City of Gothenburg

Strategies for Climate change mitigation

How to deal with rising sea levels and intense rainfall in a delta city

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Gothenburg a delta city

The river GÖTA:

- Average flow 575 m^3/s
- Catchment area 50.000 km^2

A city evolving over 400 years

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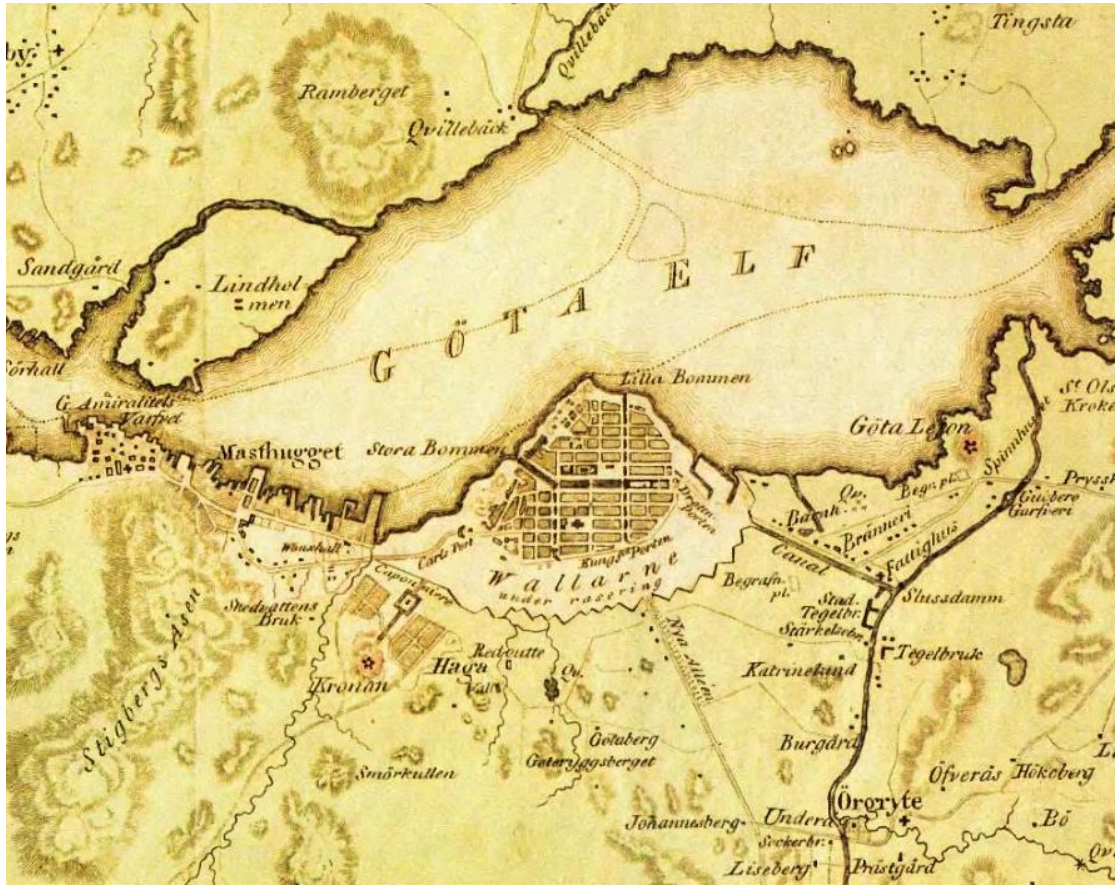
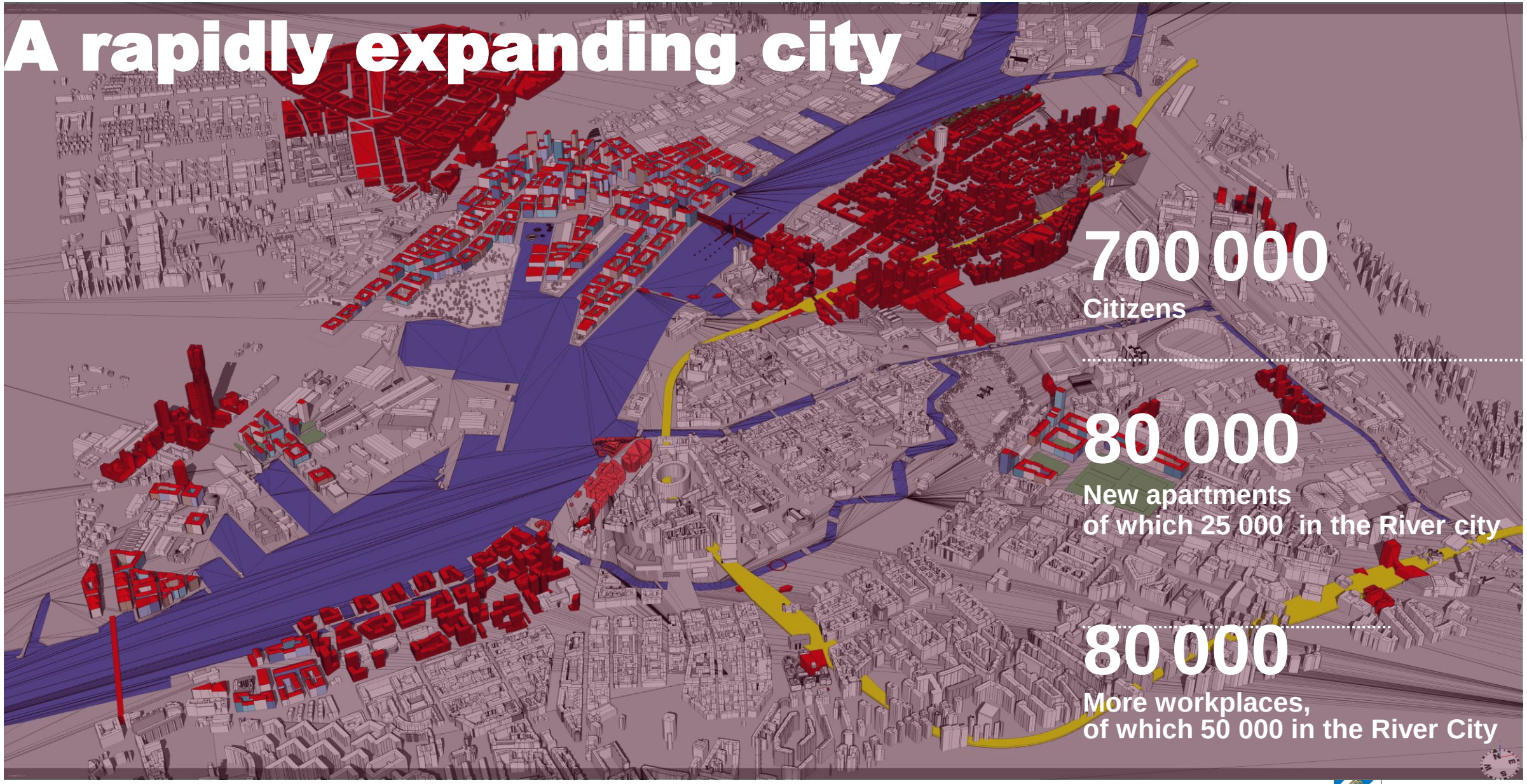


