

# Flood risk management in the Netherlands

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## Background



PhD in spatial planning: Geographical dimensions of risk management

Lecturer Applied Safety and Security Studies

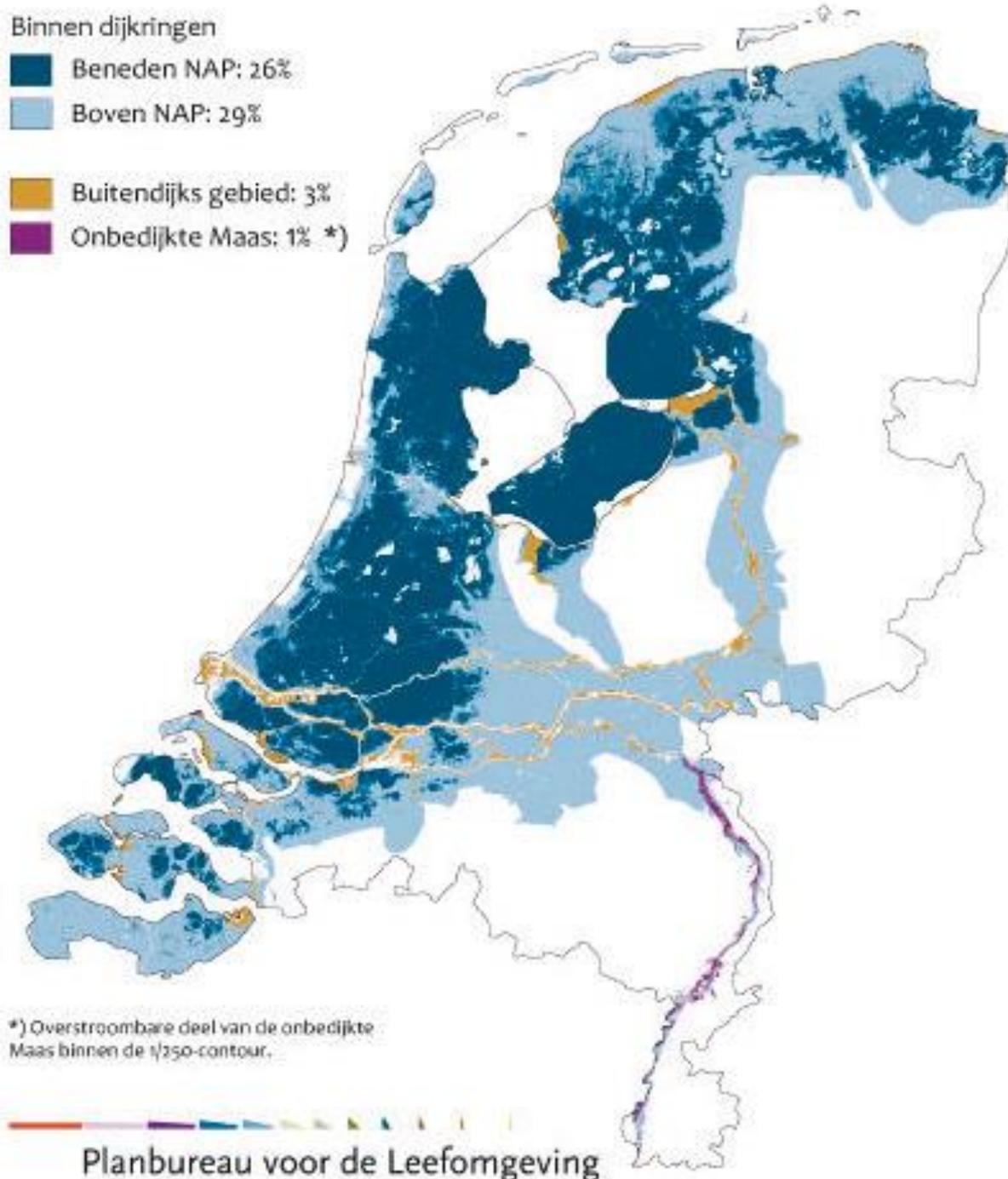
Researcher at the National Environmental Agency and at Saxion

Involved in research projects on safe urban planning

Binnen dijkringen

- Beneden NAP: 26%
- Boven NAP: 29%

- Buitendijks gebied: 3%
- Onbedijkte Maas: 1% \*)



\*) Overstroombare deel van de onbedijkte Maas binnen de 1/250-contour.

**Dark blue: below sea level 26% of the Netherlands**

**Light blue: flood prone and above sea level 29% of the Netherlands.**

**Yellow: Non protected areas 3% of the Netherlands (note some of these areas have been raised above the flood levels and average dike height)**

