Deltares
Enabling Delta Life

Country case study: lessons from the Netherlands

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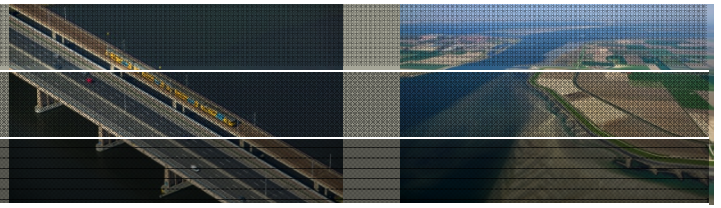
ECONADAPT Policy Workshop
27-28th September 2016, Brussels

Contents



1. **The Dutch Delta Program**
2. **Economic analysis: three examples**
   - CBA for New Flood Protection Standards
   - CEA Rhine-Meuse Estuary
   - CBA Fresh Water

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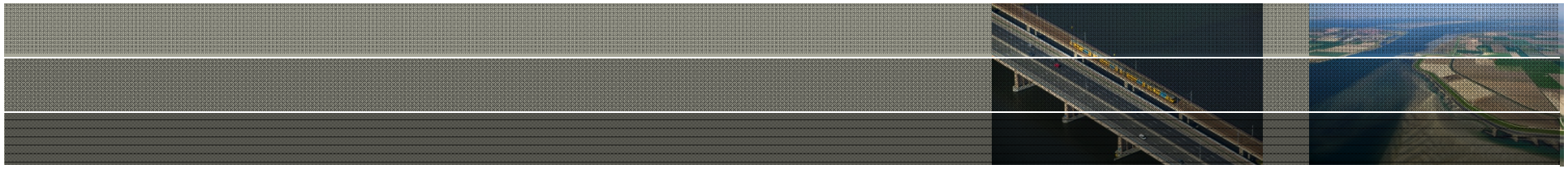

The Dutch Delta Program

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The National Delta Program

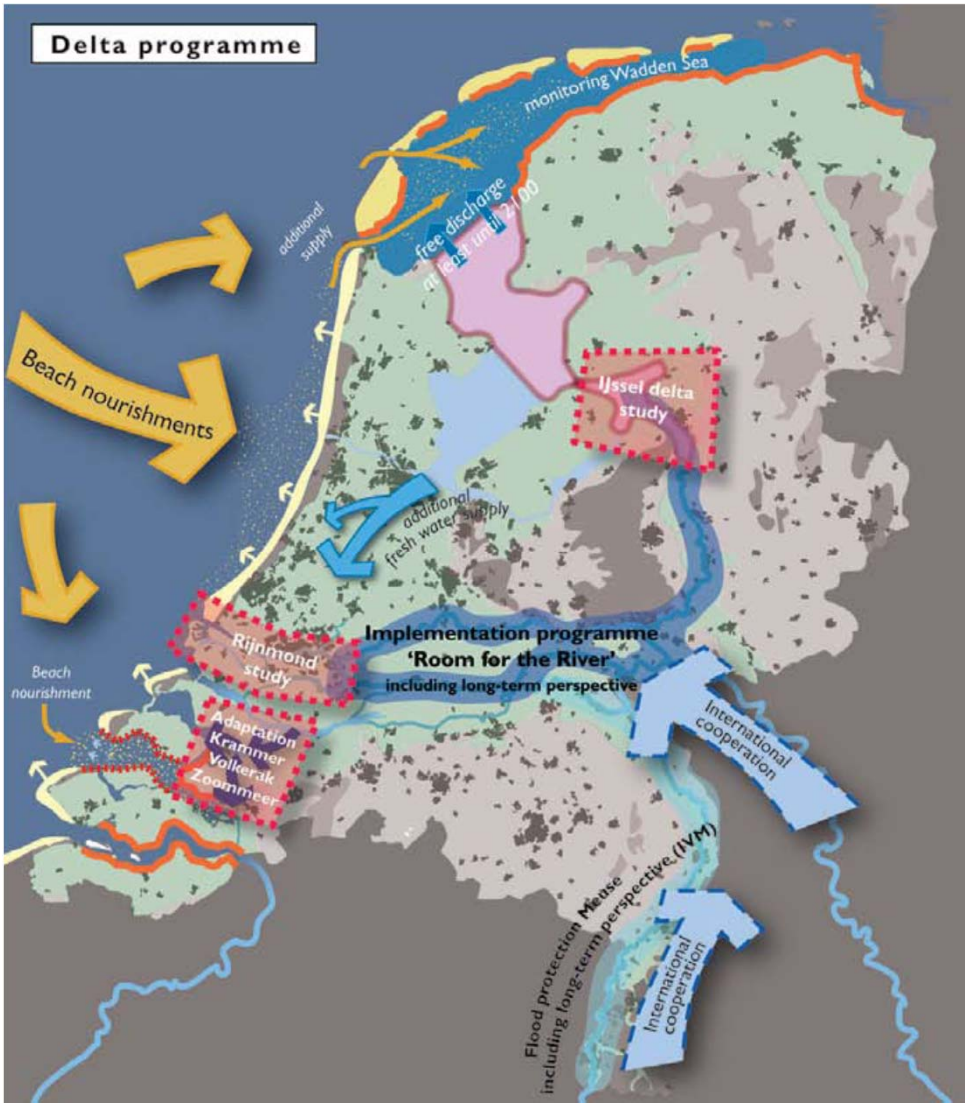
Multi-governance

Long term (2050 / 2100)

- Flood protection
- Fresh water supply
- Spatial adaptation

Well embedded

- Delta Law
- Delta Fund (€ 1 billion p.a.)
- Delta Commissioner
- Delta Program (annual)
- Delta Decisions



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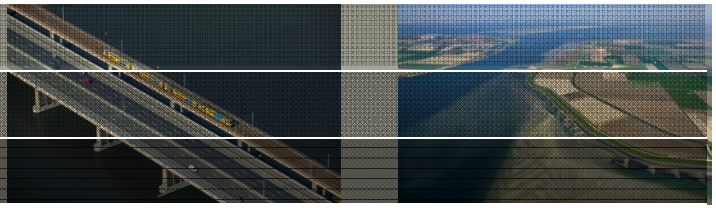
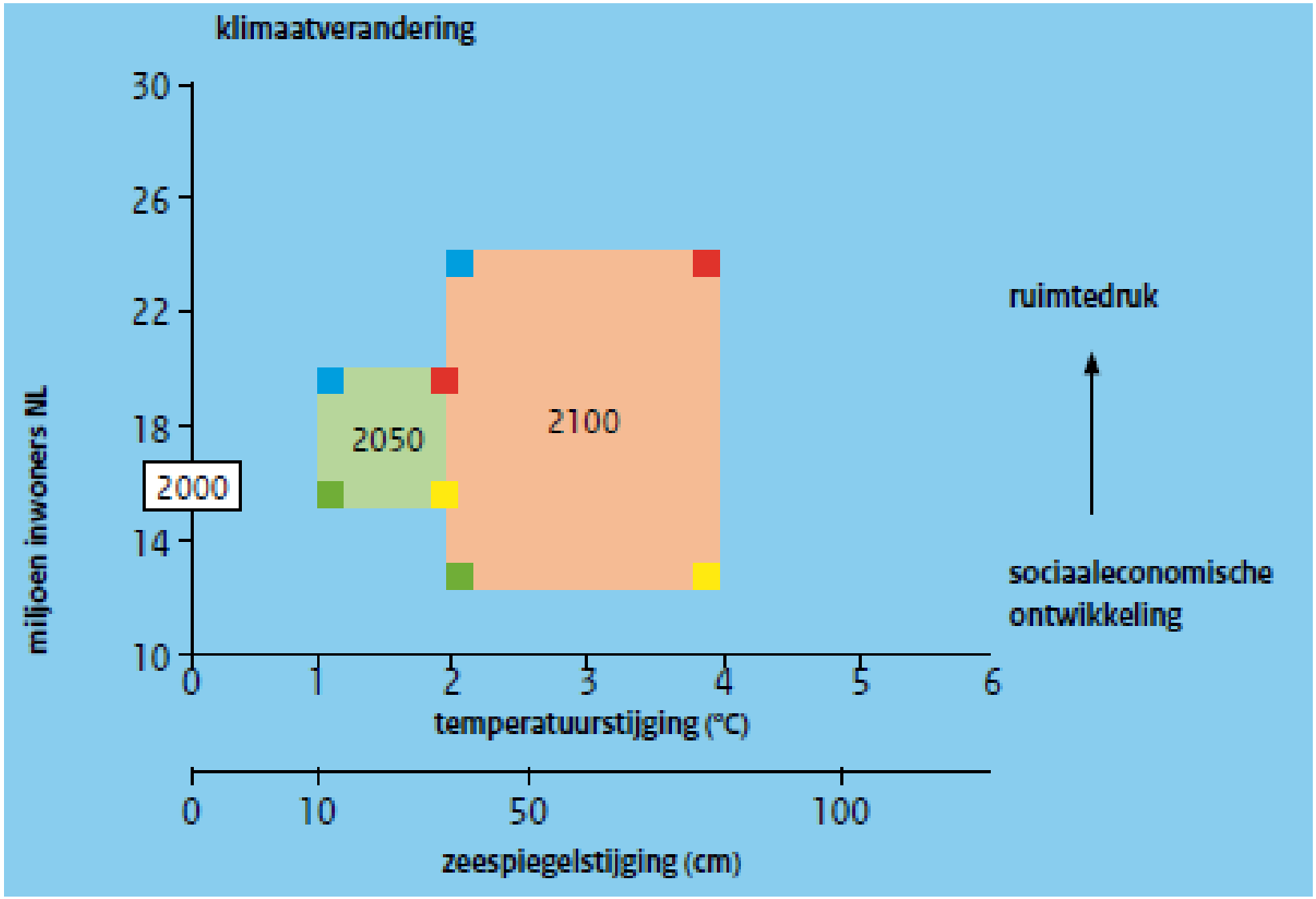
National Delta Scenario's





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Adaptation Tipping Points

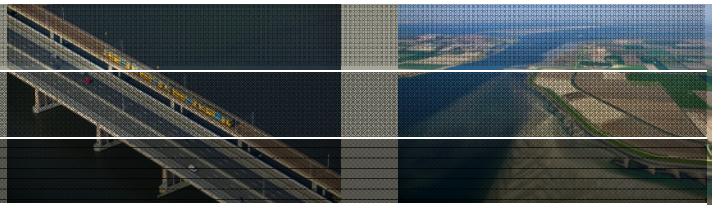
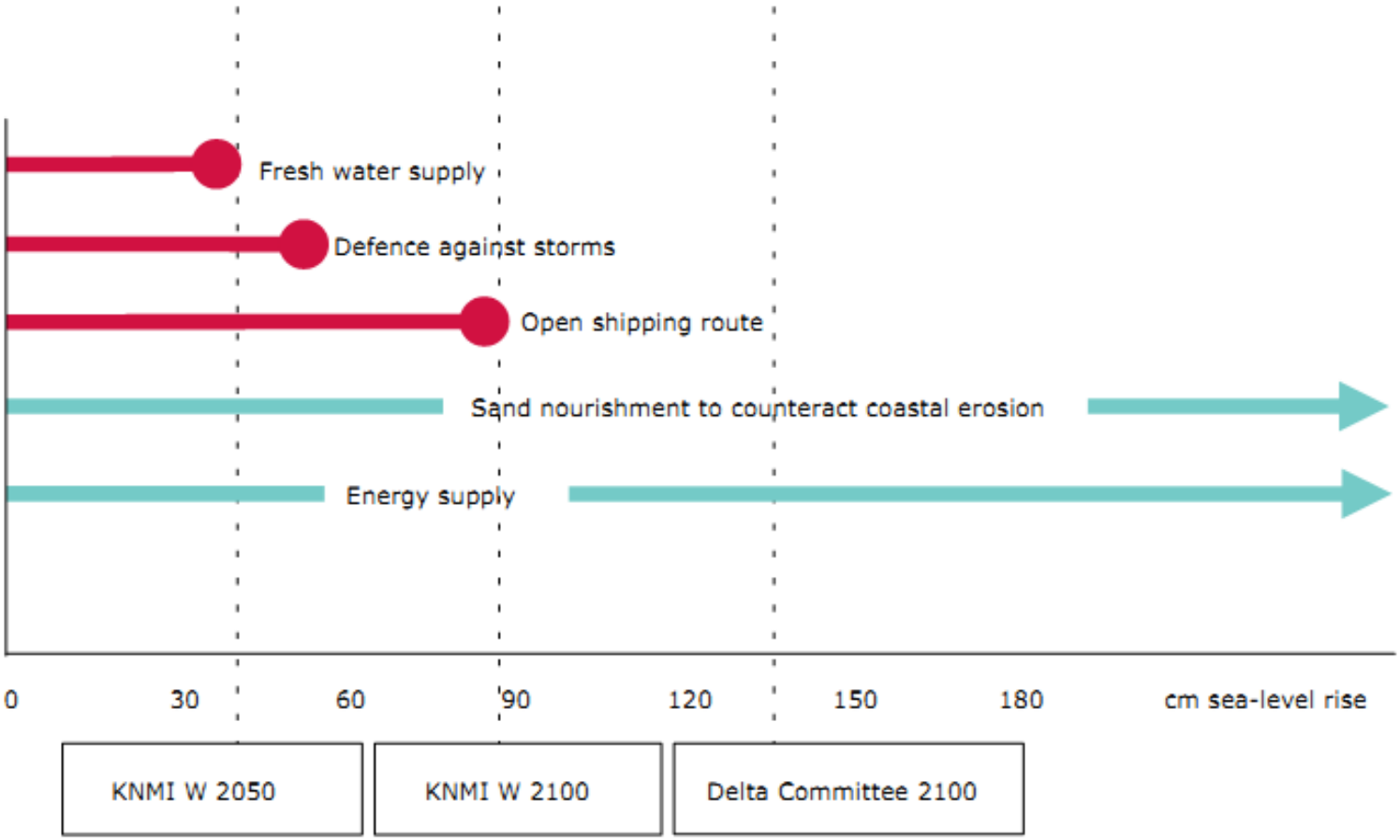