A rapidly expanding city



700 000
Citizens

80 000
New apartments
of which 25 000 in the River city

80 000
More workplaces,
of which 50 000 in the River City

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Risks associated with water

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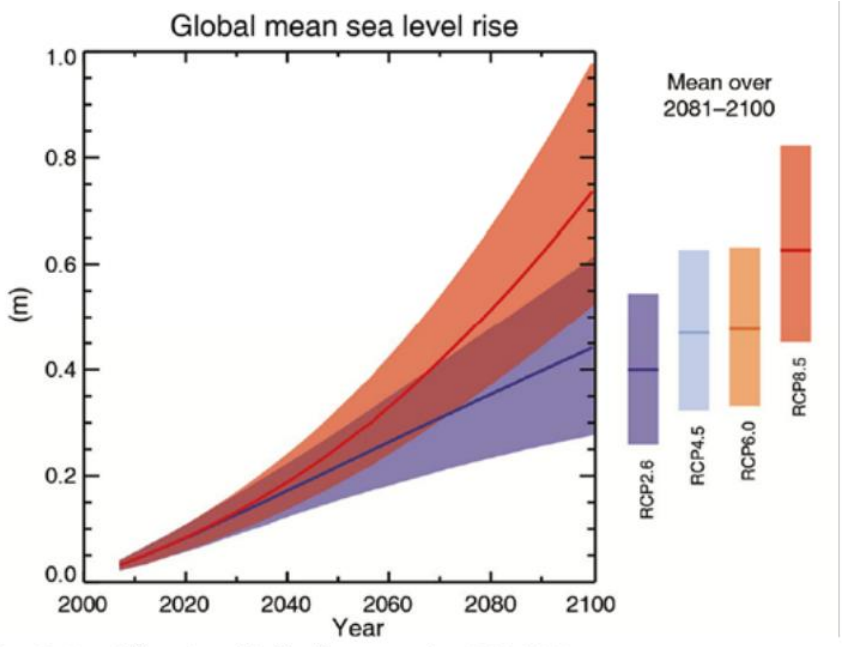
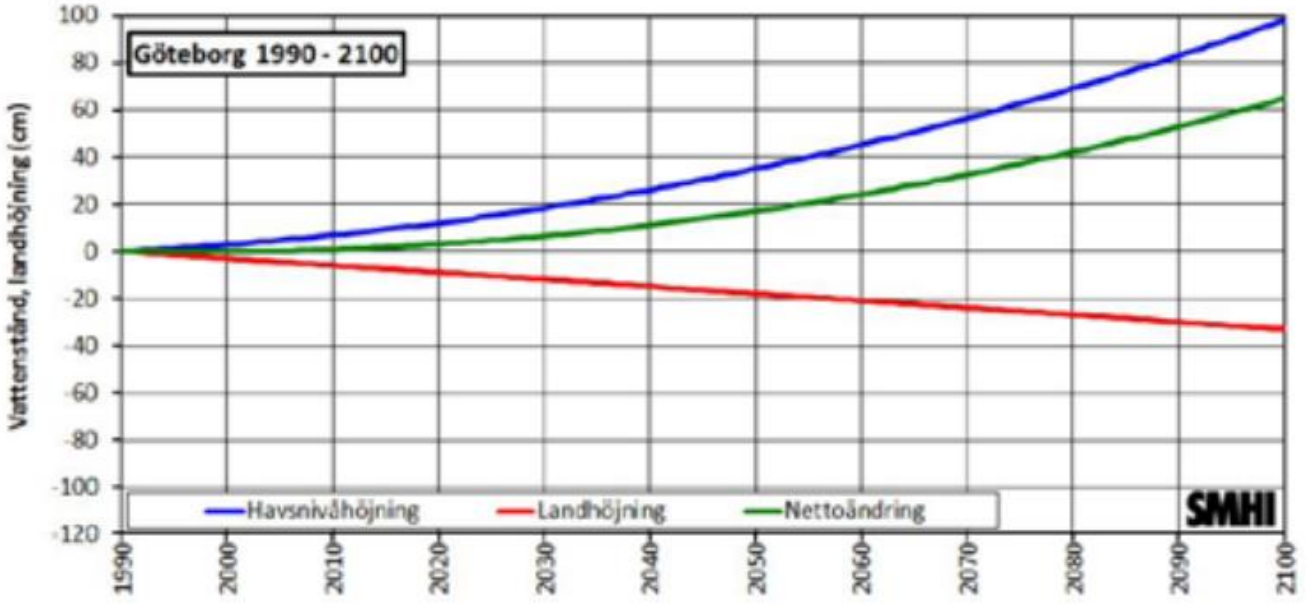
RISK	DURATION WHEN ASSESSING RISK
The Sea	Hours to 24 hours
Intense rain	Days to Weeks
Inland waterways	Hours to 24 hours

