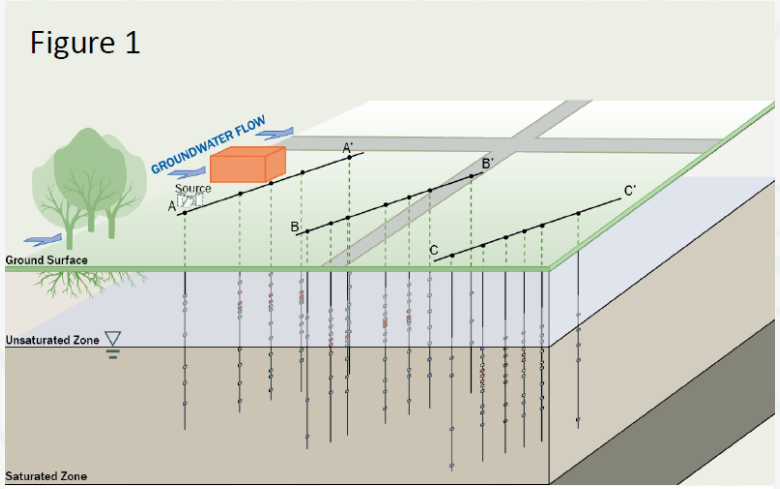


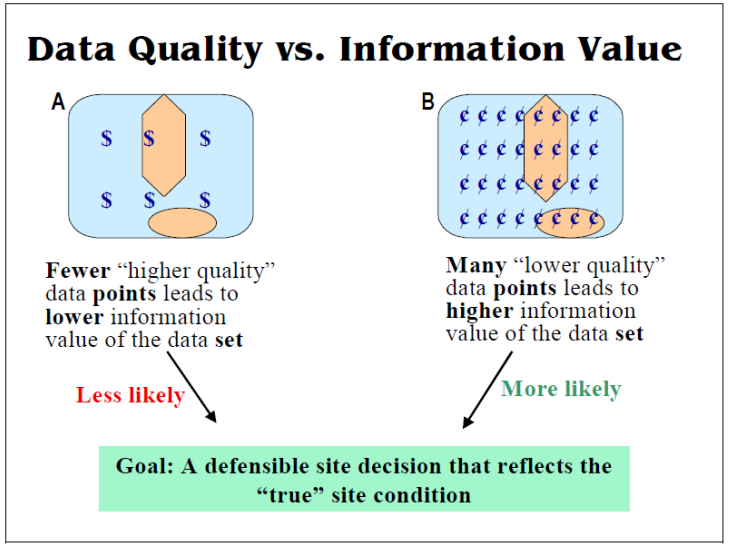






High Resolution Site Characterisation

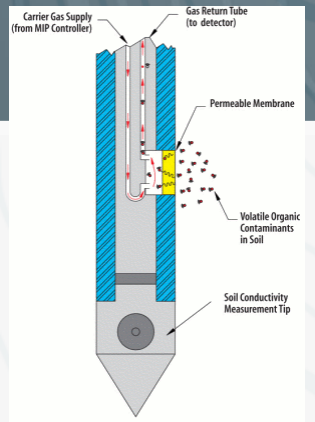


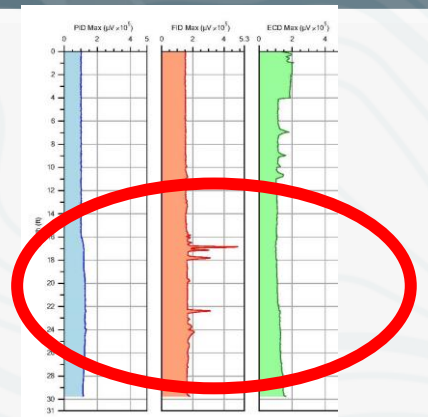


- Groter succes van sanering door gedetailleerder CSM
- Betere evaluatie van gerichte in situ en ex situ saneringsopties
- Sanering op basis van zwakke of onvolledige CSM zal niet verlopen zoals verwacht, wat leidt tot
  - Het niet halen van de vastgestelde timing
  - Buitensporige kosten
  - Niet bereiken van saneringsdoelstellingen
- Remediation cost vs characterization cost:

  "Pay a little more now to avoid paying a lot more later"