**Purple: Non protected areas and partially protected area's along the Meuse River,**

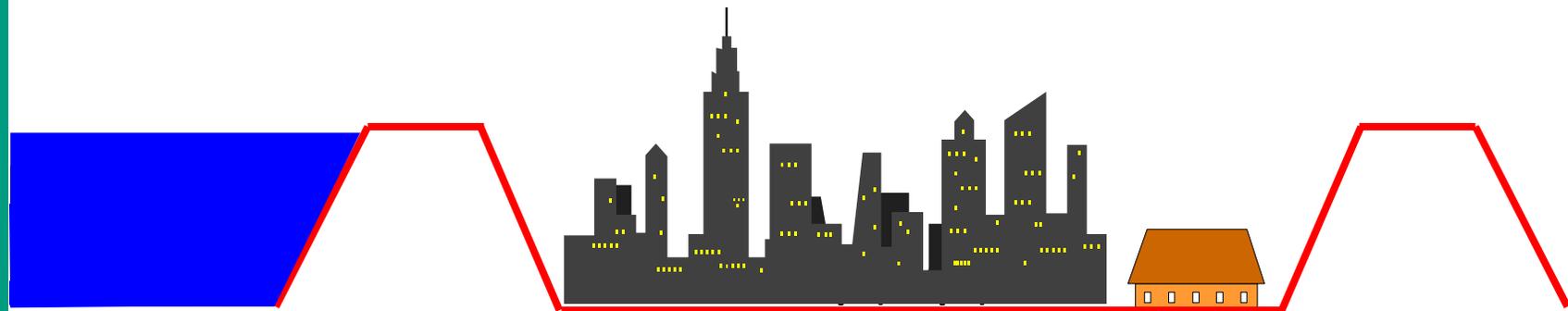
**Source: Planbureau voor de Leefomgeving, PBL, 2010]**

# Flood risks may increase

Climate change: sea level rise, increase of river discharges

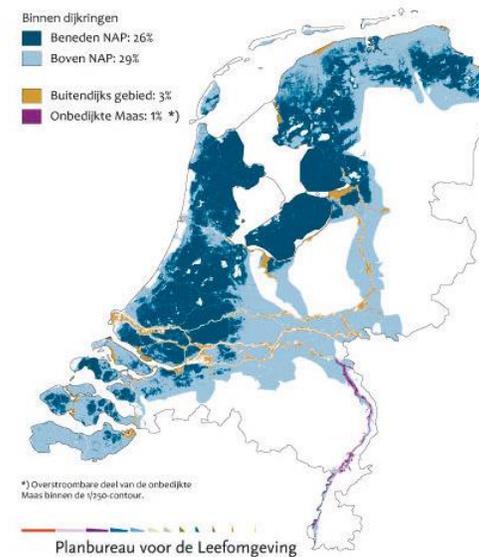
Increase of potential damage through population and economic growth

Land subsidence e.g. through settling



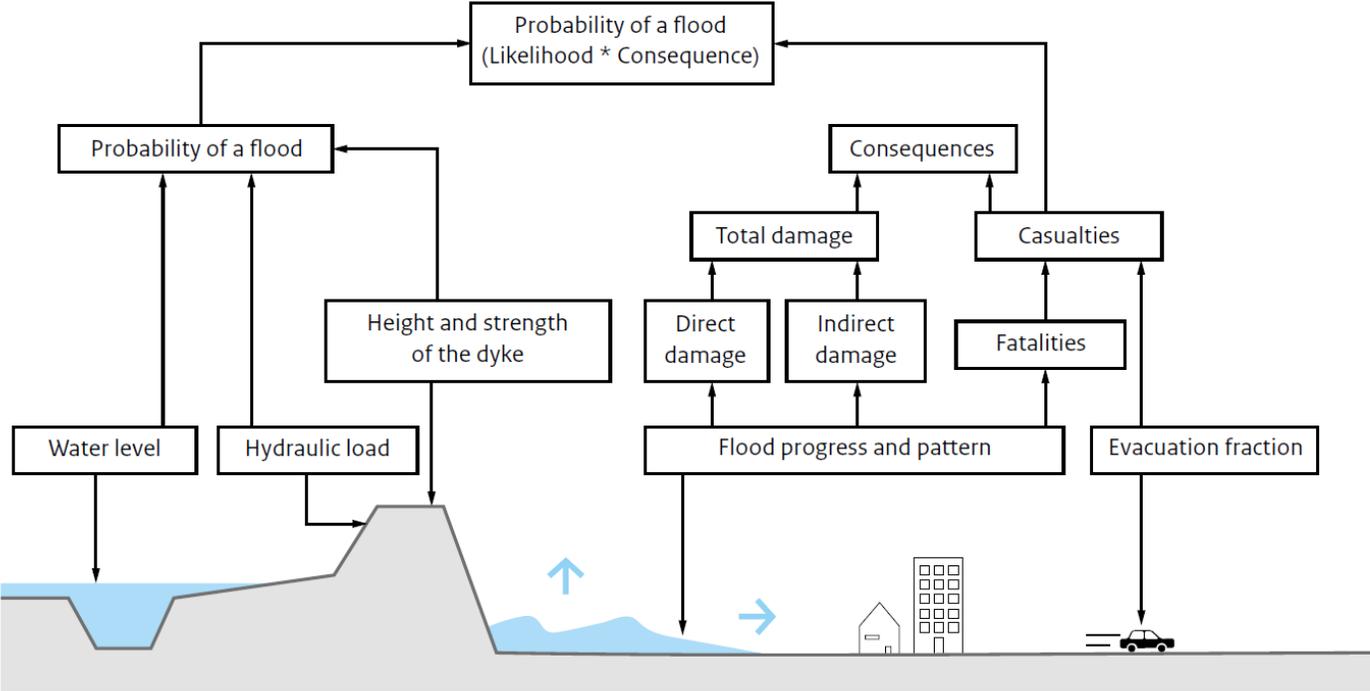
# A revised flood risk management strategy

In 2050 basic safety level applies to everyone living behind the dikes and dunes. This basic safety level means that the risk of fatalities due to flooding is no higher than 1 in 100,000 per year.

