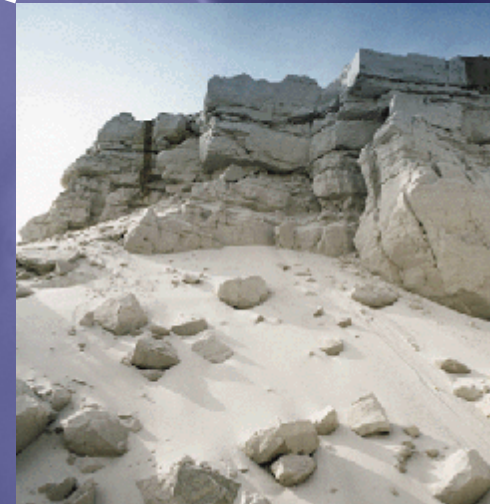


Nabron

Naturally increased levels of Arsenic in the coastal provinces of the Netherlands

Nederlands Instituut voor
Toegepaste Geowetenschappen TNO



What is the problem

- **How to deal with naturally occurring high arsenic levels?**
 - Current regulations in the Netherlands: concentrations $>$ intervention value \rightarrow then clean-up / remediation
- **Inventory of existing problems of policy-makers**
 - Large area with similar problems : AREA-SPECIFIC
 - Local problems: building permits/ excavations...

Legislation Netherlands

	SOIL	GROUNDWATER
Intervention value (NL)	55 mg/kg d.s	60 ug/l
Guideline value (WHO)	29 mg/kg d.s.	10 ug/l

Advice from National agency for the protection of soils:

- Arrive at an INTEGRATED policy to reduce the threats of naturally occurring substances to a multi-functional landuse
- How: Soil management plan (soil + groundwater)

- Steps:

- increase knowledge
- inventory of limitations of landuse with respect to As
- estimate the effects of changes in landuse
- estimate the effects of changing environmental conditions
- (monitoring)

NABRON

NABRON Participants



- **TNO**
- **University**
- **Private Consultancy**
- **Coastal provinces**
- **National Agency**

The NABRON project:

- **Aim:**

To support policy-makers with decision-making of the use of soil, groundwater and stream bed sediments in areas with naturally increased Arsenic concentrations

- **How:**

SYSTEM-APPROACH and AREA SPECIFIC:

Why is 'As' there? What are the common factors?

- **Results:**

- Risk maps
- Soil management plan
- Practical guide

Increasing knowledge: occurrence of As in...