HRSC Tools : MIP

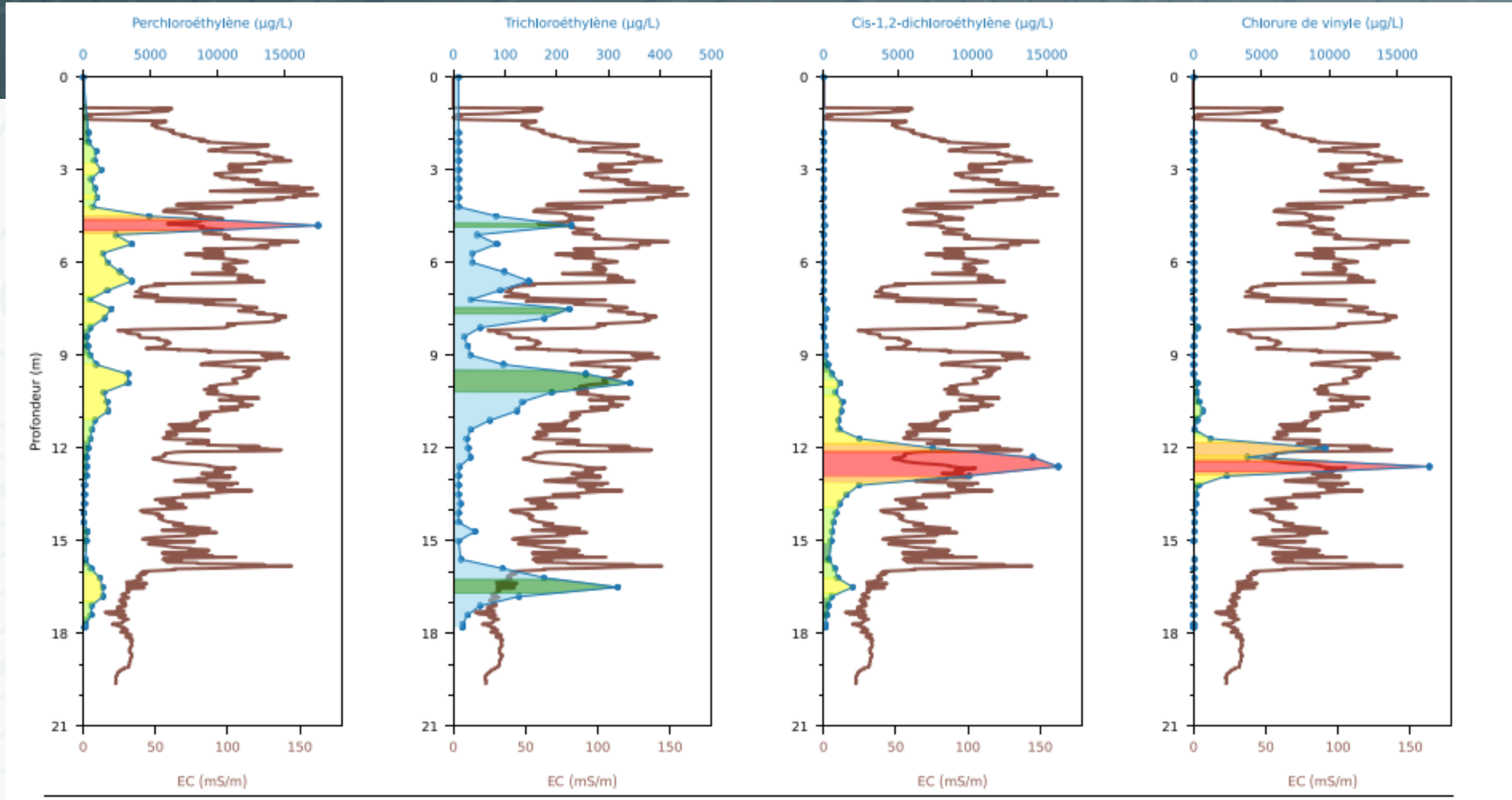




MIP: Membrane Interface Probe

- Geoprobe ™ Direct push tool
- On-site Screening tool for VOC's in soil and groundwater

- Local heating of soil
- Volatilization and diffusion through membrane
- Inert carrier gas & transport to detector


Perchloroéthylène (µg/L)
Trichloroéthylène (µg/L)
Cis-1,2-dichloroéthylène (µg/L)
Chlorure de vinyle (µg/L)
Profondeur (m)
EC (mS/m)

MIP en PAK verontreiniging

Carry-Over Effects of the Membrane Interface Probe

by Jan Bumberger[1], Dirk Radny[2], Andreas Berndsen[3], Tobias Goblirsch[4], Johannes Flachowsky[4], and Peter Dietrich[4]

Abstract

The membrane interface probe (MIP) is widely used to characterize the subsurface distribution of volatile organic compounds (VOCs). One problem that arises during MIP application is that disproportionately high MIP signals are obtained after passing source zones which contain mobile or residual phases. This serious problem occurs because of a carry-over effect, in particular caused by compound-specific retention times in the conventional unheated transfer line, commonly used during such an investigation. The objective of this study

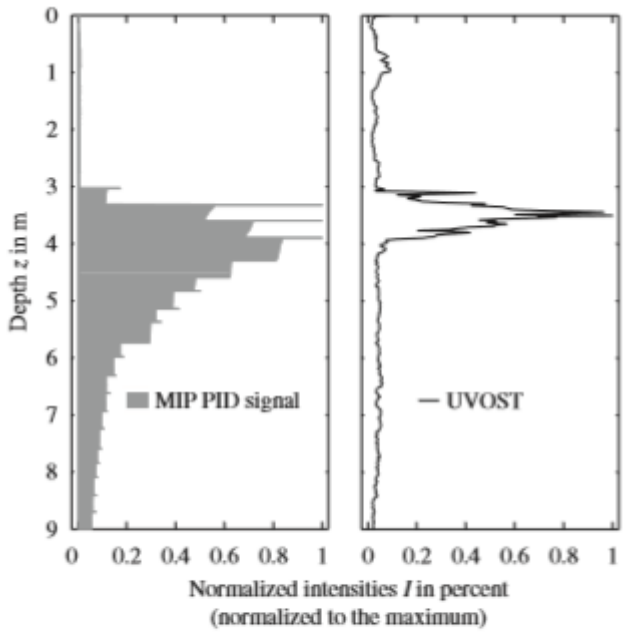


Figure 2. Conventional MIP PID signal results using standard MIP data acquisition software and UVOST for the probing location at the Elsterwerda field test site.

"This serious problem occurs because of a carry-over effect which is caused by cross-contamination and specific individual retention times of different substances in the unheated transfer line."

Specific individual retention times in MIP trunkline

De sonde is verbonden met een kabel die via de boorstangen naar de regel- en detectie-instrumenten loopt.