Impact of climate change

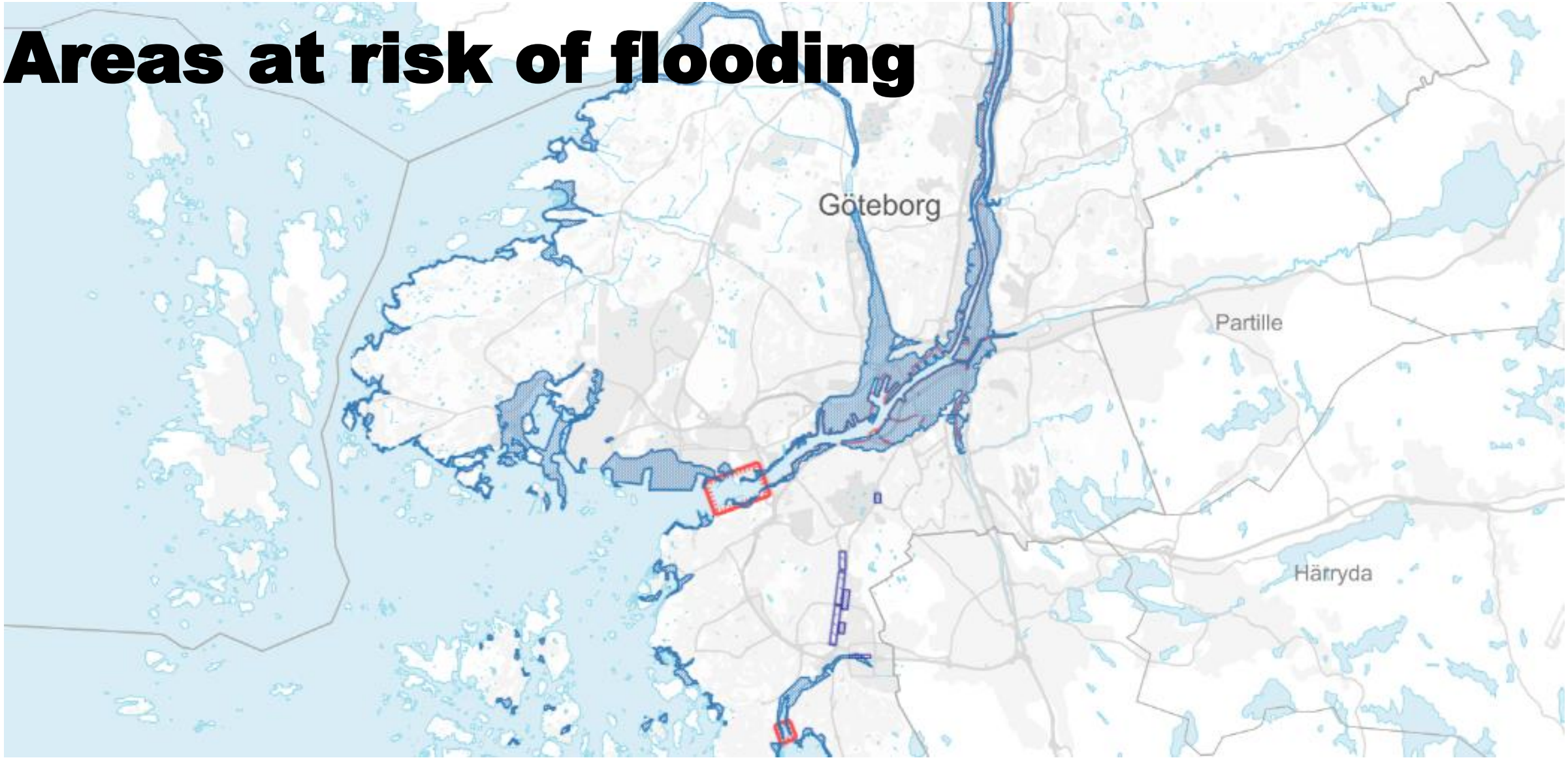


Figur 5: Havsnivåstegring vid olika klimatscenarier (IPCC 2013).

