

Sustainable management of contaminated sites

Presentation 2.3

Soil and groundwater survey equipment

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October, 2021

Soil and groundwater sampling equipment

Content

- Smart start know what you measure
- Aim of the field engineering equipment
- Principles of sampling
- What do we need to know



Soil and groundwater survey equipment

Smart start Know what you measure*

- **There is a Dutch saying:**
- *...Meten is weten!... (To measure is to know!)*
- **Combine that with the Latin saying:**
- *... Scientia potentia est ... (Knowledge is power)*
- **That tells us:**
- *If we measure, we know, if we know we can act correctly*

Soil and groundwater survey equipment

Aim of the field engineering equipment*

- Research and sampling of the
 - ✓ Soil above the groundwater or vadose zone or unsaturated zone
 - ✓ Soil and groundwater below the groundwater or saturated zone
 - ✓ Sediment below surface water
- The central question in environmental soil and groundwater survey is:
Is the concentration in the sample above a certain threshold limit value ?
- **Incorrect sampling means incorrect analysis and conclusions!**



Or

Rubbish in is rubbish out!

Soil and groundwater survey equipment

Principles of sampling

- **Destructive sampling for off-site/laboratory analyzes**
 - ✓ A sample is abstracted from the medium
 - ✓ Sample is packed & transported
 - ✓ Sample is analyzed off-site
- **Destructive sampling for on-site, ex-situ analyzes**
 - ✓ A sample is abstracted from the medium
 - ✓ Sample is analyzed on-site
- **Non-destructive sampling for on-site in-situ analyzes**
 - ✓ No sample is abstracted from the medium
 - ✓ Characteristics are established by remote sensing



Soil and groundwater survey equipment

What do we need to know?

Destructive soil & aquatic sediment sampling for off-site analyzes

- Borehole specifications, location and installation technique
- Soil texture identification method
- Soil profile description and recording method
- Sensorial observation description and recording method
- Soil sampling technique
- Aquatic sediment sample specification and location
- Aquatic sediment sampling technique
- The packaging and preservation of samples
- HSE rules
- Cross contamination prevention method
- Decontamination technique
- Systematic sample coding and labeling method
-



Soil and groundwater survey equipment

What do we need to know?

Destructive groundwater sampling for off-site analyzes

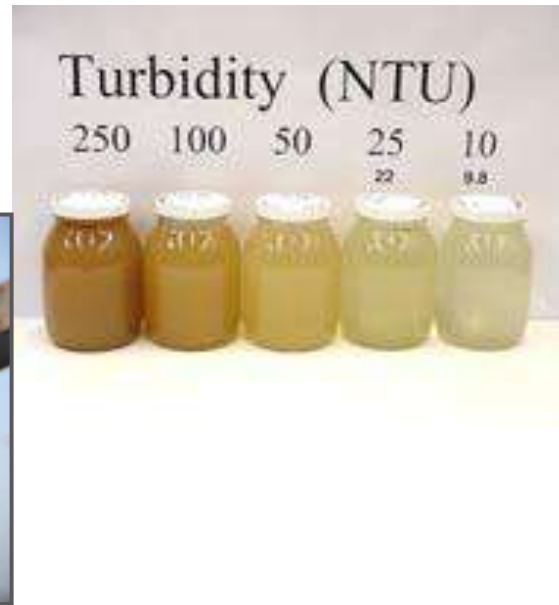
- Groundwater well specifications, location and installation technique
- Groundwater well description and recording method
- Development and purging of wells technique and method
- Groundwater sampling technique
- The packaging and preservation of groundwater samples
- Groundwater table measurement technique and recording
- Measurement technique and recording the thickness of LNAPL
- HSE rules
- Cross contamination prevention method
- Decontamination technique
- Systematic sample coding and labeling method
-



Soil and groundwater survey equipment

Aim of the field engineering equipment*

How to get the most representative sample and therefore, the most representative data?