45m kabel met gas leiding die VOC's transporteert
Coal tar/creosote: brede range aan chemische producten

BTEX/VOCL : beperkte verschillen en stabiele "travel time"

PAK: important delays!

Het MIP-detectorsignaal is een combinatie van alle afzonderlijke verbindingen die de detectoren bereiken.

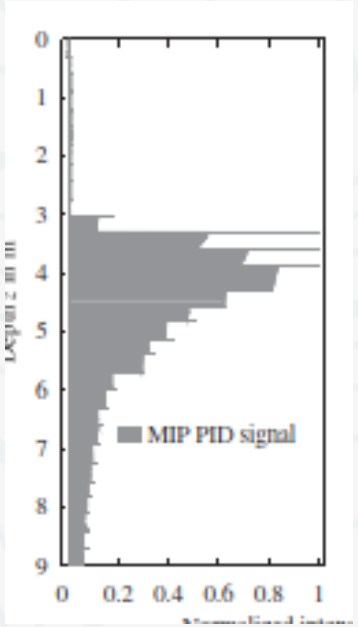
Specifieke individuele retentietijden in de MIP

MIP results : detector signaal vs diepte

De interpretatie gaat uit van een constante "reistijd".

Mengsel?

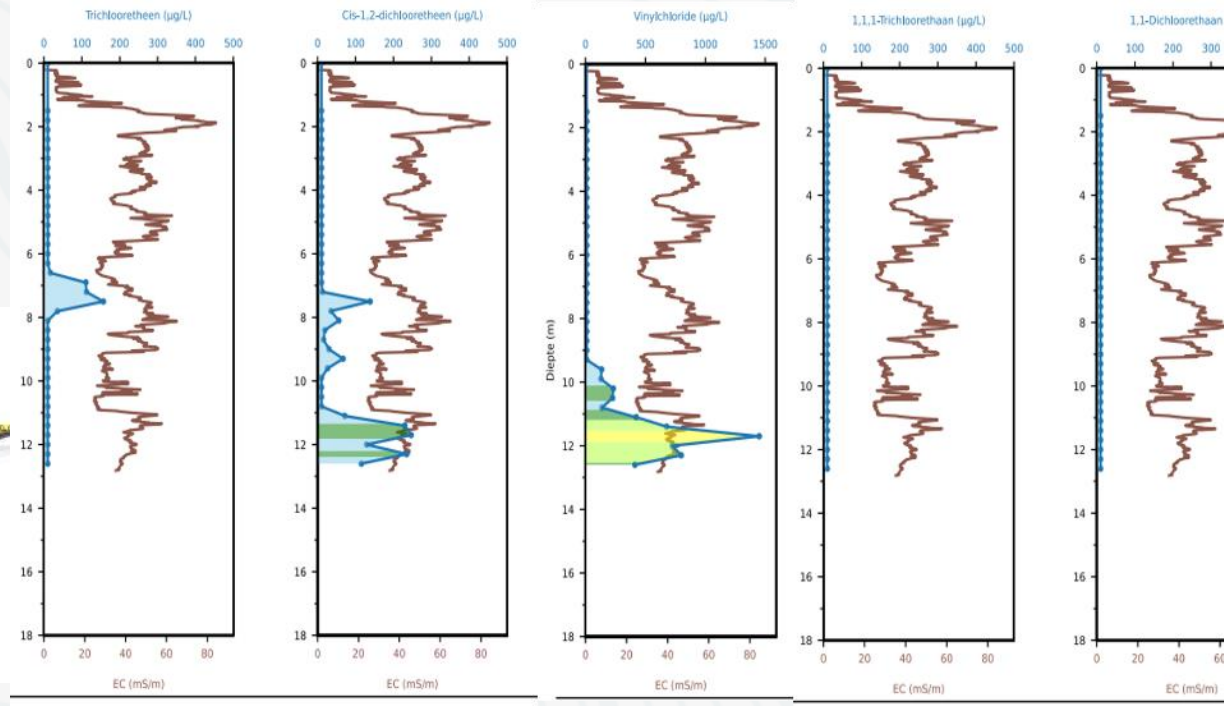
Diepteverschuiving van de resultaten!



EnISSA MIP

DETECTION OF INDIVIDUAL VOC's

- EnISSA: Lab in the Field
  - MIP rechtstreeks aangesloten op GC-MS
    - Individuele detectie van 12 verbindingen elk 1 min
    - Gedetailleerde informatie over afbraakproducten
    - Lage detectiegrenzen voor pluimafbakening

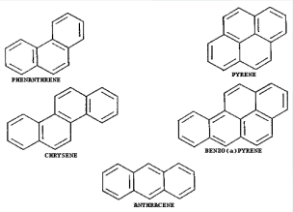


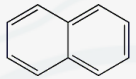
EnISSA –MIP componenten lijst

- Chlorinated Solvents:
  - PCE; TCE; cis-1,2-DCE; 1,1-DCE, trans-1,2-DCE, VC
  - 1,1,1-TCA; 1,1,2-TCA; 1,1-DCA; 1,2-DCA, chloorethaan
  - Tetrachloormethaan, Trichloormethaan, dichloormethaan, chloormethaan
  - Freons
  - Monochlorobenzene,
  - ….
- BTEX, Naphthalene
- MTBE, TBA
- trimethylbenzene
- tetrahydrofuran, aceton, Isopropyl Alcohol, hexaan, methyl-hexaan, cyclohexane, Diethyl ether, MEK, n-butylacetate
- Indane, indene,
- 2,2,5,5-Tetramethyltetrahydrofuran , 2-methyl-2-propanol
- tetrahydrothiophene