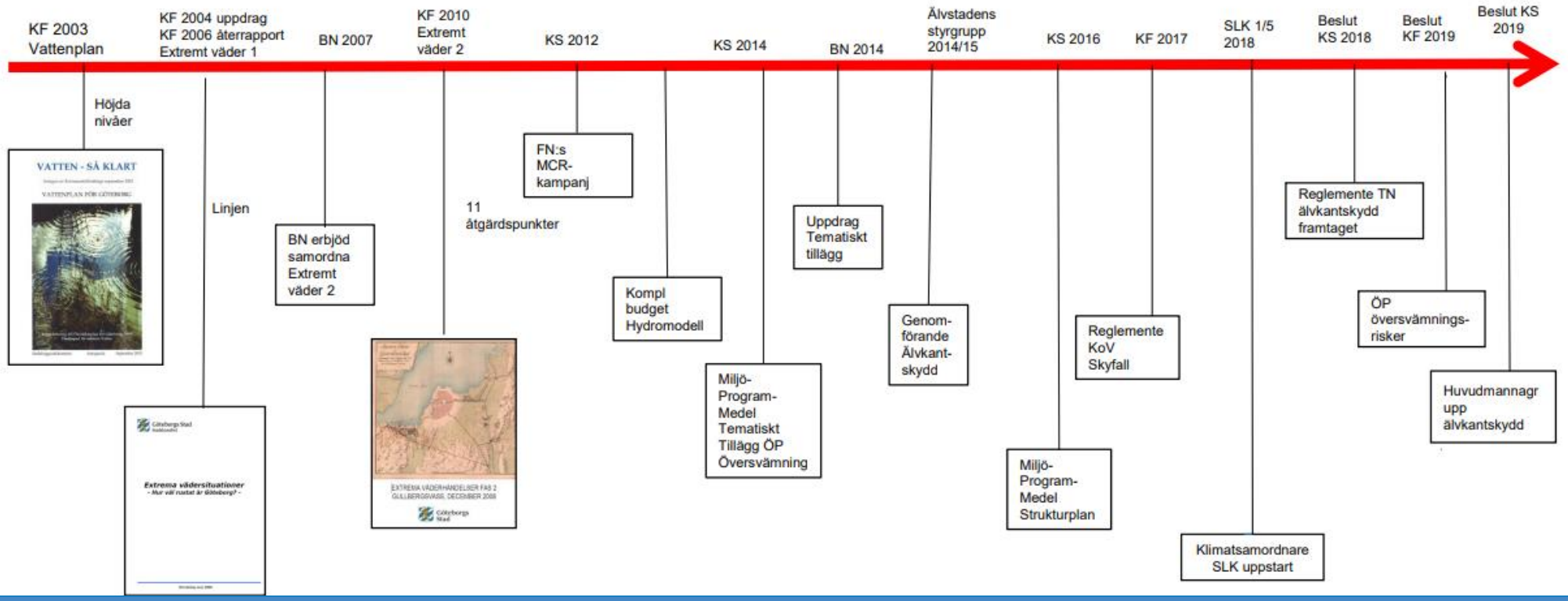


Figur 6: Medelvattenytans förändring fram till år 2100 från SMHI:s regionala klimatanalys.

Areas at risk of flooding



Climate Mitigation on the agenda since 2003



- Involvement of City Council and City Board
- Development of Hydromodel (calculation & visualisation)
- Included in Comprehensive plan

- Holistic perspective (planning – deployment – maintenance)
- Revised Instructions to city administrations

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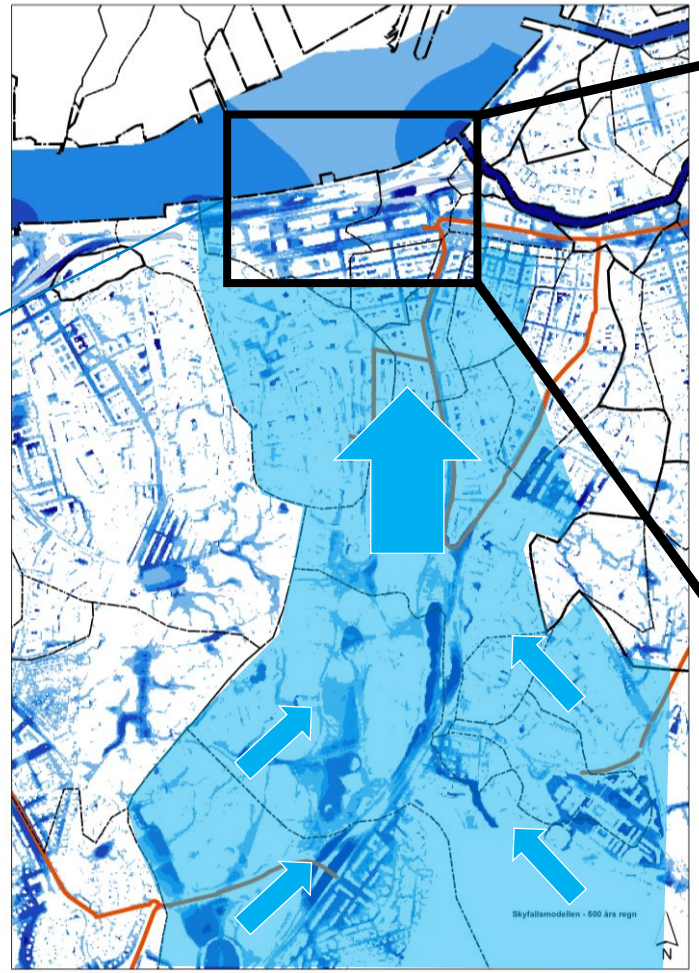
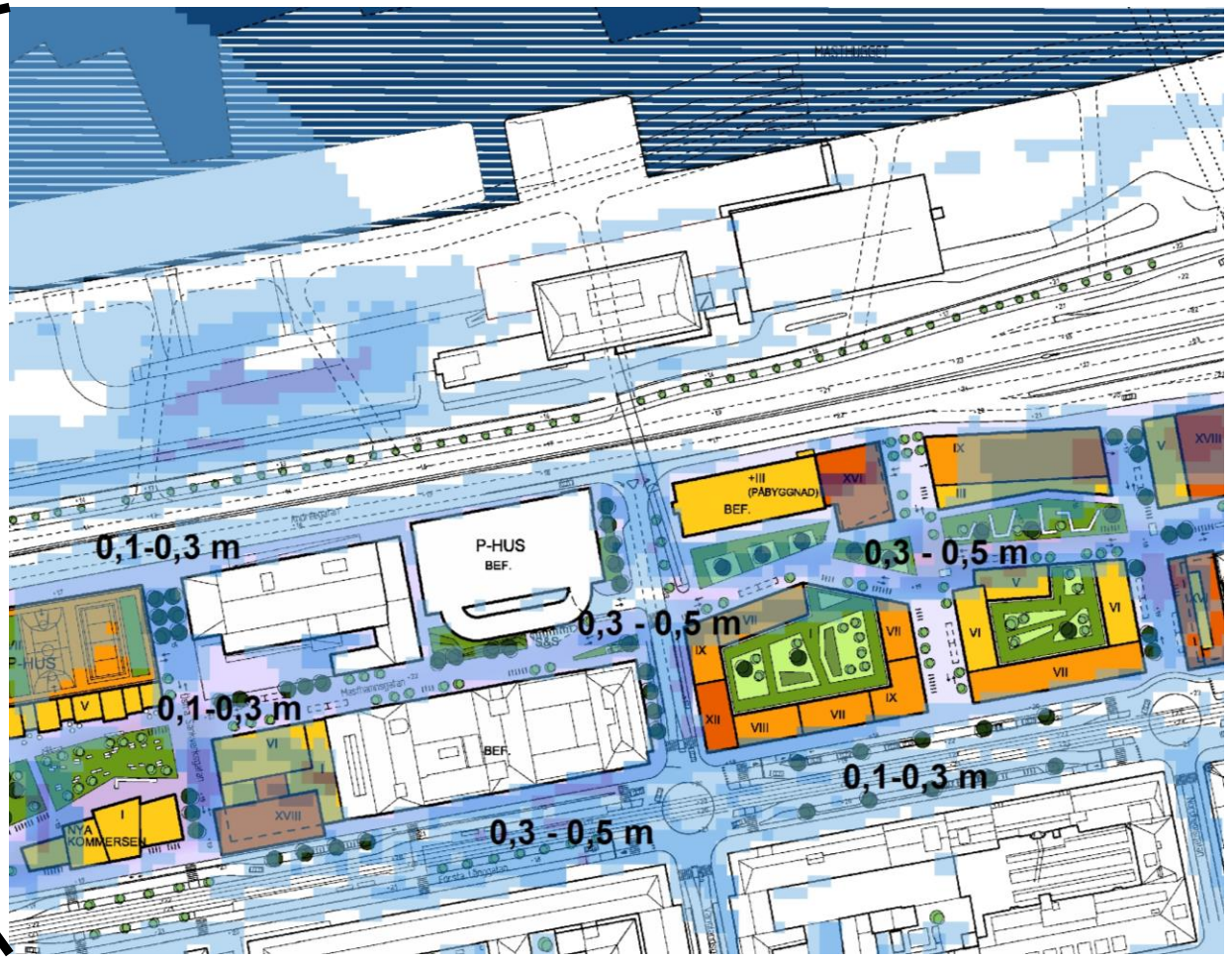
Risk assessment in Comprehensive Plan