*Slide prepared by Eijkelkamp



Soil and groundwater survey equipment

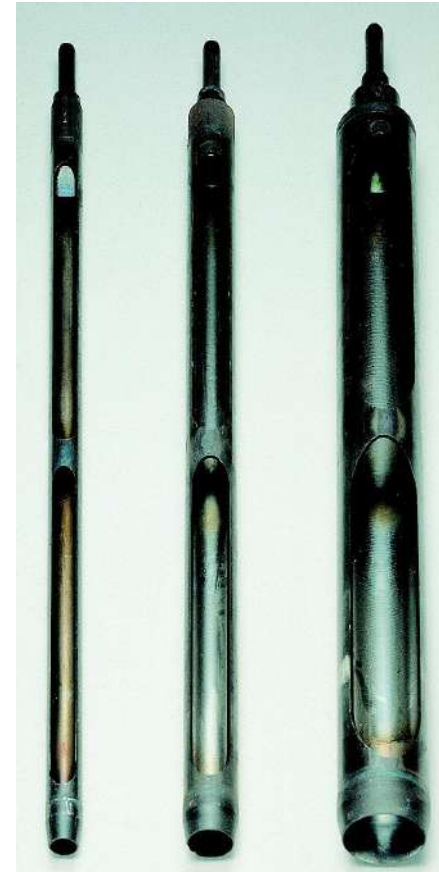
Soil sampling for non-volatiles*



Manual work to
gouge debris-rich
soils



Electric
percussion
gouge and/or
digging or
excavator for
debris-rich soils



Manual gouging to explore
soft soils

Soil and groundwater survey equipment

Soil sampling for non-volatiles*

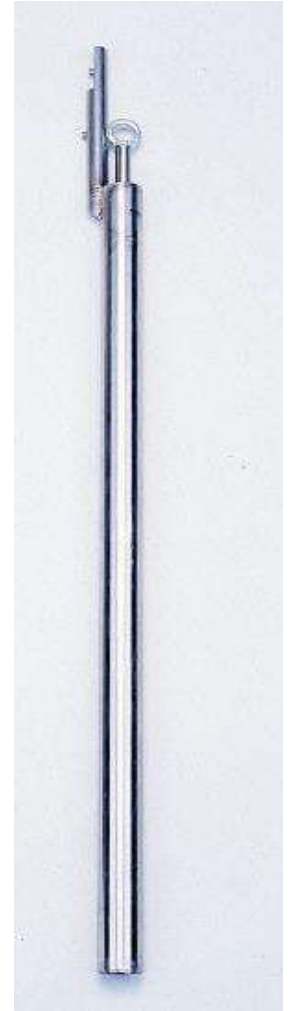
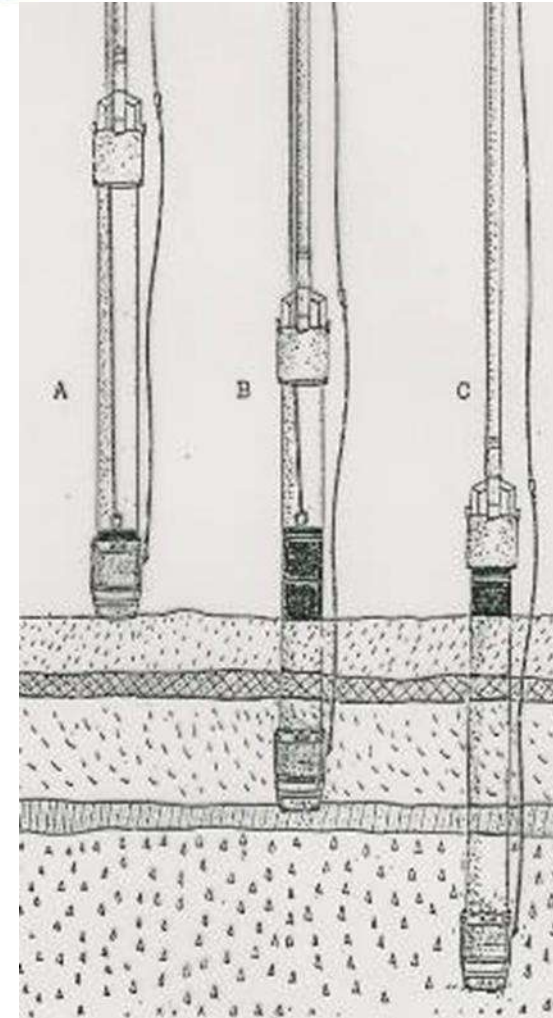


- Drill bids for manual drilling in soft soils
 - ✓ Edelman auger
 - ✓ Sand auger
- Drill bids for manual drilling in hard, dry or loose soils
 - ✓ Riverside for gravel
 - ✓ Spiral auger for stone

Soil and groundwater survey equipment

Soil sampling below groundwater*

- In non-cohesive below groundwater
 - ✓ Coring tubes
 - ✓ Piston sampler
- In cohesive below groundwater
 - ✓ Edelman auger



Soil and groundwater survey equipment

Main errors borehole installation, profile description and sampling*

- Incorrect interpretation of soil horizons
- Incorrect depth determination
- Missing of soil horizons
- Loss of volatile compounds from sample
- Cross contamination
- Mixing up soil types during drilling and sampling
- Not using standard bore logs
- Loss of sample
- Incorrect sample labeling
- Incorrect recording
- Not maintaining could chain
-



Soil and groundwater survey equipment

Cross-contamination can be caused by

- Smearing of soil during drilling
- Contaminated material from above falls in borehole
- Contact of soil samples and/or drilling equipment with
 - ✓ Contaminated (soil) surfaces
 - ✓ Contaminated standing water
- Use of contaminated sampling container
- Use of contaminated material and/or drilling equipment
- Insufficiently clean state of drilling equipment