Specifieke dieptecorrectiefactor voor naftaleen

MIP is beperkt tot de detectie van vluchtige stoffen. PAK's ? Naftaleen meest vluchtige en meest mobiele



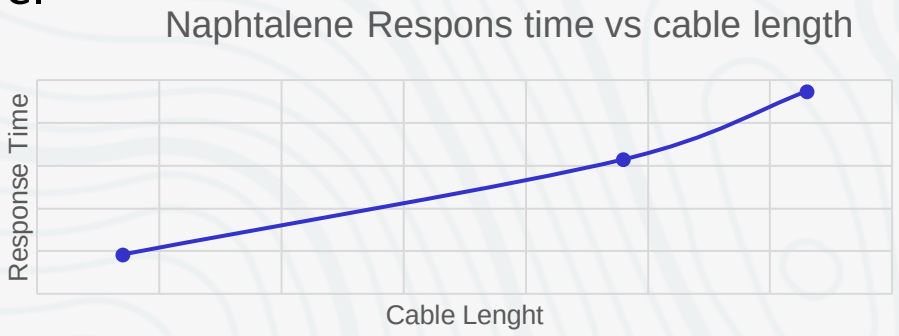


Laboratoriumtest:

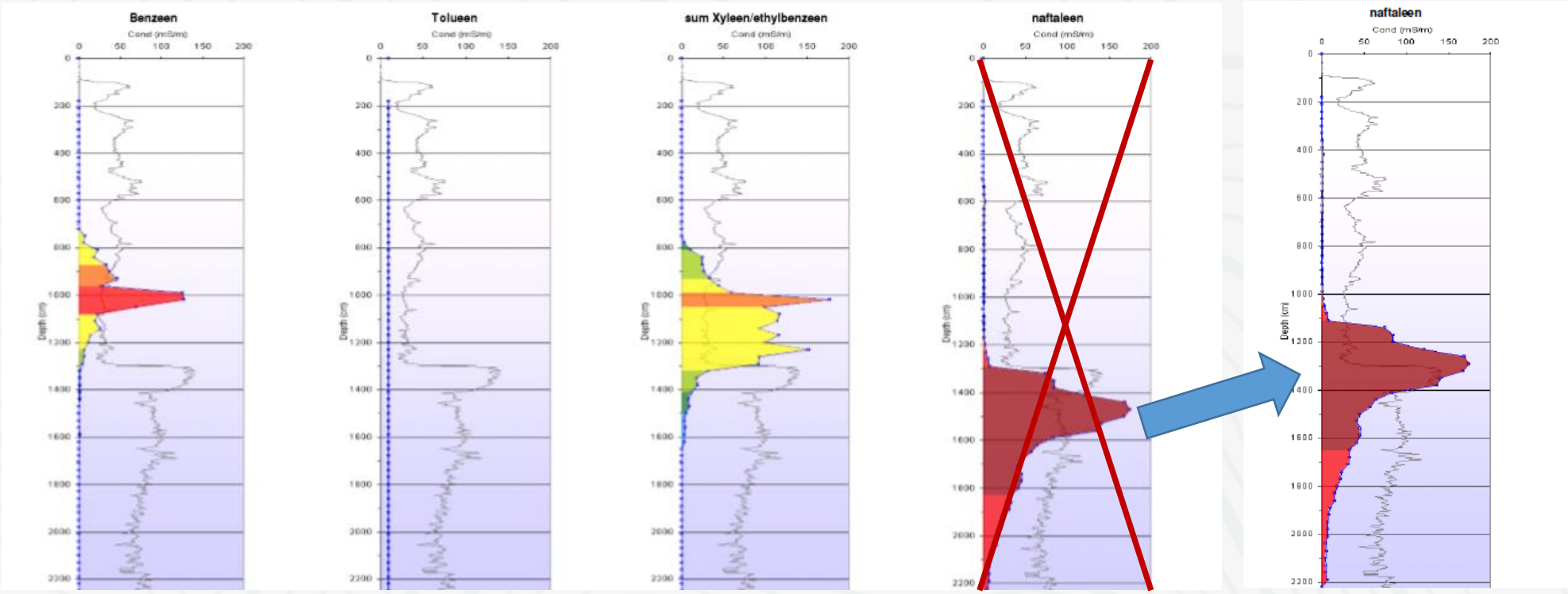
GCMS Methodeontwikkeling voor gelijktijdige detectie van BTEX en naftaleen

MIP-respons Naftaleen: tijdsverschil met BTEX

langere reistijd: gerelateerd aan de interactie in de kabel



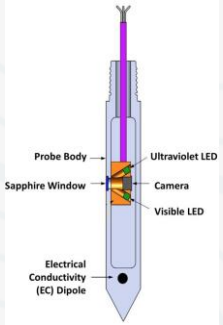
Specific depth correction factor for Naphthalene