Figure 2.8 Adaptation tipping points for the Rhine-Meuse estuary



Note: Red bullets indicate endpoints of a strategy, blue arrows indicate the strategy can cope with higher sea levels. The climate scenarios used in the Netherlands are marked with dotted lines.

Source: Jeuken et al., 2010.

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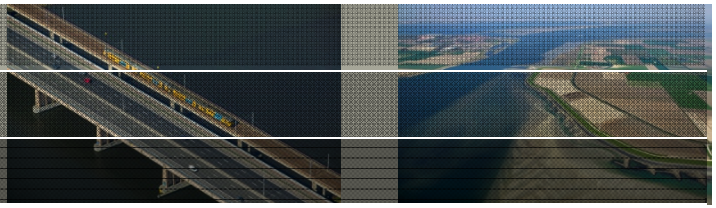
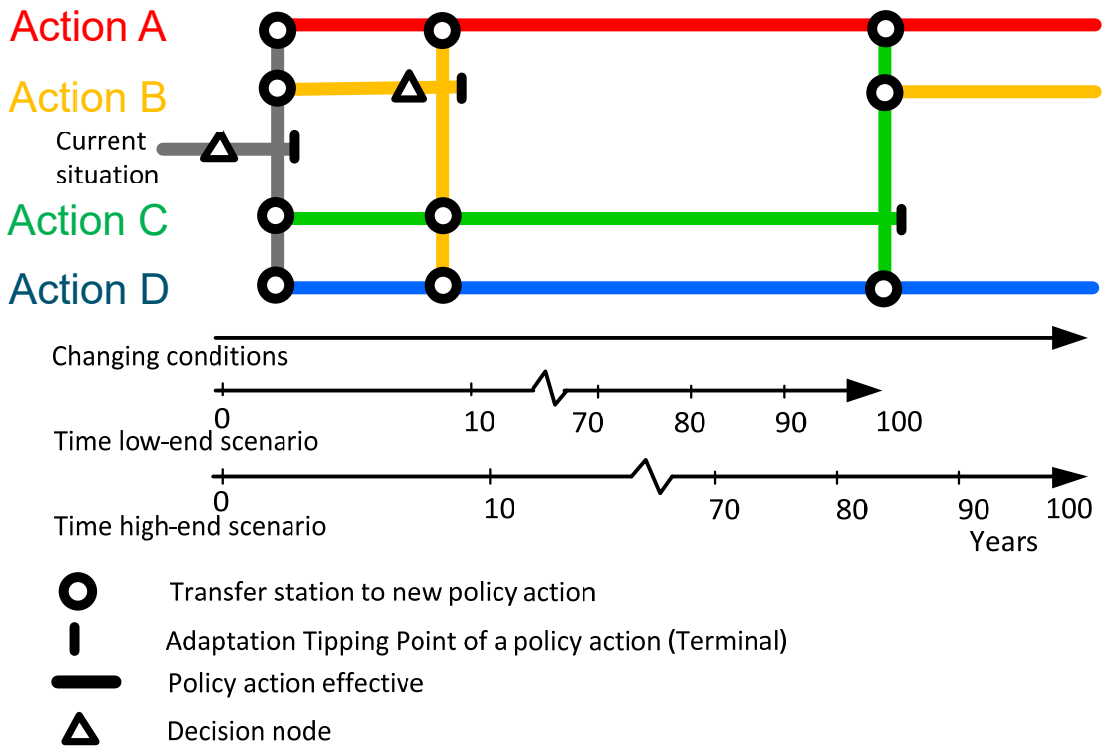
Adaptation Pathways



Adaptation Pathways Map



Costs and benefits of pathways

Time horizon 20 years

Time horizon 50 years

Time horizon 100 years

Pathway	Costs	Benefits	Co-benefits
1	+++	+	0
2	+++++	0	0
3	+++	0	0
4	+++	0	0
5	0	0	-
6	++++	0	-
7	+++	0	-
8	+	+	---
9	++	+	---

Pathways that are not necessary in low-end scenario

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

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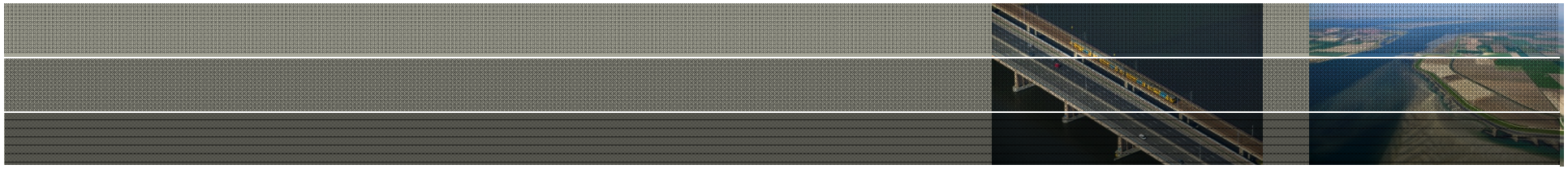

CBA for
Flood Protection Standards

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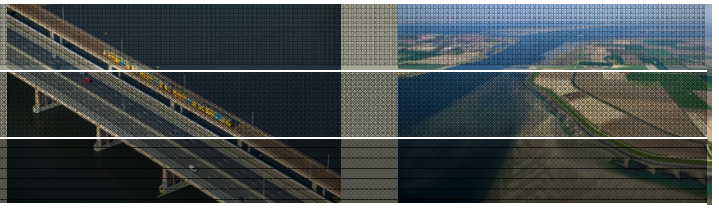
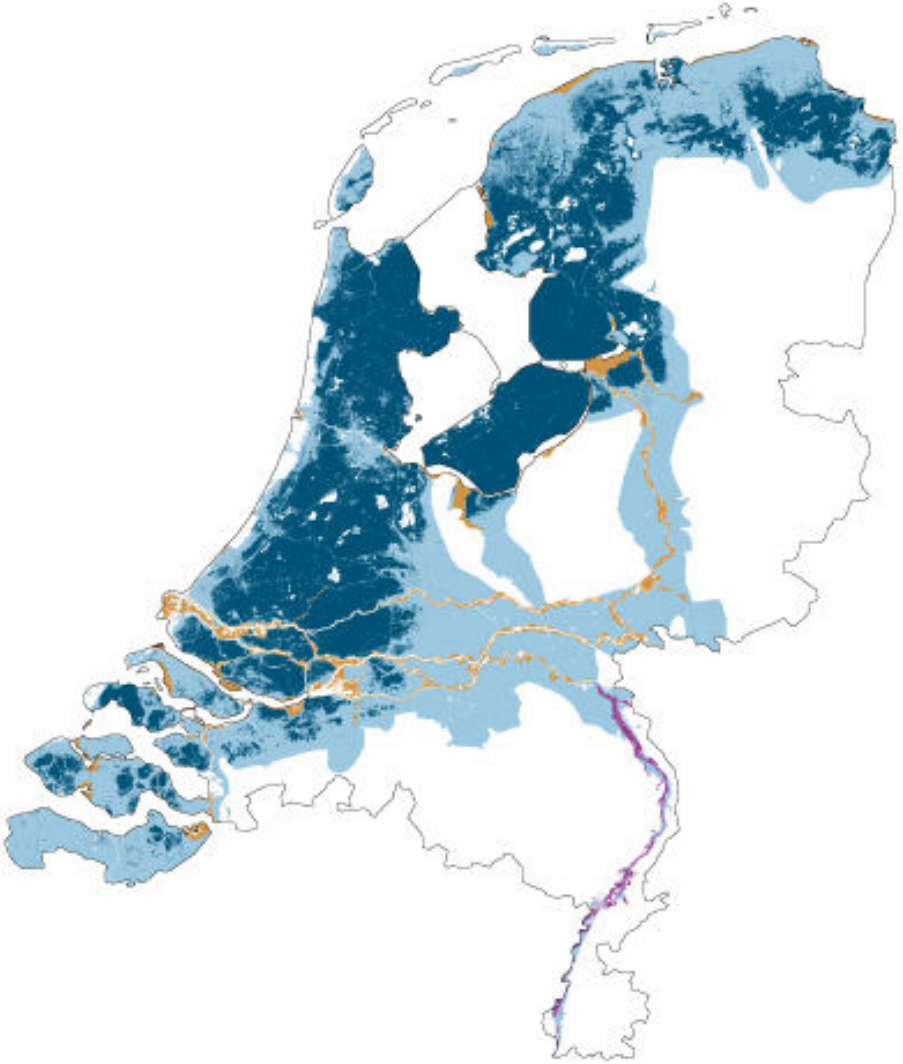
Flood risk in the Netherlands





55% of the Netherlands is flood prone:

- 26% below sea level
- 29% above sea level

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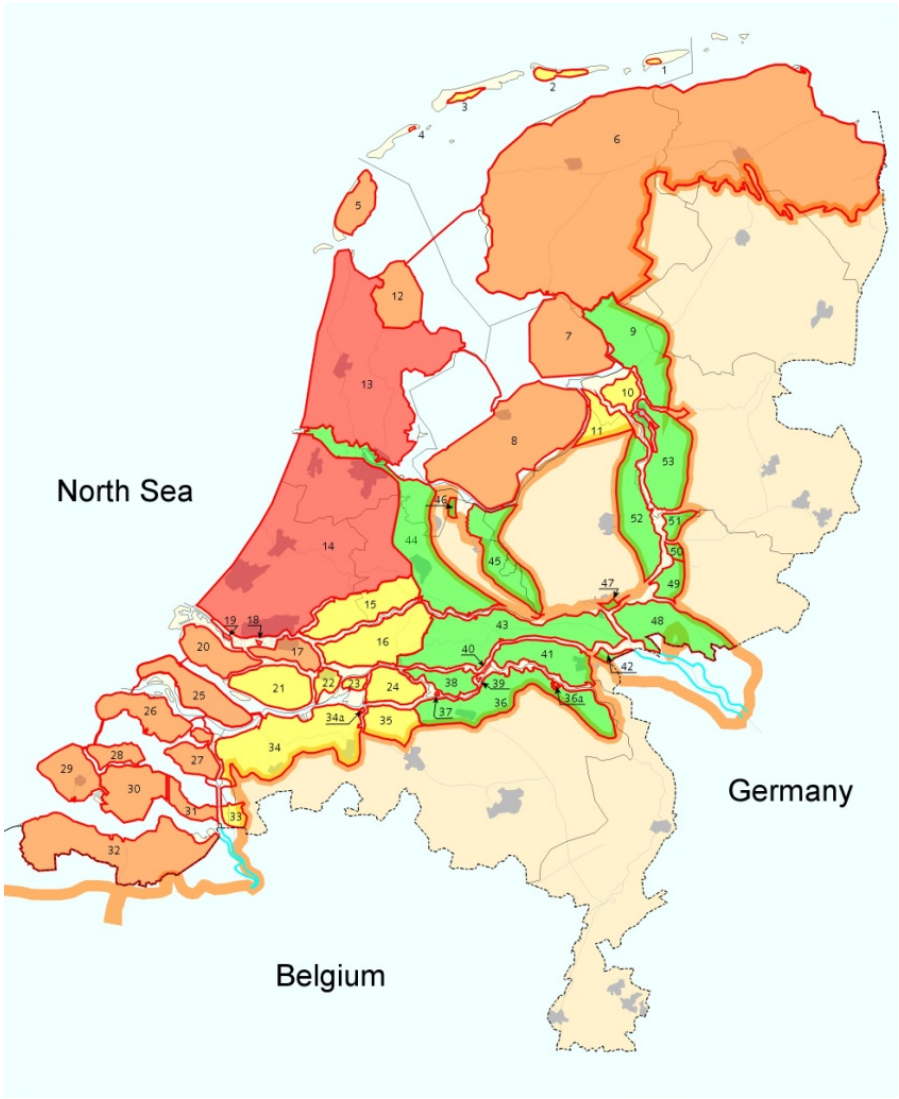
Flood protection: legal standards for dike ring areas