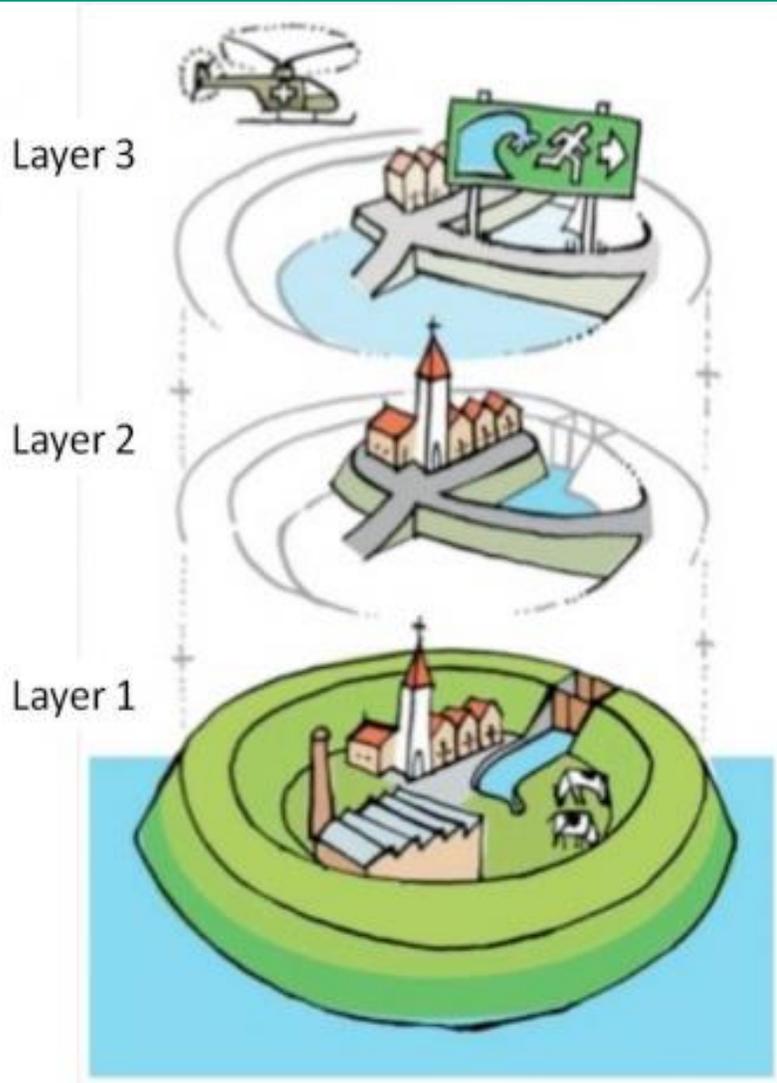


# Risk based approach: likelihood and consequences

the risk of fatalities due  
to flooding is no higher  
than 1 in 100,000 per  
year.



# Achieving the basic safety level: a multi-layer approach



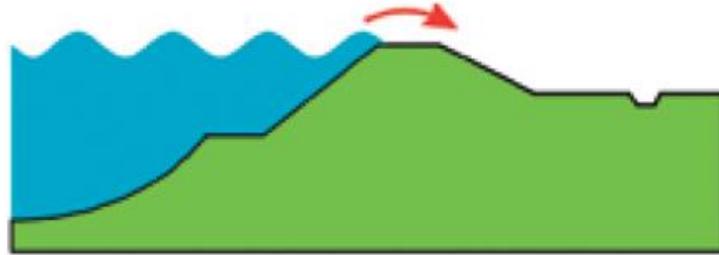
3. Flood preparedness through preparing emergency response

2. Mitigation of potential flood consequences through sustainable spatial development

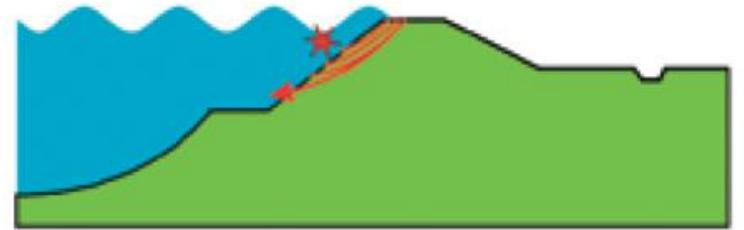
1. Flood prevention through water defences and room for the river

