



Flooding strategy

The City has expanded over wetlands



1809



1921



1910

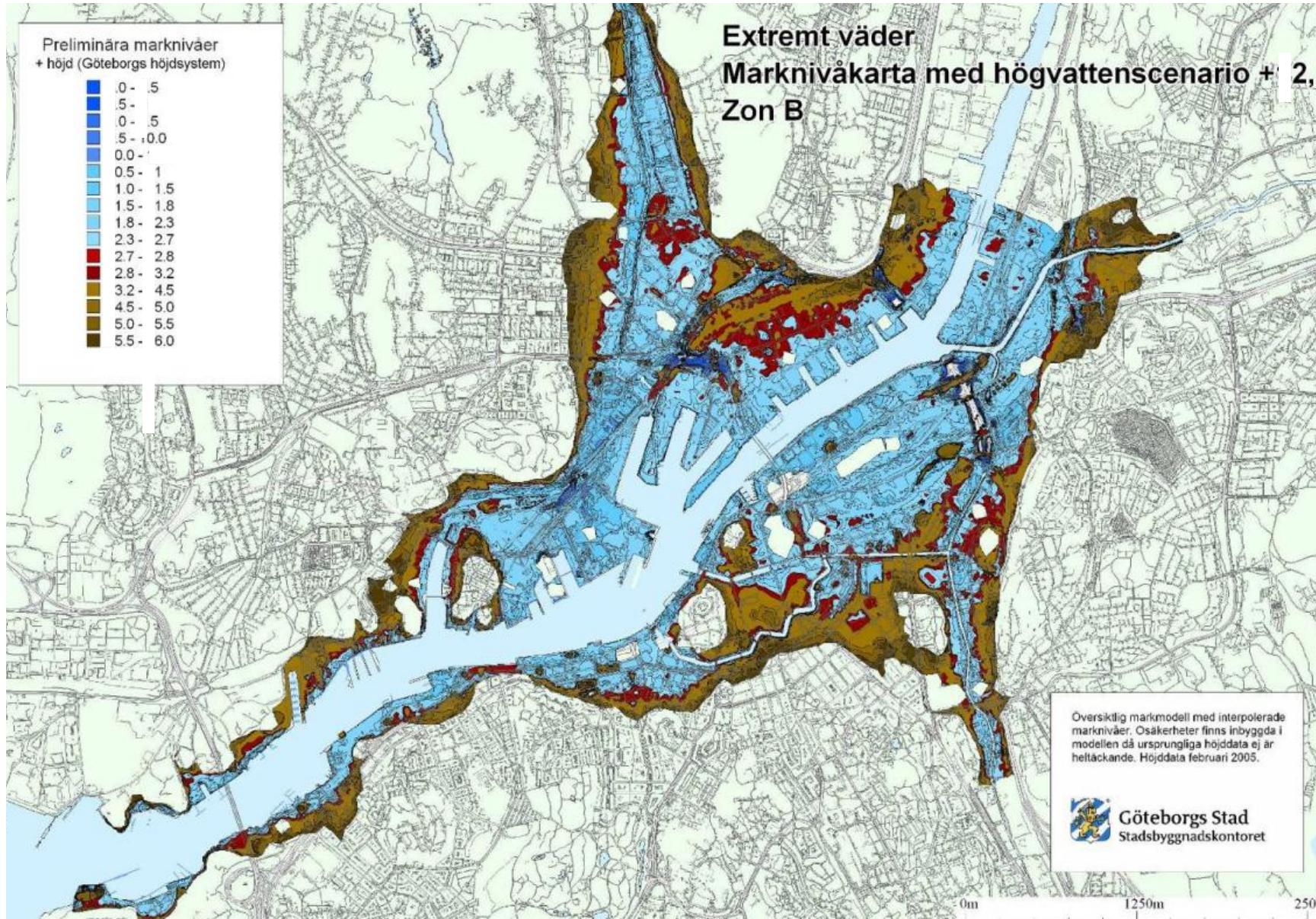


2011



Göteborgs
Stad

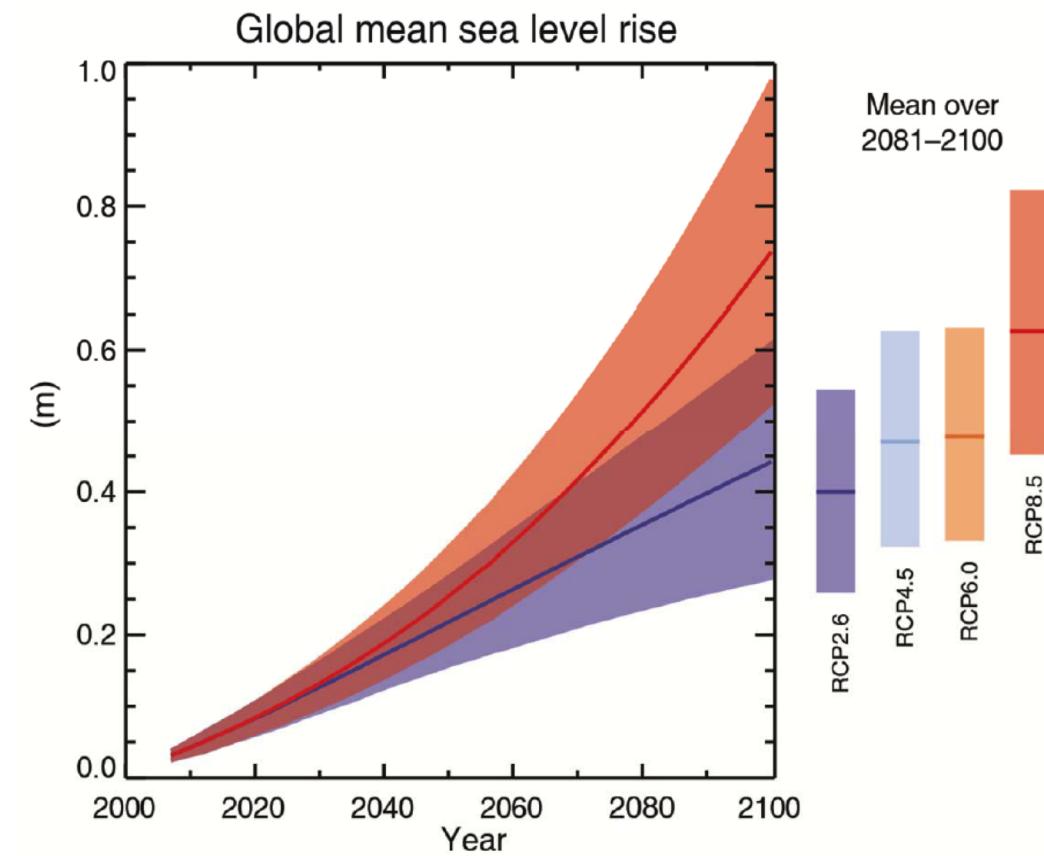
A future extreme weather event



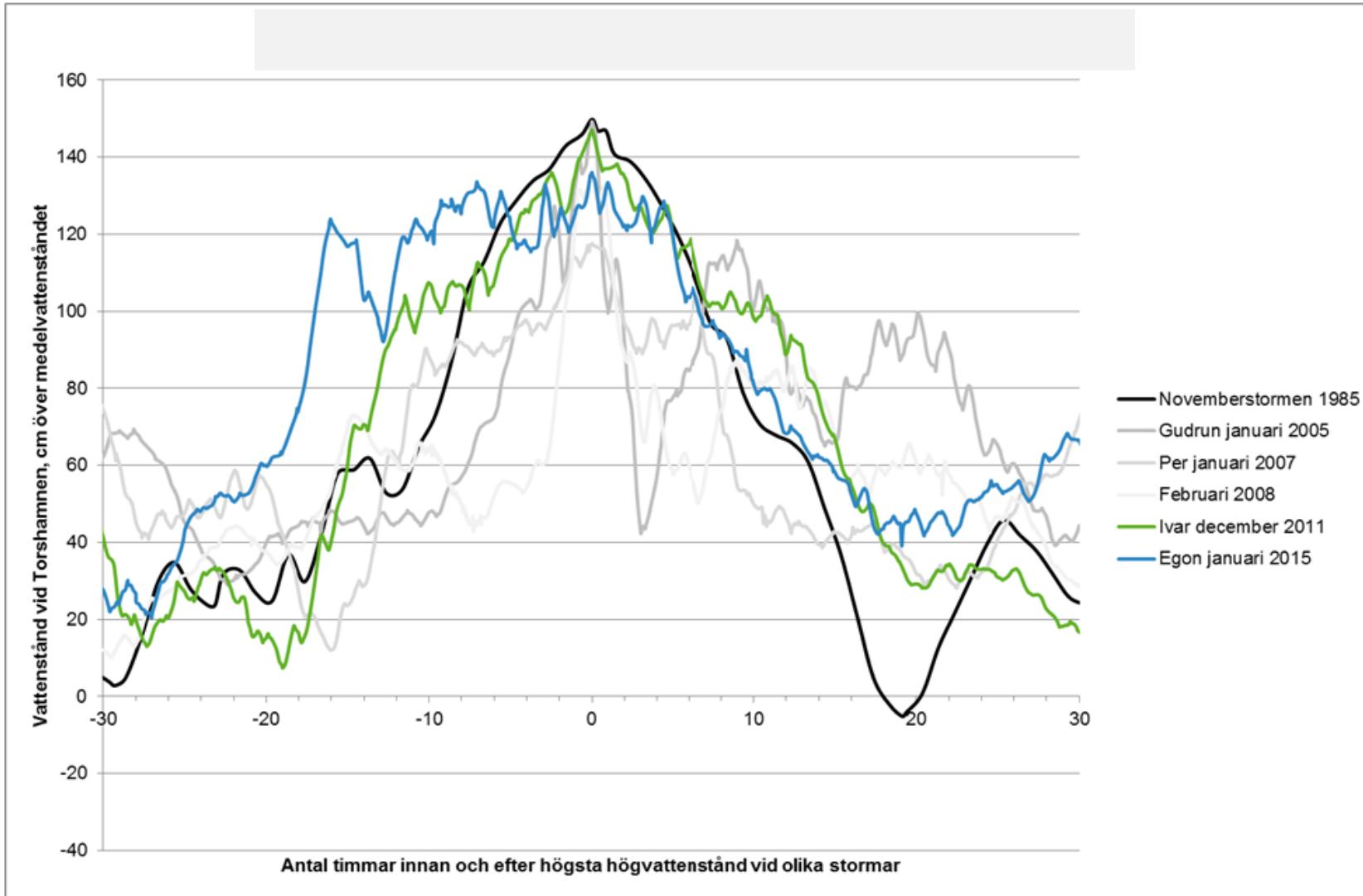
Climate change Rising sea levels

- Mean water level 2100 + 0,7 m (0,98 m)