Legal standards

Coastal areas:

1/4000 – 1/10.000 per year

River:

1/1250 – 1/2000 per year

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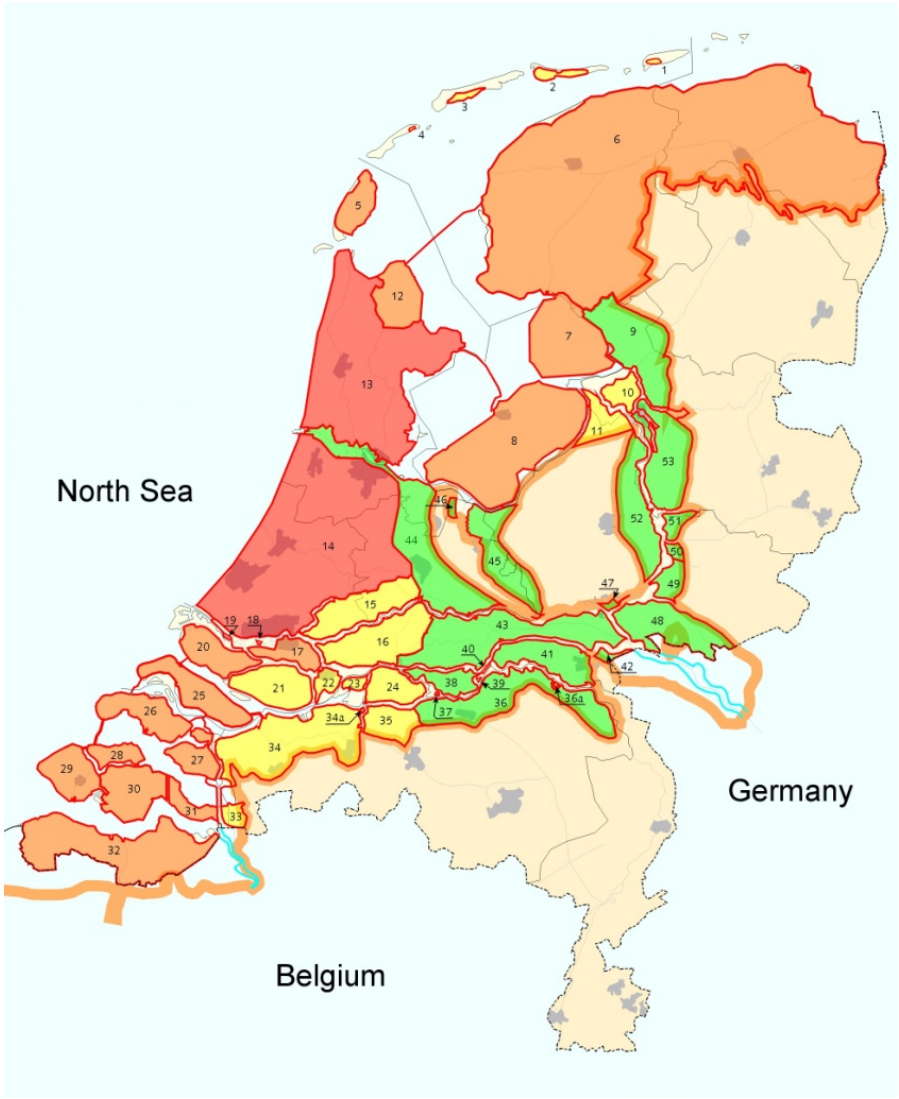
Flood protection: legal standards for dike ring areas



History of legal standards:

1953: Floods in Southwestern part of the NL

1960: (First) Delta Committee: protection standards for coastal areas

1977, 1993, 1995: protection standards for other areas proposed by other Commitees

1996: Flood Defenses Act: protection standards enforced by law

Hence, existing legal protection standards:

1. **have no common basis**
2. **are not up to date**

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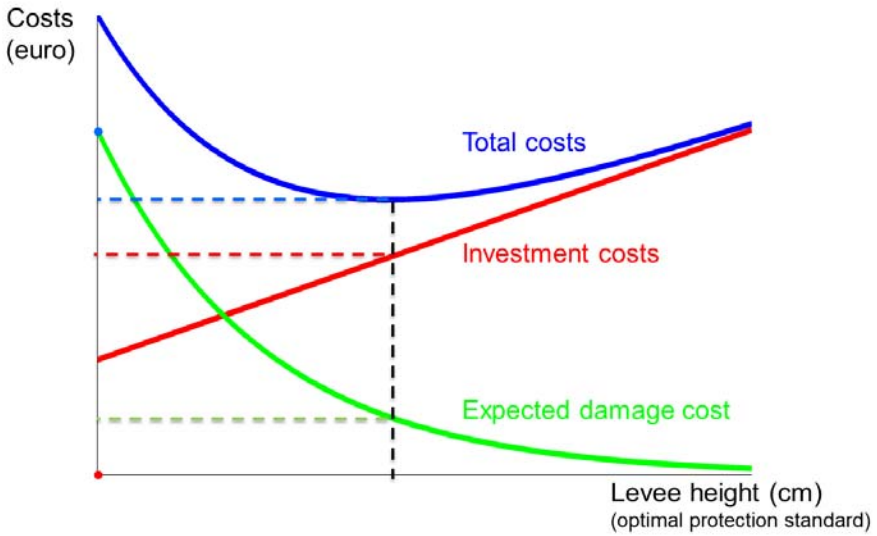
Cost-benefit analysis, from static to dynamic

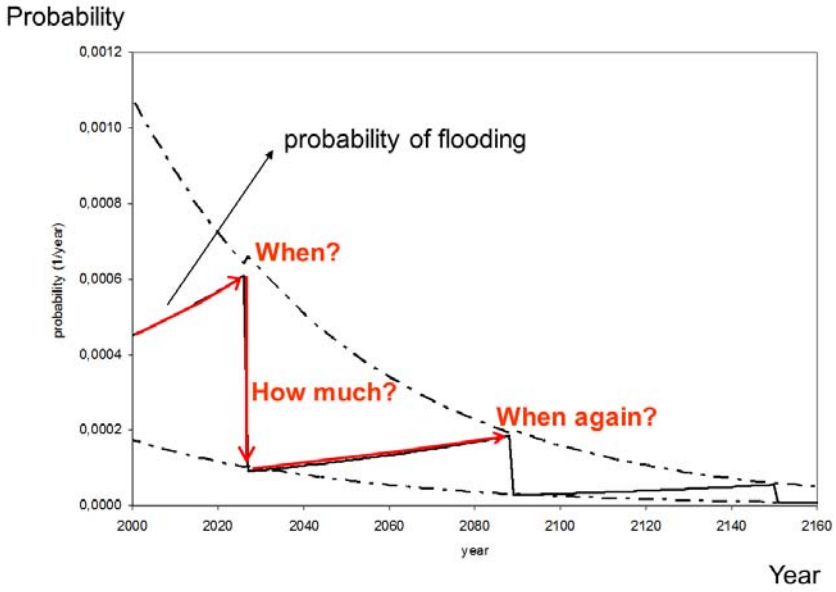
Static CBA:

- How much to invest?
- Minimize total of investments and expected damages



Dynamic CBA:

- How much, when and when again to invest?
- Minimize total of investments and expected damages



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www.dutchwatersector.com/news/news/2013/04/dutch-flood-expert-team-wins-2013-edelman-award-with-method-to-calculate-the-ec

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Home > News > Dutch flood expert team wins 2013 Edelman Award with method to calculate the economic optimal dike heights

Dutch flood expert team wins 2013 Edelman Award with method to calculate the economic optimal dike heights

April 9th, 2013 by nwp

A team of Dutch organisations specialized on flood control, headed by the Dutch Delta Program Commissioner, won the 2013 Franz Edelman Award for Achievement in Operations Research and the Management Sciences in San Antonio on April 8.

The Dutch organisations Delta Commissioner of Holland, Ministry of Infrastructure and the Environment, CPB Netherlands Bureau for Economic Policy Analysis, Delft University of technology, Tilburg University, research institute Deltares, consultancy

com/news/wp-content/uploads/2013/04/dws-edelman-award-2013-jaap-kwadijk2-525px.jpg lly Efficient

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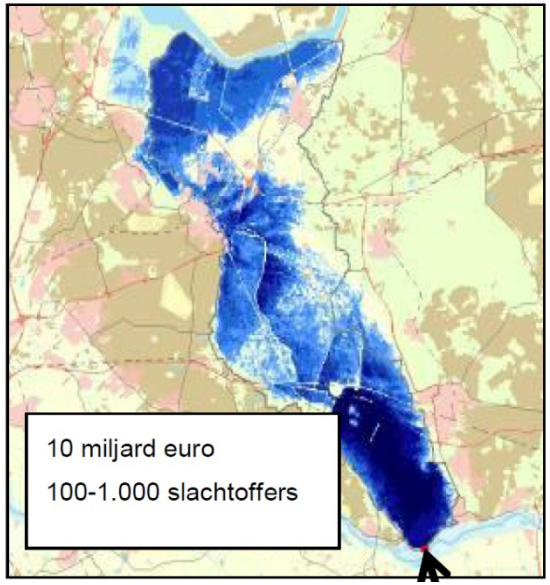
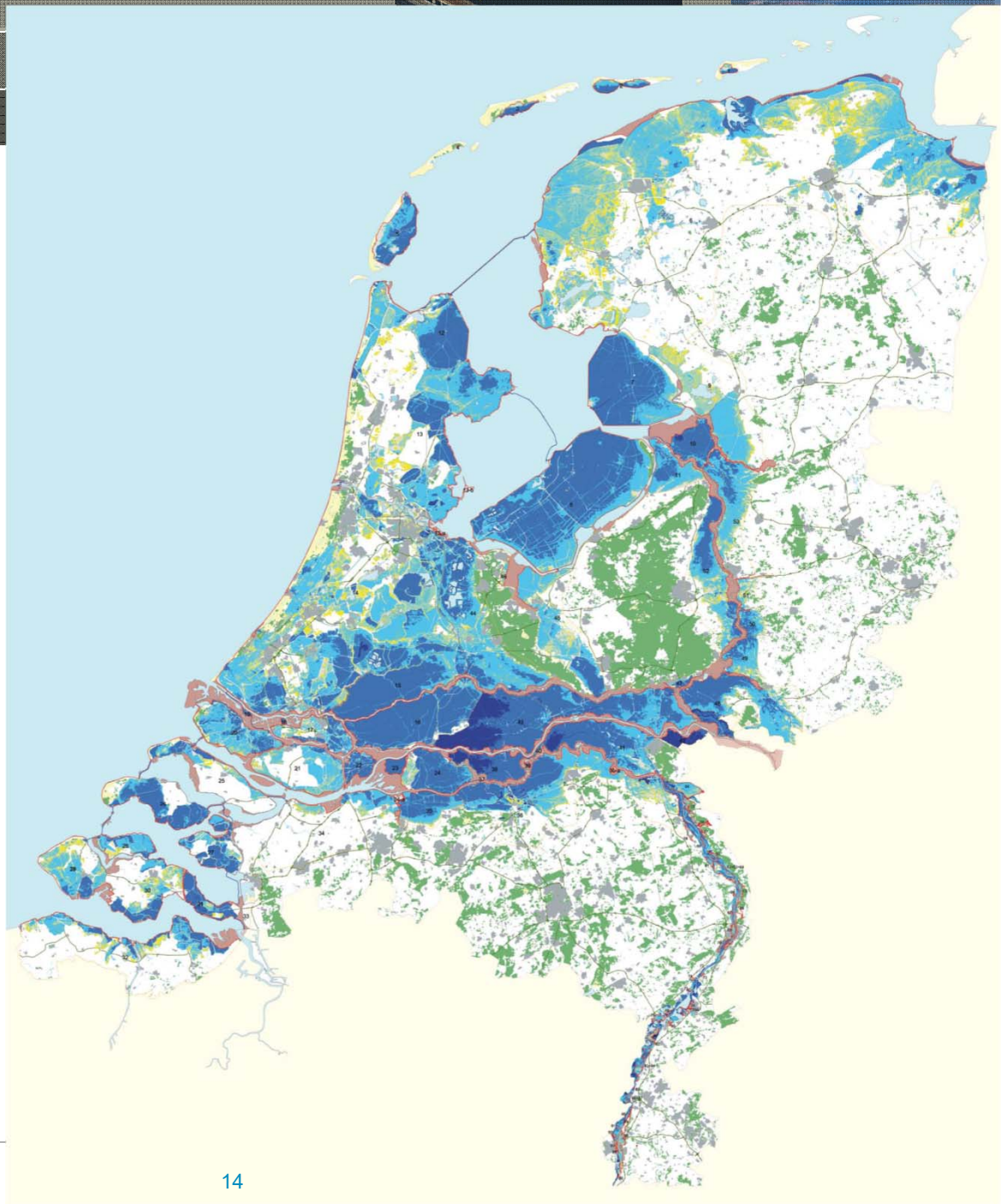
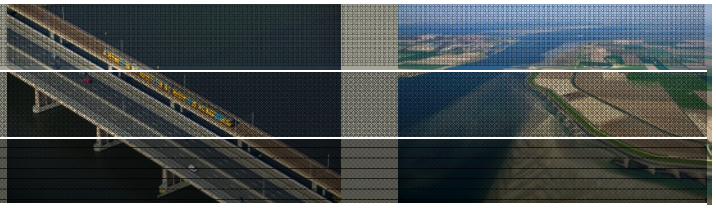
Flood damage