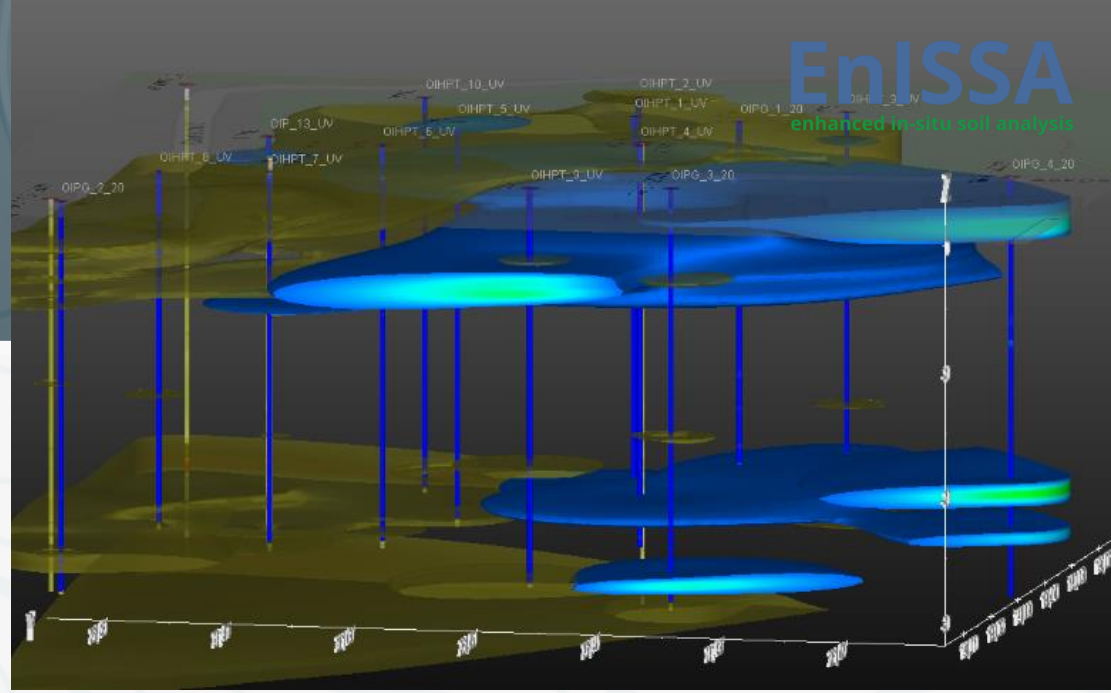


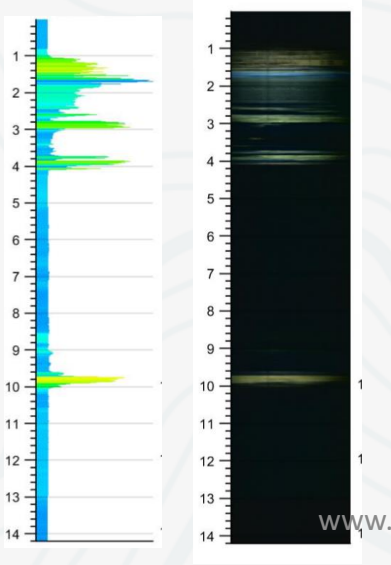
HRSC Tools: Optical Image Profiler

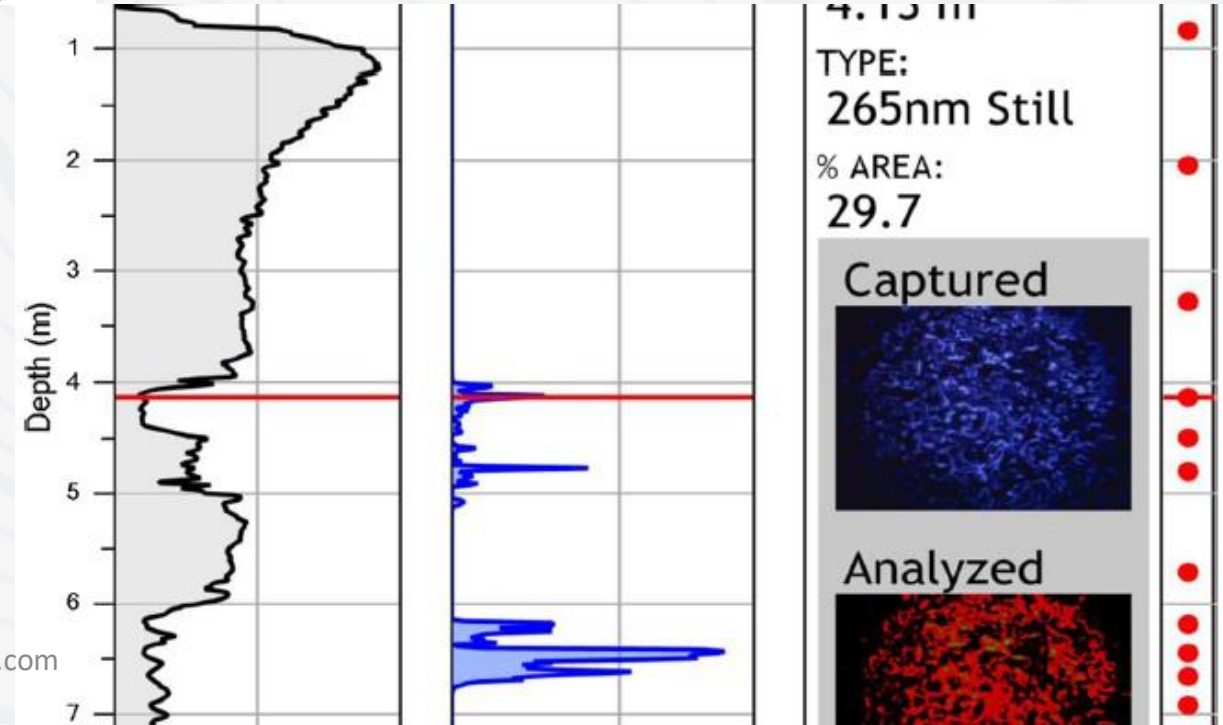
- New Geoprobe ™ direct push tool for determination of presence and distribution of petroleum NAPLs in the subsurface