- Land rise effect about 0,3 m
- **RCP 8,5**
 - Carbon dioxide emissions three times today.
 - Methane emission rises sharply
 - Earth population is 12 billion
 - Slow technology development
 - High dependence on fossil fuels
 - No additional climate policy

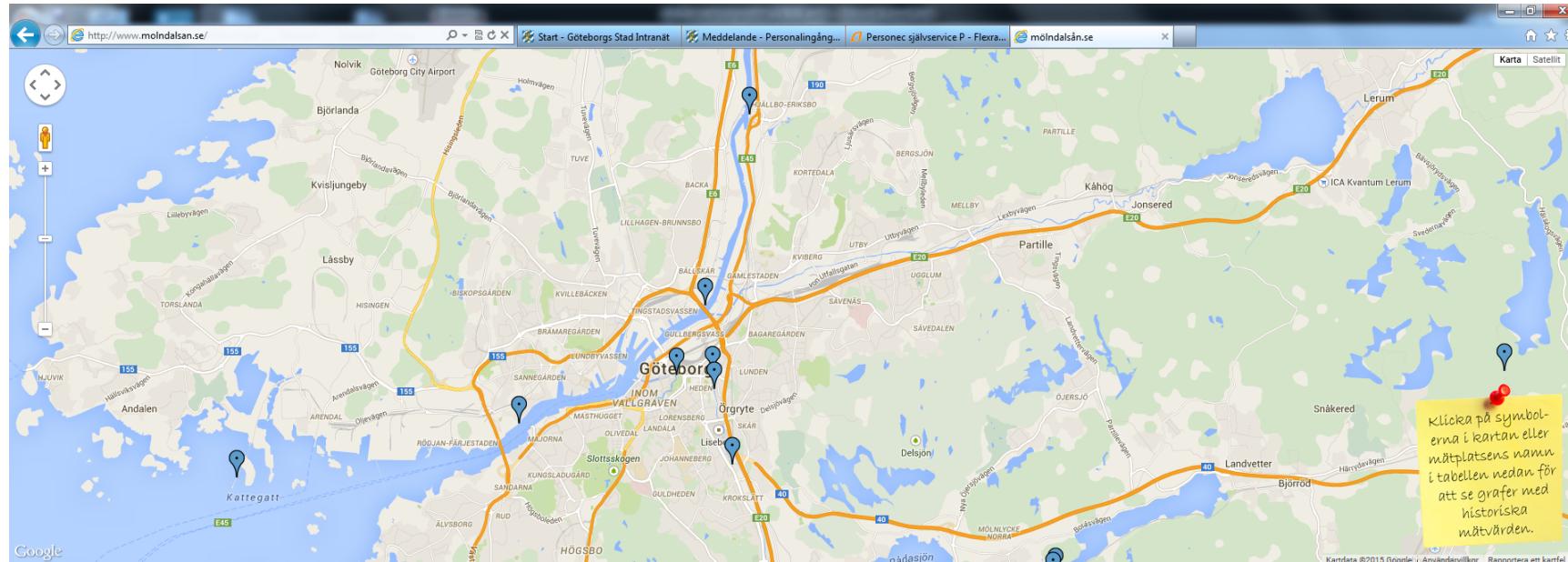
Figure SPM.9 [FIGURE SUBJECT TO FINAL COPYEDIT]