Risk	Dimensioning Event	Planning Tools
The Sea	Water level in 2070 with 200 years return time	Hydromodel, HW 2070+2100, scenario IPCC RCP 8,5
Intense rain	Climate adjusted rainfall in 100 years with 100 years return time	Intense rain simulation of climate adjusted intense rainfall in 2100 with 100 years return time (+20%)
Inland waterways	Flow in 100 years with 200 years return time	National Contingeny Agency assassement of expected flows in 2098

Return time (yr)	Probability for event during planning period				
	5	10	50	100	200
10	41	65	99	100	100
100	5	10	39	63	87
200	2	5	22	39	63
500	1	2	10	18	33
10 000	0	0	0	1	2

Need for an integrated approach





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Long term storm surge strategies

Decision point for long term strategy

Mid-term
River bank protection
Inland waterways

Long term
Large scale barriers

HHW +1,8

NOW

HHW +2,3

2040

HHW +2,6

2070

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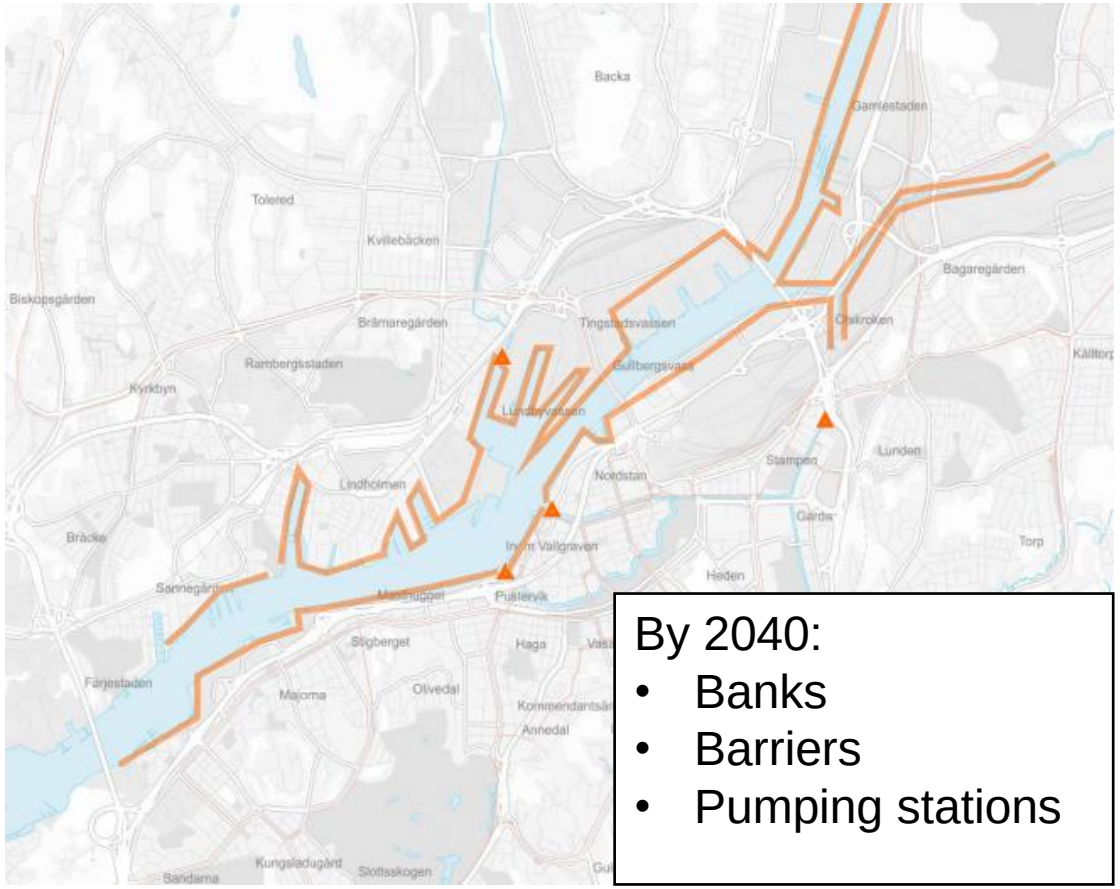
River bank protection