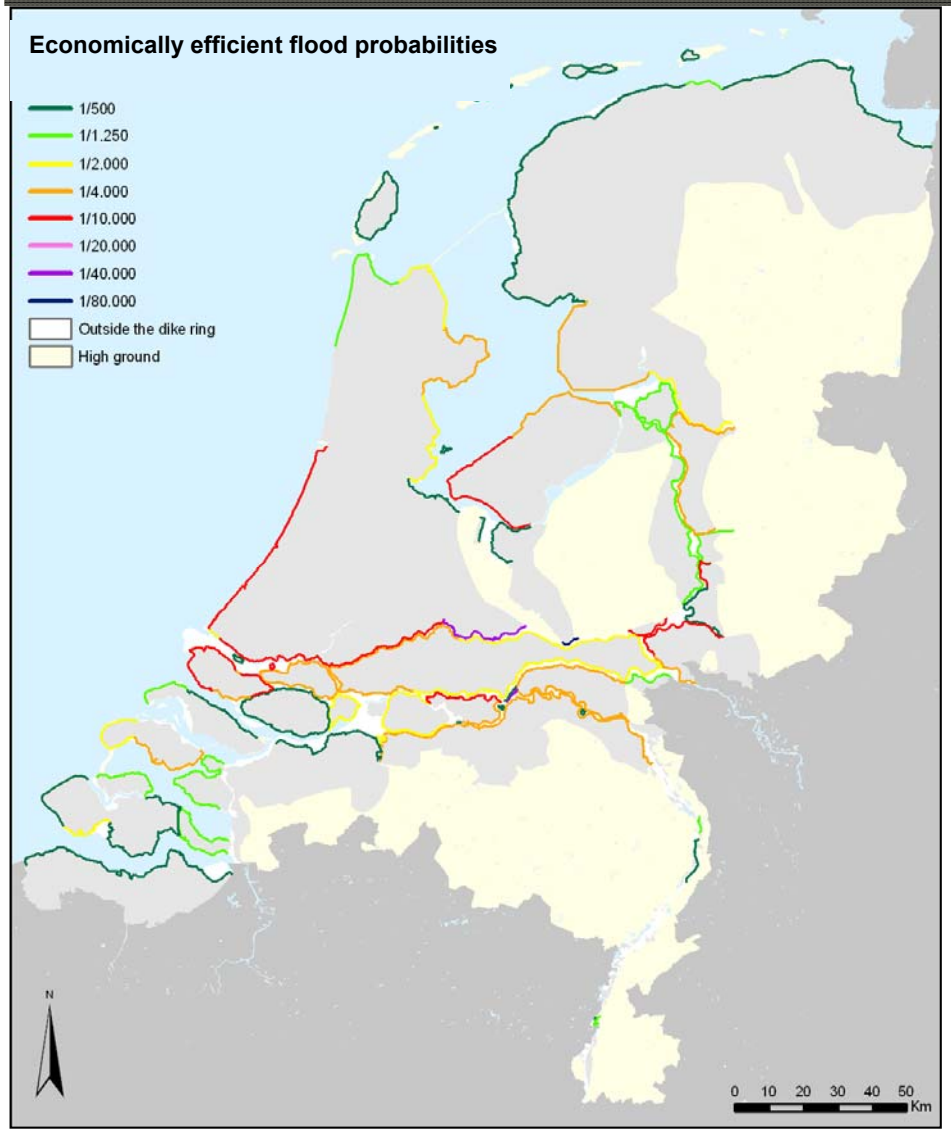


- > 700 inundation scenario's
- For each scenario assessment of economic damages and number of casualties



Results





Probability per year

- 1/500
- 1/1.250
- 1/2.000
- 1/4.000
- 1/10.000
- 1/20.000
- 1/40.000
- 1/80.000
- Outside the dike ring
- High ground

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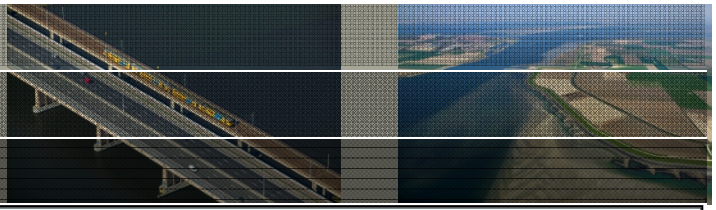
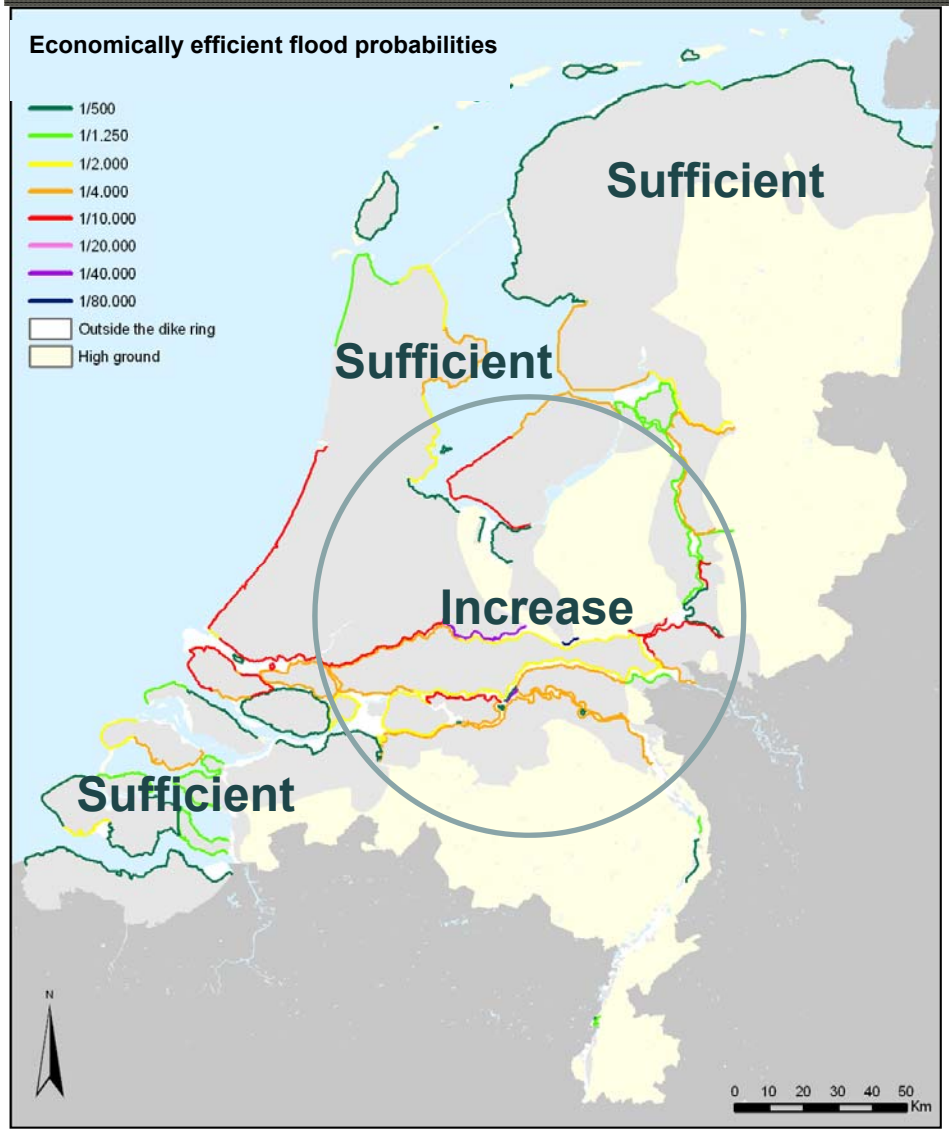
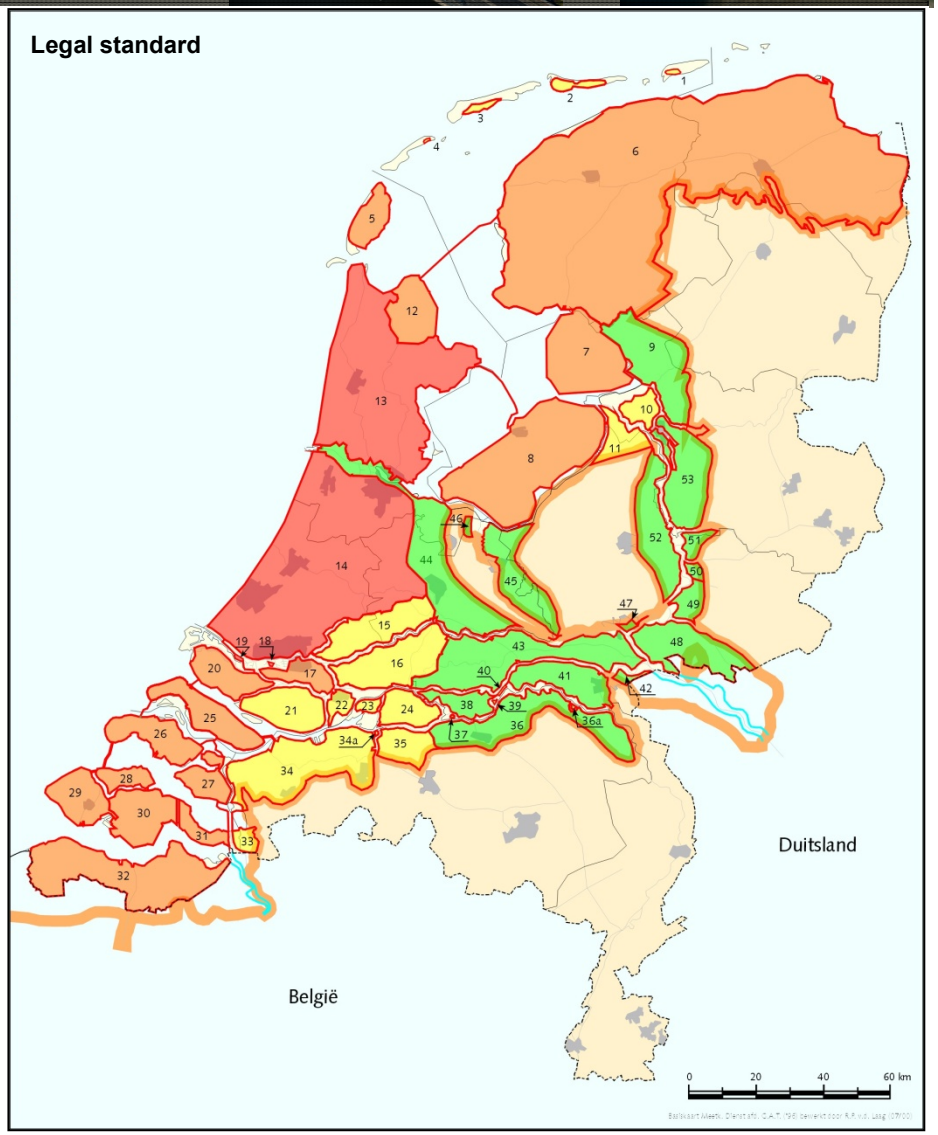
Results