High levels in the sea



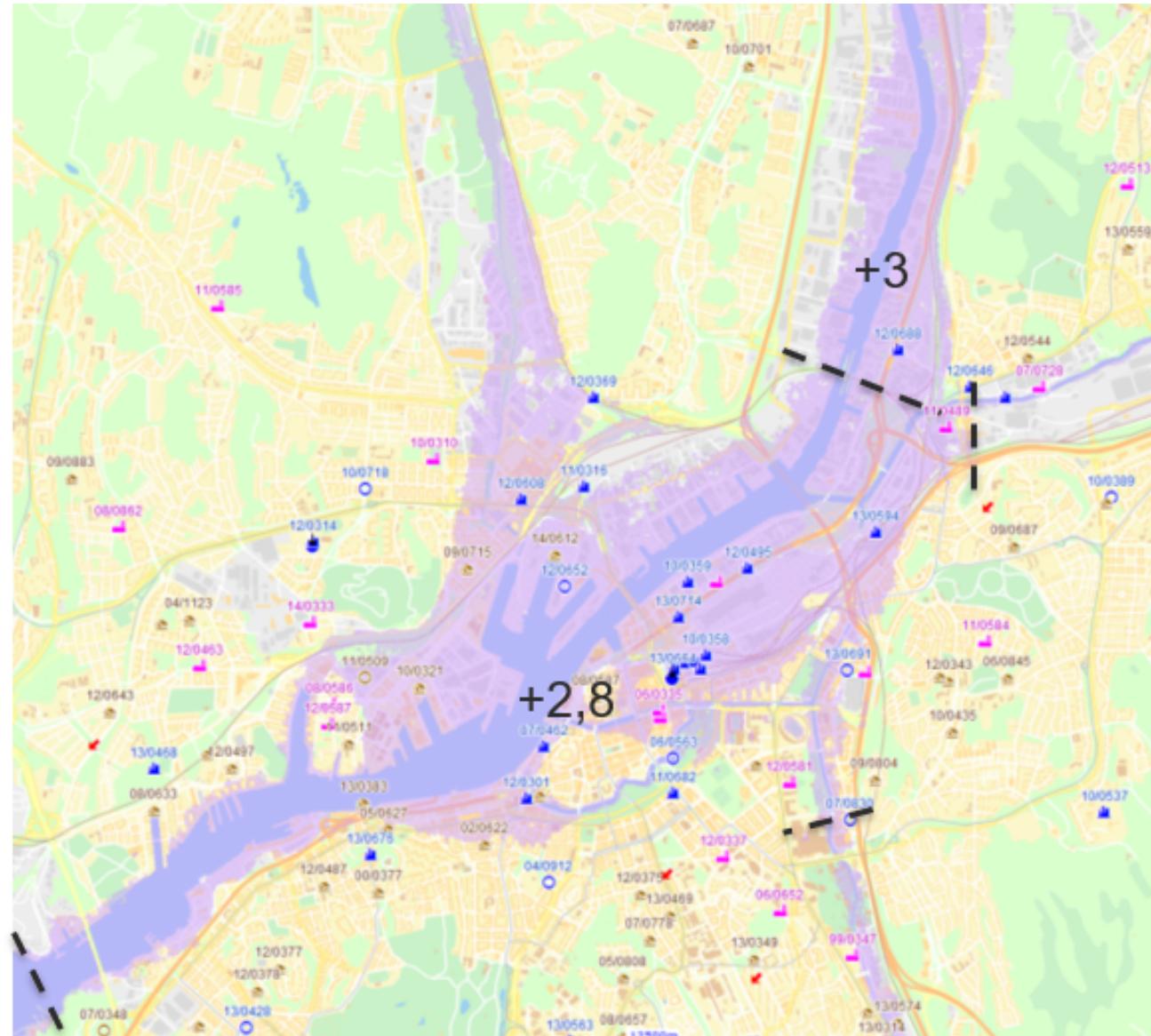
Water level meters



Aktuella flöden och nivåer i Mölndalsån och Göta Älv 2015-02-03 08:48

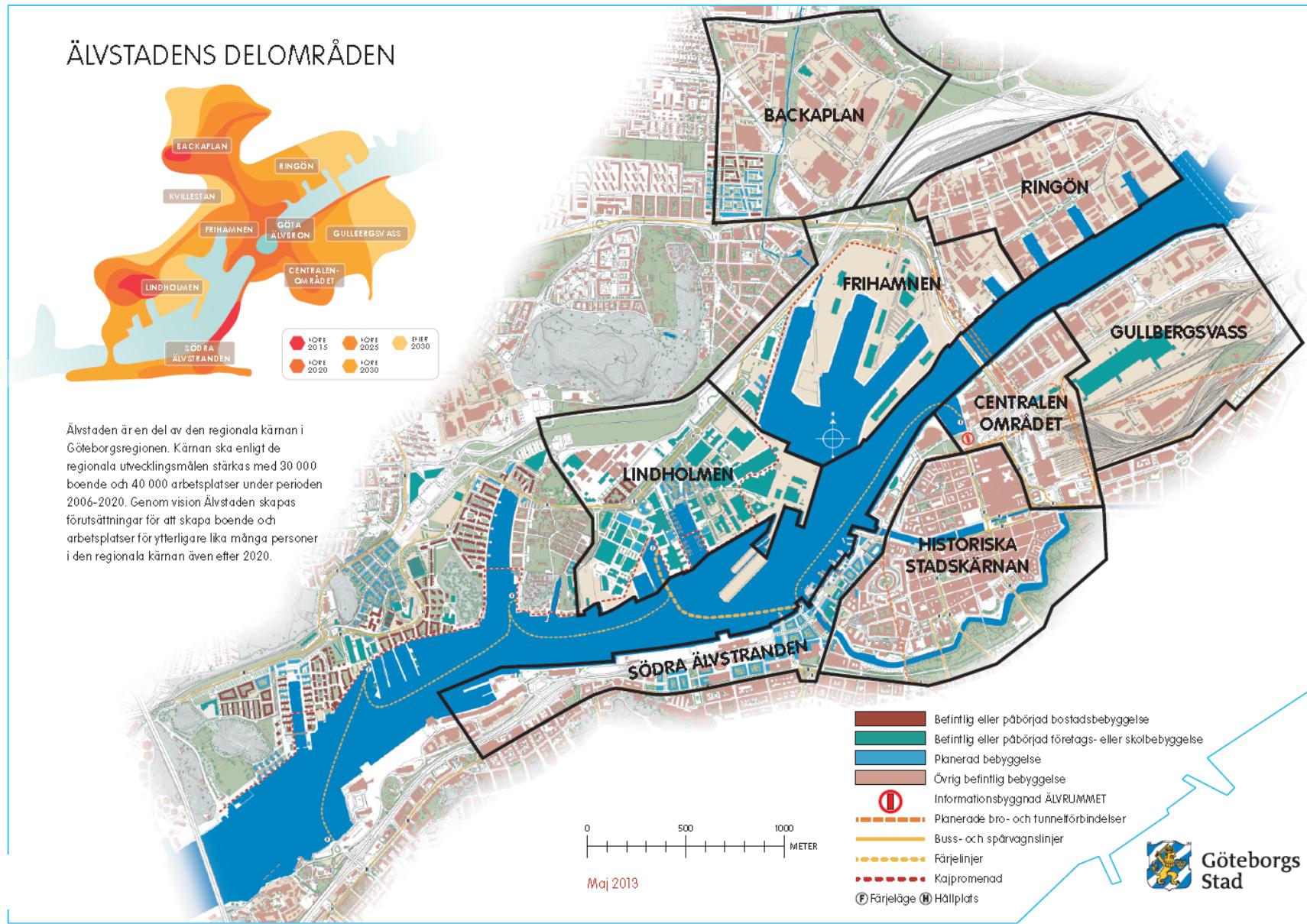
Mätplats	Vattennivå (RH2000)	Nivå nedströms dämmme (RH2000)	Flöde/tappning (m ³ /s)	Undre riskgräns (RH2000)	Övre riskgräns (RH2000)
Nedsjöns dämme	121,28	120,24	3,4	119,12	121,97
Härslö dämme	91,21		1,17	89,46	91,66
Arketjärn	54,69			54,54	54,95
Landvettersjöns dämme	54,67	51,77	5,6	54,54	54,95
Rådasjön	49,73			49,14	49,72
Stensjö dämme	49,60		10,2	49,14	49,72
Källaredsbacken	8,38			7,76	9,55
Möldal C	1,76		9,63	1,25	2,00
Skårs led	1,47			1,25	2,00
Levgrensvägen	1,38		9,79	1,25	2,00
Gårda dämme	1,41	0,48	9,8	1,25	1,55
Slussen	1,38	-0,02	0	1,25	1,55
Agnesberg	0,14			-1,10	2,85
Lärjeholm	0,16			-1,10	2,85
Tingstad	0,03			-1,10	2,85
Eriksberg	0,02			-1,10	2,85
Torshamnen	0,06			-1,10	2,85