By 2040:

- Banks
- Barriers
- Pumping stations

Large scale barriers

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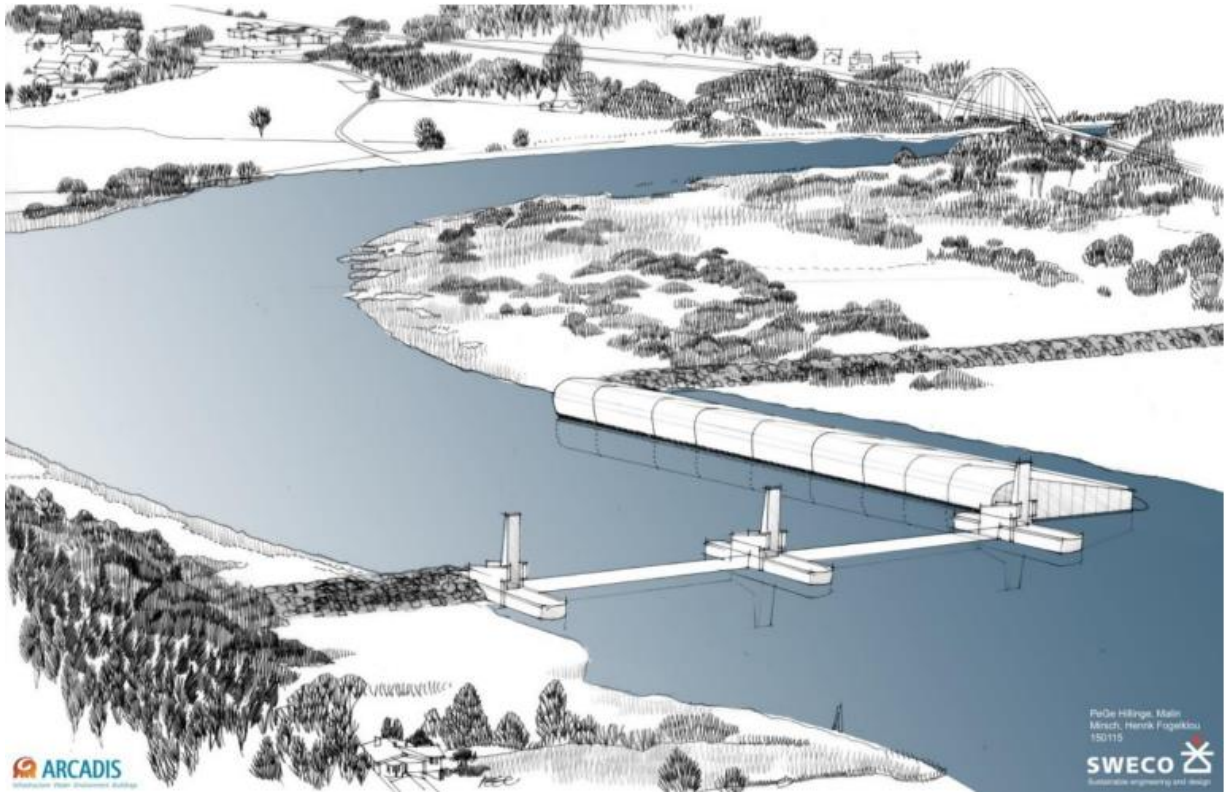

Estimated costs from storm surge

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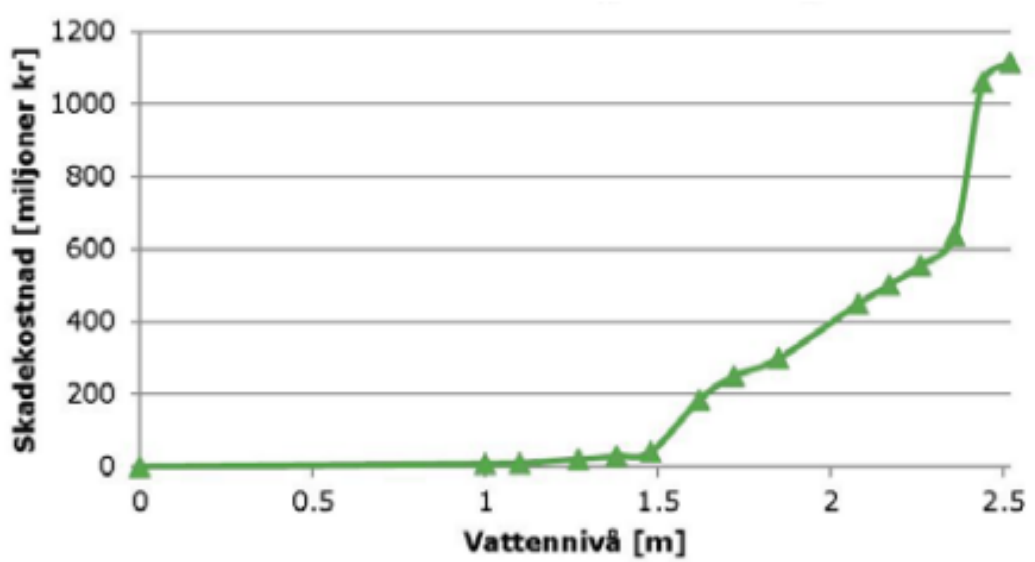
Damage cost for single event:
Now: 5 MEUR
2070: 20 MEUR
2100: 30 MEUR

Accumulated cost (NOW-2100):
- 200-500 MEUR

Mitigation costs:
- 700-1200++MEUR

Damage costs in relation to Mean Water Level



Figur 16: Resultat från hydromodellen som visar skadekostnad om inga åtgärder vidtas vid olika vattennivåer längs Göta älv inom Göteborg stad.