Soil and groundwater survey equipment

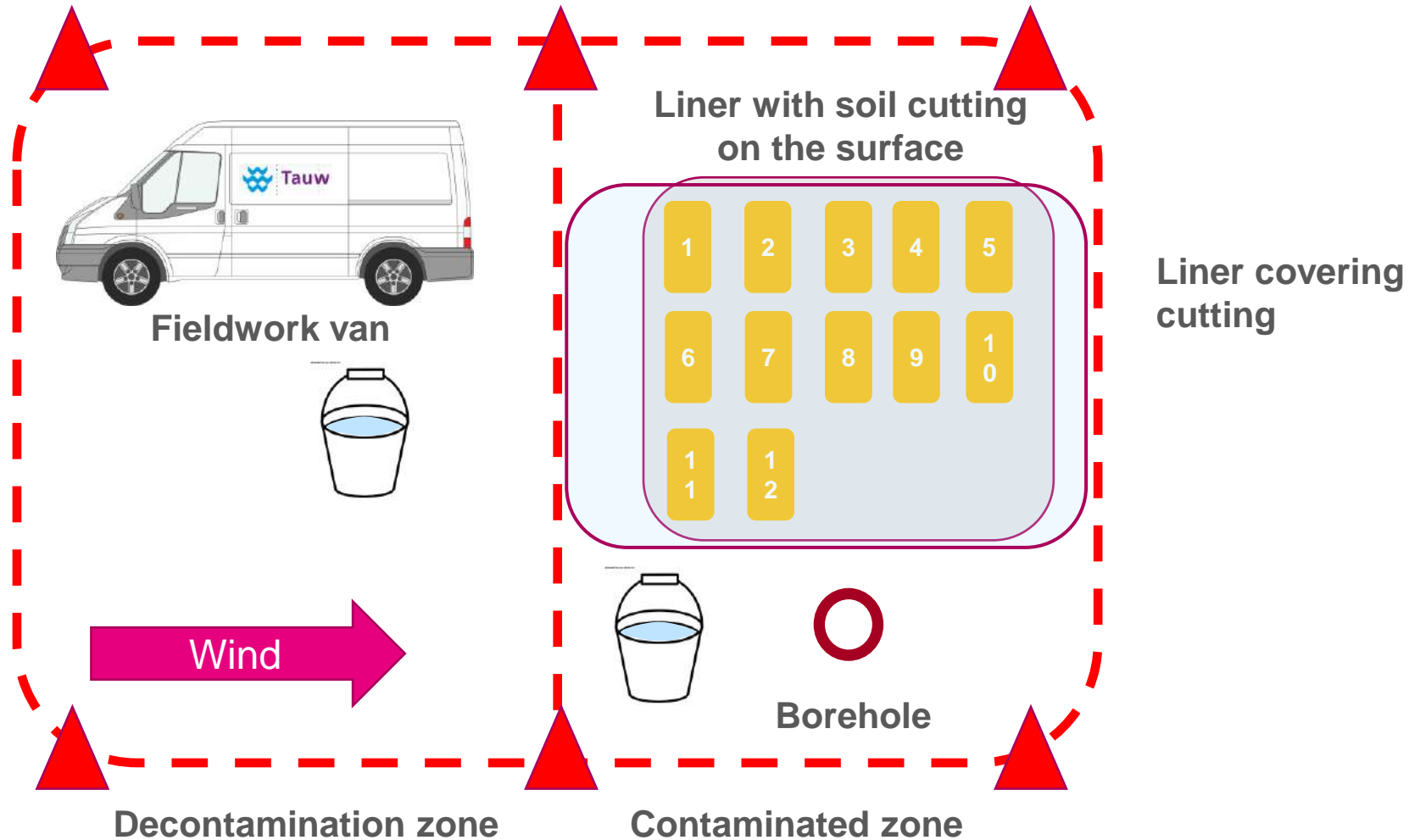
Preventing cross-contamination soil sampling*

- Sample on soil surface - always use clean plastic foil
- Proper and clean equipment
- Soil cuttings are positioned in the sequences taken from the borehole
- Implement and enforce HSE zoning
- Decontaminate equipment before every sample



Soil and groundwater survey equipment

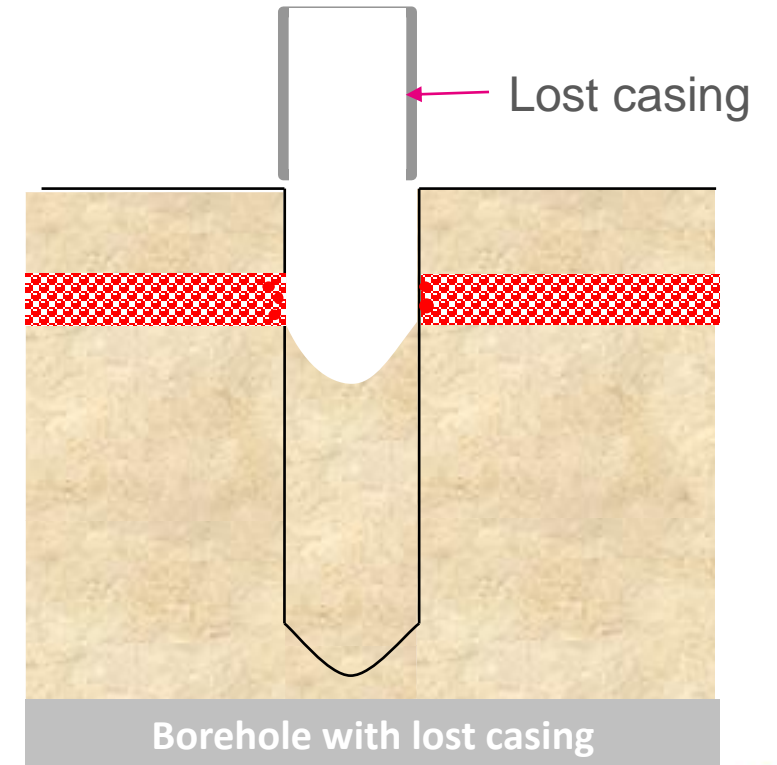
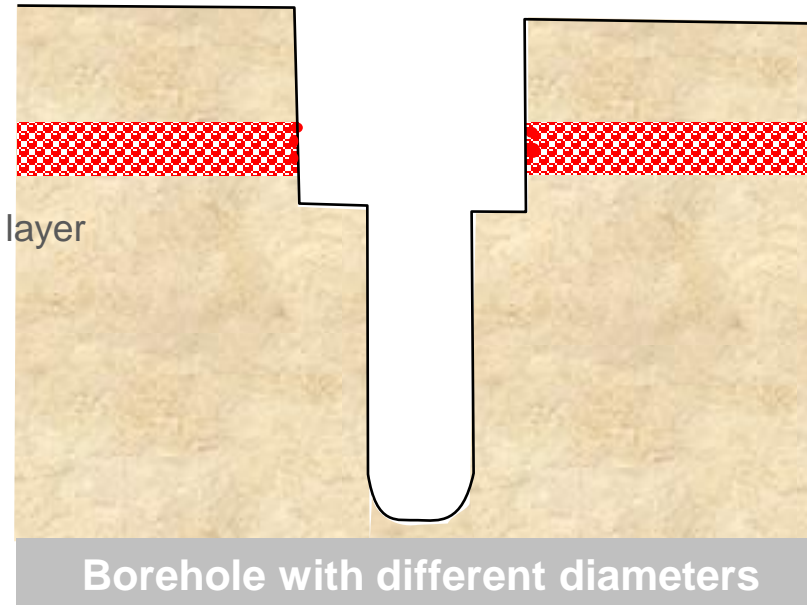
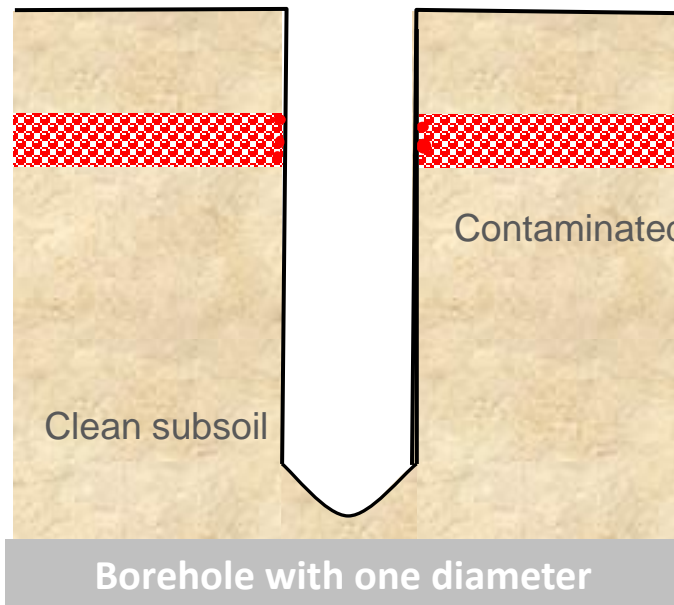
HSE Zoning at sample location