Planning levels

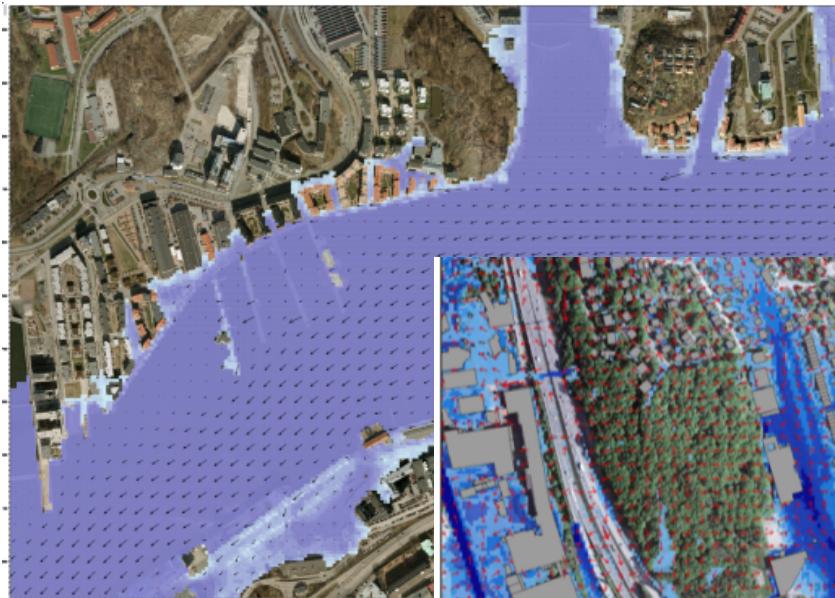


+2,5

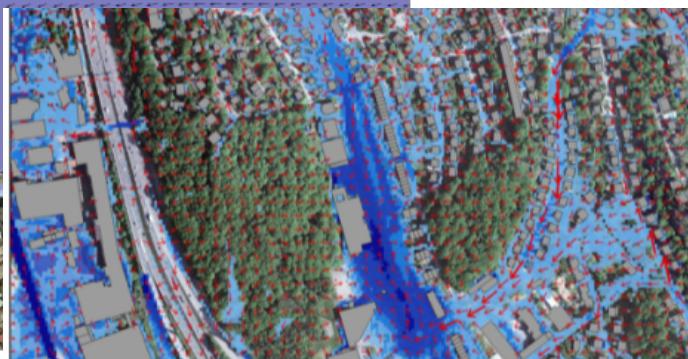
Expansion plans



Mapping of floodrisks



*Hydromodel
Increasing discharge – rising seal levels*



Teckenförklaring

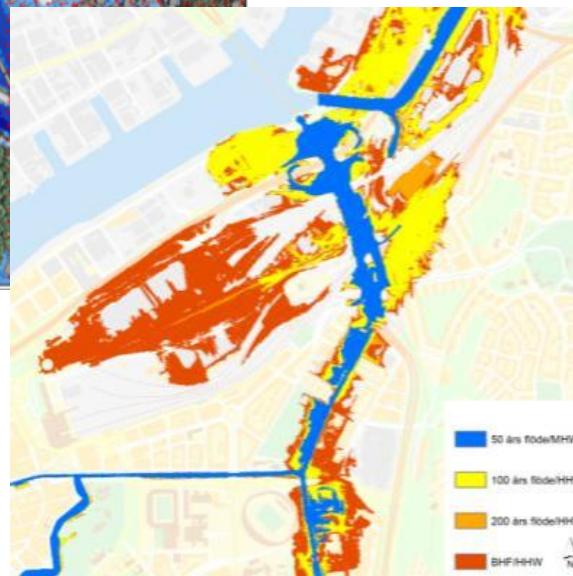
Ytvattenflöde

- ↑ < 0,28 m/s
- ↑ 1,5 m/s
- ↑ 4,15-4,44 m/s (max beräknat flöde)

Maximalt vattendjup (m)

