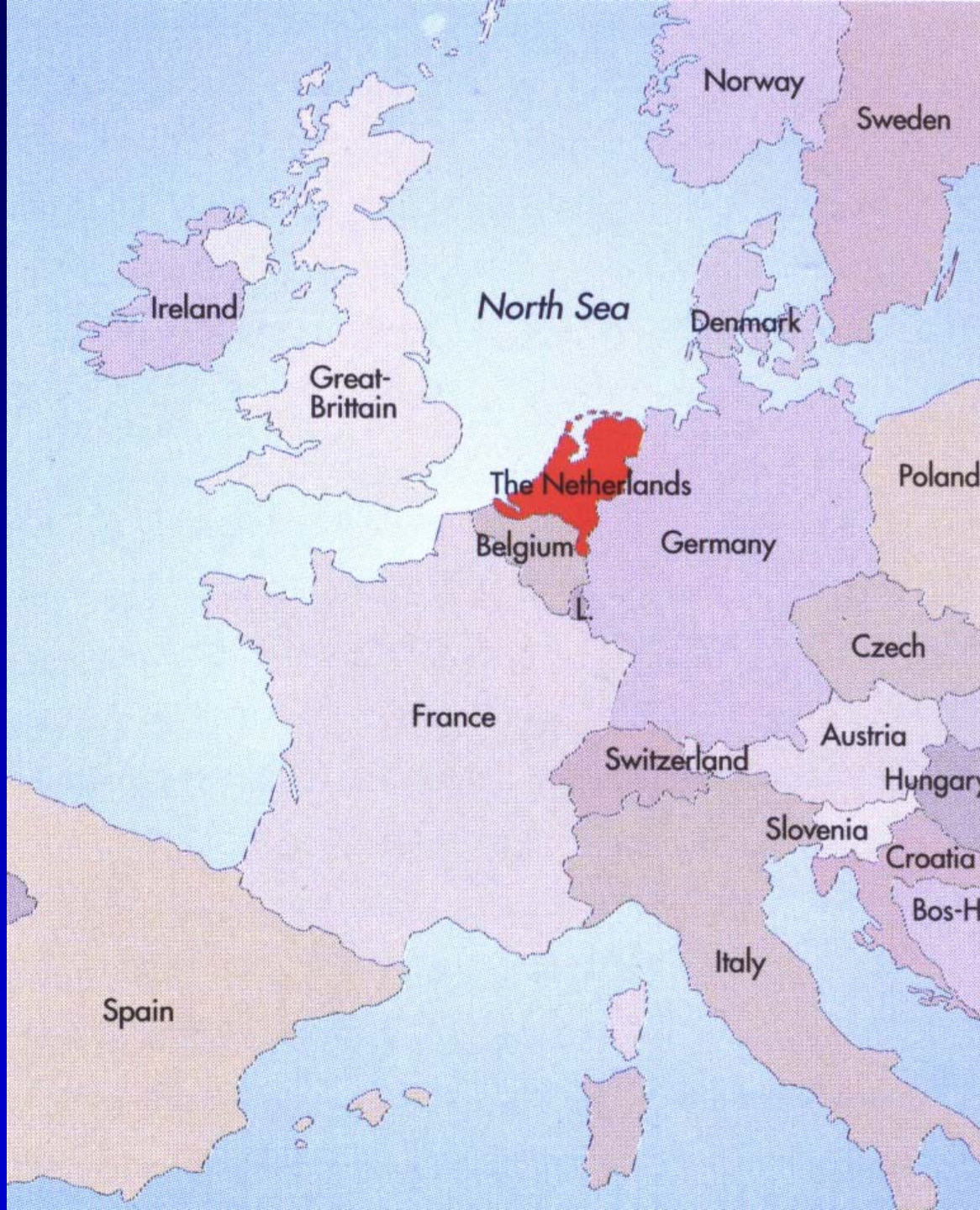
4th International Symposium on Flood Defence
Managing Flood Risk Reliability and Vulnerability
Toronto, Ontario, Canada, May 6-8, 2008

Flood Management in the Netherlands:

Coping with Risks

Prof. dr. Wim van Leussen
University of Twente / CSTM
Ministry of Transport, Public Works and Water Management
The Netherlands