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Cross-contamination

- Prevent contamination of deeper layers by loose contaminated material in the borehole
 - Drill with a larger diameter to below the contaminated layer and continue with a smaller diameter
- Or
- Use lost casing



Soil and groundwater survey equipment

Hand operated soil & aquatic sediment sampling

Auger type	Depth m	Bedrock	Clay loam peat	Sand		Coarse		Samples	
				groundwater		Stones & gravel	Rubble	Disturbed	Undisturbed
				Above	Below				
Edelman	8	-	+	+	-	-	-	+	-
Bailer	8	-	-	-	+	-	-	-	-
Piston	8	-	+	+	+/-	-	-	+	+
Gouge	8	-	+	+/-	-	-	-	+	+

Soil and groundwater survey equipment

Mechanical operated soil & aquatic sediment sampling

Auger type	Depth m	Bedrock	Clay loam peat	Sand		Coarse		Samples	
				groundwater		Stones & gravel	Rubble	Disturbed	Undisturbed
				Above	Below				
Hollow stem	40	-	+	+	+/-	-	+/-	-	+
Solid stem	40	-	+	+/-	-	-	+/-	+	-
Percussion gouge	8	-	+	-	-	+	+	-	+
Tricone	>100	+	-	-	-	+	+	-	-
Rotary core	>100	+	-	-	-	+	+	-	-
Bailer	150	-	+/-	+	+	-	-	+	-

Soil and groundwater survey equipment

Undisturbed sample in borehole

- Bailer with casing allows tube sampling
- Hollow stem auger allows split spoon sampling
- Solid stem auger with casing allows tube sampling
- Tri-cone drilling with casing allows tube sampling
- Rotary drilling with casing allows tube sampling

Soil and groundwater survey equipment

Soil sampling volatiles with coring set*

- Coring tubes in stainless steel for sample storage
- Stainless steel filling blocks to fill empty space
- Preferably horizontal transport



Soil and groundwater survey equipment

Soil sampling volatiles with mini coring set*



*Slide prepared by Eijkelkamp



Soil and groundwater survey equipment

Soil sampling volatiles with Methanol extraction method*

ISO 22155 Methanol extraction method

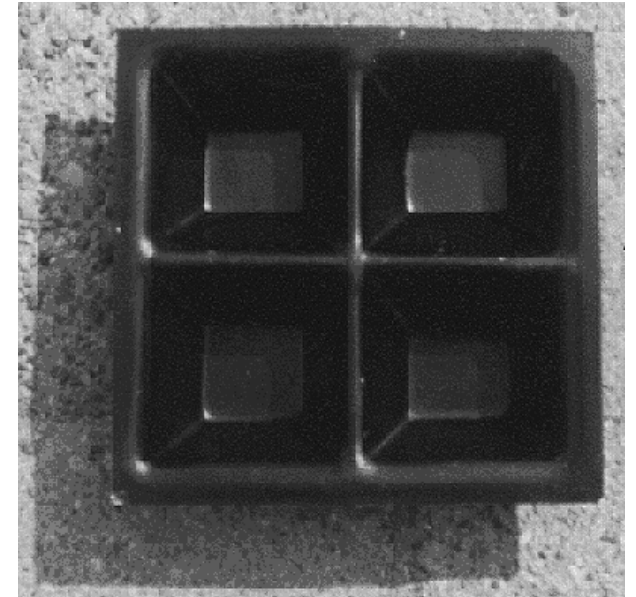
- To sample volatile substances in the field
- A bottle is filled with methanol and soil sample
- Volatile substances will dissolve in methanol
- On-site extraction