- 0,1 - 0,3
- 0,3 - 0,5
- 0,5 - 1,0
- > 1,0

*Model of heavy rainfall
100 och 500 years returntime*



Hydrologic models

•Strategy



Critical
time



City of
Gothenburg



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Mid term

Long term



HHW
+1,8

År 2014

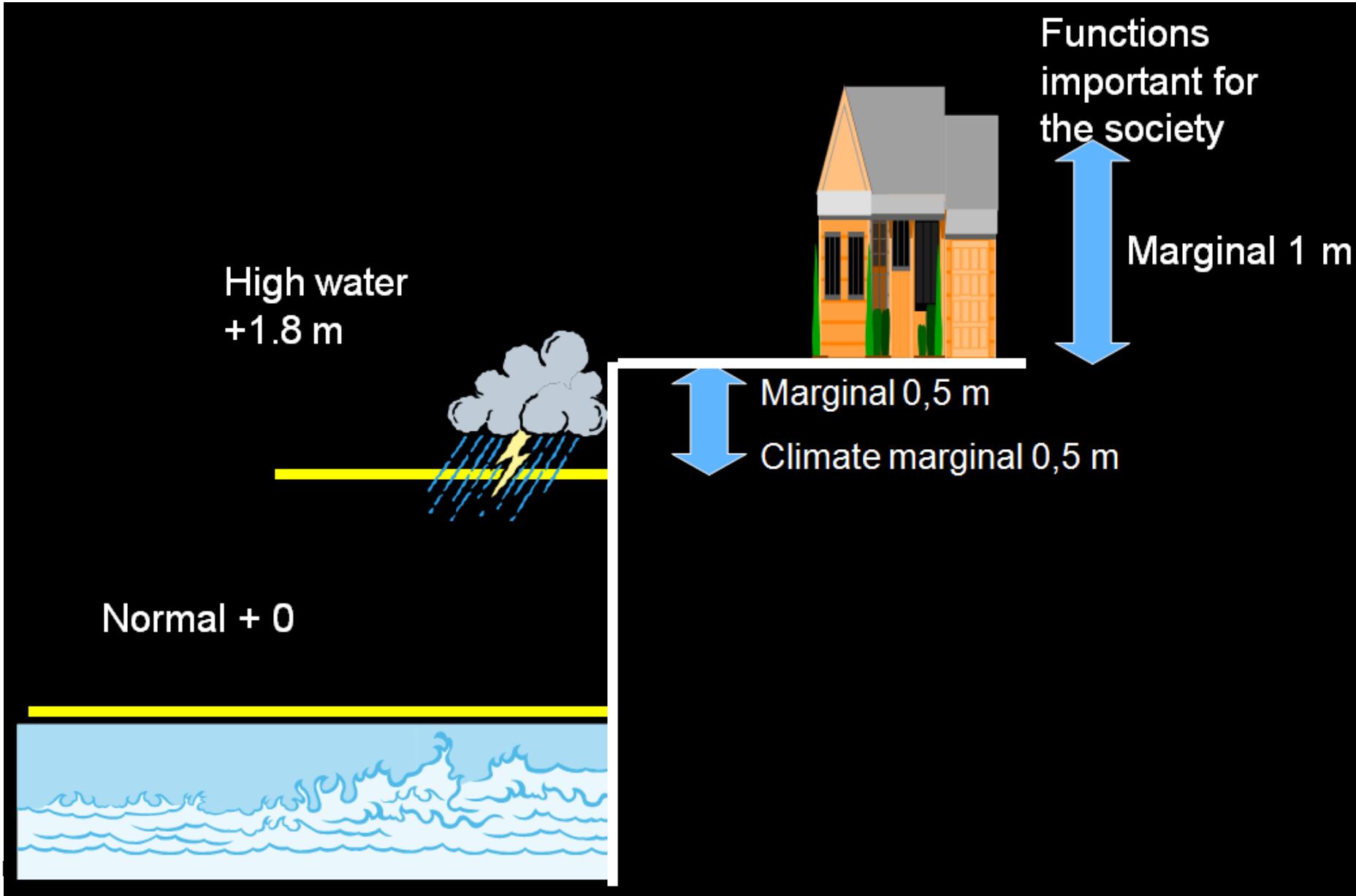
HHW
+2,3

År 2050

HHW
+2,6

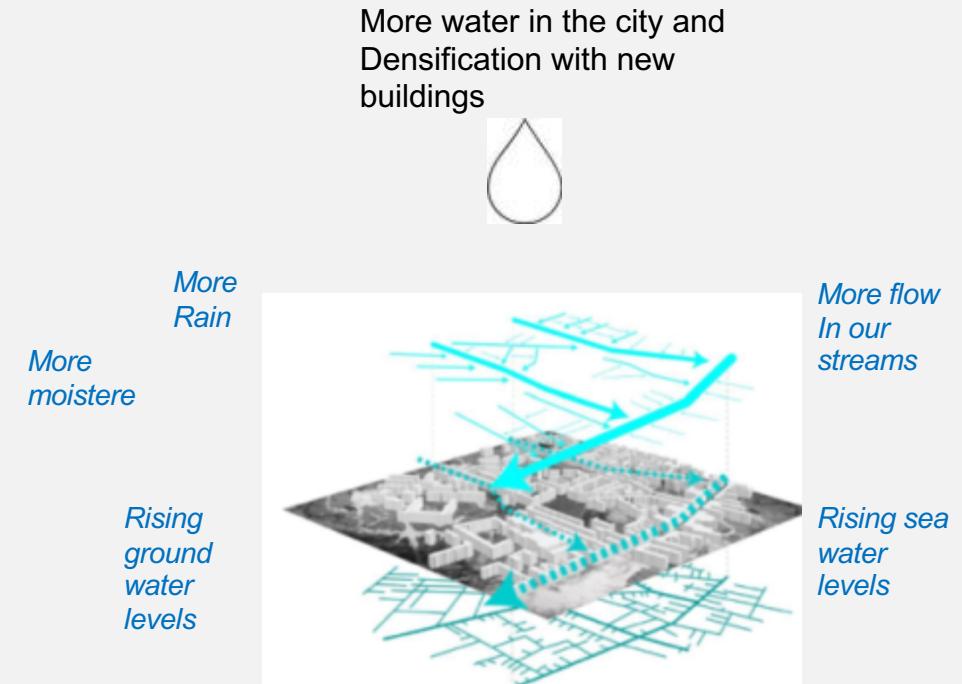
År 2100

Criteria for selection of protection- current planning levels



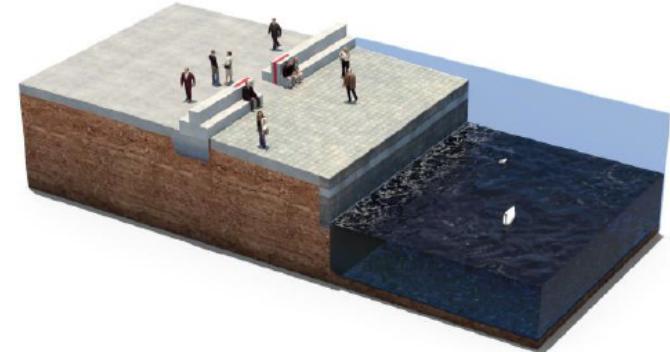
Thematic comprehensive plan on flooding risks

- Adopted by the City Council
- ***The goal is to create a robust society handling with flooding risks***
- From IPCC scenario RCP 8,5
- Set dimensional levels for:
 - cloud burst,
 - high flow in our streams and rivers,
 - extreme high water levels in the sea
- Set distance to the dimensional levels depending on function, example:
 - accessibility,
 - normal building
 - functions important for the society
- set strategy in mid term and long term

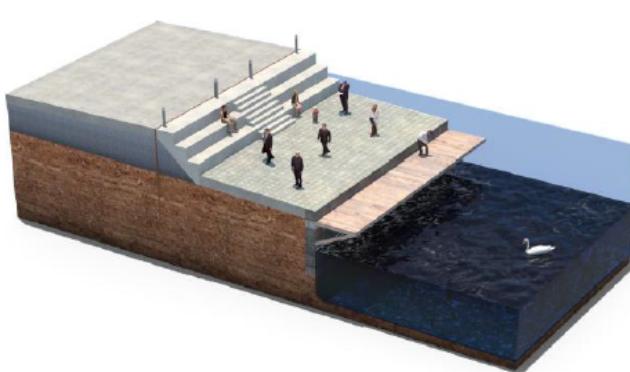




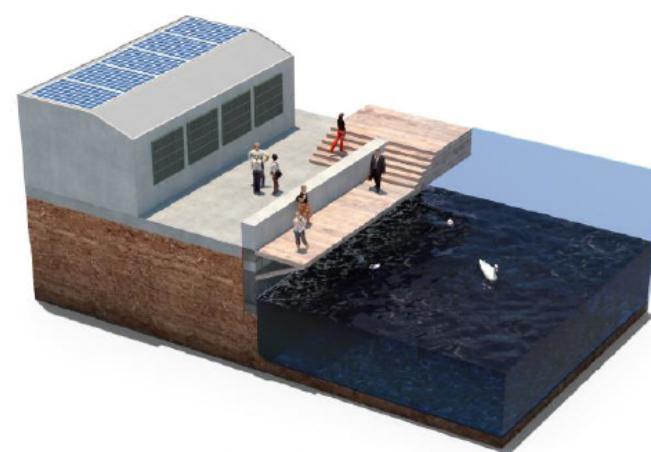
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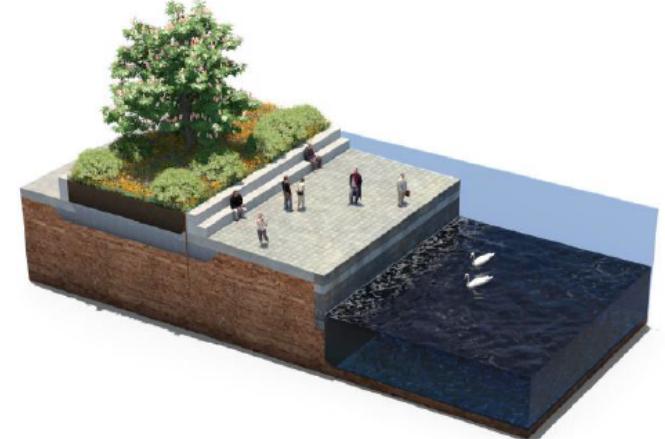
Figur 11. Alternativ 1a Sittmur med skjulportar



Figur 13. Alternativ 1c Kajplan utformad med förhöjning inåt med trappa/gradänger