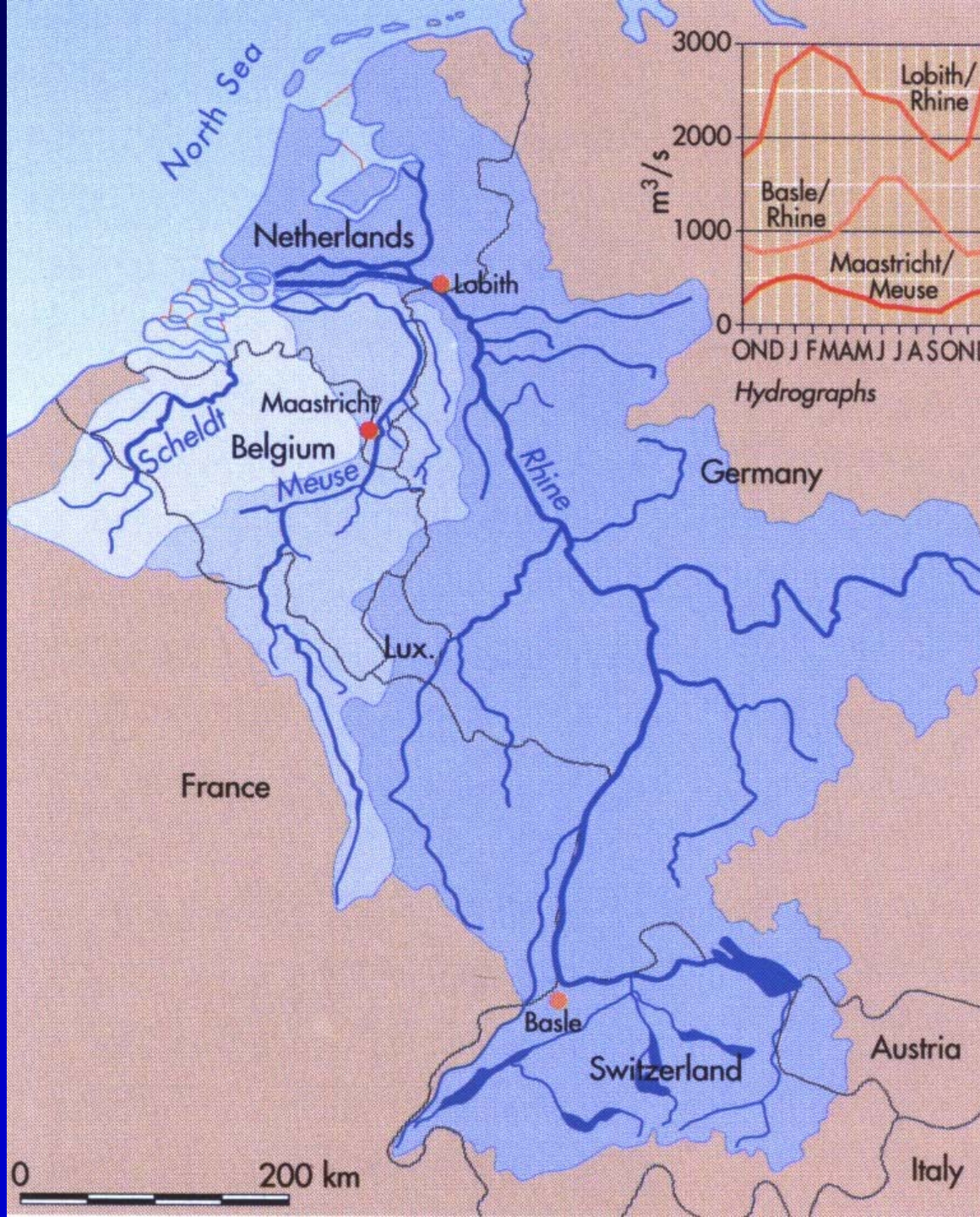
Typical location of the Netherlands



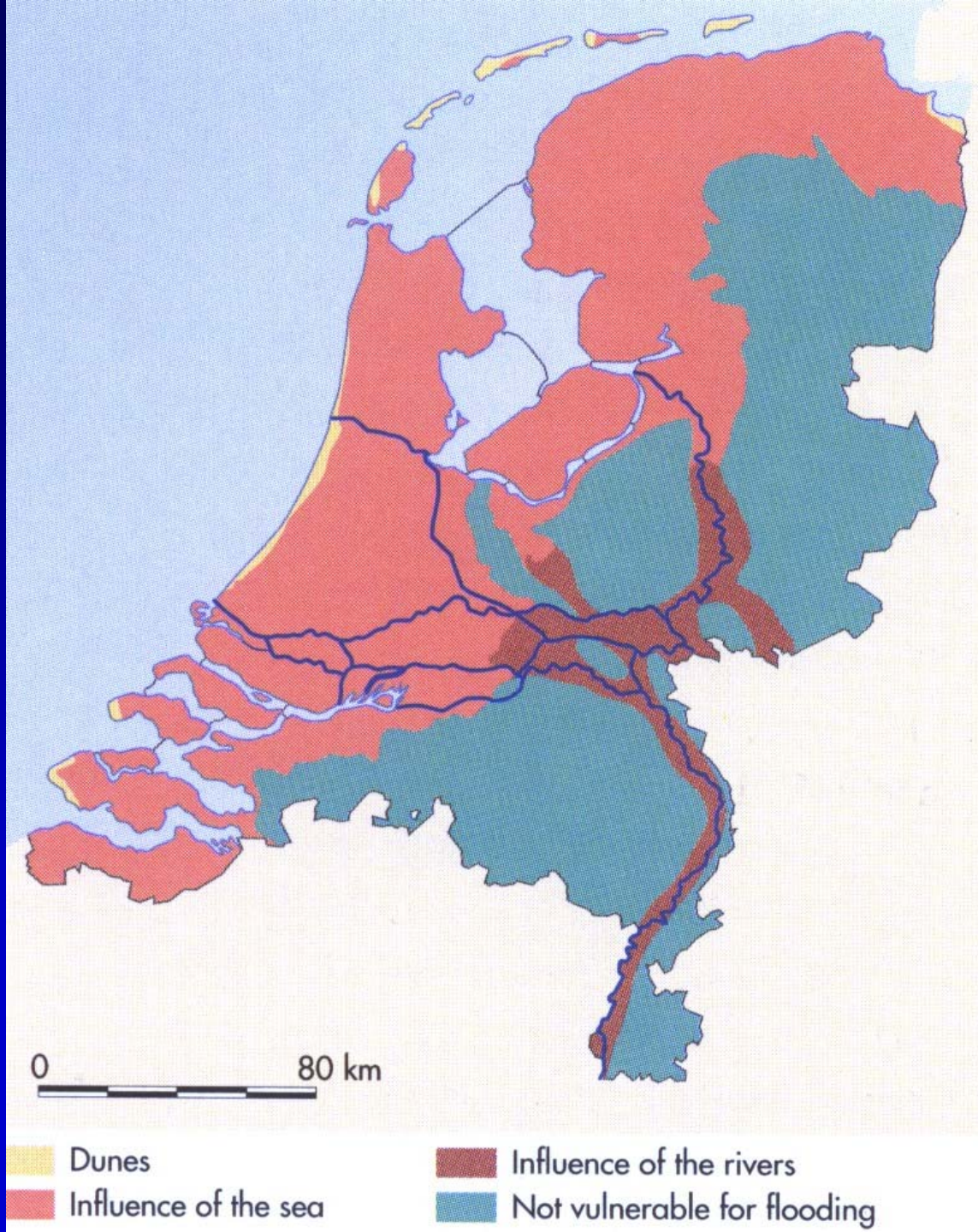
Essential characteristics of the Netherlands:

- Delta of 4 major rivers
  (Rhine, Meuse, Ems, Scheldt)
- Densely populated area, of which more than 50% is below sea level
- Long history of coping with floods
- "Man-made lowlands"