# Layer 1. Prevention is the starting point

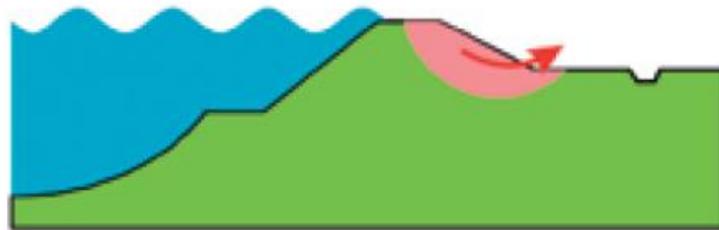
overflowing and wave overtopping



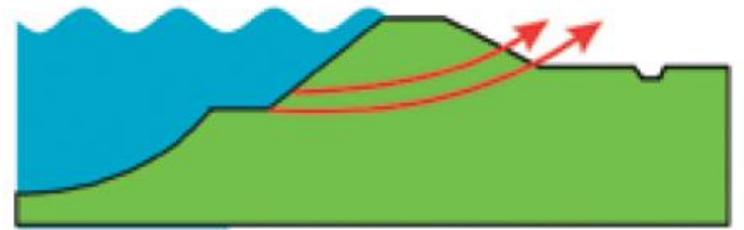
erosion outer slope



instability inner slope