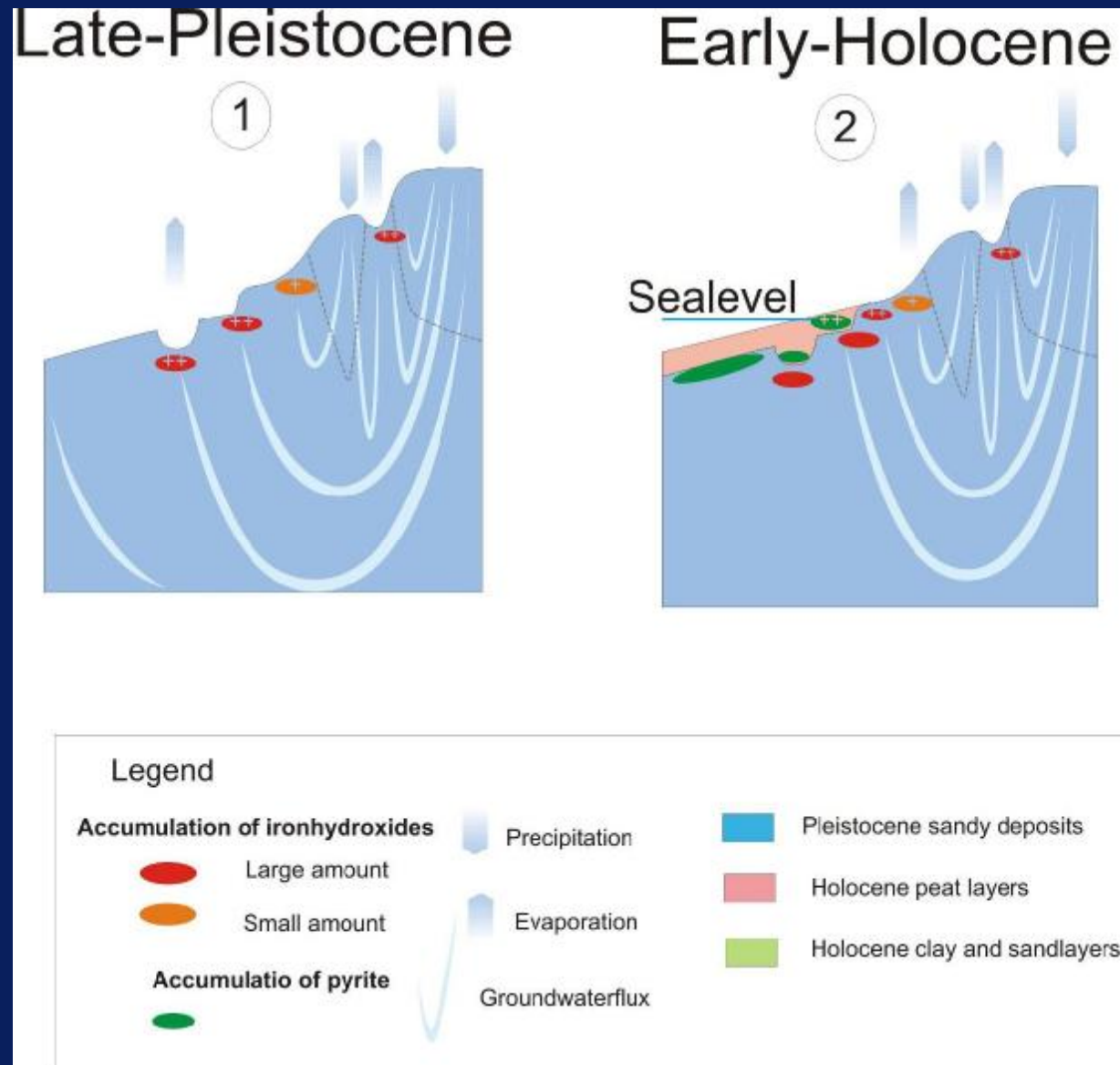


“Iron-hydroxide-type”

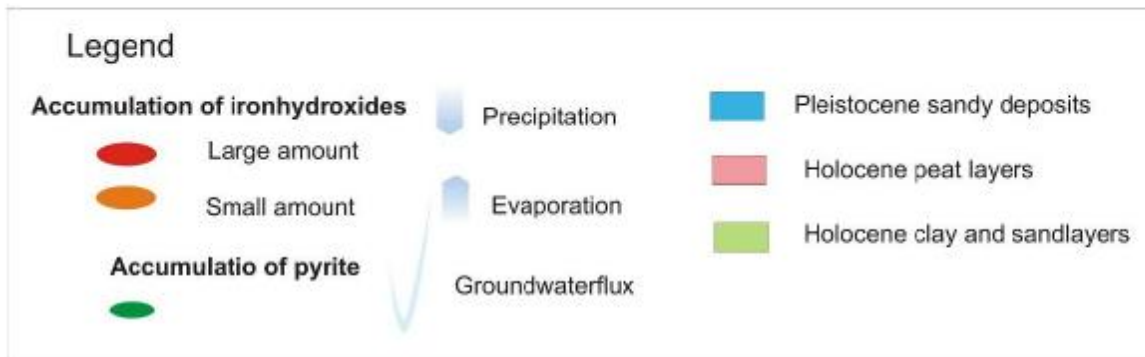
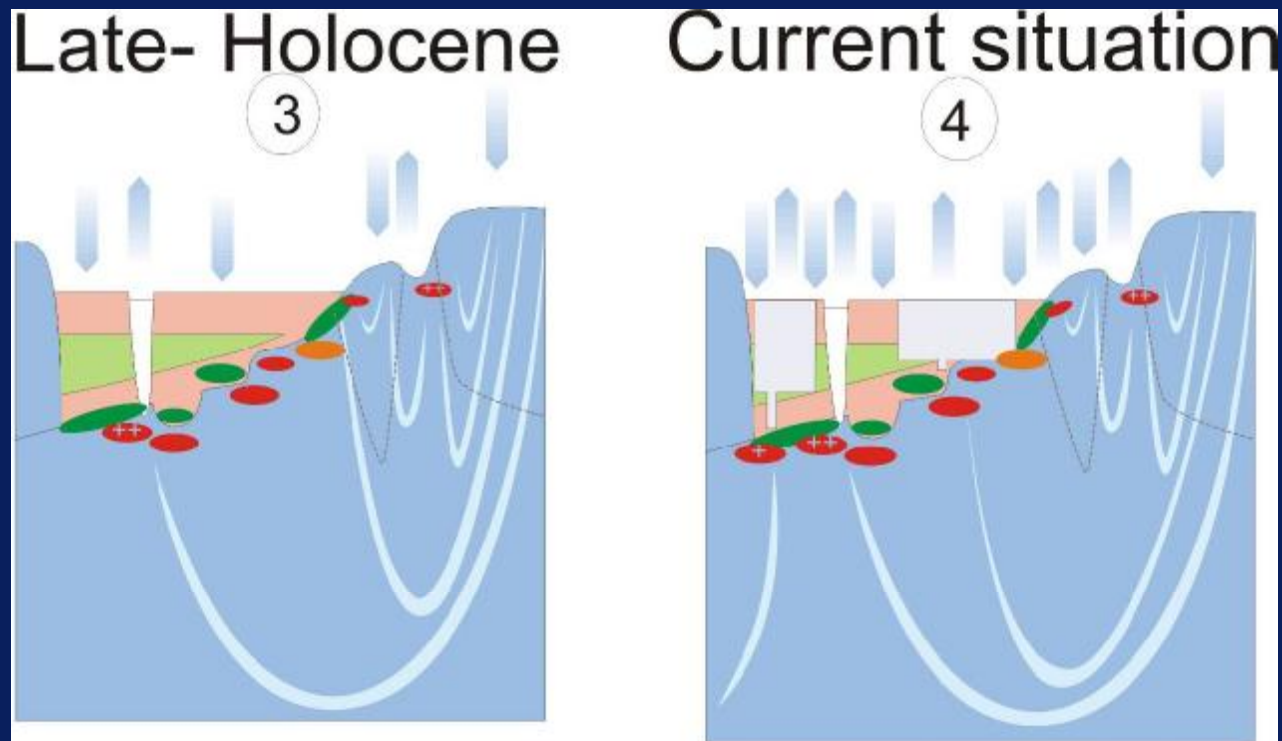