Economically efficient flood probabilities



Legal standard



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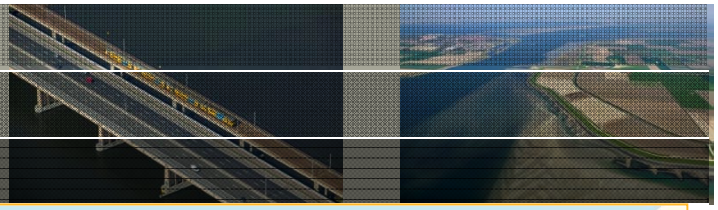
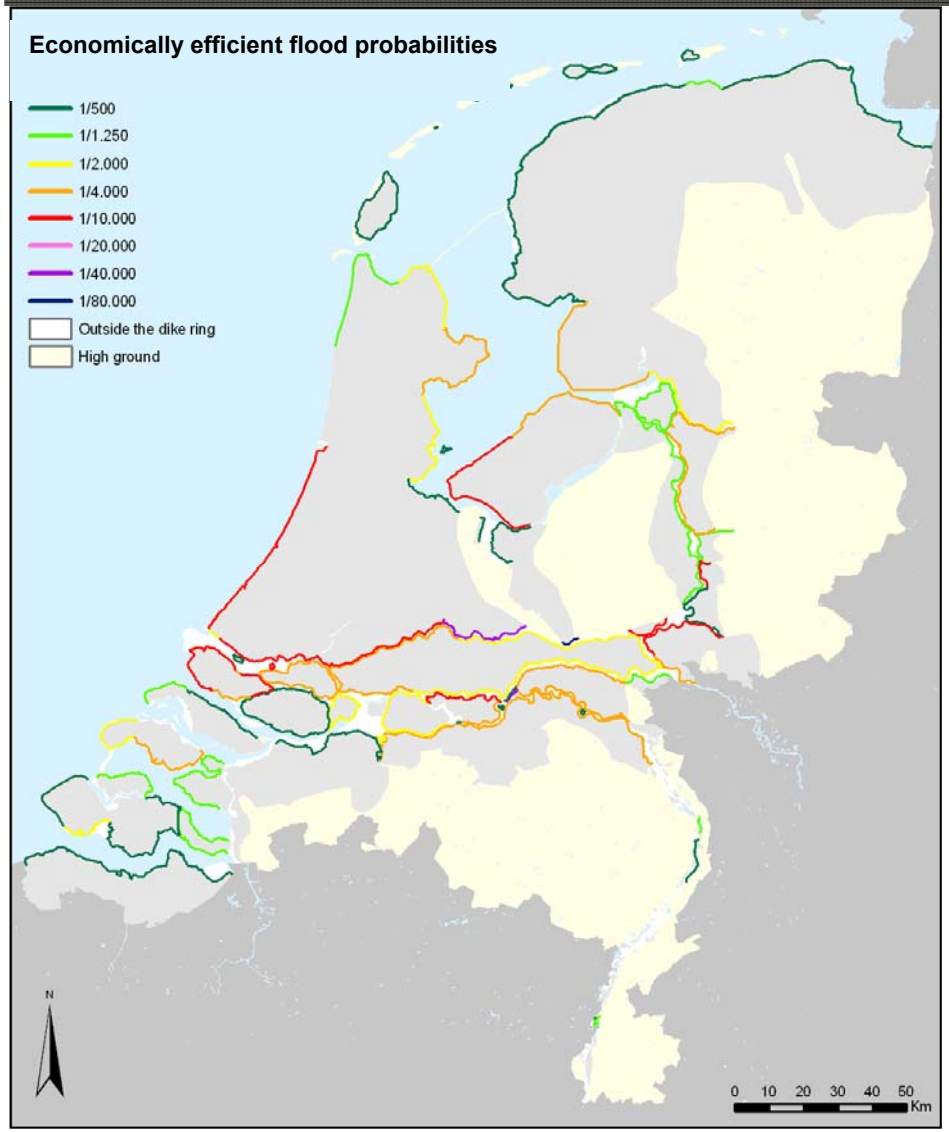
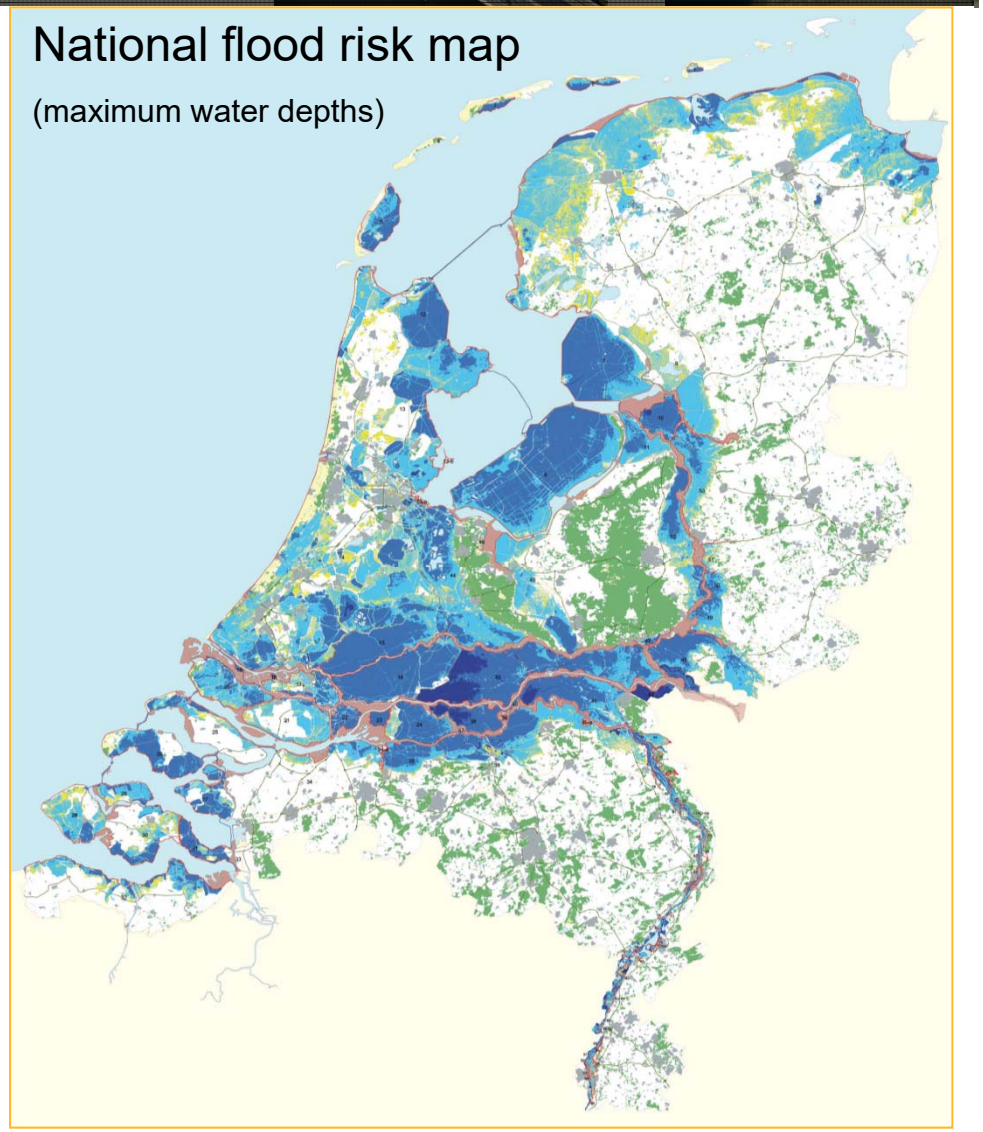
Results







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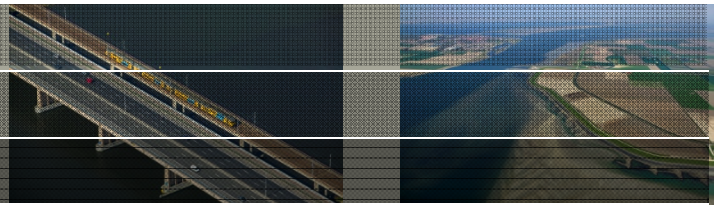
CBA Conclusions



- Existing standards are inefficient (too high, too low)
- Higher standards are needed esp. along Rhine and Meuse
- → Flood risk reduction 67%, at a cost of € 3.7 billion.

- Earlier advice of 2nd Delta Commission, 2008: tenfold increase in standards everywhere
- → Flood risk reduction 90%, at a cost € 11.5 billion.

- Hence, CBA leads to savings in investment cost of € 7.8 billion.

- Extensive support for CBA: most of the updated flood protection standards (approved in Parliament in 2016) are in line with CBA outcome.

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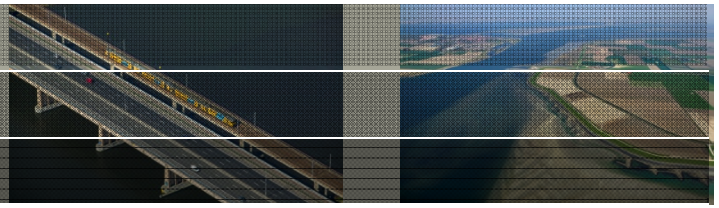
Lessons learned



New flood protection standards

- Sensitive issue, equity and efficiency considerations
- Long process (>10 years between start CBA and political decision in Parliament)
- Dependent on political support and openness
- CBA by consortium, led by Deltares, involving consultants and universities (→ credibility)
- International scientific recognition through Franz Edelman Award 2013
- Uncertainty range in optimal standards considerable → new classes of 1/1000; 1/3000; 1/10000 etc. per year.