Figur 15. Alternativ 2b Trång sektion med höjning av endast kajkant



Figur 12. Alternativ 1b Parkmässig planterad vall med sittkant/mur

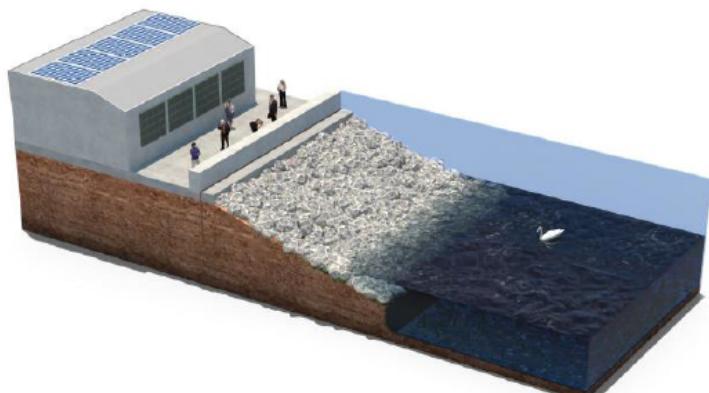


Figur 14 Alternativ 2a Höjd kajkant och kajplan



Figur 16. Alternativ 3 Slänt ned i vattnet med påbyggnad av vall med GC-väg på krönet

Pre studie river sides protection



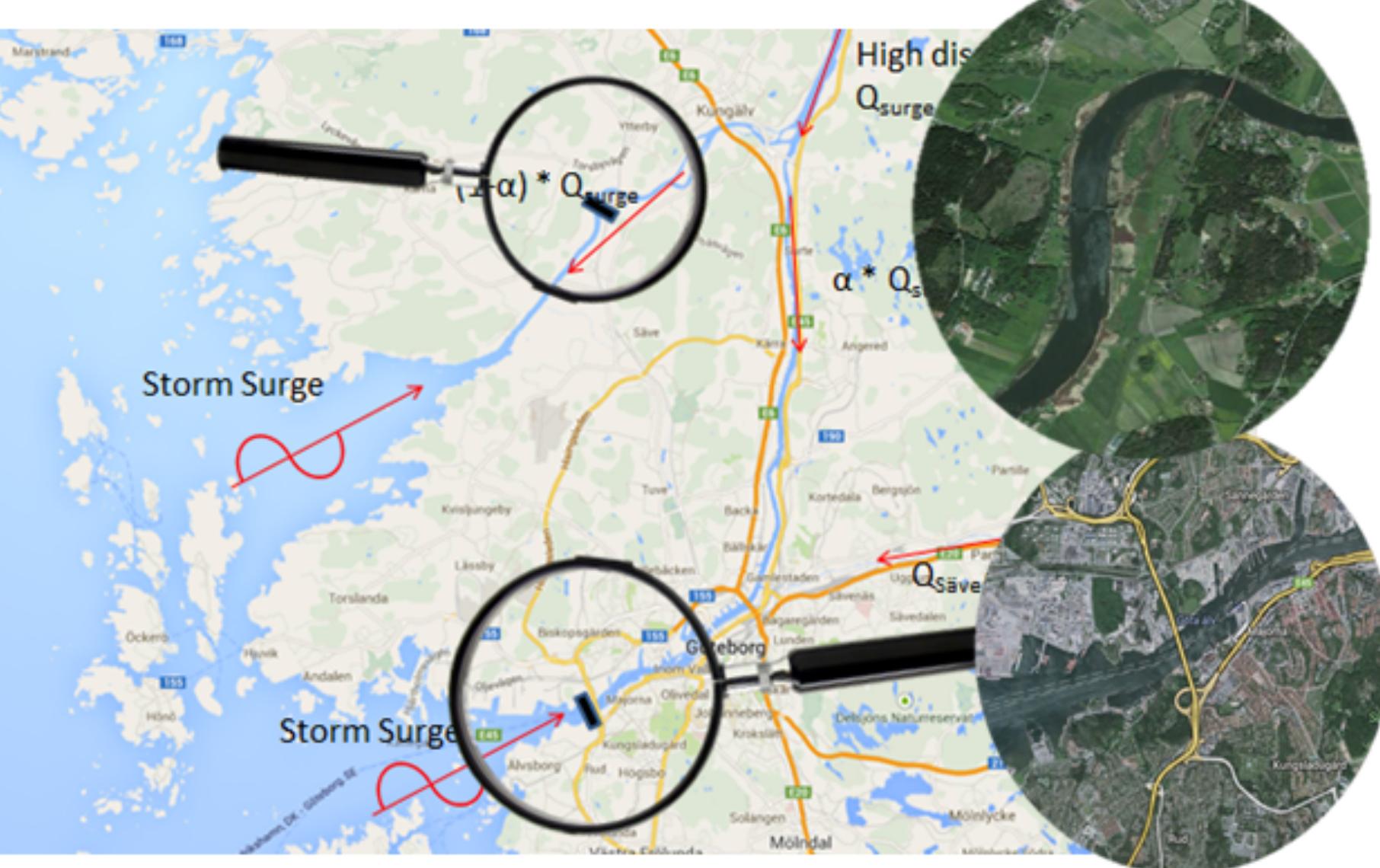


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**River side
protection
alternatives**

Storm surge barriers



Älvborg Storm surge barrier



- “Robust” alternative:
 - Segment gates (Thames barrier)
- “Navigational alternative:
 - Horizontal sector gates (Maeslant-barrier)

Barrier & Visitor centre

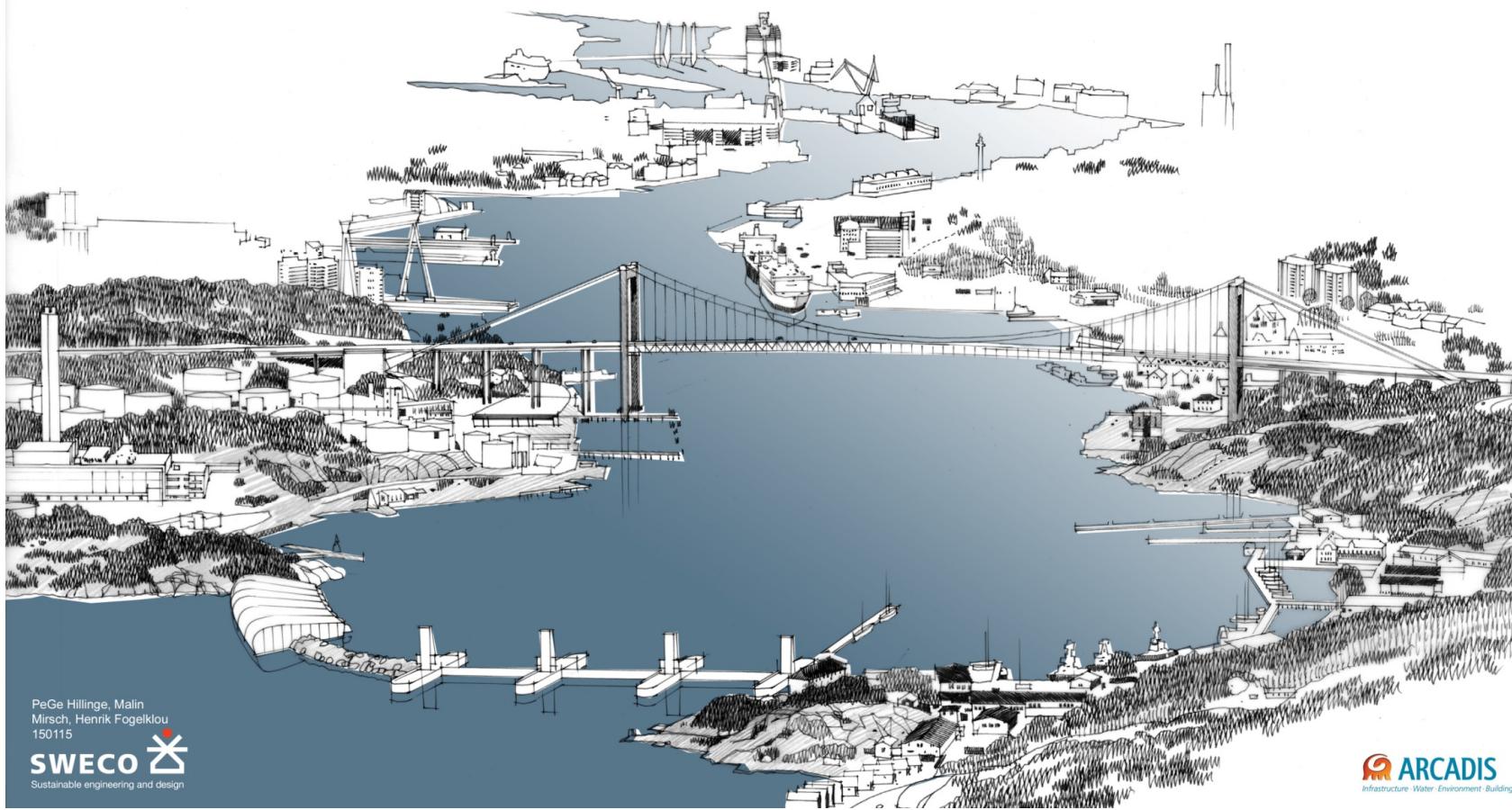
- 3 openings
- 1 pumping station
- 1 wall
- Visitors centre close to the barrier
- Example Maeslantbarriären in Netherlands