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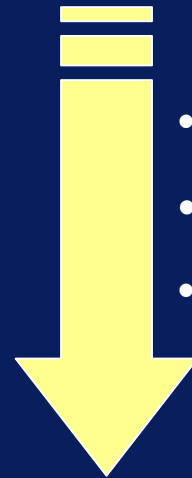
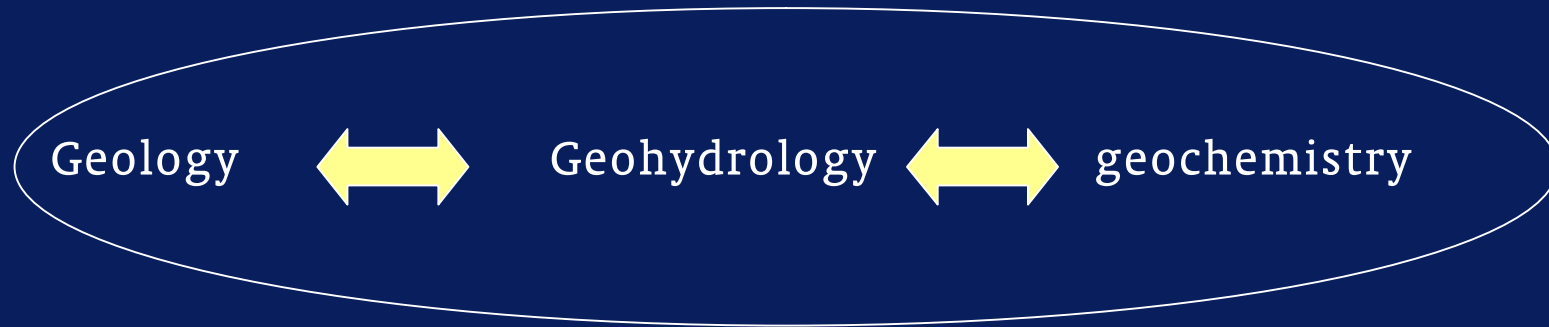
Increasing knowledge: where