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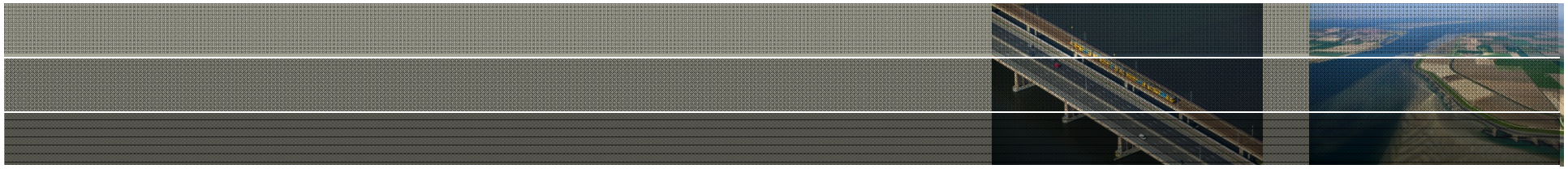

CEA for Flood Protection Strategies Rhine-Meuse Estuary

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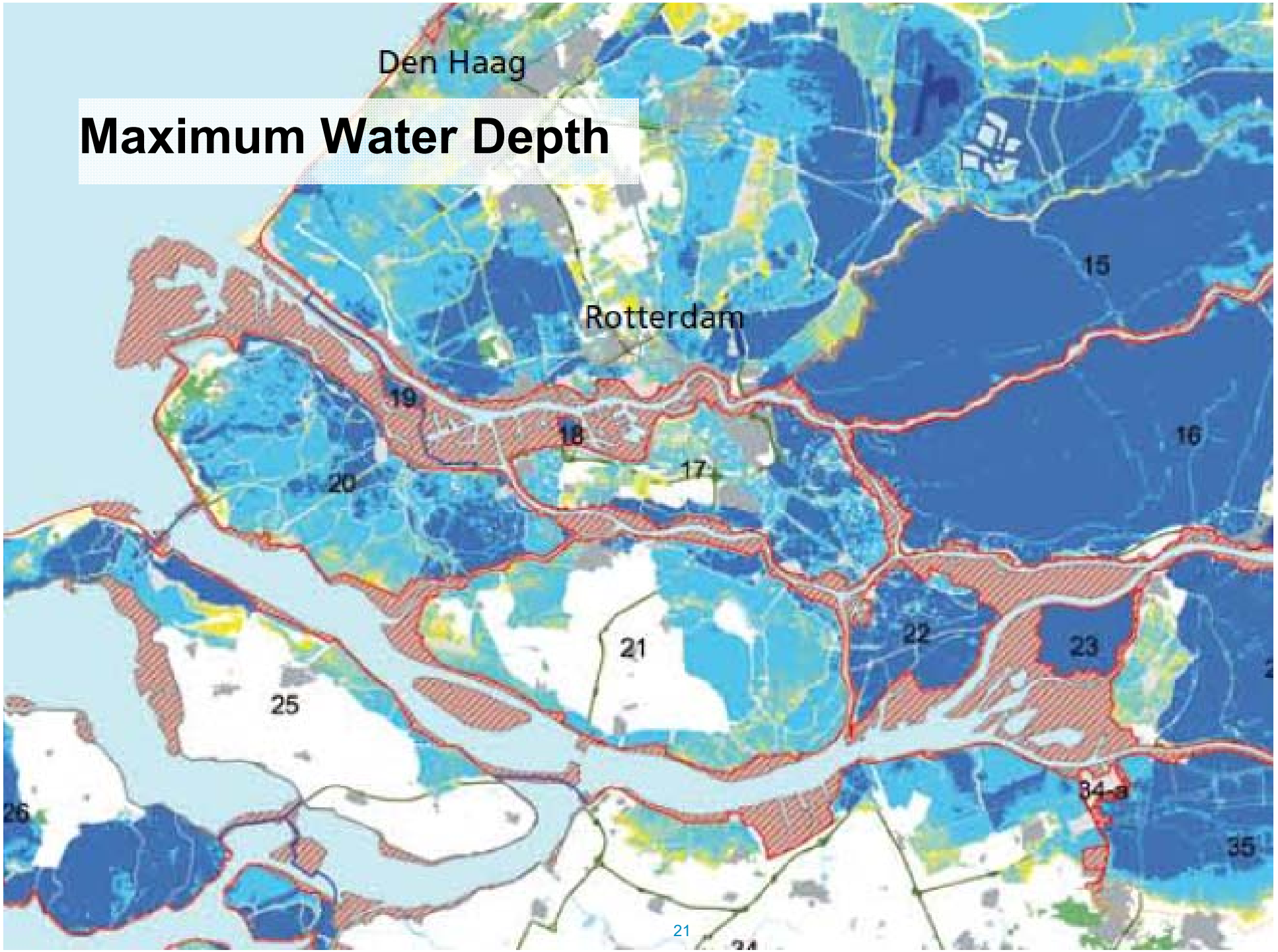
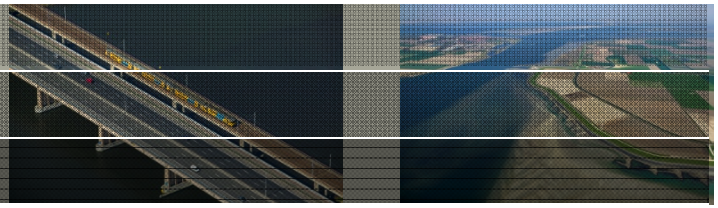
Maximum Water Depth



Context



- Sea level rise, increased river discharges, socio-economic development

- Objective: reach and maintain (updated) flood protection standards
- Default measure: improve dikes
- Other measures:
  - Storm surge barrier (improve / replace)
  - Water storage
  - Change discharge distribution
  - (Room for the River)
- Q: What is an optimal strategy? → Cost-effectiveness analysis

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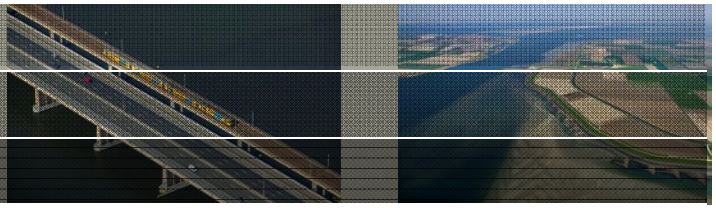
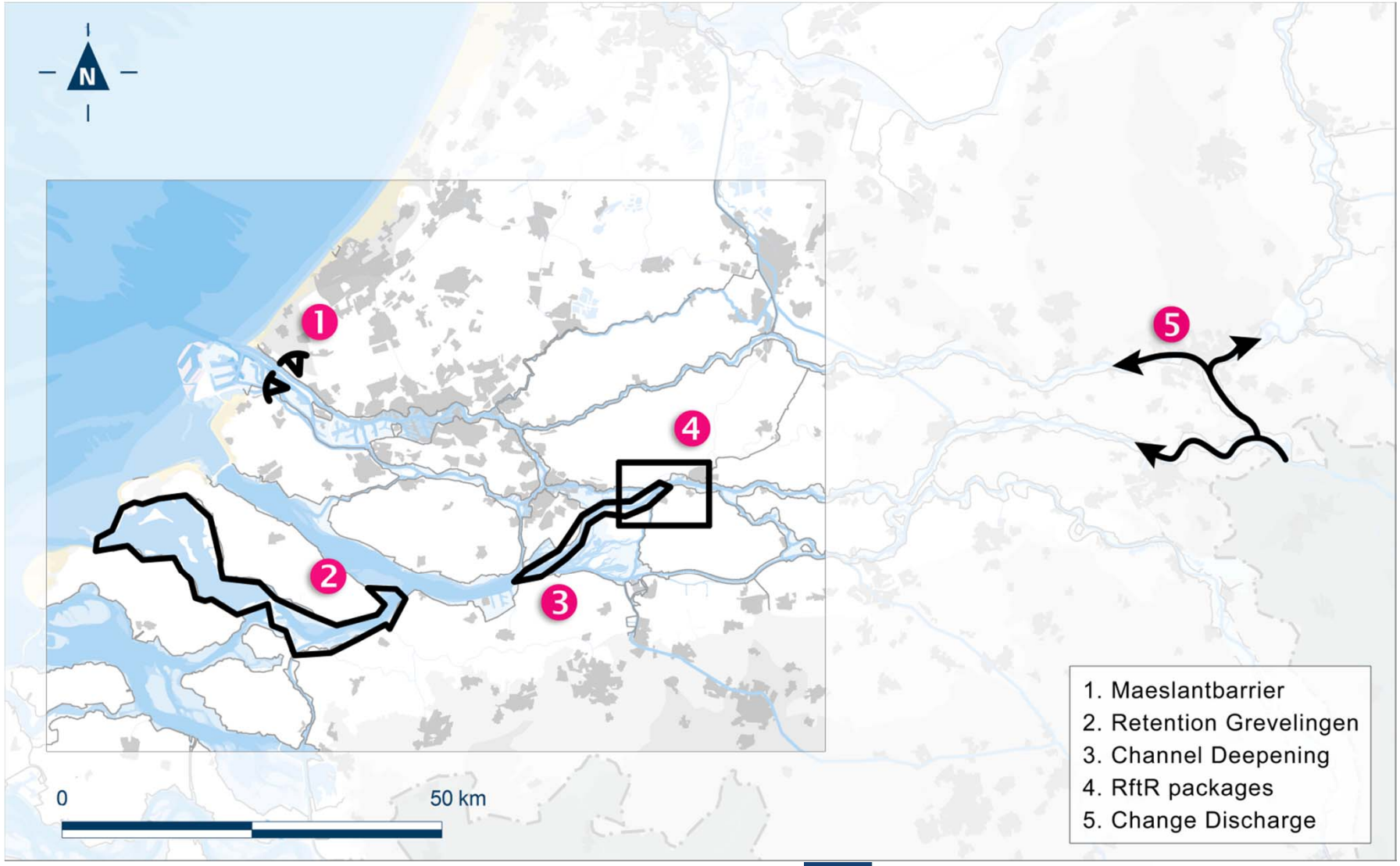
The Maeslant Storm Surge Barrier

Location of Measures





Rijkswaterstaat
Ministerie van Verkeer en Waterstaat

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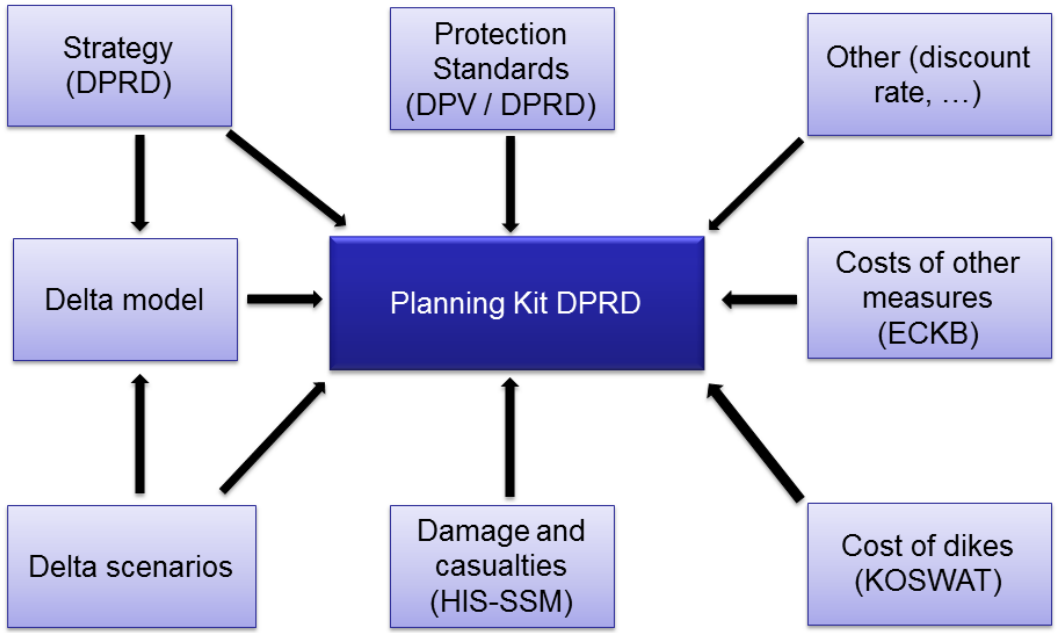
Purpose of the Planning Kit DPRD

1. What are economically efficient measures?
2. When should those be implemented?
3. What combinations are possible?
4. What are the remaining cost for dike increases?
5. Consistent calculation framework, database