Catchment areas of major rivers, flowing out through the Netherlands

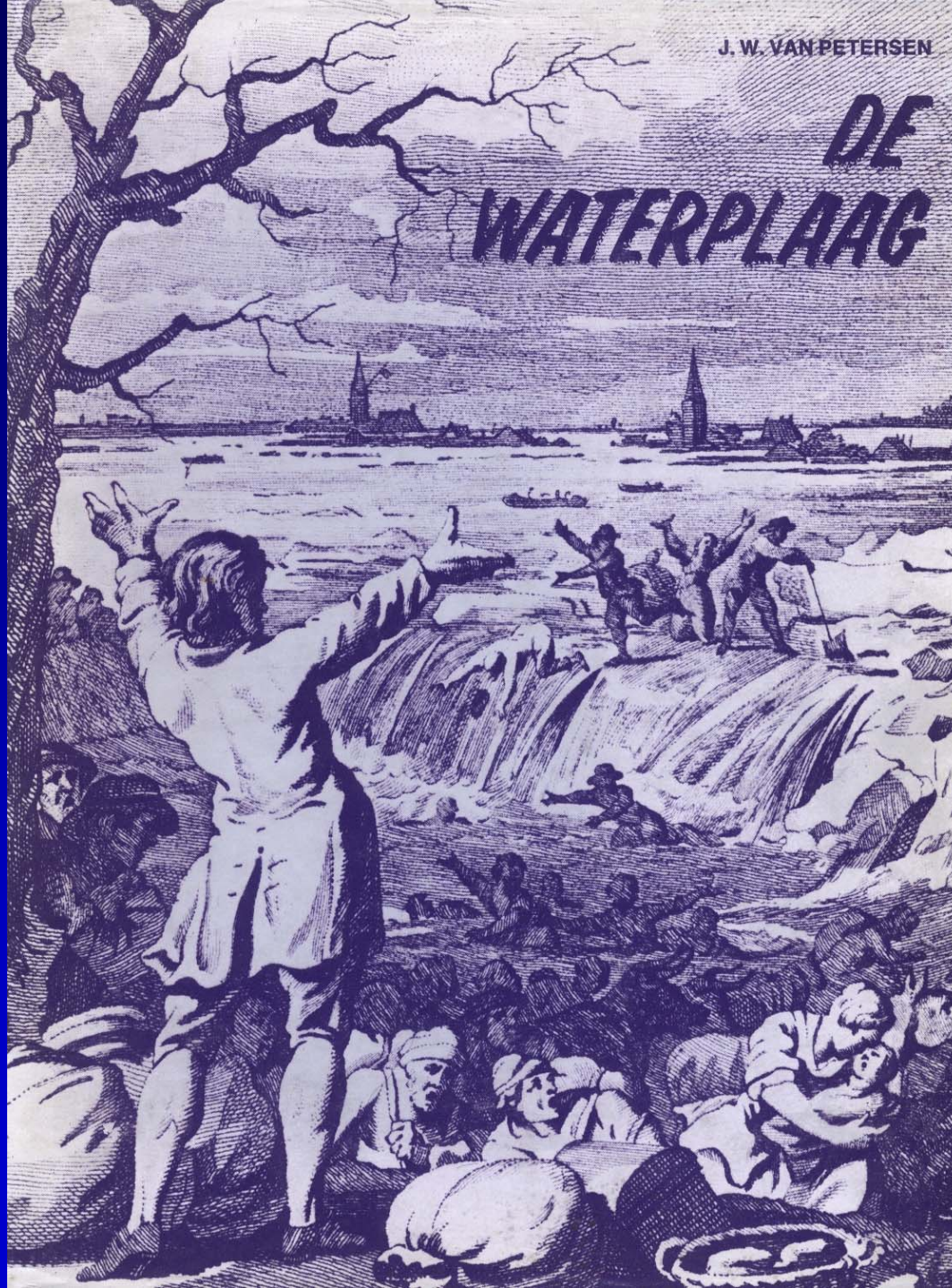


More than 50% of the country is below sea level

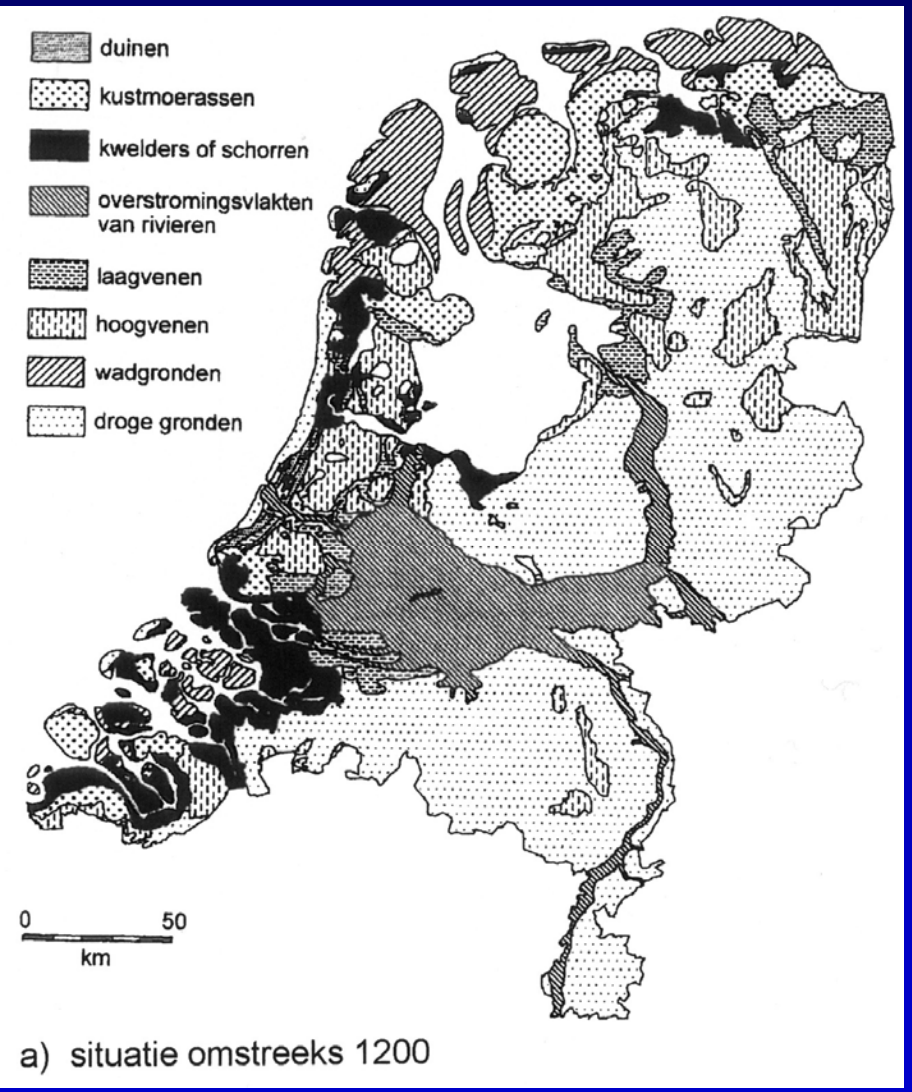


Dutch history:

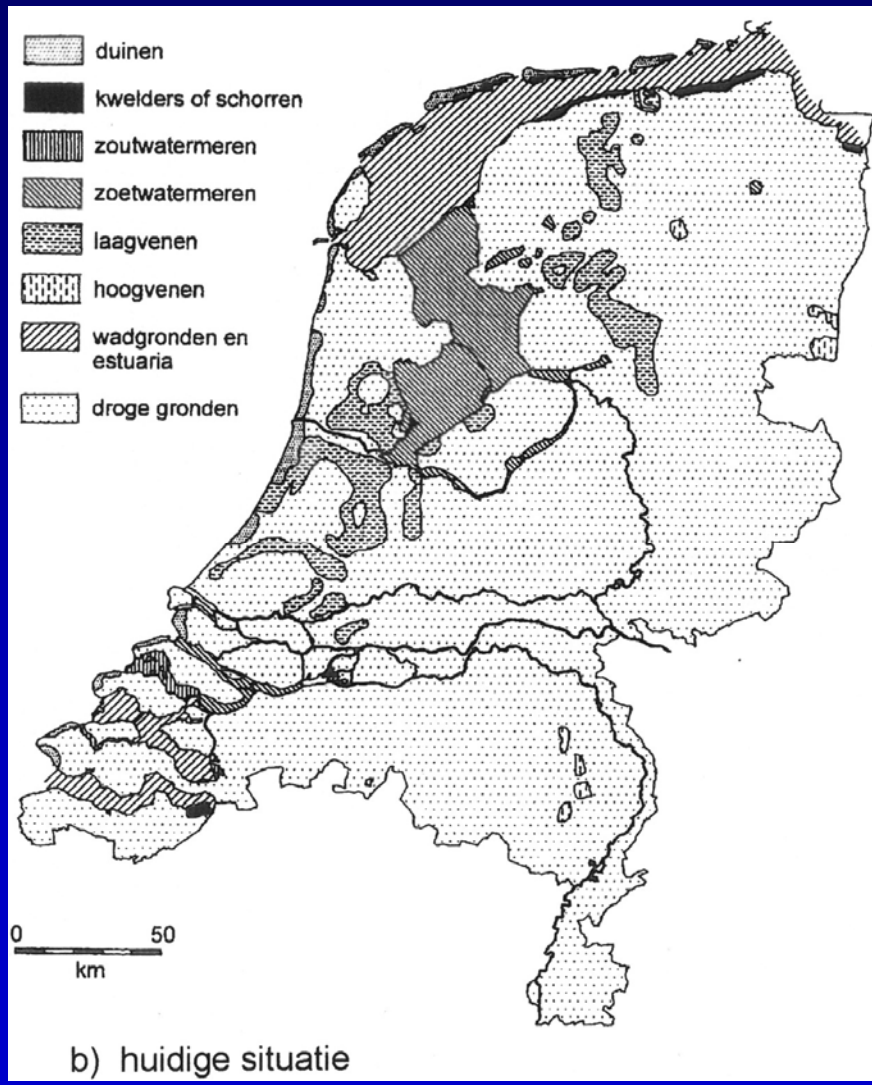
"battle against the water"



marshes, wetlands and other water areas in the Netherlands



around 1200



at present

The Netherlands is situated in the Delta of four major rivers

Much interest into protection against extreme floods

Governance of Water Resources in the Netherlands

history:

- *< 1200: people in small settlements in the rural areas.*
  Struggle with floods; defence by primitive dikes or living on higher dwellings.

- ***1200 – 1798: local and regional water management***
  - intense fighting with the floods
  - water boards

- ***1798 – 2000: centrally guided water management***
  - Rijkswaterstaat (1798)
  - large-scale construction of flood protection infrastructure
  - integrated water management

- ***21st century: EU-directed water management***
  + updated flood policy
  - Water Framework Directive; RBMPs
  - EU Floods Directive
  - WV21
  - etc.

< 1200: People in small settlements in the rural areas

- Communities grouped around a chief farm or court owned by nobility or church
- Defence against floods:
  - Primitive dykes with hydraulic structures
  - Living on higher dwelling mounds ('*terpen*' in Dutch)
- Landowners had to maintain the hydraulic structures; supervision by local administration

< 1200: People in small settlements in the rural areas

Dwelling mound of Hogebeintum in Fryslân
(8.00 m + mean sea level)

Overview locations of dwelling mounds in the northern part of he Netherlands

1200 – 1798: local and regional water management

- more organized, but at relatively small scales
- water boards
  (caring for the dikes, locks, sluices, dams + water management)
  (ca 3000, incl. polder boards)
- large areas reclaimed
- creation of polders – wind mills

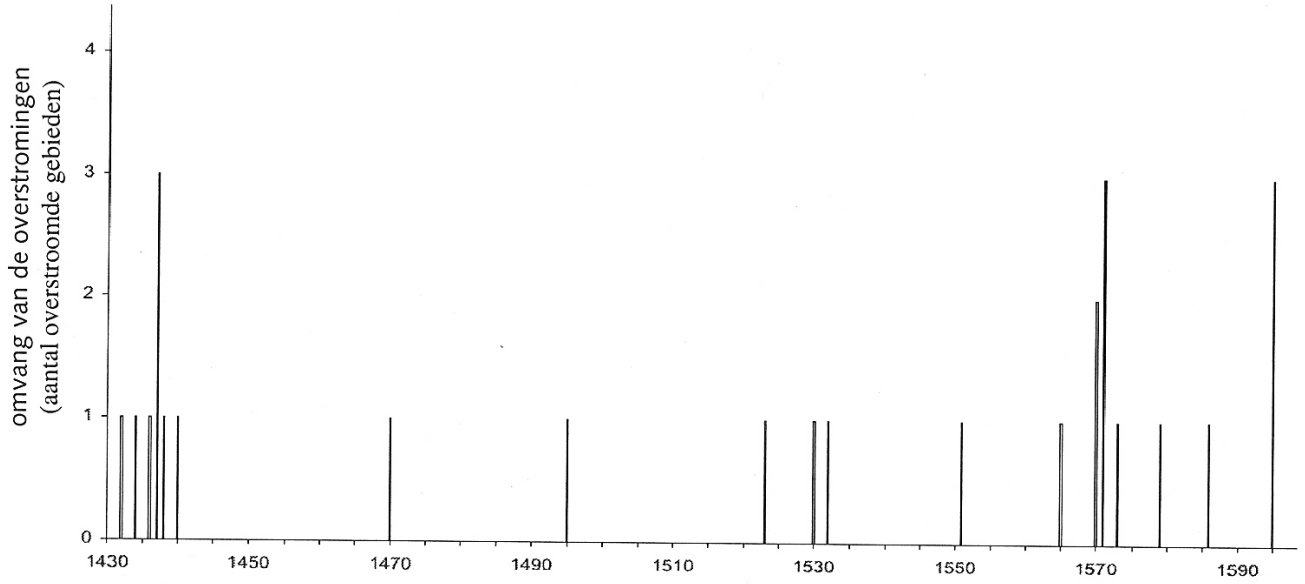
➔ keeping the country liveable for many centuries. Nevertheless a number of severe flood disasters occurred
(1421: St. Elisabeth Flood;
1530: St. Felix Flood;
1570: All Saints' Flood)