Increasing knowledge: where



Combine knowledge: Integrated approach

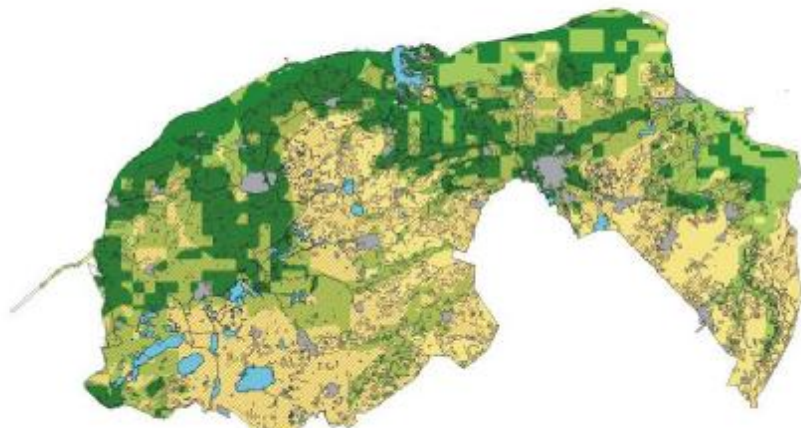


- Risk maps
- effect of environmental conditions
- effect of land use

Soil management plan

RISK MAP: Possibility of increasing regulatory values

Regional pattern of high As concentration in the soil and freatic groundwater



Risk of presence of high Arseen concentrations

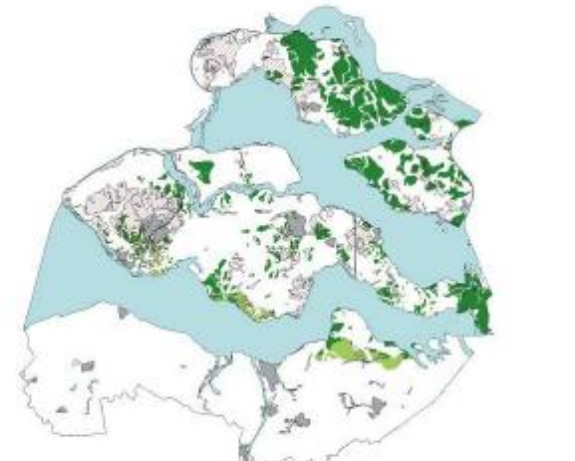


“Fe-OOH-type



Proefserie 300.4.1006
 Peiltoon: een lokale verhoogde arsenicogehalte in de bodemprofielen
 Oorspronkelijke gegevens: Groningen, Fryslân, Noordoost- en Zuid-Holland, Zeeland en Breda

Regional pattern and depth of high As concentration in peat



Depth to basal peat



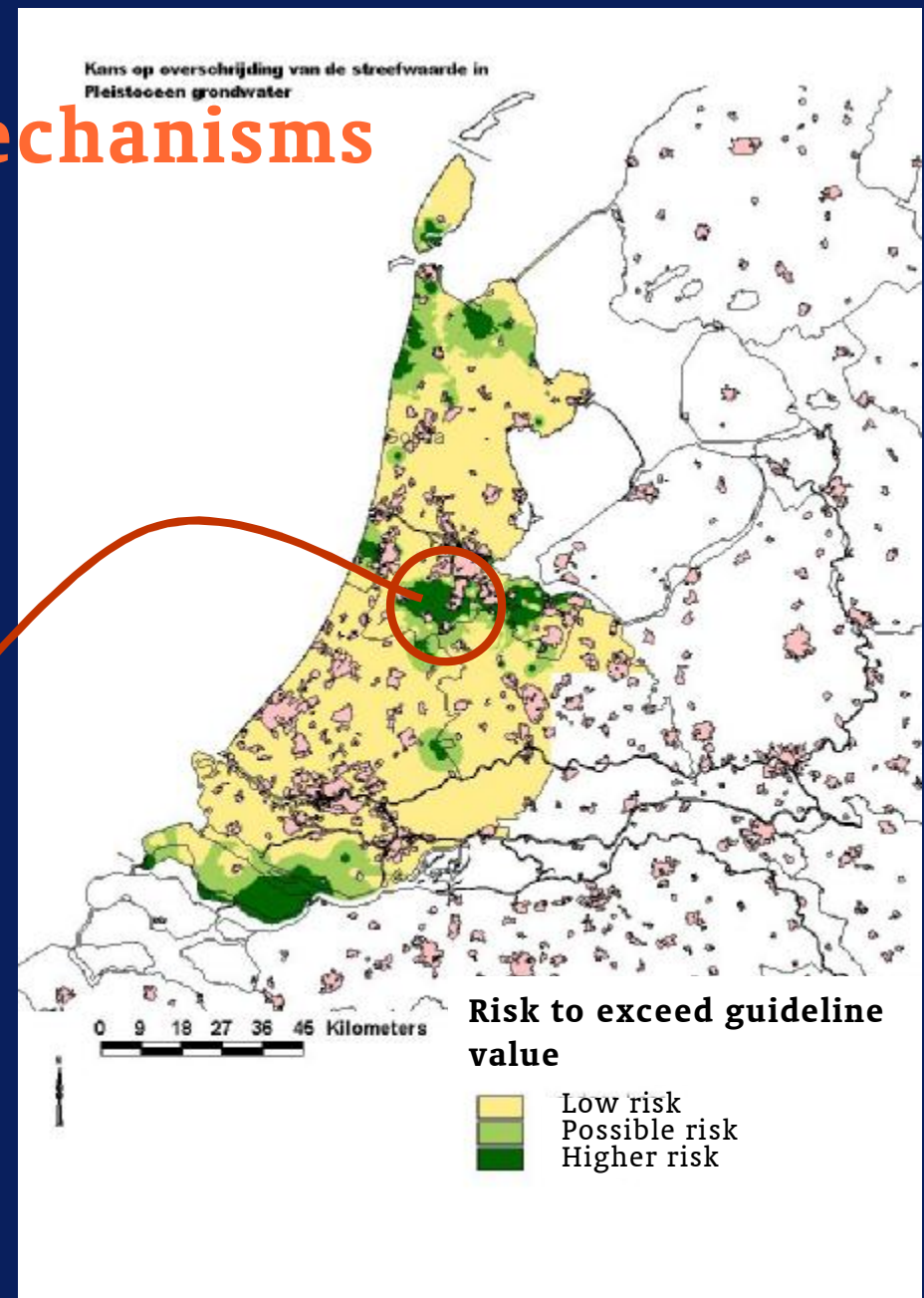
“Pyrite-type



Proefserie 300.4.1006
 Peiltoon: een lokale verhoogde arsenicogehalte in de bodemprofielen
 Oorspronkelijke gegevens: Groningen, Fryslân, Noordoost- en Zuid-Holland, Zeeland en Breda