Soil and groundwater survey equipment

Sensorial observation

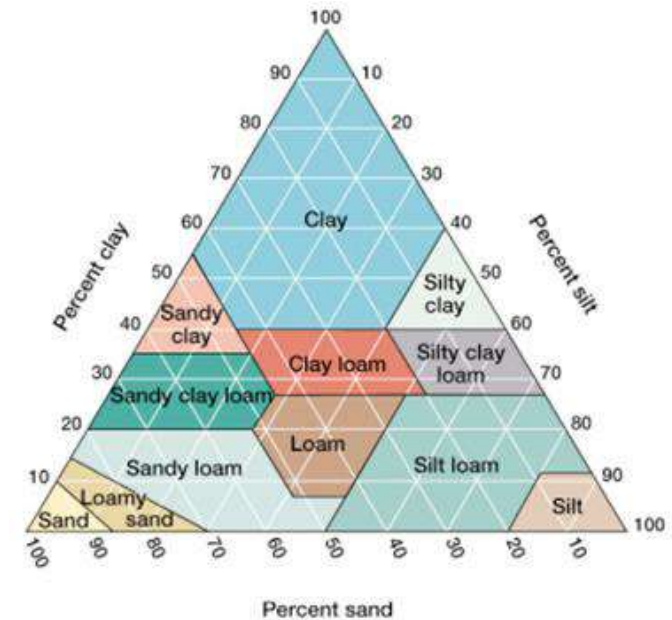
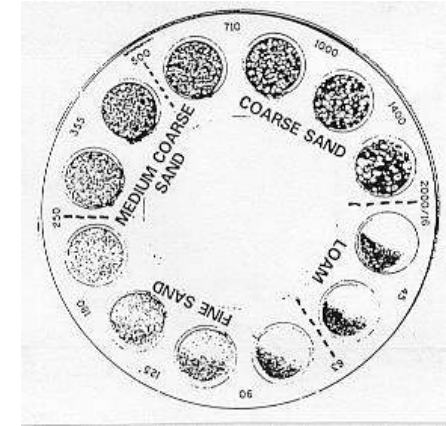
- To detect the presence of anthropogenic / extraneous materials and odour in soil
- Do not take risks while making sensory observations. Certain substances can create adverse health effects when inhaled or allowed to come into contact with skin
- Use simple oil pan for detection oil
- Describe soil layers
 - ✓ Thickness
 - ✓ Colours
 - ✓ Texture
 - ✓ Structure



Soil and groundwater survey equipment

Soil texture

Particle size (μm)*	Description
0 – 2	Clay fraction (the grains are invisible)
2 – 63	Silt fraction (the grains become powdery when rubbed dry)
63 – 2,000	Sand fraction
2,000 – 63,000	Gravel fraction
> 63,000	Stone fraction



*1 μm / 1 micron = 0,001 millimetre

Soil and groundwater survey equipment

Bore logging & sample identification

Bore logging

- Project number
- Project title
- Name of foreman driller
- Date of execution
- Soil layers
 - ✓ Depths of the bottoms
 - ✓ Texture
 - ✓ Odors given off
 - ✓ Colors
 - ✓ Number of samples taken
- Groundwater level
- Boring systems used
- Results oil detection pan
- Depth of the filter's

Sample identification

- Site identification number
- Site name
- Company name
- Name of sampler
- Sample code
- Section depth
- Date of sampling



Soil and groundwater sampling equipment

Purpose of monitoring well installation and groundwater sampling*

Groundwater sampling are taken from monitoring wells which are purged before sampling

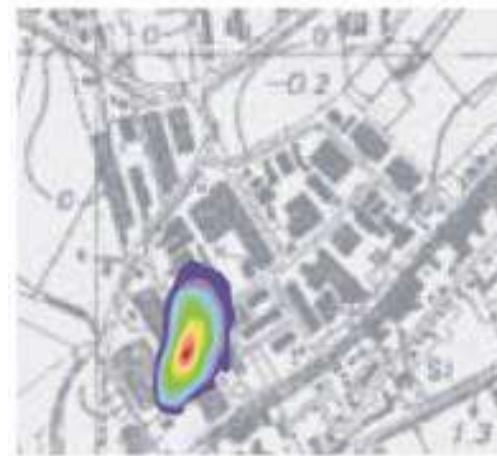
- The objective is to have a representative groundwater sample
- During purging field measurements of the sampled water are taken (pH, EC, DO or turbidity, ...)
- Clean field equipment is essential



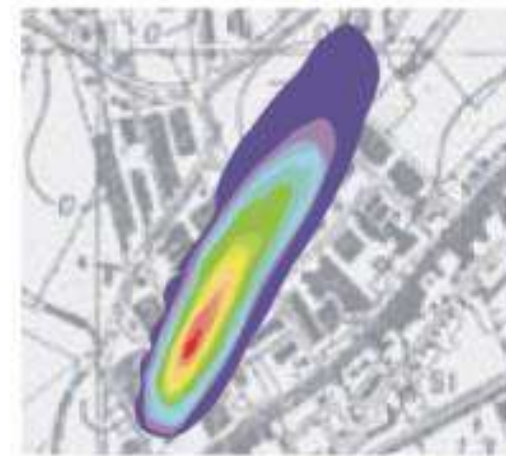
Soil and groundwater survey equipment

Purpose of monitoring well installation and groundwater sampling*

- For sampling and analyzes of groundwater samples
- Detect and measure DNAPL and LNAPL
- Groundwater level survey: hydrological research



Figuur 18a: Actuele pluim.



Figuur 18b: Pluim over 10 jaar.