River floods and inundations

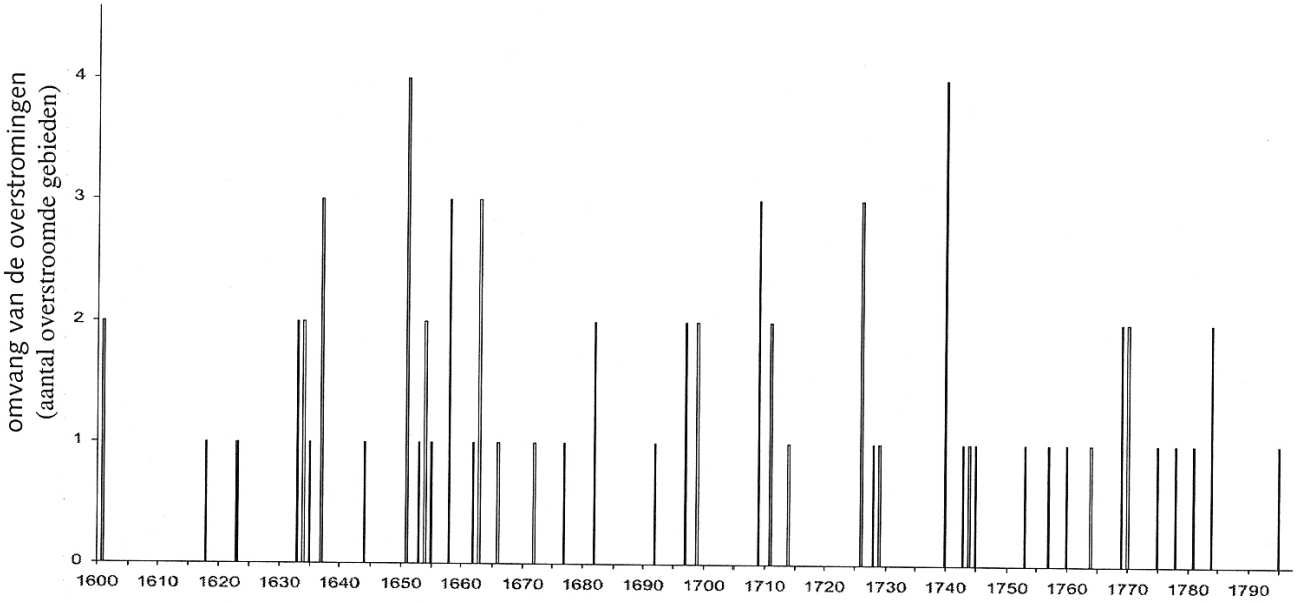
1400-1800

number of flooded areas

river inundations in the 15th and 16th century



river inundations in the 17th and 18th century



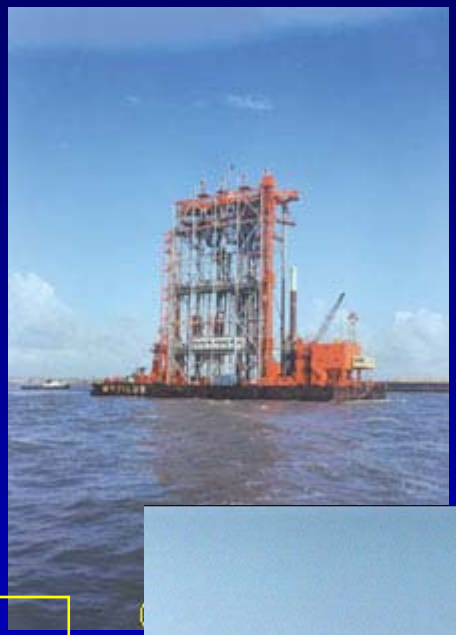
1798 – 2000: more centrally guided water management

- Establishment of Rijkswaterstaat (1798)
- Large-scale construction of a flood protection infrastructure
  (dikes, land reclamation projects, large closure works, etc.)
- Many innovations
  - mechanical pumping (after 1900)
  - new materials (steel, reinforced concrete, synthetic materials, etc.)
  - advanced hydraulic research and modelling
  - etc.

1798 – 2000: more centrally guided water management

Afsluitdijk:
closure of the
Zuiderzee (1932)

1798 – 2000: more centrally guided water management



Deltaworks: protection of the southwestern part of the Netherlands (after 1953)

1798 - 2000: more centrally guided water management

Storm surge barrier in the Rotterdam Waterway (1997)

1798 – 2000: more centrally guided water management

- Establishment of Rijkswaterstaat (1798)
- Large-scale construction of a flood protection infrastructure
  (dikes, land reclamation projects, large closure works, etc.)
- Many innovations
  - mechanical pumping (after 1900)
  - new materials (steel, reinforced concrete, synthetic materials, etc.)
  - advanced hydraulic research and modelling
  - etc.

➔ **High degree of safety against flooding**
However, never a 100% protection against flooding can be guaranteed.