Understanding the mechanisms

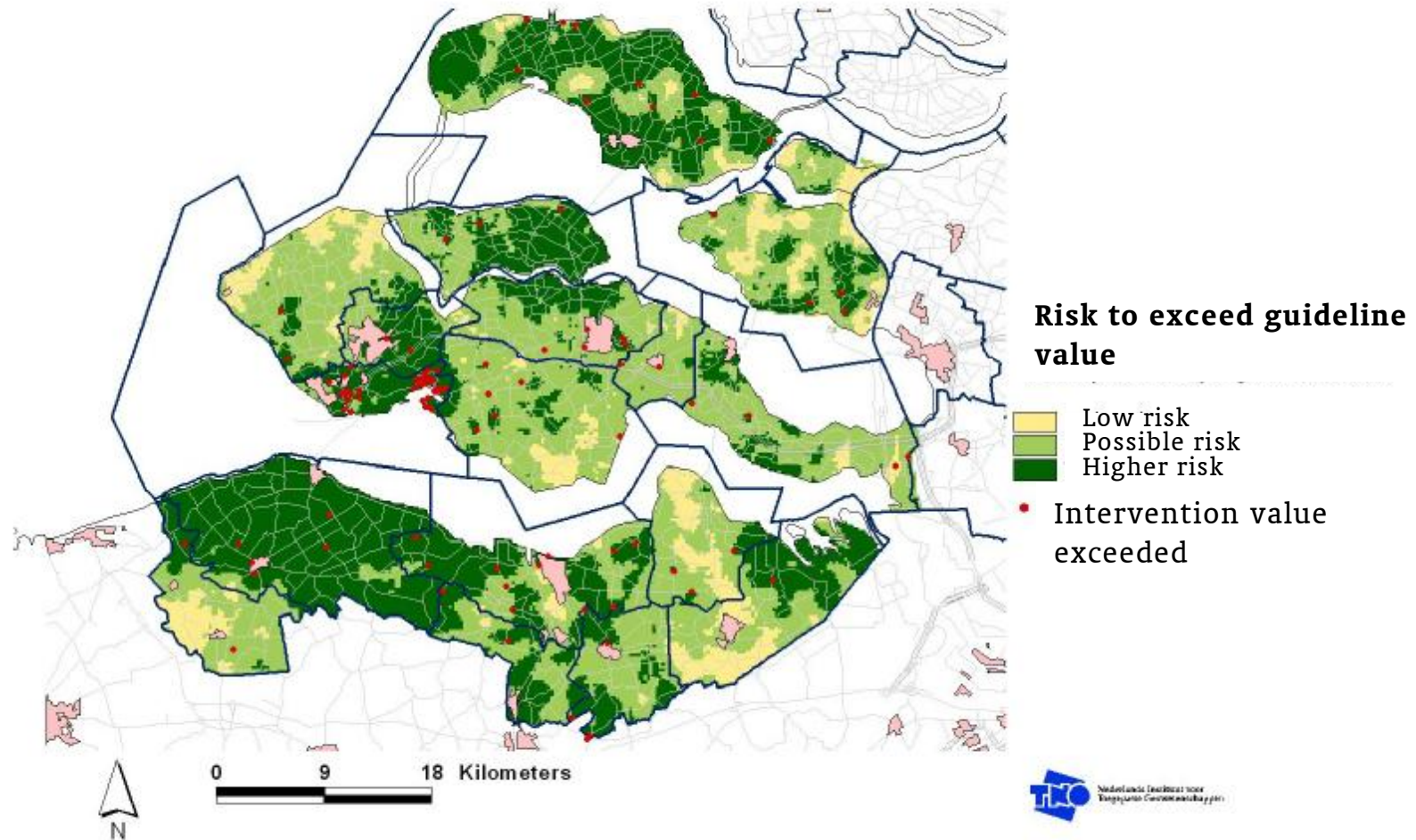
- Mechanisms explain regional patterns and predict where and at what depth high As-concentration can be expected
- Amsterdam area (ice-pushed ridges):
 - High concentrations in (deep) groundwater in restricted area
 - Area also shows high concentrations in basal peat
 - Bog iron ore at greater depth



RISK MAP:

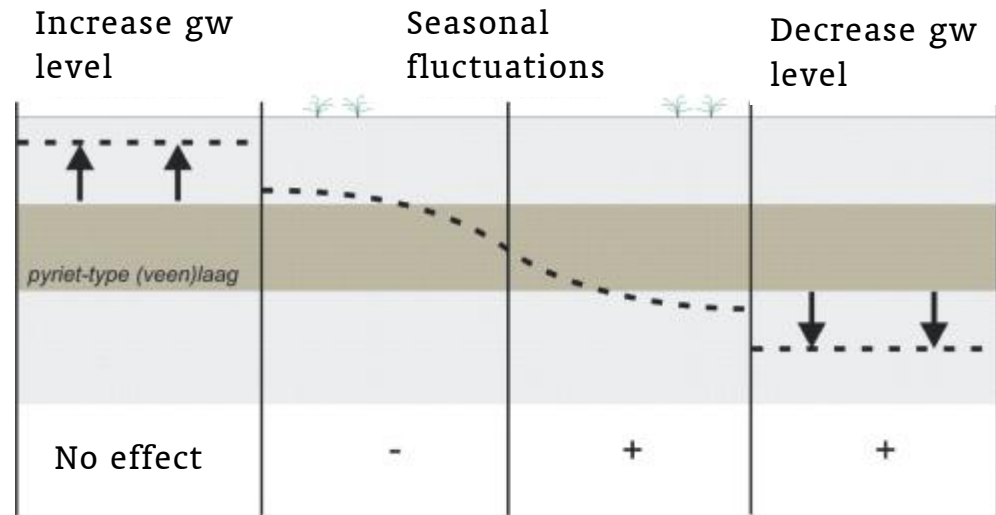
Detailed mapping of increased As: Fe-OOH type

Risk of exceeding the guideline value/ intervention value of As in freatic groundwater

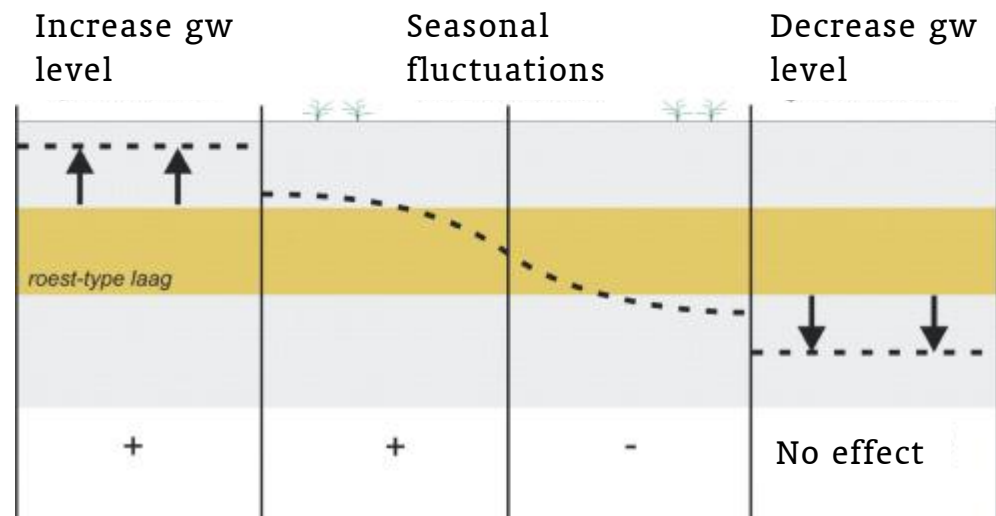


Effect of environmental conditions (1)

“Pyrite type”