- Fluorescence of PAH's is induced by UV or green LEDs and captured by the in-probe Camera







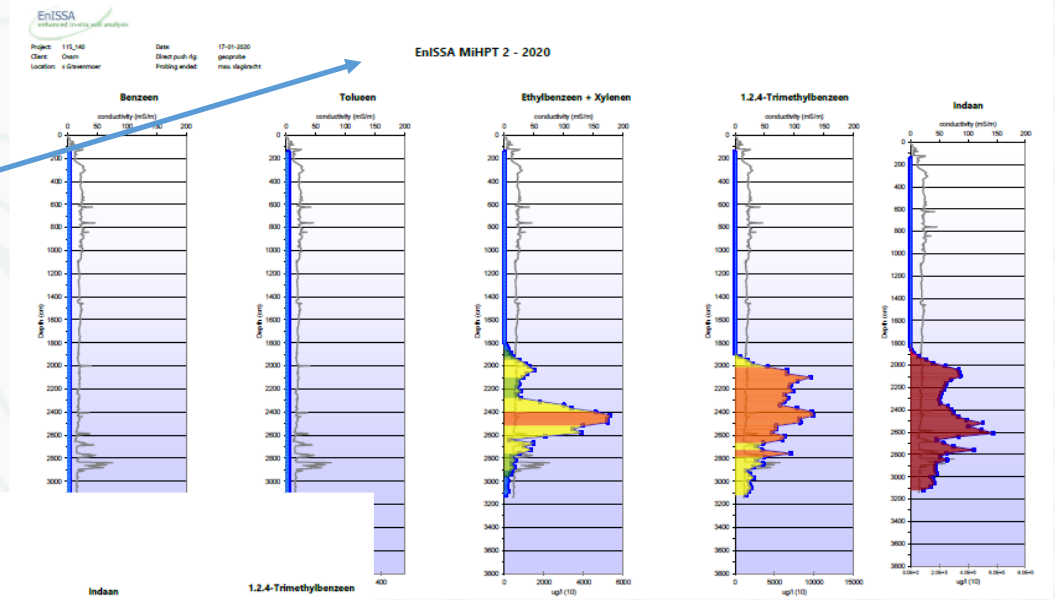


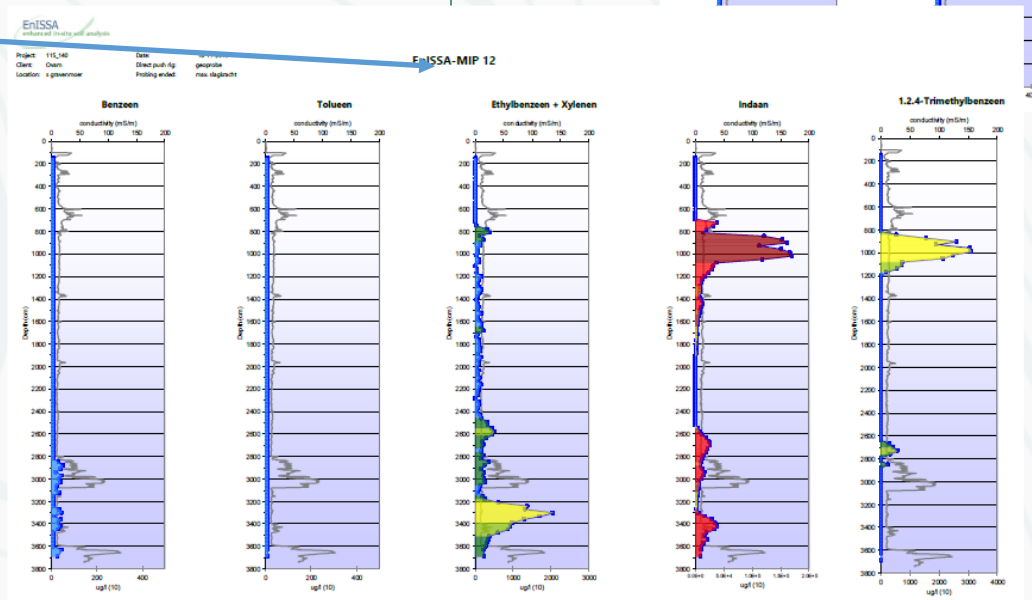
Update Conceptueel Site model: s Gravenmoer

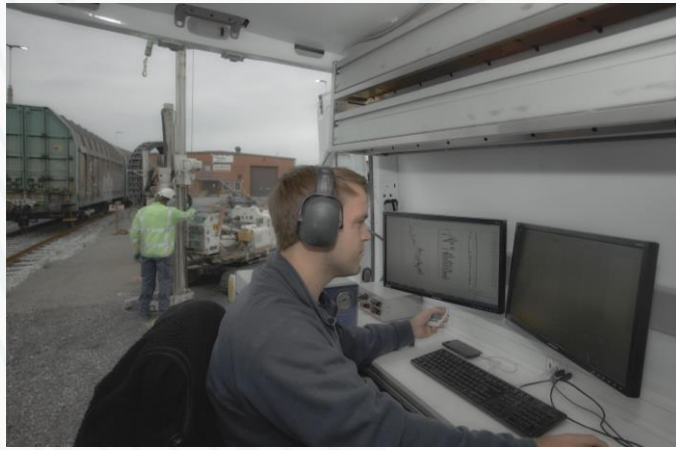
EnISSA- MIP

MIP met GCMS detectie

- In zones waar geen OIP signaal meer gemeten werd
- Evaluatie van grondwaterconcentraties