➔ **New or adapted flood defence policies after a severe flood or inundation**

Storm surge 1953

Flooding disaster in
south-western Netherlands
- 1832 people died
- economic damage > 1 billion Euro

Delta Commission (1953)

safety norms along the coast (1960)

+ advice 1/3000 along the major rivers

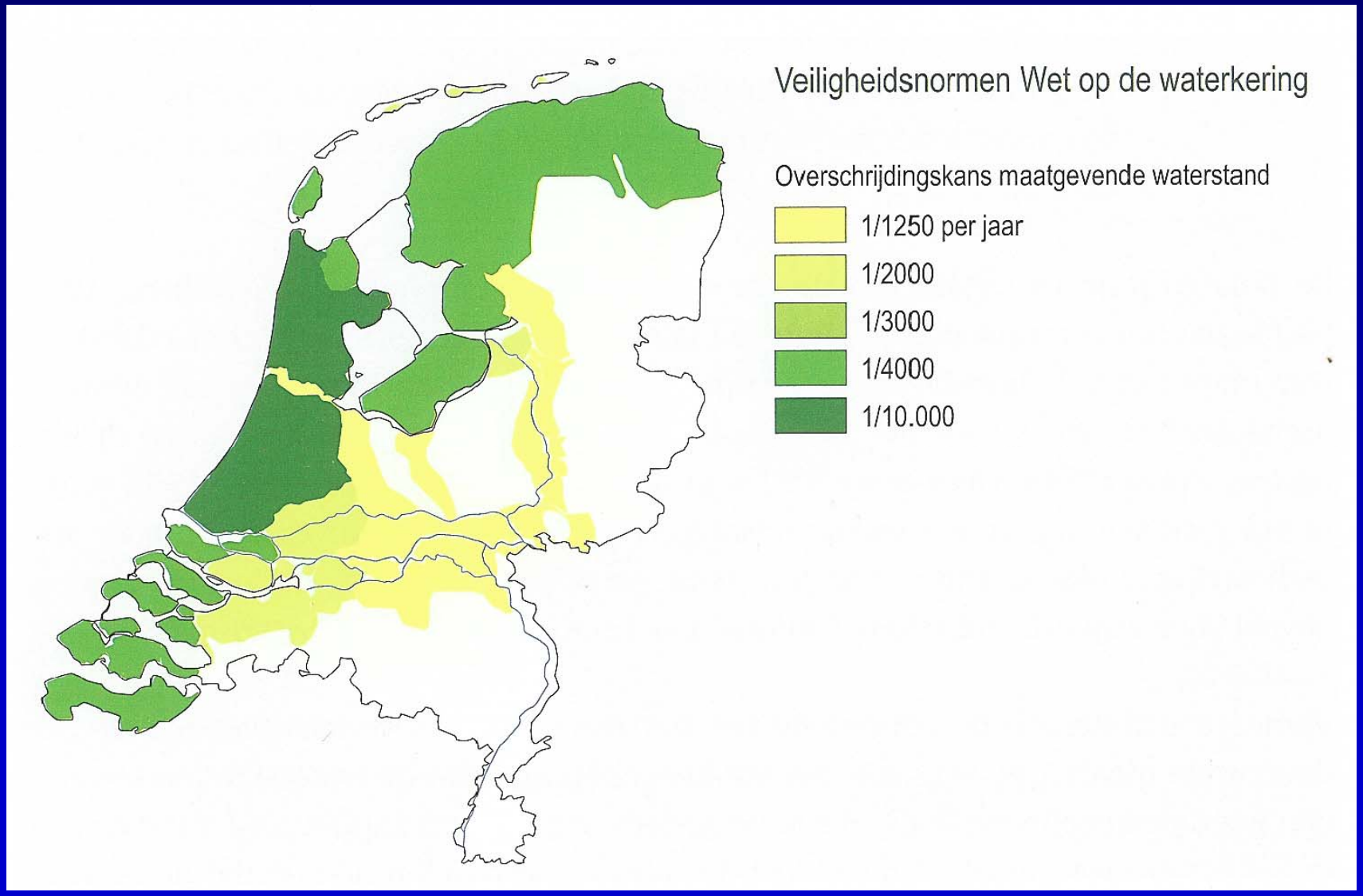
↓

many discussions (costs + effect on landscape)

1975-1977: Commission Becht (Rhine)
1992-1993: Commission Boertien I (Rhine)
1993-1994: Commission Boertien II (Meuse)

→ 1/1250 along the major rivers

Flood safety standards under Dutch national law



extreme river discharges in 1993 and 1995

1993 1995

Deltaplan Major Rivers

Rhine:
15.000 ⇒ 16.000 m³/s

Meuse:
3.650 ⇒ 3.800 m³/s

policy 'Room for the River' (1996)

1998
Water inconvenience

Commission Water Management 21st century

(**WB21** = Waterbeheer 21e Eeuw)
(2000)

Evaluation of present situation

- the strength of the dikes is higher than ever before and the probability of flooding has been reduced
- the risks of casualties and economic damage have become much higher in the past 50 years
  (due to increasing number of inhabitants and higher economic investments)

→ *How to handle this paradox?*

- **social aspects:** it seems the public no longer considers flooding in NL to be a natural hazard. Flooding seems to be regarded as risk similar to external risk such as a plane crash.