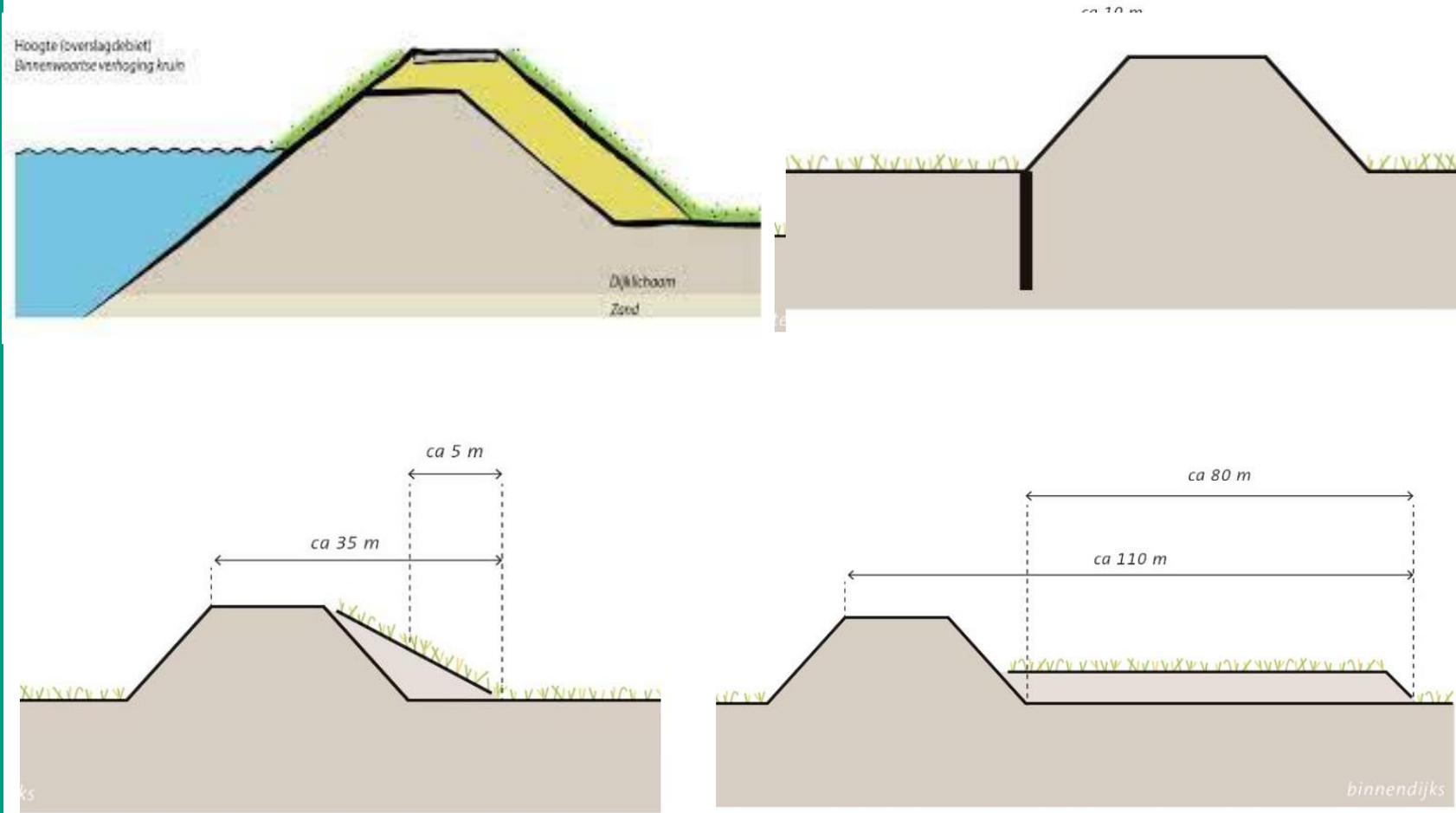


seepage and piping

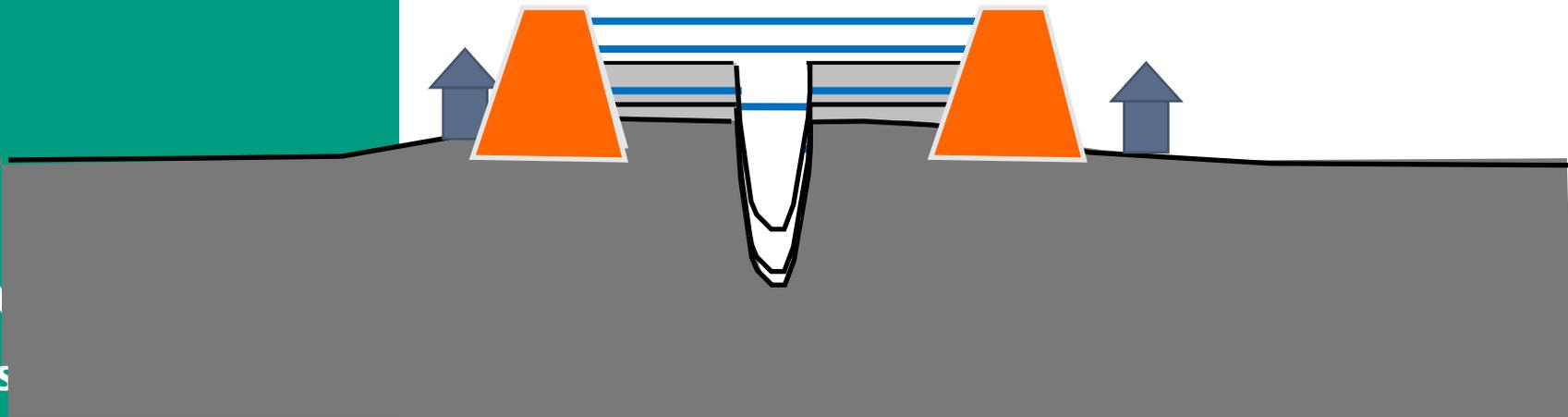


# Layer 1. Prevention is the starting point

e.g. through  
reinforcement of  
water defences