*Slide prepared by Eijkelkamp



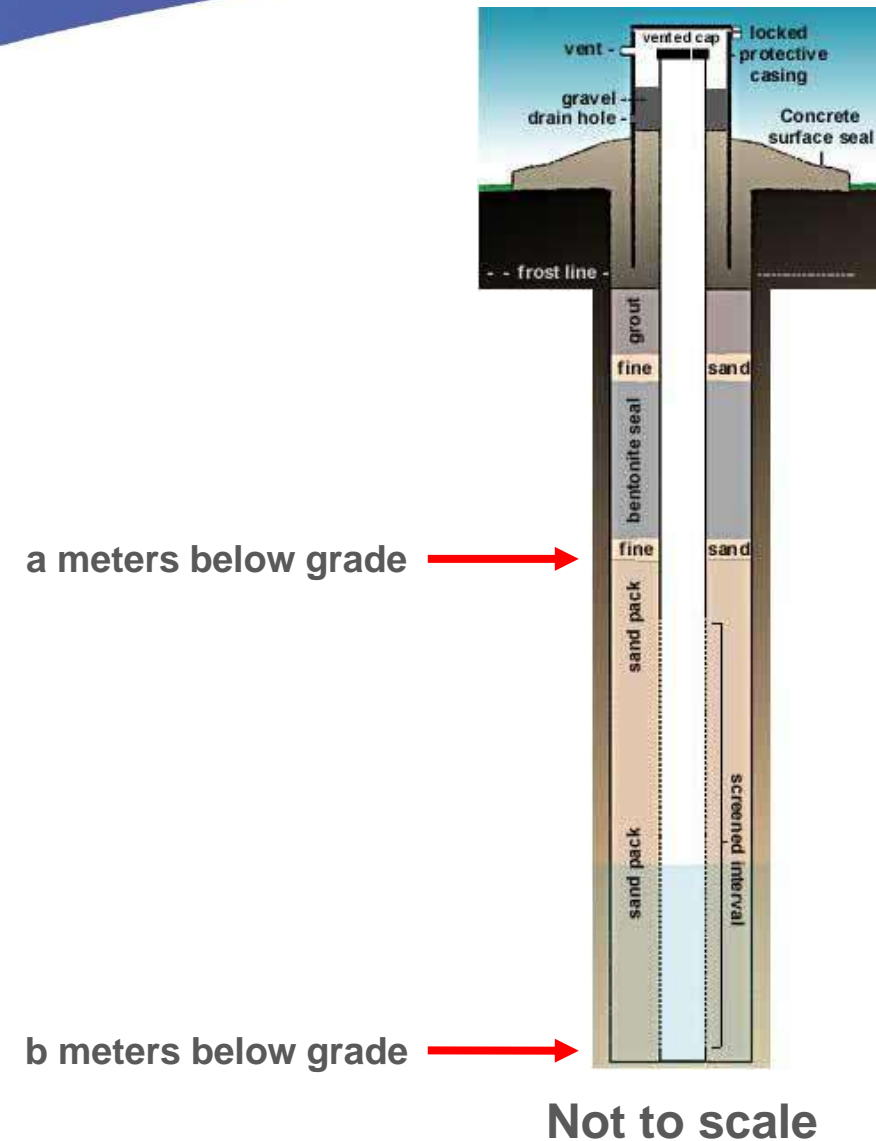
Soil and groundwater survey equipment

Design monitoring well

Monitoring well installation in accordance with SIKB VKB 2001

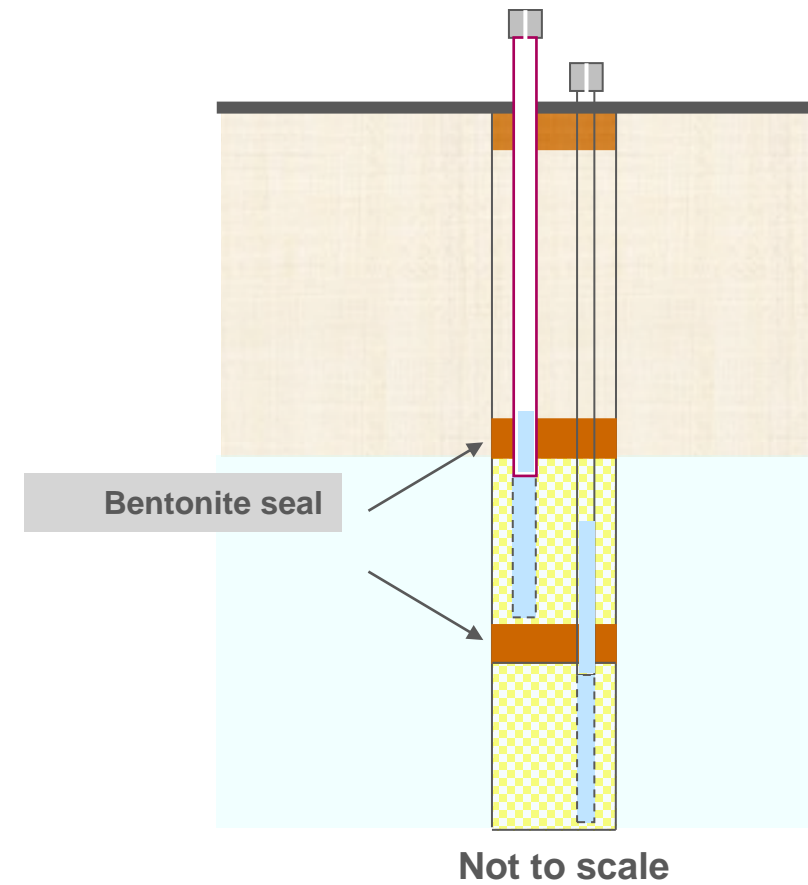
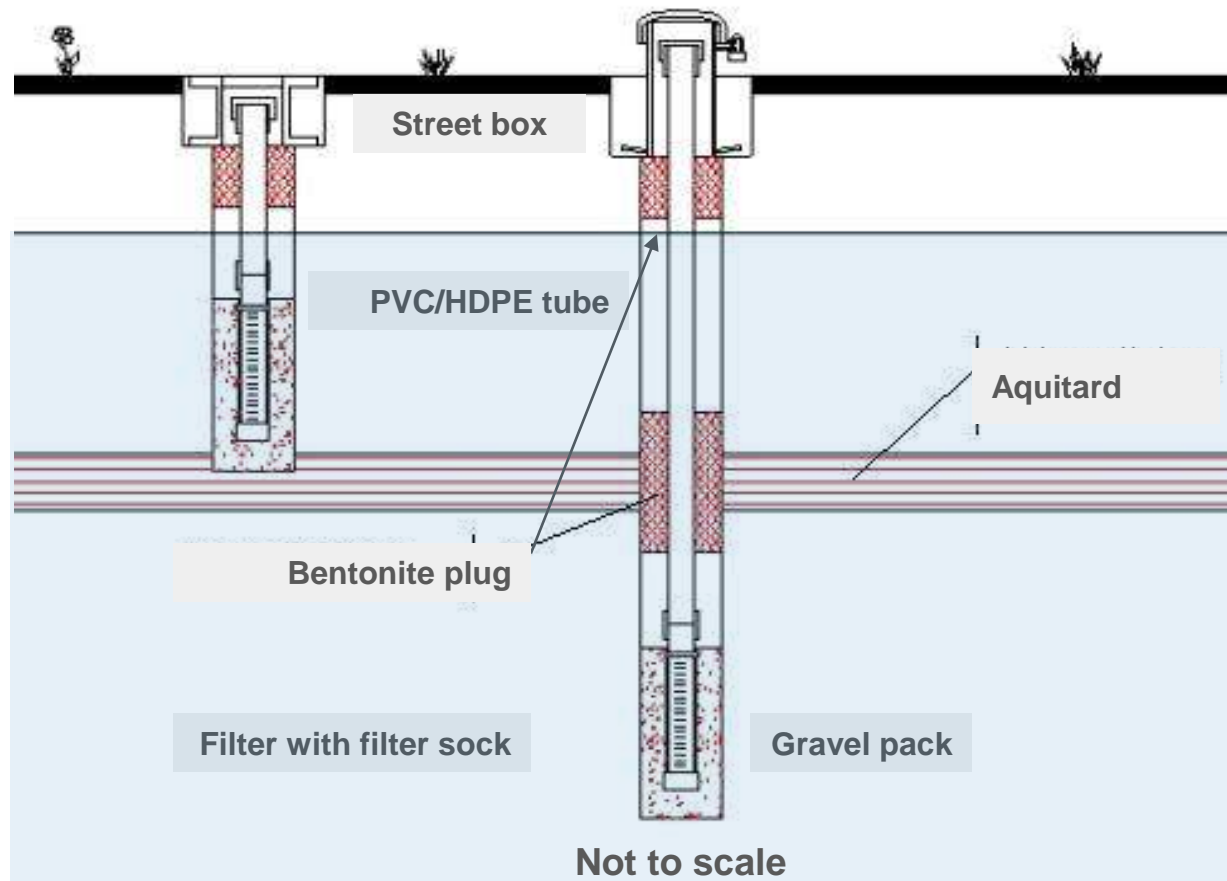
Specification Observation well

- Material filter HDPE
- Casing HDPE
- Min Diameter 32 mm
- Slots filter 0,3 mm
- Nylon Filter sock around filter
- Label with
 - ✓ Well number
 - ✓ Project code and name
 - ✓ Installation date
 - ✓ Well depth
 - ✓ Filter depth
 - ✓ Name installer



Soil and groundwater survey equipment

Design observation well



Soil and groundwater survey equipment

Design observation well*

- Prevent cross contamination
- Repair impermeable layers in the borehole by installing Bentonite plug(s)
- Pump the well clean after constructing by pumping groundwater at least 3 times the volume of the borehole