needed: *new flood risk policy* → **WV21**

Flood Safety 21th century

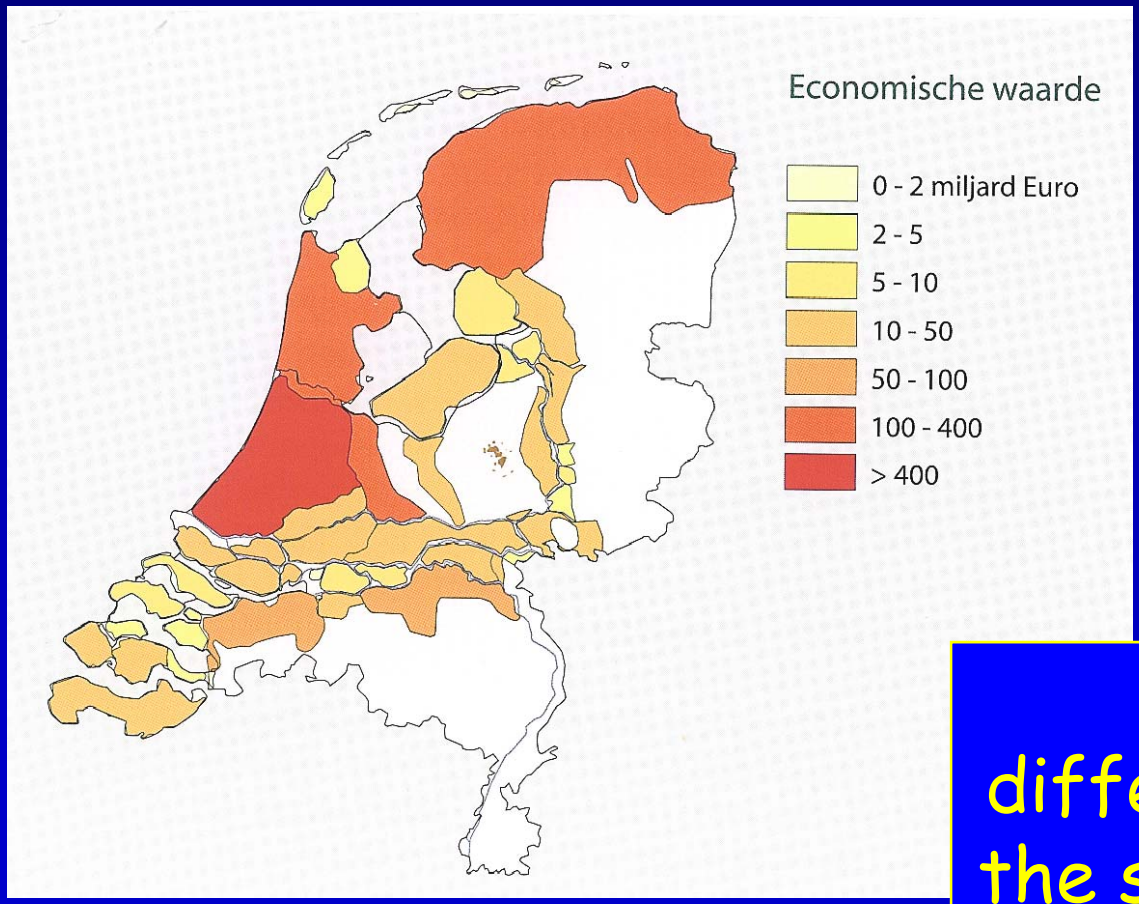
WV21 Flood Safety 21th Century

background: (present safety norms date from 1950-1960)

- climate change
- increasing number of inhabitants (population density)
- increasing economic investments

WV21 Flood Safety 21th Century

present economic values in the polder districts



adapted differentiation of the safety values?

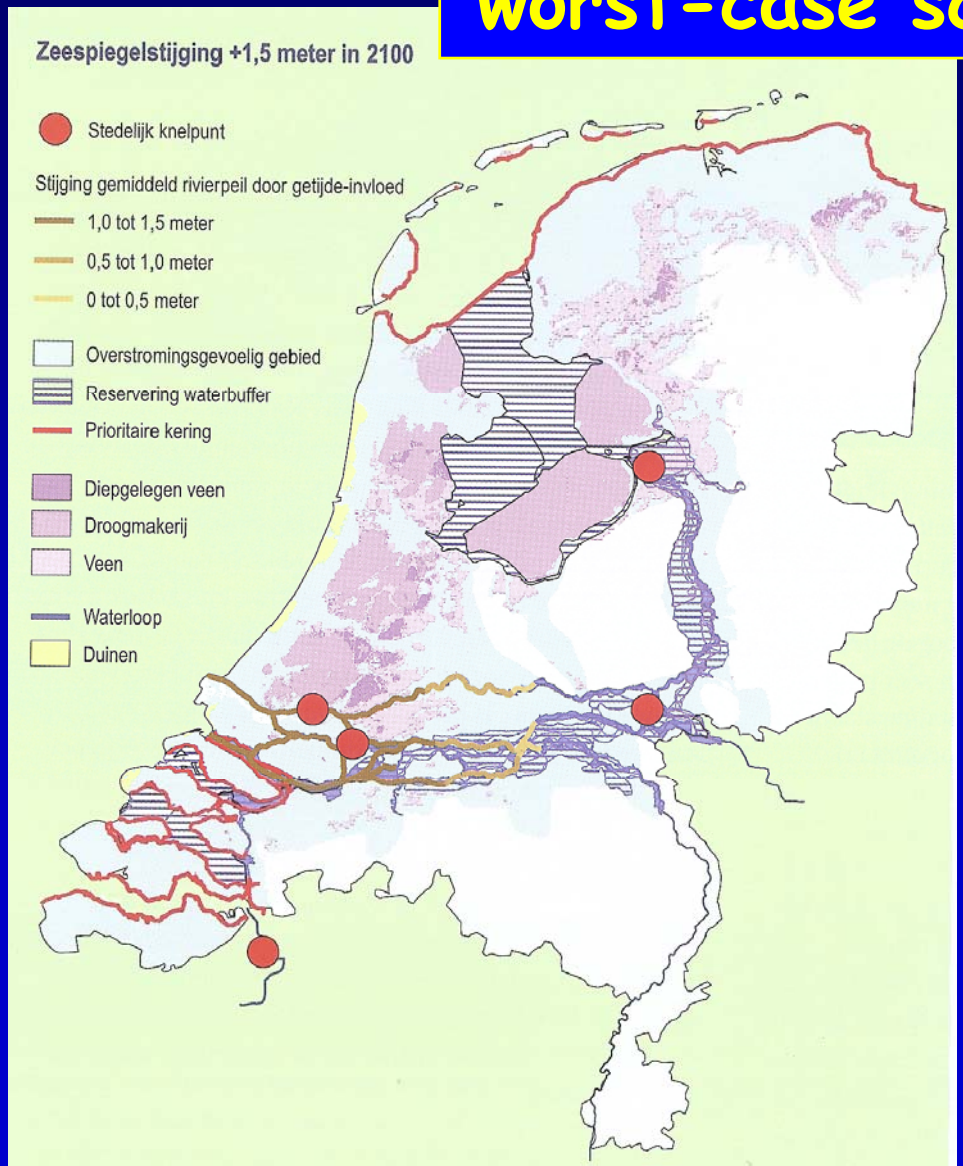
WV21 Flood Safety 21th Century

Effects of climate change on water management in the Netherlands

effect of climate change (in 100 year)	
temperature	**2 to 4 degrees**
increase **sea level**	**max. 0.85 m**
river discharge **Rhine**	**7 to 18 %** in winter
river discharge **Meuse**	**5 to 10 %** in winter

WV21 Flood Safety 21th Century

worst-case scenario



Question in Parliament:

- vulnerability NL for worst-case scenario + what to do?