Storm barrier Älvborg

STORMBARRIÄR ÄLVSBORGSBRON

ALTERNATIV A, STÄNGD



PeGe Hillinge, Malin
Mirsch, Henrik Fogelklou
150115

SWECO
Sustainable engineering and design

 **ARCADIS**
Infrastructure - Water - Environment - Buildings

Risks and uncertainties



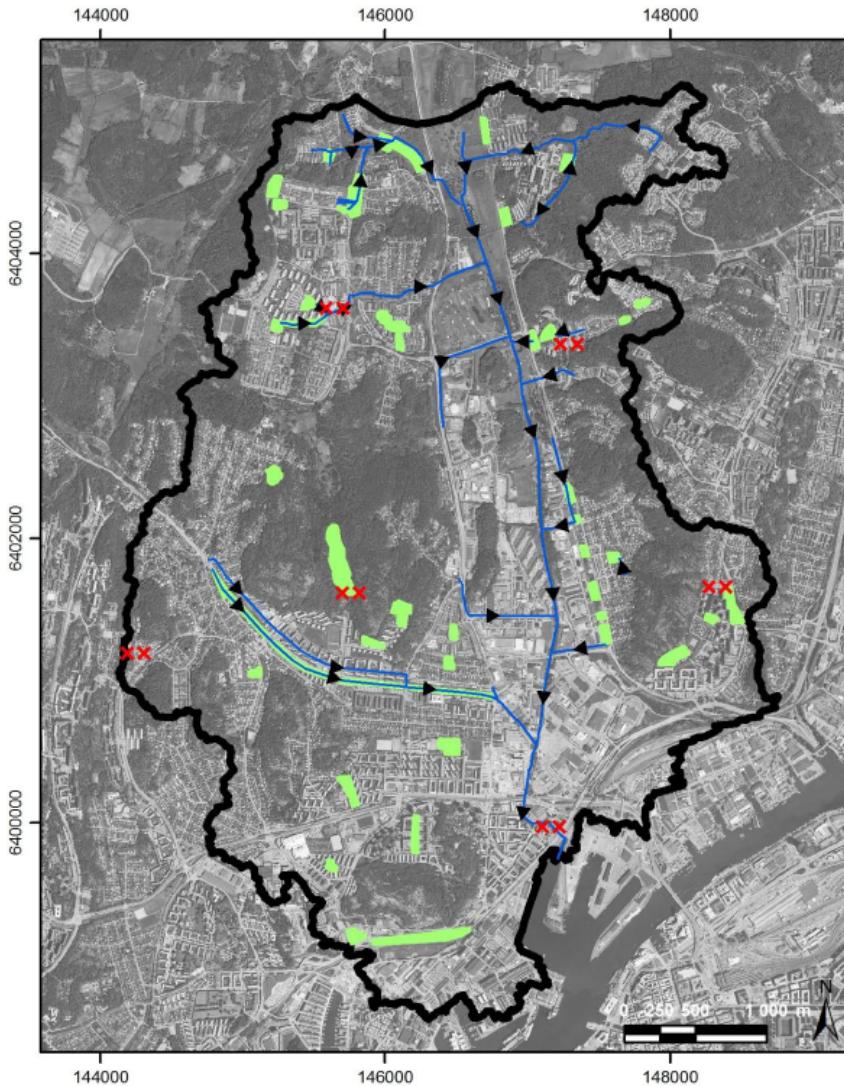
- Geotechnical information is scarce, especially at Älvsborgbron (possible consequence: increased cost of foundation)
- Projections of future sea levels and discharges
- Discharge from the smaller streams
- Political decision-making process
- Permitting (especially related to environmental aspects)



Experiences from the Netherlands

- Decision-making on (large) storm surge barriers is complex
- Historic examples show decades of decision-making (several “false starts”)
- Transparency/traceability is crucial in all studies undertaken