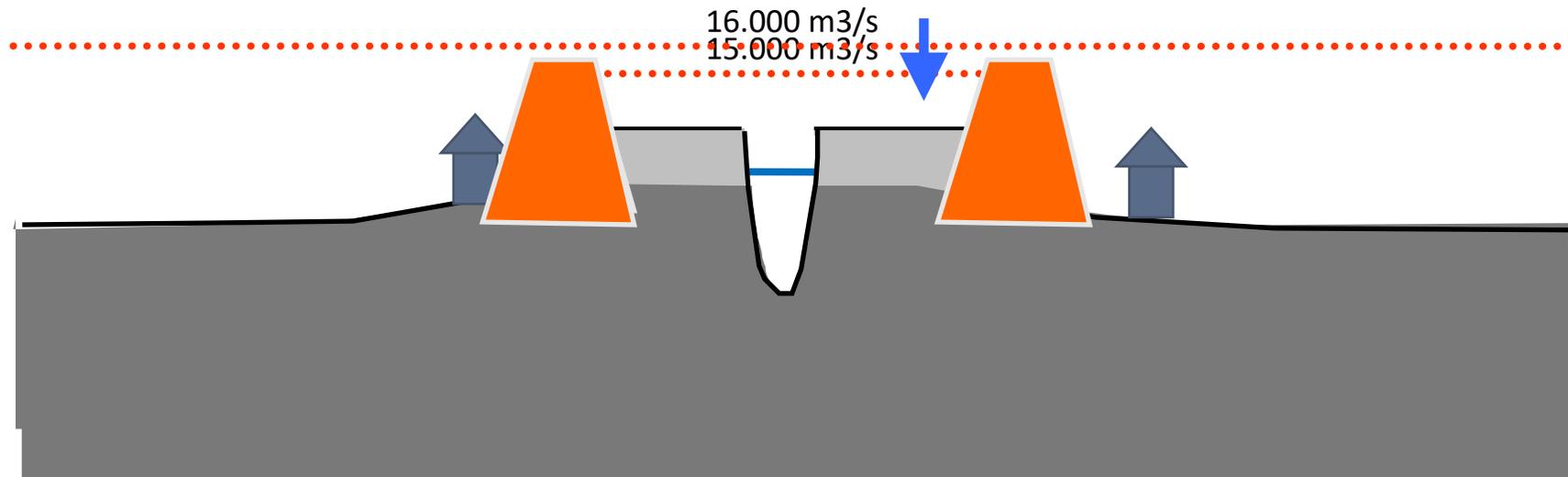




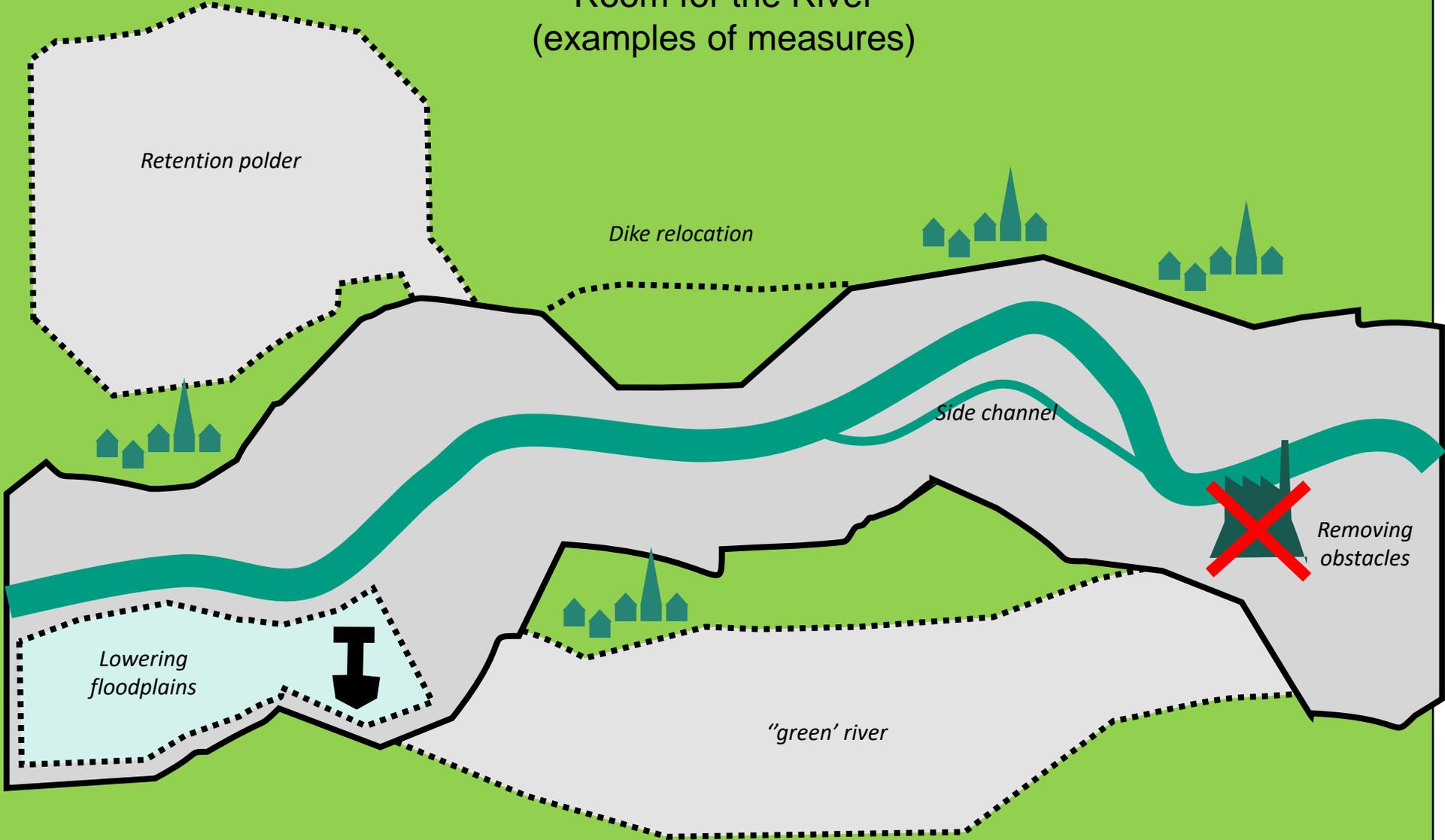


Normative discharge Rhine 15.000 → 16.000 m<sup>3</sup>/s

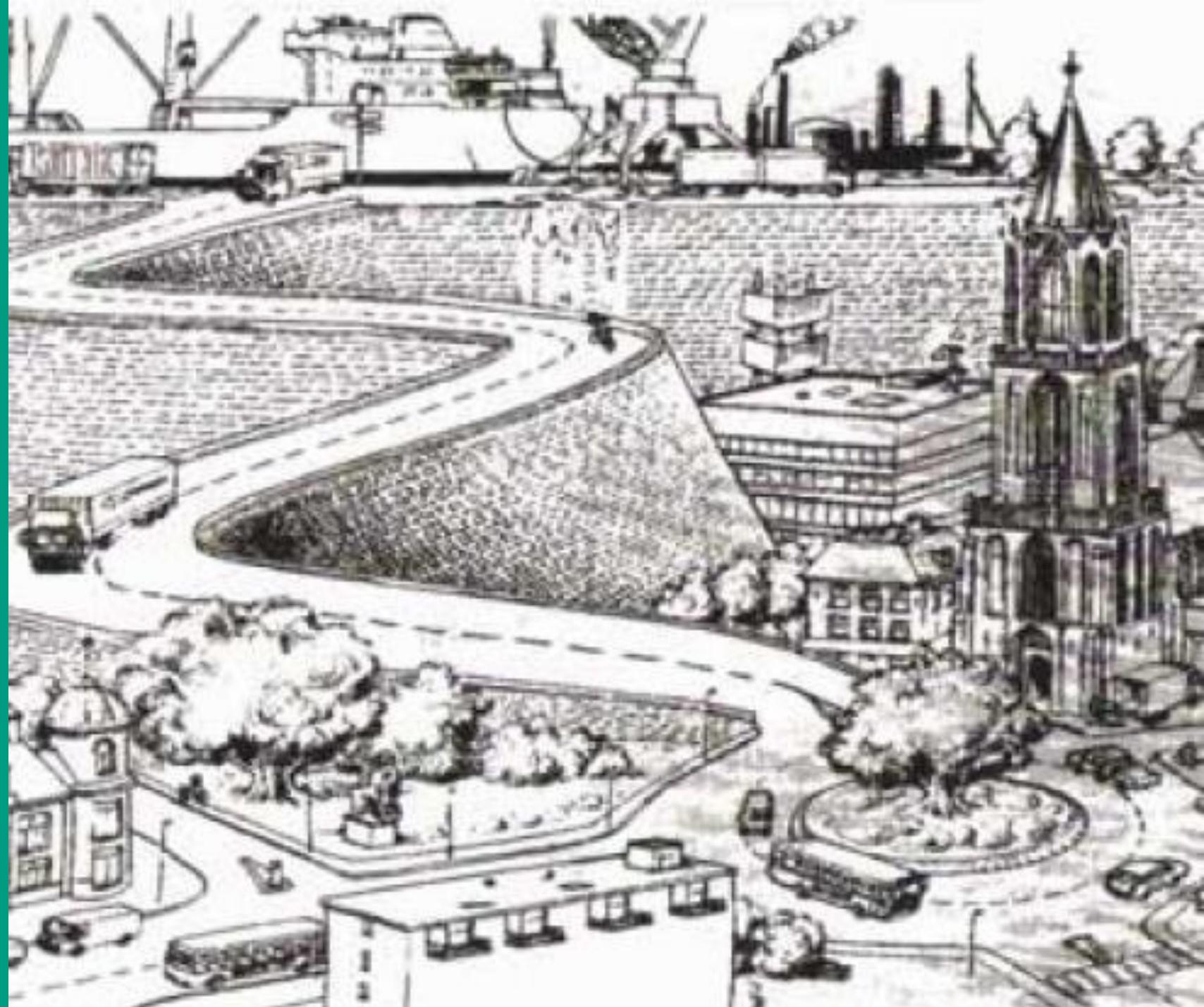
How to deal with it? Strengthening dikes?