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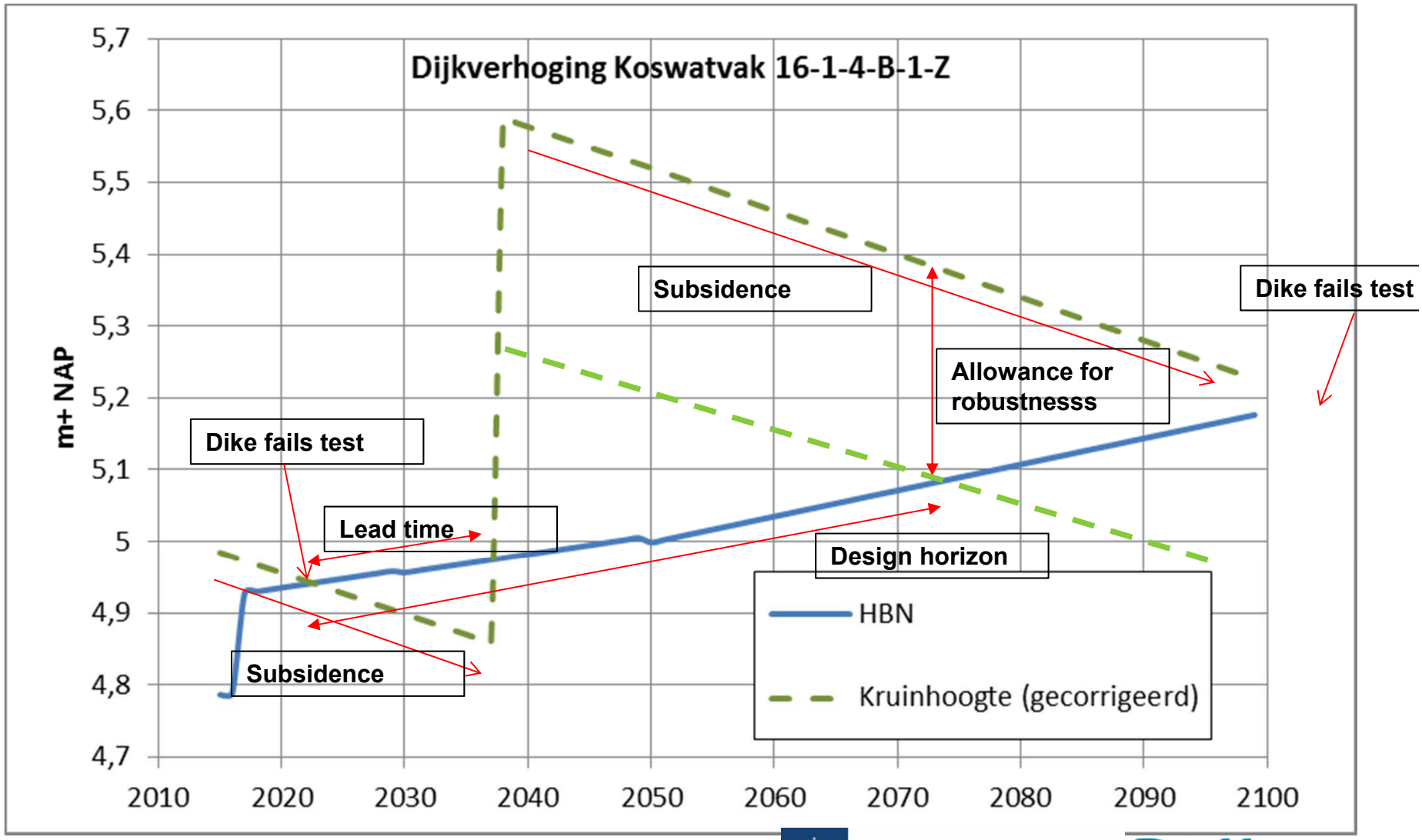
Hydraulic boundary conditions and dike design



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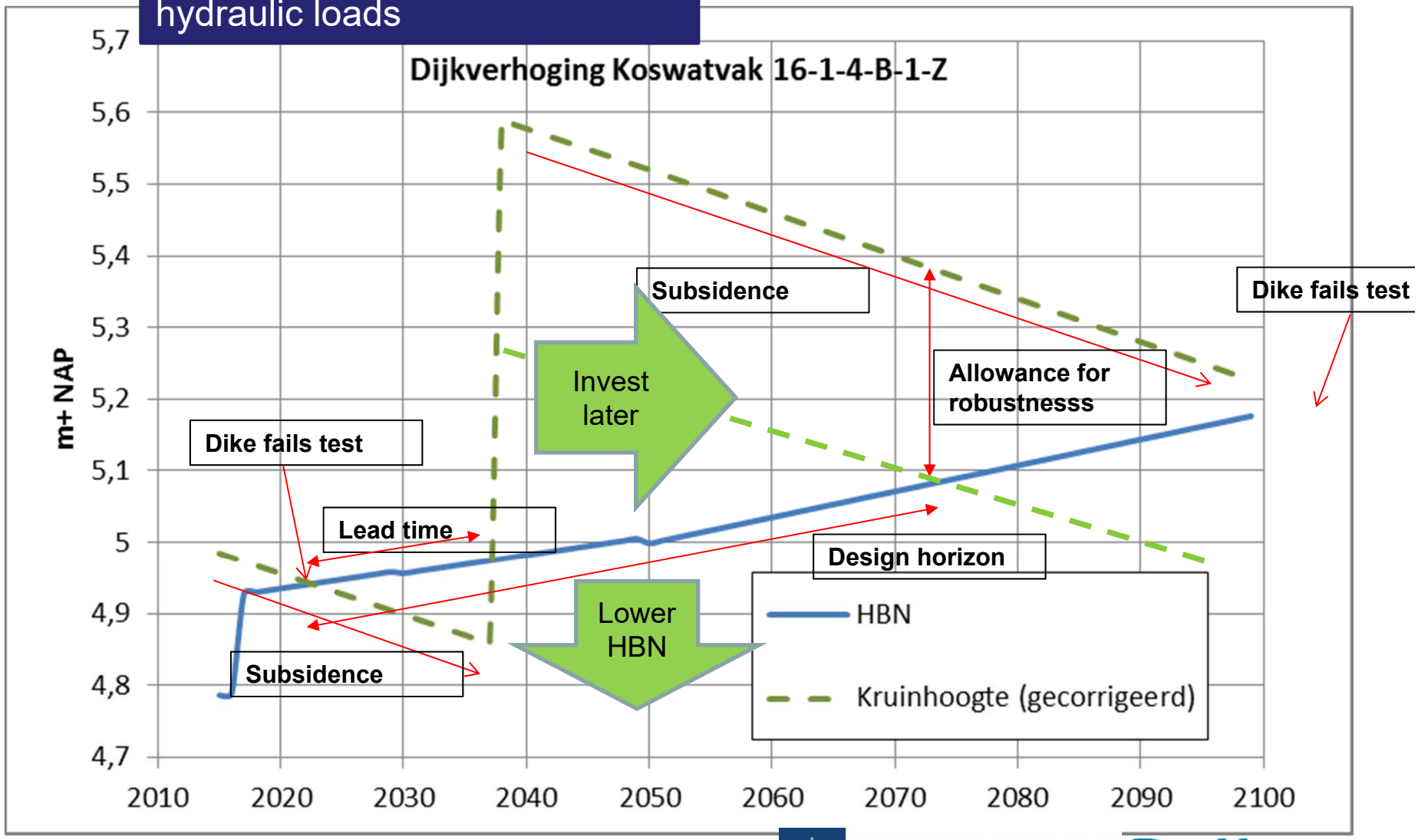
Hydraulic boundary conditions and dike design

With measures which reduce hydraulic loads



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Adaptation path-ways

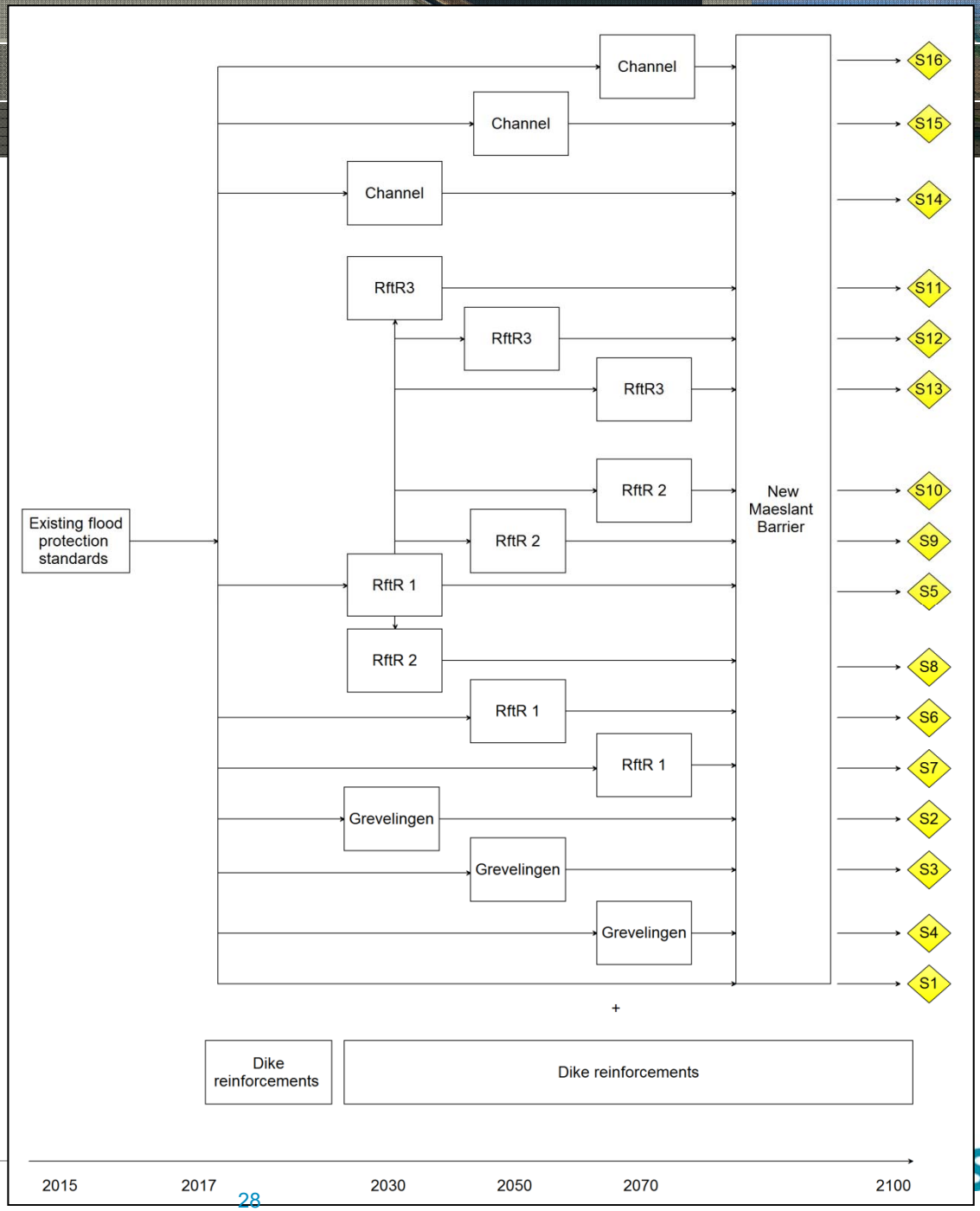
5 measures

4 choices:

- Do not implement
- Implement in short term
- Implement in medium term
- Implement in long term

→ 1024 combinations

2 x 16 chosen for Steam and Rest scenario



Costs for the different pathways

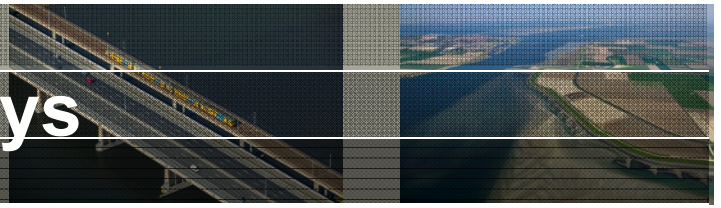
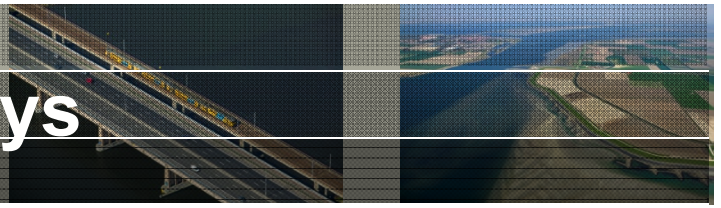


Table 2: Summary of strategies and present values of costs and expected damages Steam scenario