Structure plan example



Kvillebäcken

xx Styrning

→ Skyfallsled

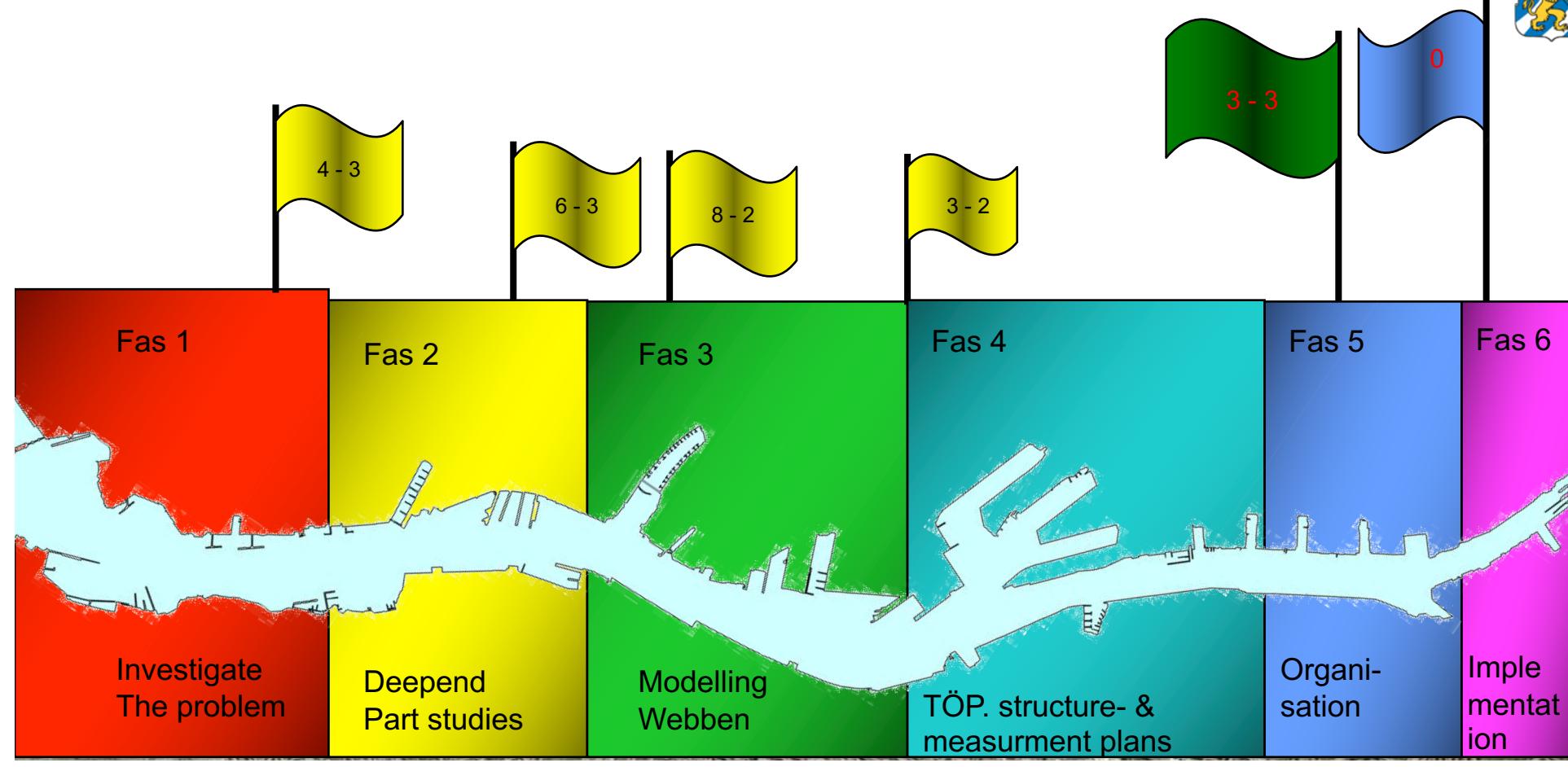
■ Skyfallsyta

Localisation of actions:

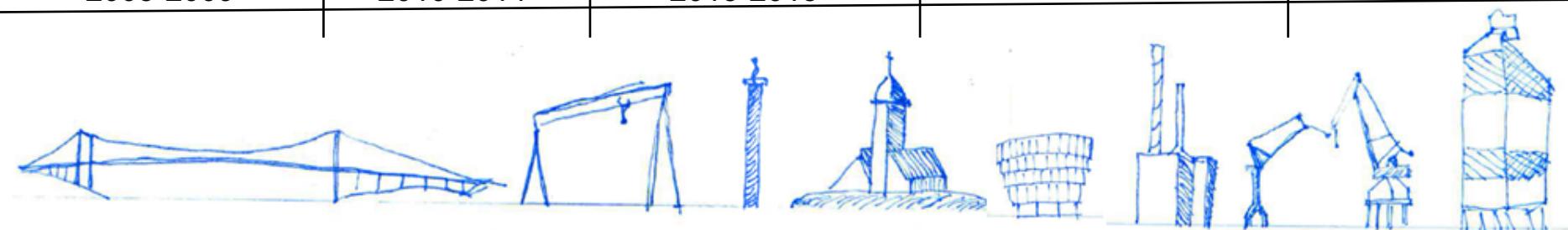
- Cloud burst roads
- Steering
- Storage



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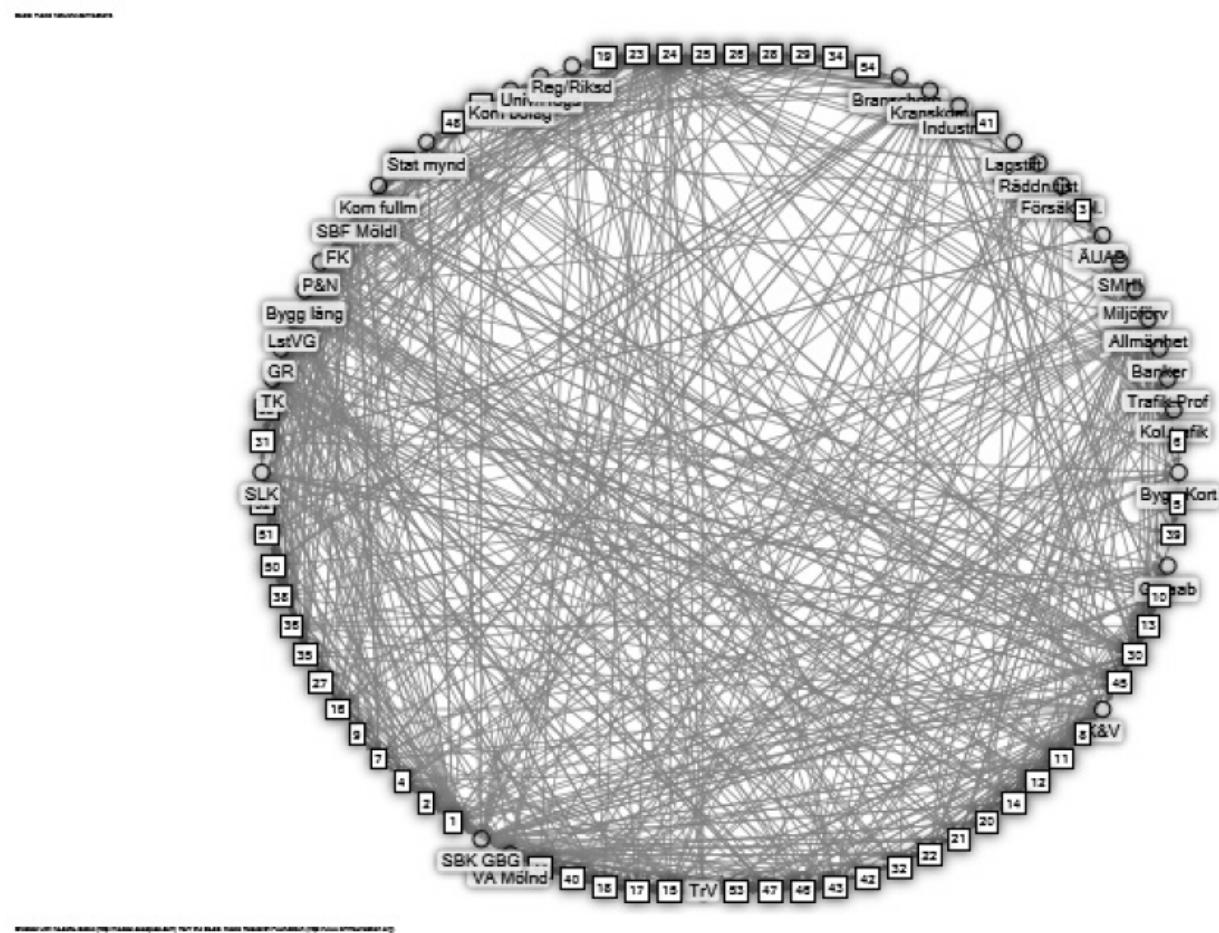


2005-2009 2010-2014 2013-2015 2015-2019 2016-? 20XX





Klimatanpassning Gbgregionen



Kontakt

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Ulf Moback

Homepages

www.goteborg.se/extremvader

www.vattenigoteborg.se