- much uncertainty !
- lower part of NL can be kept safe, also > 2100
- 100% safety can never be given
- more attention to reduction of consequences of flooding
- climate-resistant spatial planning

WV21 Flood Safety 21th Century

Three pillars:

- *prevention*
- limiting the *consequences* of a flood disaster
- increase the *awareness* within society of the possibility of flooding

Consider the whole safety chain:

- pro-action *(protection vital infrastructure, etc.)*
- prevention *(heightening of the dikes, etc.)*
- preparedness *(early warning systems, etc.)*
- response *(alarming and warning systems, etc.)*
- after-care *(insurance, restoration, psycho-social help, etc.)*

WV21 Flood Safety 21th Century

prevention

- from *'probability of exceedance'*
  to *'probability of flooding'* **(flood risk approach)**

  risk = probability x consequence

  - *dike ring approach*
  - *various failing mechanisms*
  - *include all uncertainties*

- *differentiation of protection against flooding?*

WV21 Flood Safety 21th Century

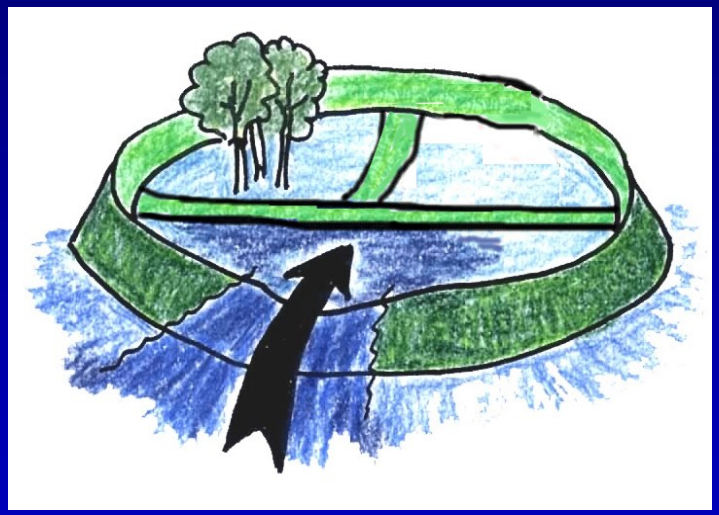
limiting the *consequences* of a flood disaster

- water safety in spatial planning
  - *not or limited building in vulnerable areas*
  - *evacuation routes*
  - *leading of unexpected floodings*
  - *retardation of unexpected floodings*

    ➔ compartmentalizing
- well-prepared crisis management
- robust buildings in high-risk areas

WV21 Flood Safety 21th Century

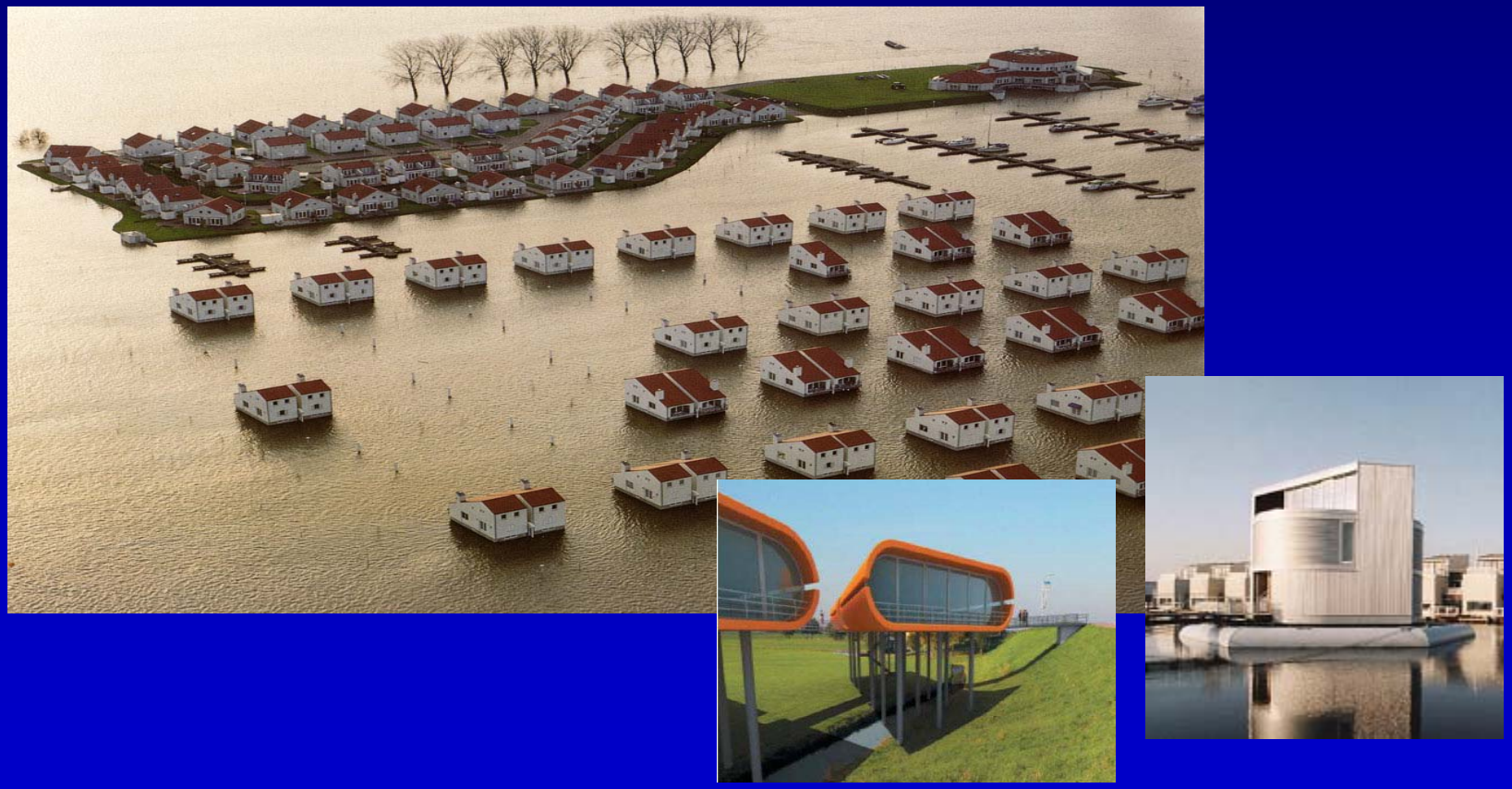
Reducing the vulnerability



Compartimentalizing: leading and stopping of floodings

WV21 Flood Safety 21th Century

Reducing the vulnerability



Robust building in flood-prone areas

WV21 Flood Safety 21th Century

increase the *awareness* within society
of the possibility of flooding

Problem: very high trust in the protection level against flooding

- communication strategy "flood risk"
- risk maps
- stimulating the self-help of citizens

CHALLENGE

spatial water strategy

➔ actualisation of prevention standards

➔ reduction vulnerability

➔ increasing spatial quality

The Netherlands continues: *"living with water"*