# Room for the River (examples of measures)

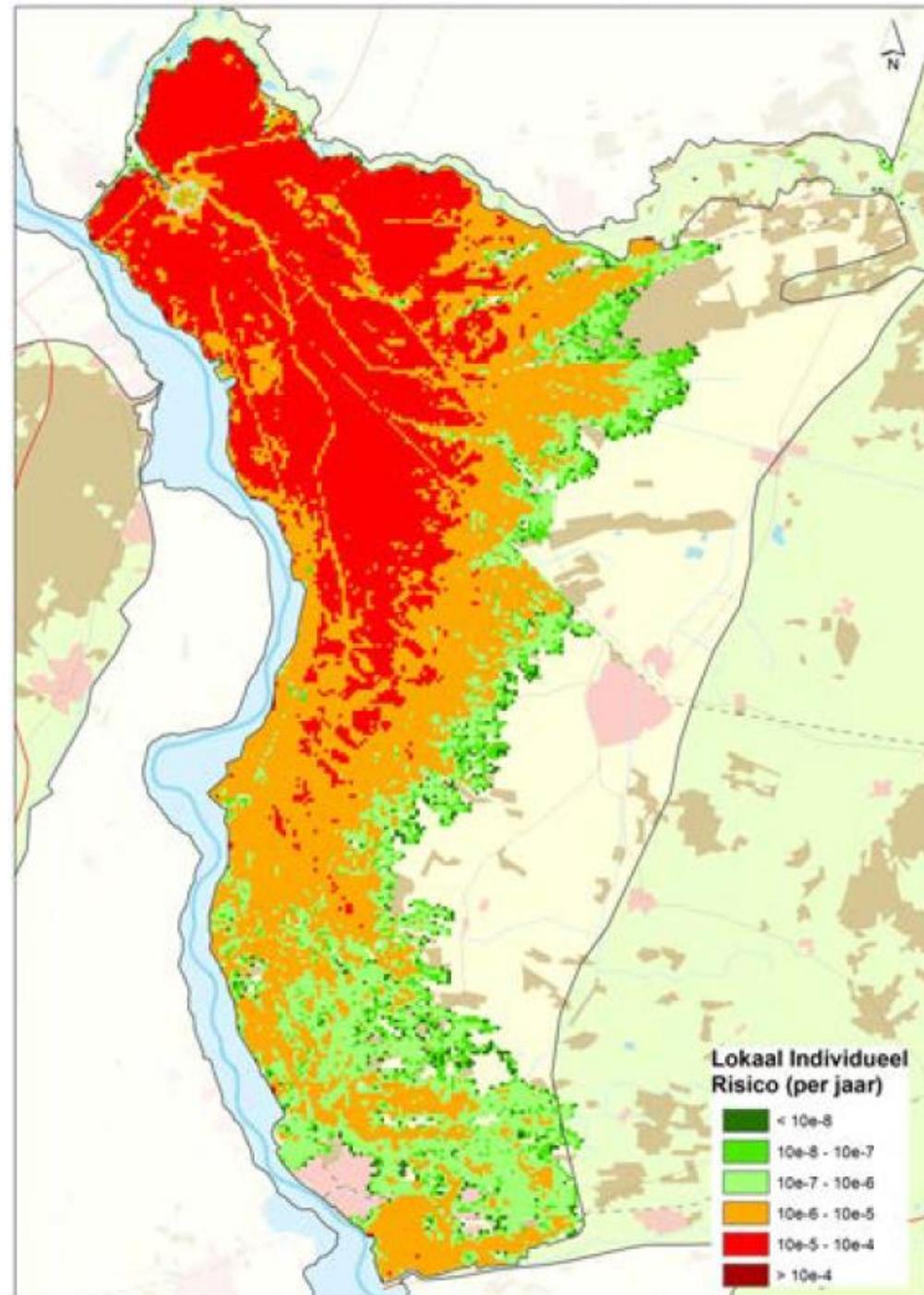


# Layer 2: Spatial planning



## Building elsewhere or adapt?

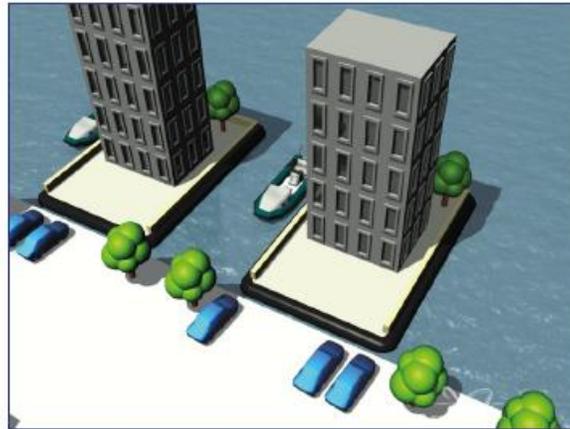
- The probability to die due to a flood differs within a dike ring
- Deep polders near the sea or major rivers are most dangerous since water levels will rise quickly in case of a breach in a dike.
- In the light of flooding, spatial developments, especially vulnerable objects, are most undesirable in the most hazardous parts of a dike ring.