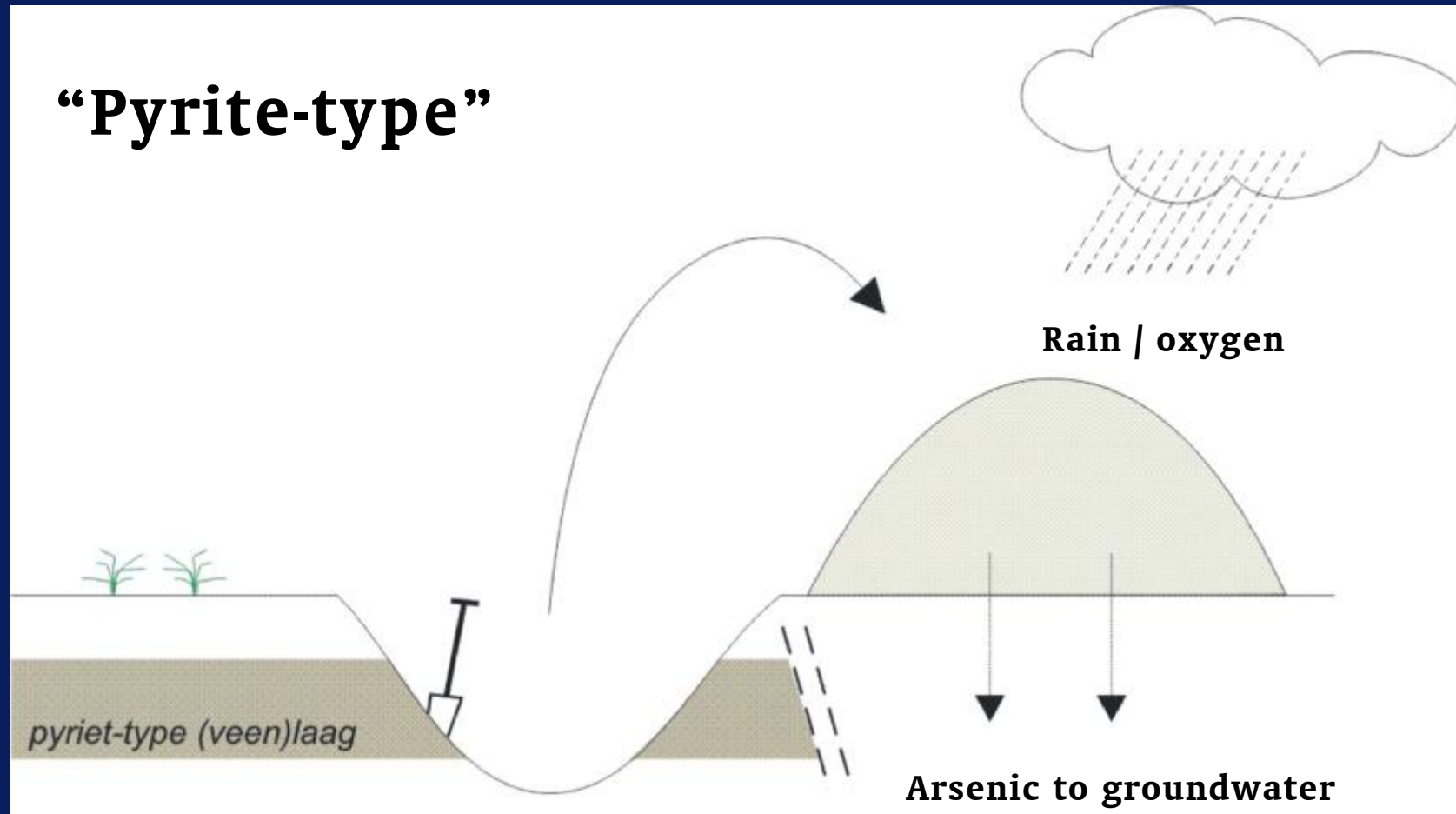


“Fe-OOH type”



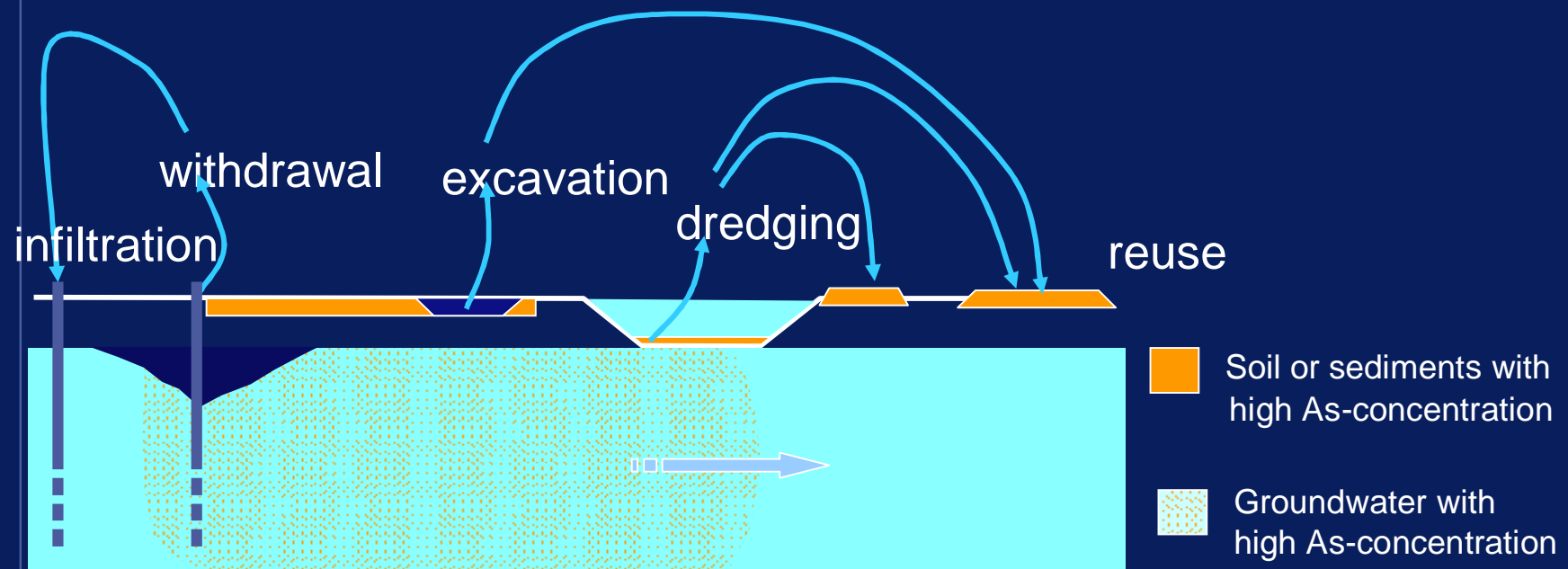
Effect of environmental conditions (2)