Strategy No.	Measures of the strategy with assumed year of implementation					Costs, in Million Euro Present Value, 2013 prices			
	Grev	RftR1	RftR2	RftR3	Chan	Cost of Dikes	Cost of Water Level Reducing Measures	Cost of Expected Damages	Total Cost
S1						1771	58	1763	3592
S2	2030					1730	184	1709	3623
S3	2050					1732	101	1752	3585
S4	2070					1767	73	1752	3591
S5		2030				1737	314	1749	3800
S6		2050				1742	146	1767	3655
S7		2070				1771	88	1762	3620
S8		2030	2030			1710	552	1740	4003
S9		2030	2050			1726	396	1750	3873
S10		2030	2070			1737	342	1748	3826
S11		2030		2030		1686	334	1749	3768
S12		2030		2050		1723	321	1750	3794
S13		2030		2070		1736	317	1747	3800
S14					2030	1734	125	1742	3601
S15					2050	1740	81	1765	3586
S16					2070	1771	66	1759	3596

Costs for the different pathways



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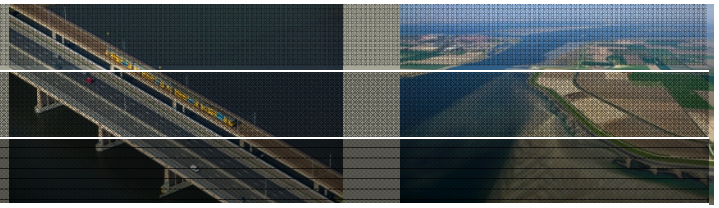
Lessons learned



- A tool is needed to collect information and provide consistent estimates of costs and benefits
- It is difficult to find (near optimal) adaptation strategies
- It is difficult to include uncertainty (climate change)
- The information was sufficient to discard certain measures

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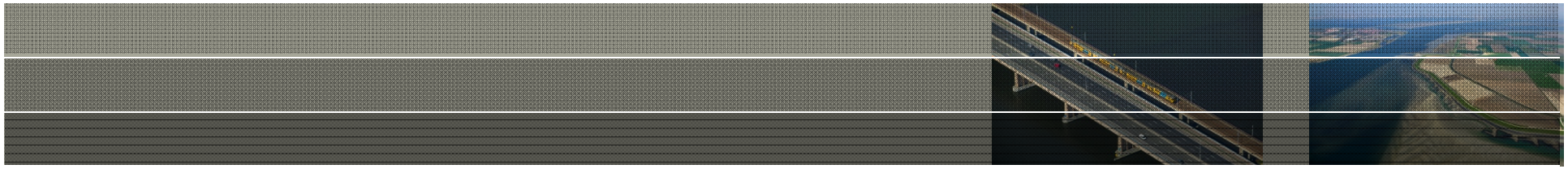

Delta Program Fresh Water

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Delta Program: Fresh water

Aim Delta Program Fresh Water: Provide sufficient fresh water

Two economic analyses were conducted within the Program to provide information on the cost and benefits of proposed national fresh water measures.

These analyses didn't provide sufficient information to take decisions.

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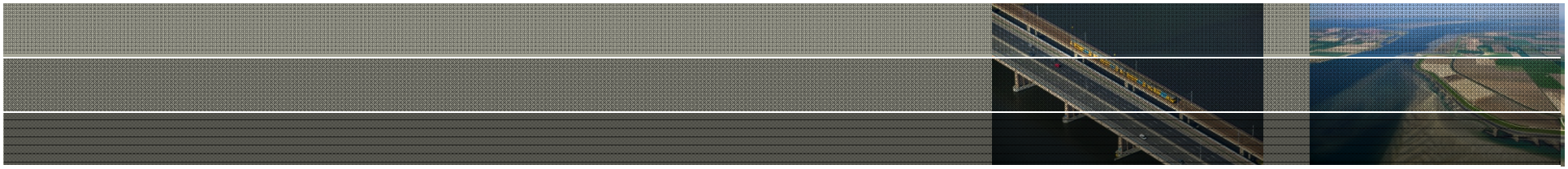


Hoofdwatersysteem en regionaal watersysteem

Korte termijn maatregelen (voor 2028)

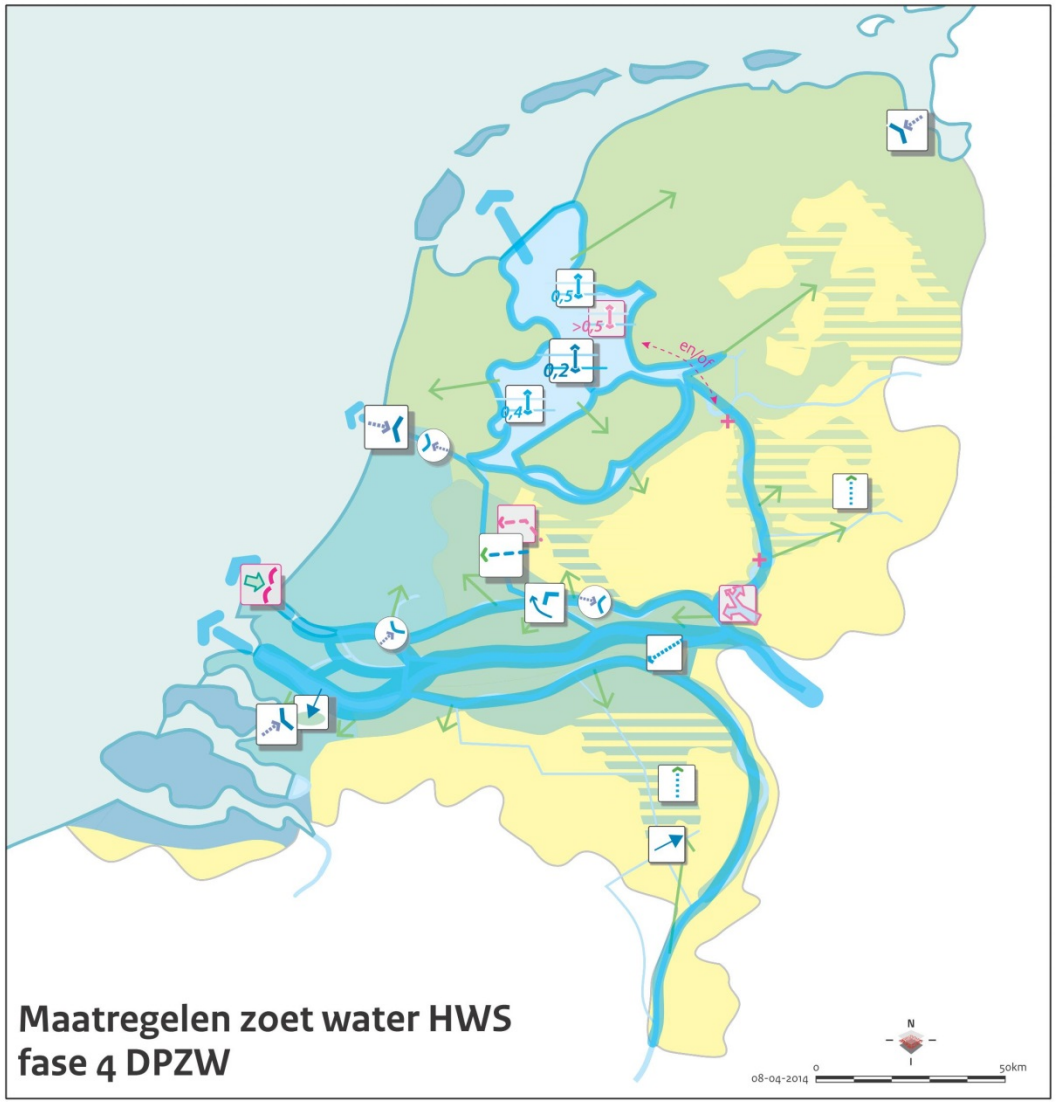
- Slim watermanagement (*stuwen Holl. IJssel en Hagestein, ARK-NZK*)
- Structurele buffer IJssel- en Markermeer (20 cm.)
- Verbeterde zoet-zoutscheiding sluizen
- Uitbreiding kleinschalige wateraanvoer (KWA naar 15 m³/sec)
- Bypass Irenesluizen (t.b.v. KWA+)
- Noordervaart naar 5 m³/sec

Middellange termijn: mogelijkheden

- Structurele buffer Marker- en IJsselmeer (tot resp 40 en 50 cm.)
- Uitbreiding kleinschalige wateraanvoer (KWA naar 24 m³/sec)
- Alternatieve robuuste zoetwatervoorziening Volkerak-Zoommeergebied
- Beperkt extra water naar Hoge Zandgronden (in gebieden met aanvoer)
- Extra Waalwater naar de Maas sturen
- Noordervaart naar 6 m³/sec

Lange termijn: opties (i.c.m. 'accepteren tekorten')

- *en/of* Verdere vergroting buffer IJsselmeer / Vergroten aanvoer via IJssel
- Uitbreiding KWA > 24 m³/sec / permanente Oostelijke aanvoer
- Beperking zoutindringing Nieuwe Waterweg



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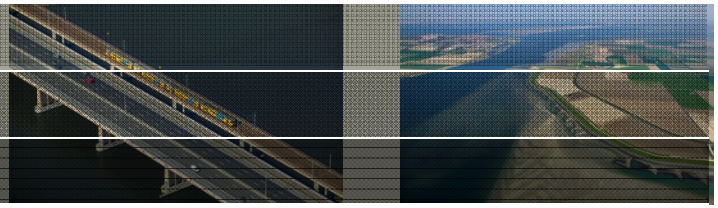
Experienced difficulties



- Lack of quantified impacts (both physical and welfare) due to high complexity:
  - Multiple sectors are affected
  - Return time is high: almost every year a sector is affected by drought. Many model runs are needed
  - Sectors adapt autonomously
- Communication problems between economists and hydrologists

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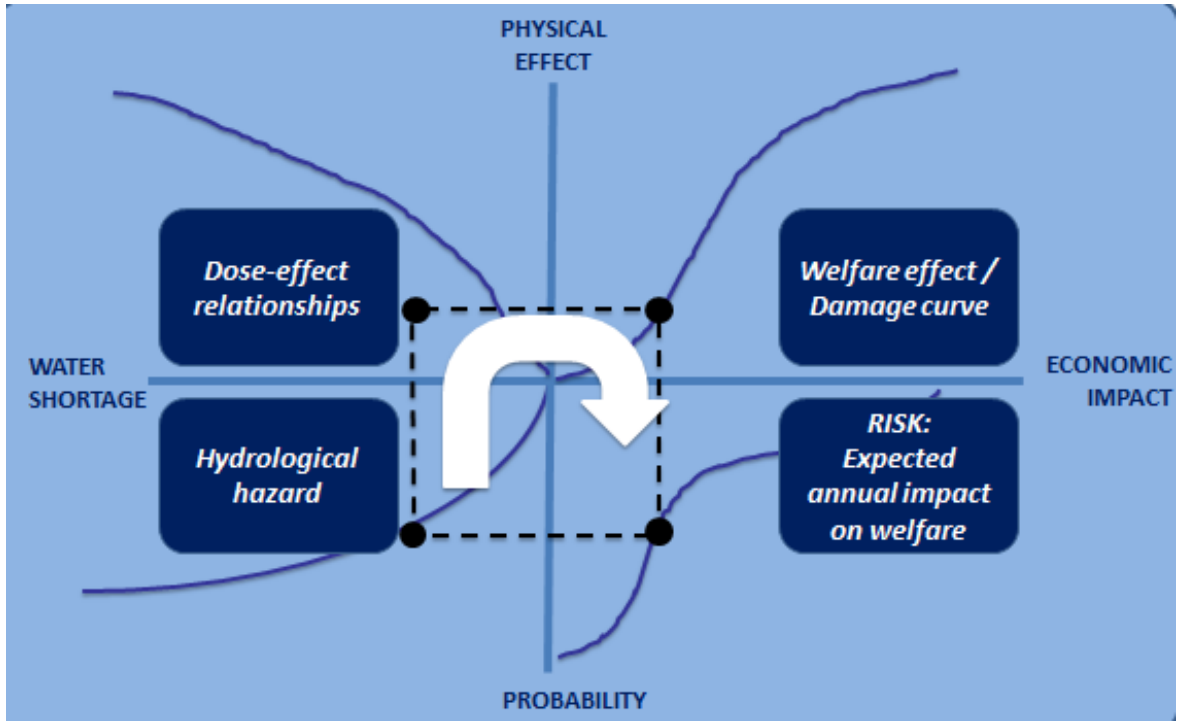
Next steps

2021: Update Delta Decision

- New measures and strategies
- Agreed service level (‘standards’)

To support these decisions a method and tool is now developed by Deltares to provide insight into the economic risk of water shortages.



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