# Examples of measures



Less intensive use of the ground floor



Floating homes

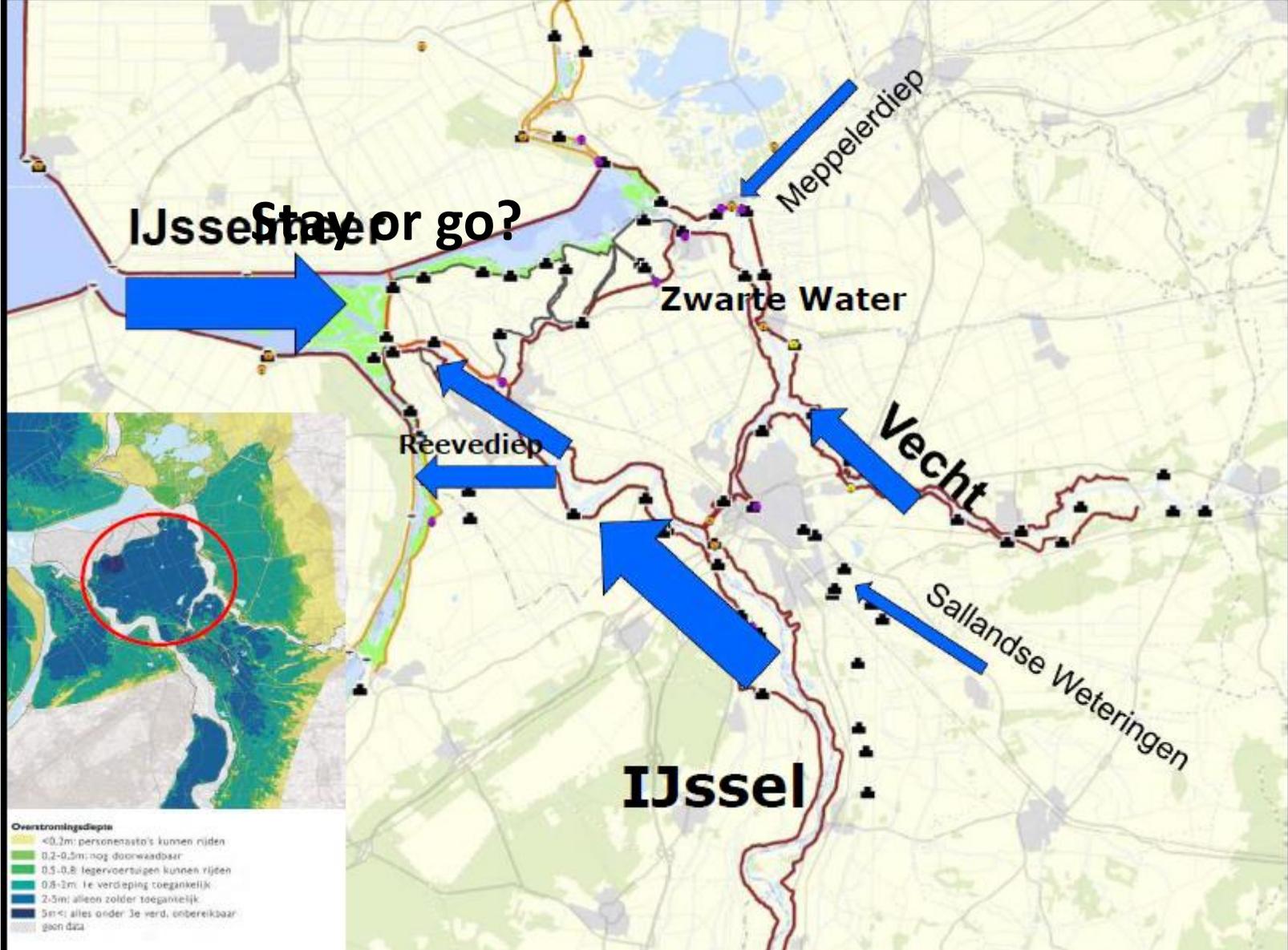


Water resistant building materials

No vulnerable activities at hazardous places



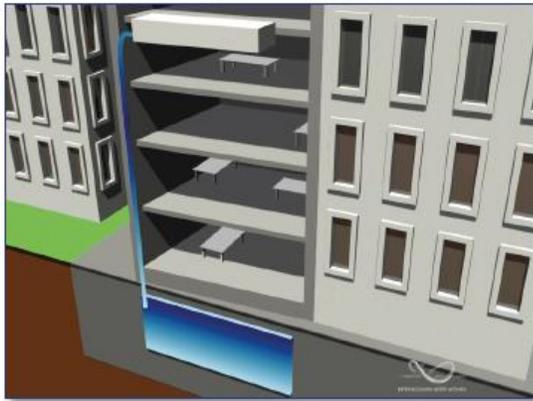
# Layer 3 flood preparedness



# Layer 3 flood preparedness

Situation	Much time	Little time
Little people threatened	Source and effect control Evacuation Management of the environment	Source and effect control Evacuation (assisting those who stayed at home)
Many people threatened	Source and effect control Evacuation Assisting those who stayed at home (management of the environment)	Source and effect control Assisting those who stayed at home

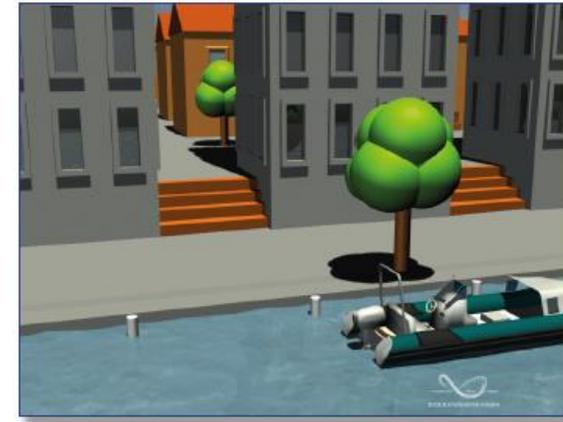
# Examples of measures



Storage of clean water



Generators



Raised areas



Protection of critical infrastructure

# Further information

## Literature

[Flood risks. Understanding concepts](#)

[Flood risk and water management in the Netherlands: a 2012 update](#)

## Movies

[Room for the river Deventer](#)

## Website

[Delta programme](#)

Thinkhazard.org