- When a LNAPL present and the groundwater must be sampled lost casing has to be used
- When a LNAPL needs to be measures the filter screen must cross the groundwater table

Soil and groundwater survey equipment

Groundwater sampling

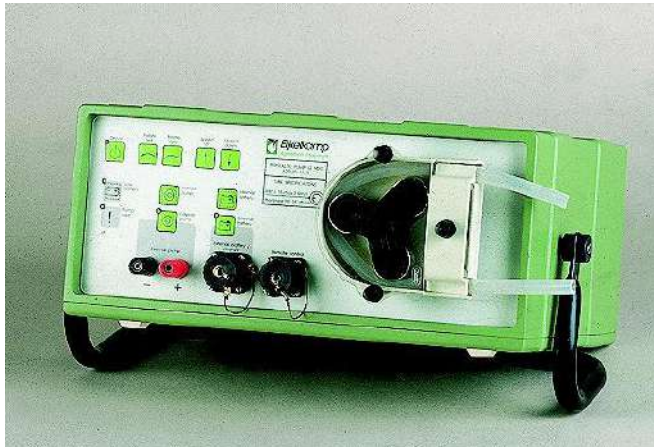
- Wait minimal 1 week before sampling
- Use clean materials such as pump, tubing and flow cell
- Use new materials such as hose and sample bottles
- Purge monitoring well till EC and O₂ are constant
- Measure / describe turbidity / optical determination of water clarity
- Label the bottle correct
- Take samples
- Sample for dissolved heavy metals; filter with 0,45 micron
- No filtration for volatile and non-volatile parameters
- Use conservation liquid (acid) when necessary
- Fill bottle without head space
- Transport sample under cold chain