“Pyrite-type”

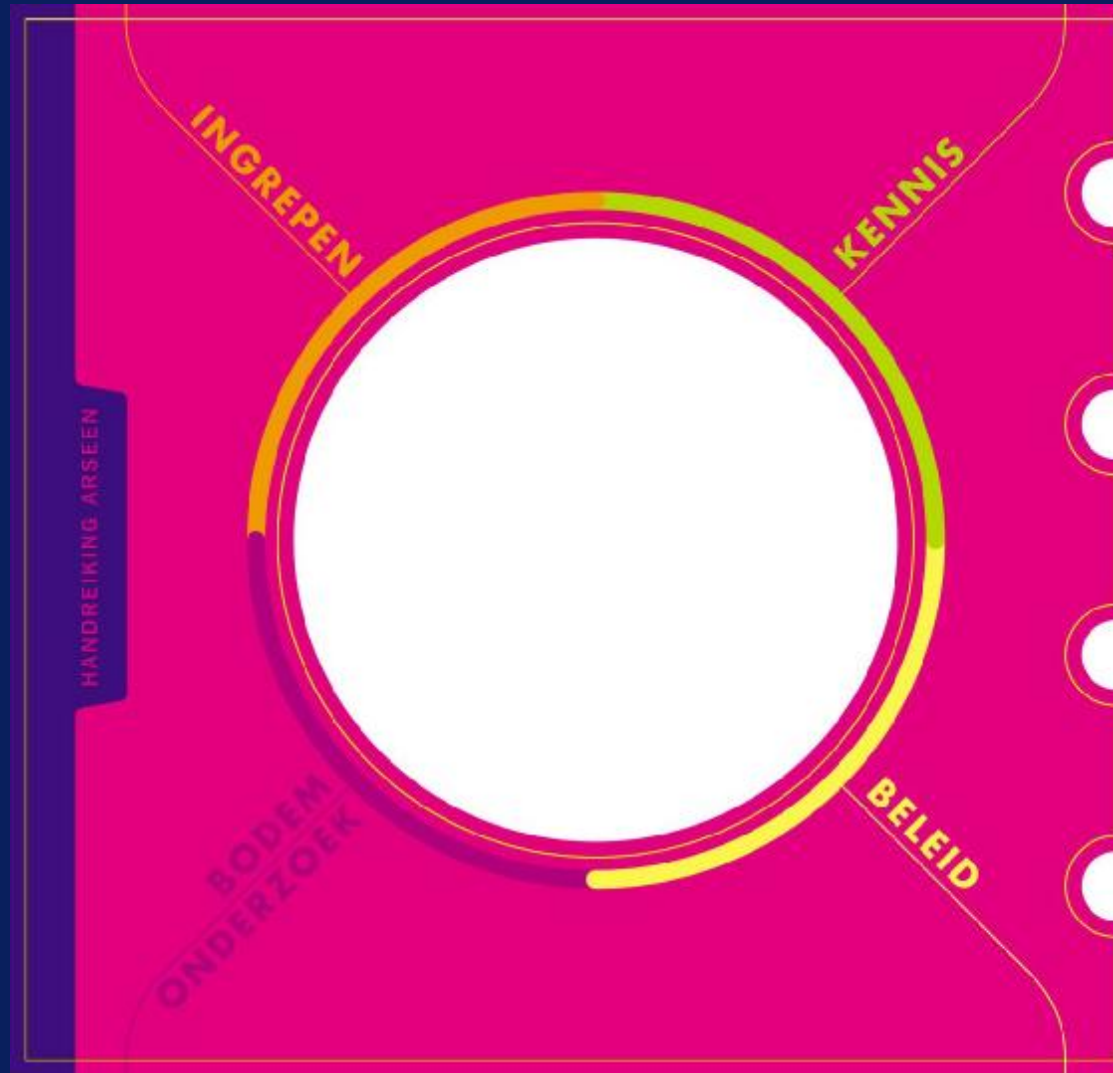


Effect of land use

- Interventions in As-rich area can contribute to the spread or release of arsenic



Practical guide for local authorities



Conclusion:

- **A regional approach is needed**
 - Geographical
 - Administrative
- **National standards are not applicable for natural As**
 - AREA-specific (system)
 - As-type dependent
- **Implementation of policy:**
 - Land use based on (human) risks
 - Assess effect of changes in land use