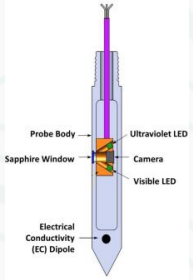


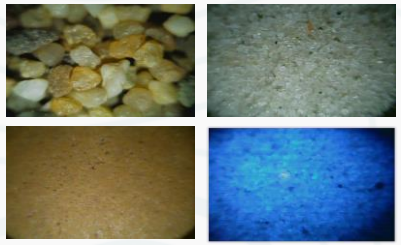
resanat
Natuurlijk saneren we de bodem

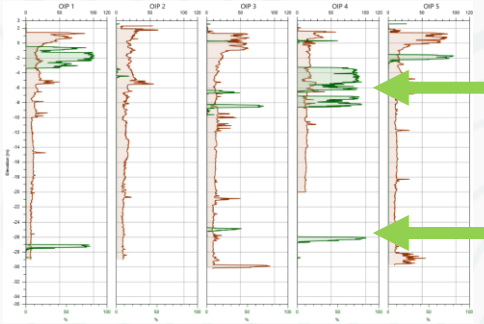
Update Conceptueel Site model: s Gravenmoer

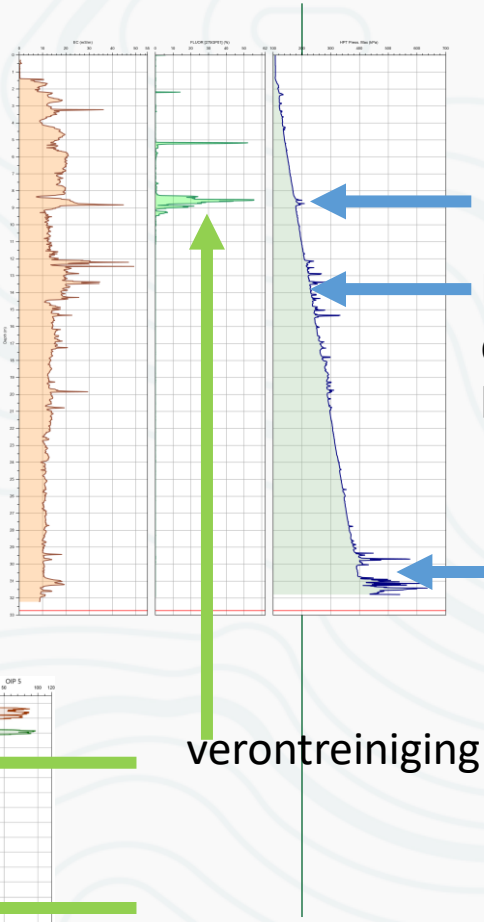
Optical Image Profiler OIP +

Hydraulic Profiling Tool



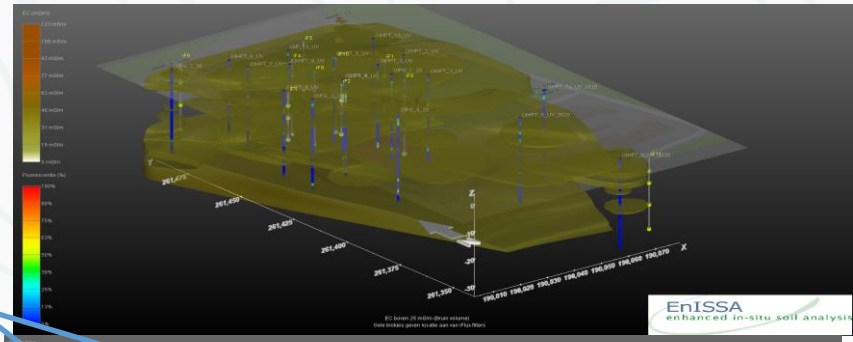


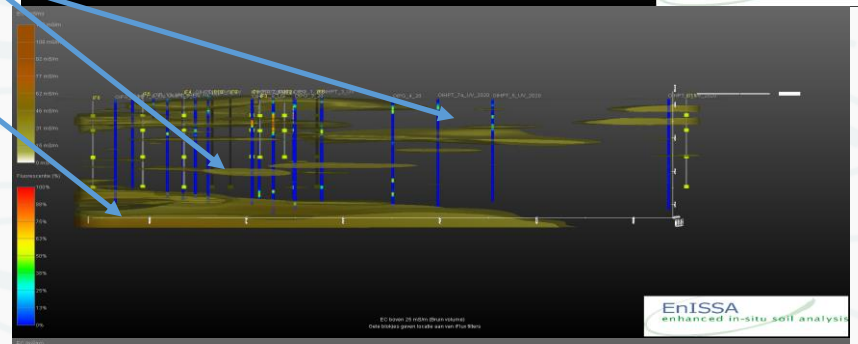


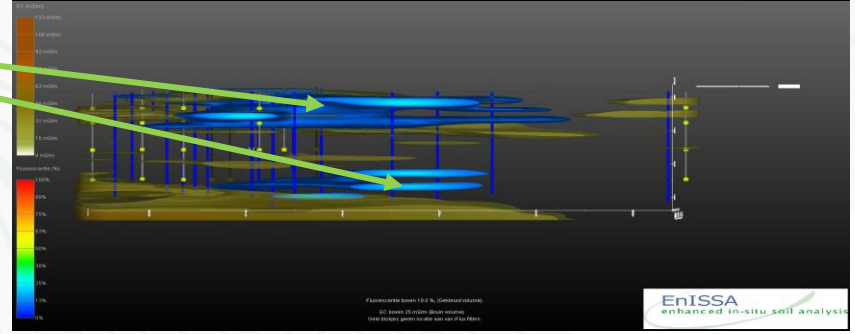