Soil and groundwater survey equipment

Groundwater sampling*

- Hand driven pump
- Electrical driven



Peristaltic pump
Sampling dept max 8 m



Impellor pump
Sampling dept max 31 m



Impellor pump
Sampling dept max 80 m

*Slide prepared by Eijkelkamp



Soil and groundwater survey equipment

Groundwater sampling*



Multi-meter



Flow through cell



Multi-meter

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Soil and groundwater survey equipment

Groundwater sampling*



LNAPL DNAPL
measurements



Turbidity meter



Water level

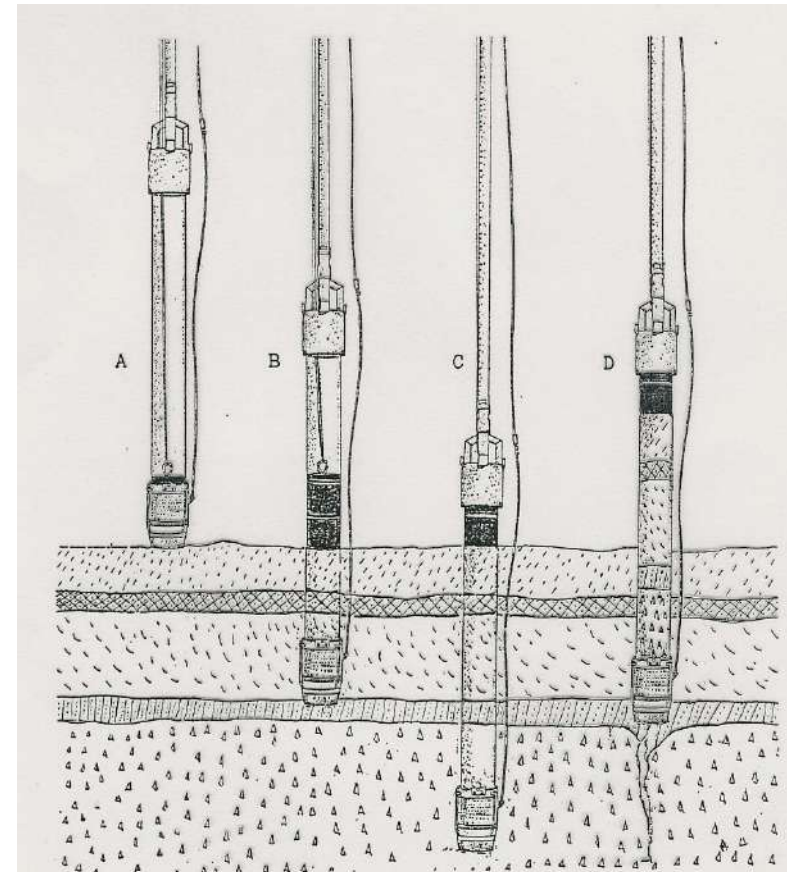


Filter 0,45 micron

Soil and groundwater survey equipment

Sediment sampling*

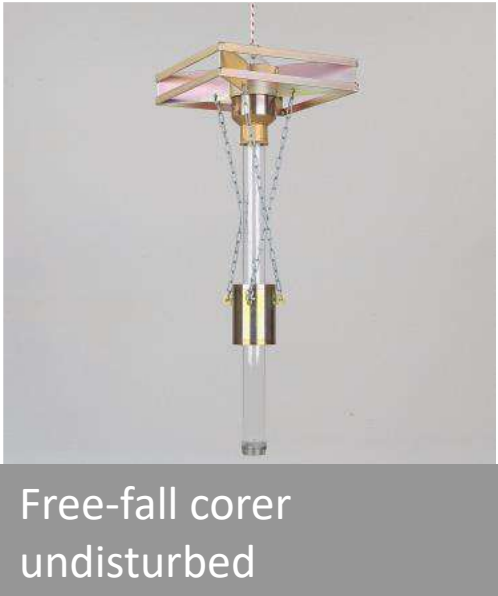
- Core sampling (with/without piston)
- Grab sampling
- Disturbed/undisturbed sampling



*Slide prepared by Eijkelkamp

Soil and groundwater survey equipment

Sediment sampling*



*Slide prepared by Eijkelpamp



Soil and groundwater survey equipment

Soil gas sampling

Soil gas sampling and on-site Measurements

- O_2
- CO_2
- CH_4



Installing gas extraction probe

Landfill gas measurements



Soil and groundwater survey equipment

Dangers for sampling*

Wrong sampling + analysis means wrong conclusions!

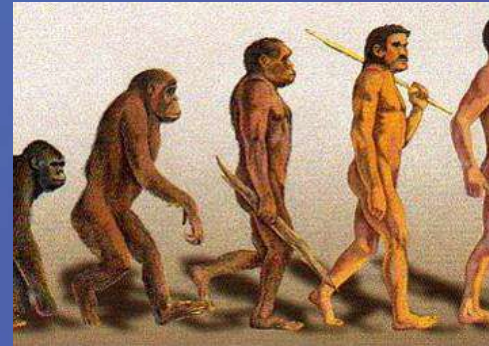
- A sample should be representative!
- **Rubbish in means rubbish out!**
- Know what and how you measure!



*Slide prepared by Eijkelkamp



Questions?



Contact



Thank you for your attention

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