Intense rain

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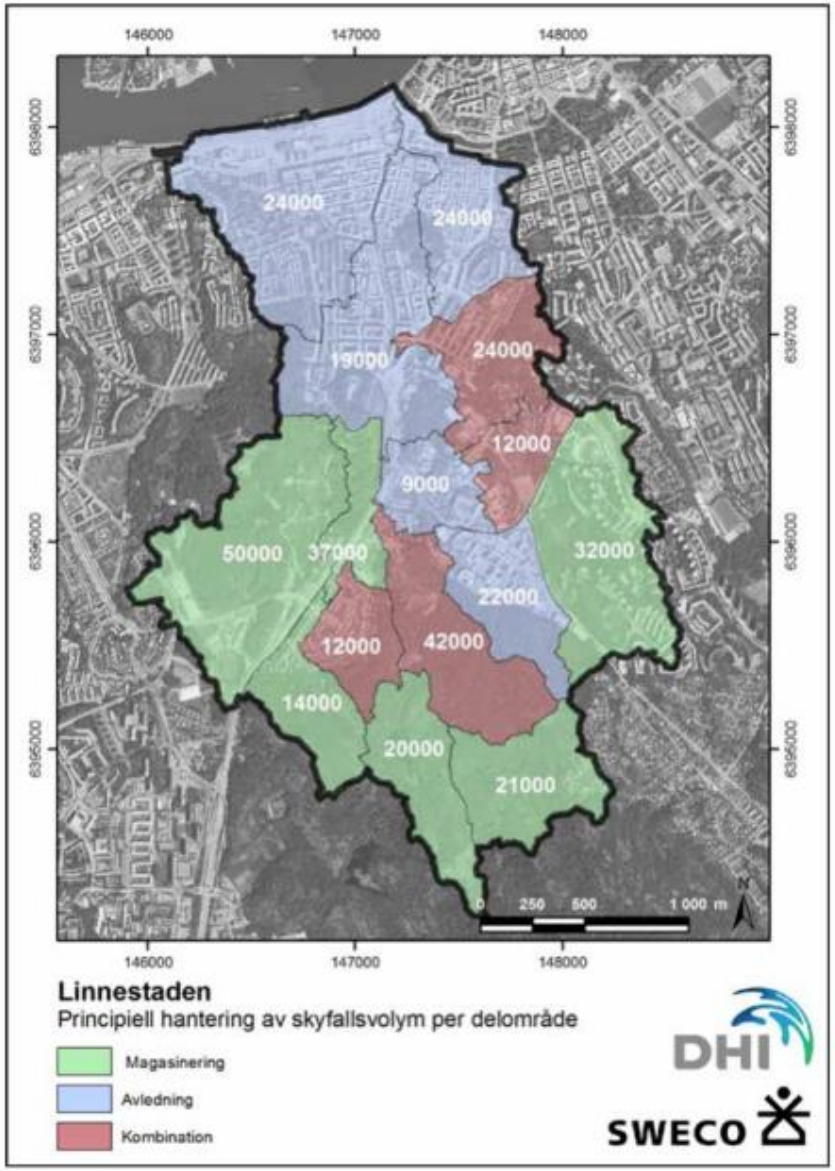
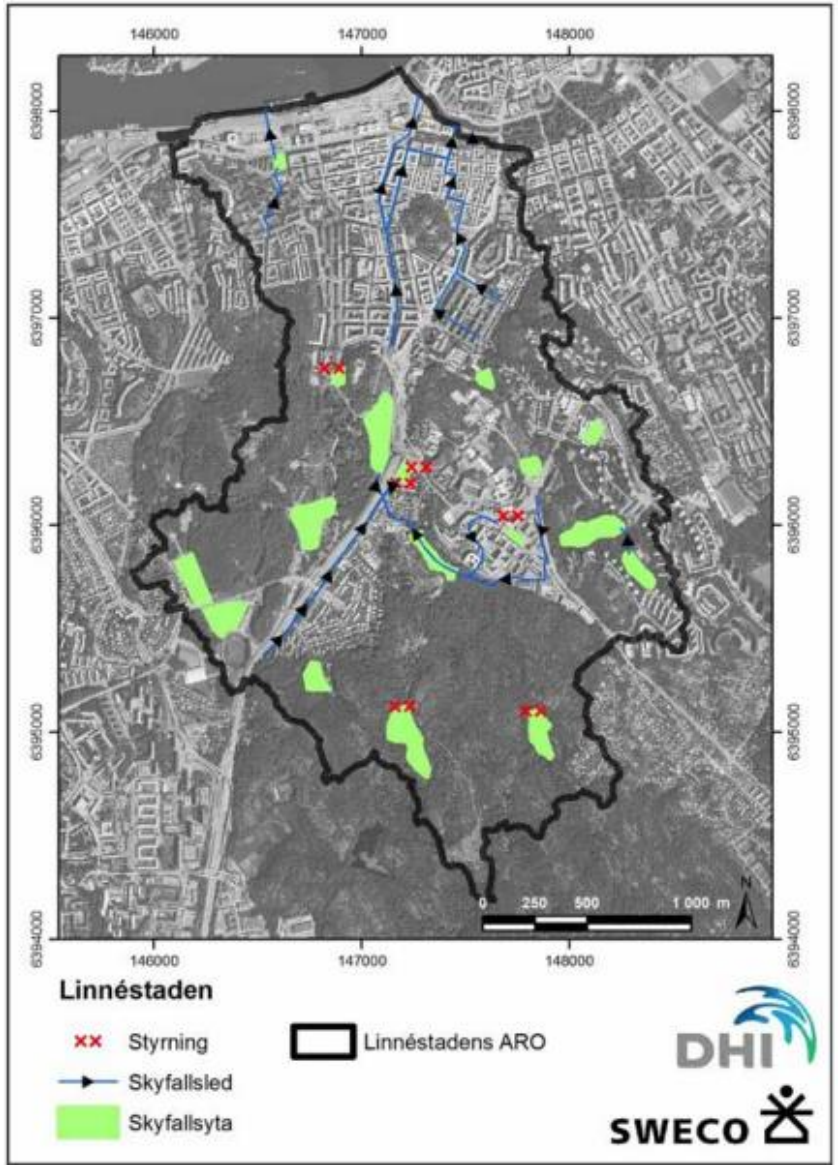
Planning based on catchment areas:

- Principal Management
- Detailed measures





Estimated costs from an intense rain incident

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Skyfall, 100 år

		High risk scenario		Low risk scenario	
Objekt	**Enhetspris [kr]**	**Antal**	**Kostnad [mnkr]**	**Antal**	**Kostnad [mnkr]**
Transformator	380000	207 st	79	94 st	36
Handel	180000	488 st	88	216 st	39
Uthus	20000	8018 st	160	5524 st	110
Offentlig	180000	1578 st	284	662 st	119
Industri	195000	1822 st	355	678 st	132
Småhus	47000	8497 st	399	8488 st	399
Flerbostadshus	190000	4112 st	781	2233 st	424
Spårväg	3000	69364 m	208	6527 m	20
Järnväg	3000	80713 m	242	12474 m	37
Motorväg	150	228608 m2	34	3424 m2	1
Huvudled	130	340080 m2	44	8048 m2	1
Lokalväg	110	623488 m2	69	24592 m2	3
			Totalt 2744		**Totalt 1321**

Väntetid	**Kostnad [mnkr]**
Spårväg	65
Järnväg	266
Vägar	15
Totalt	**346**

Incident related costs:
- 160-300 MEUR

Mitigation costs:
- 400-600++ MEUR

Key Issues still to be resolved

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- Financing
  - National initiatives
  - Private property owners
- Legal Framework
  - New developments
  - Old developments
  - Coordination
- Capacity building
  - Knowledge
  - Organization
  - Budget

From planning to practice

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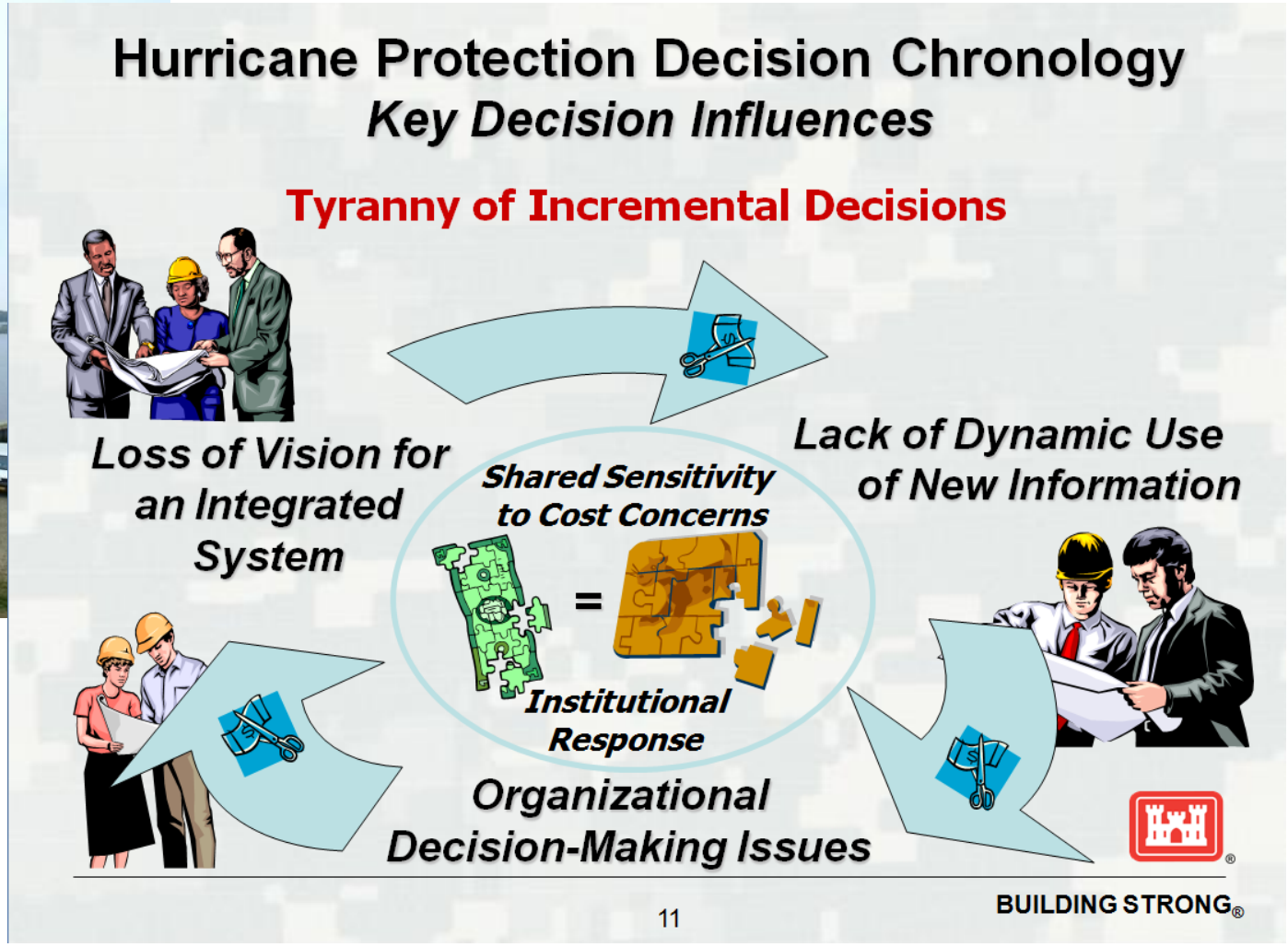

Skyfallet som kan förändra Göteborg - YouTube

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