Minder doorlatende lagen

verontreiniging

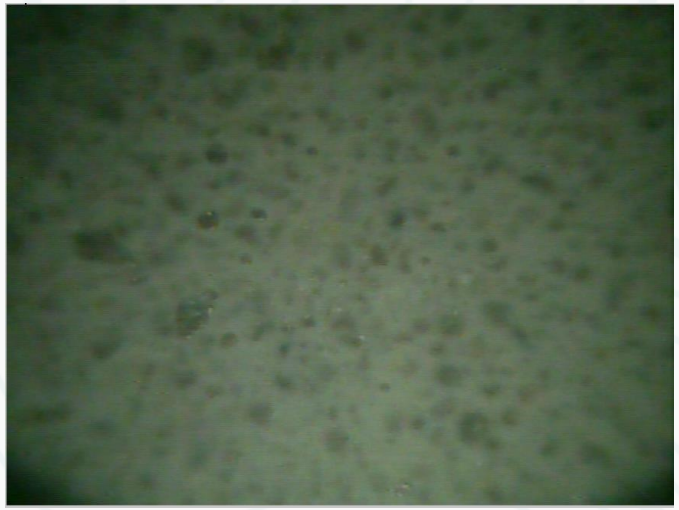






resanat
Natuurlijk saneren we de bodem

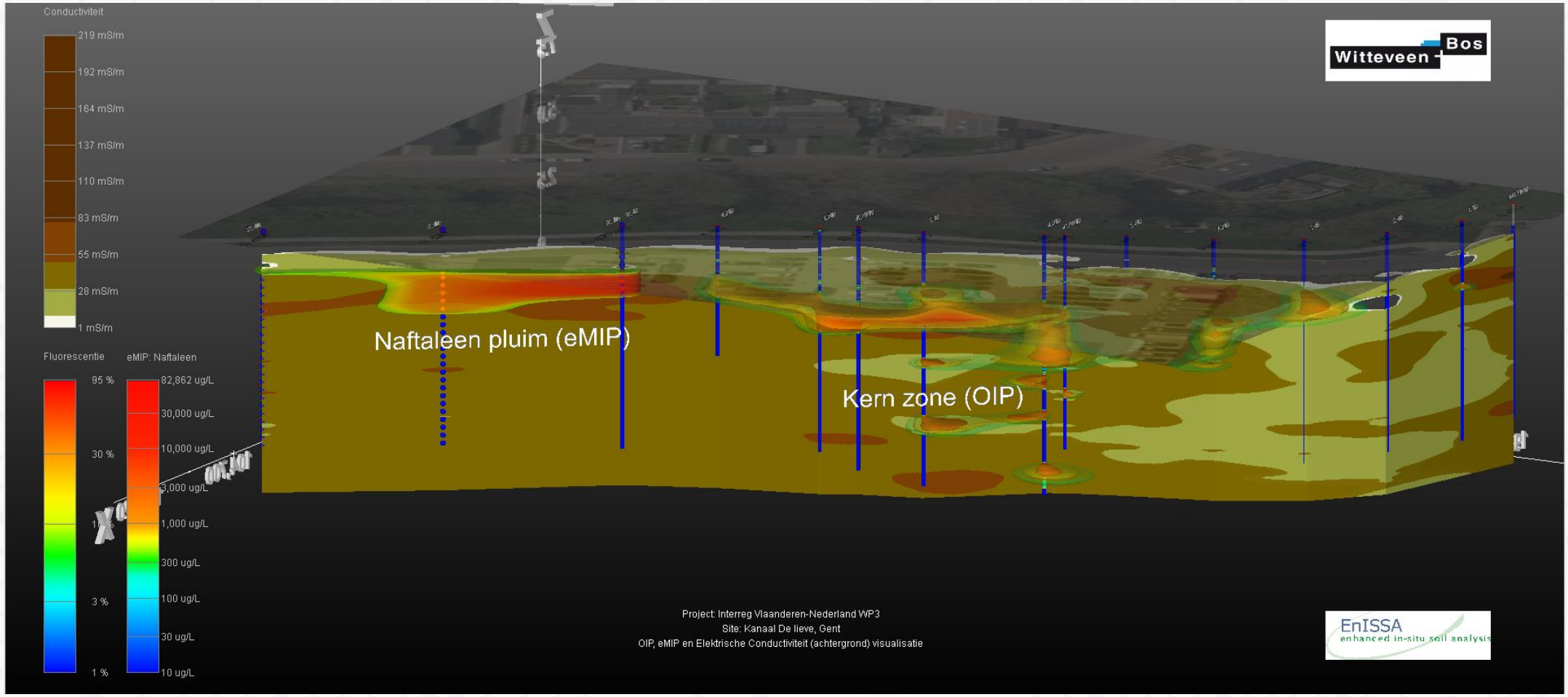
Creosoot in beeld



Update Conceptueel Site model: 3D viewer

Viewer.ctech.com

Update Conceptueel Site model: De Lieve



Info@EnISSA.com

@EnISSA -Enhanced in Situ Soil Analysis

Gorislaan 49
1820 Steenokkerzeel
Belgium
Tel +32 2/759.59.30