



Ministry of Foreign Affairs of the
Netherlands

Strategies for Coastal Protection and Resilience

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...hold on to your hats...

- Landscape as Destiny
- Current Challenges
- Delta Program (the lens for the future)
- Projects (and why Al Gore was wrong)
 - In the Netherlands (coastal, riverine, urban)
 - In the US (New Orleans and New York)

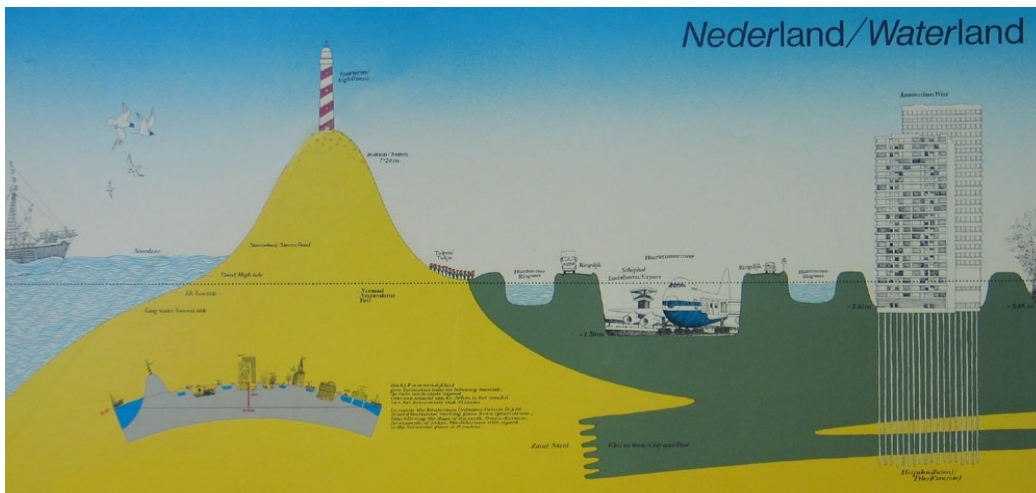


Geography 101: The Netherlands, in Europe





The Netherlands: a delta landscape, penetrated by rivers, subject to sea and river flooding



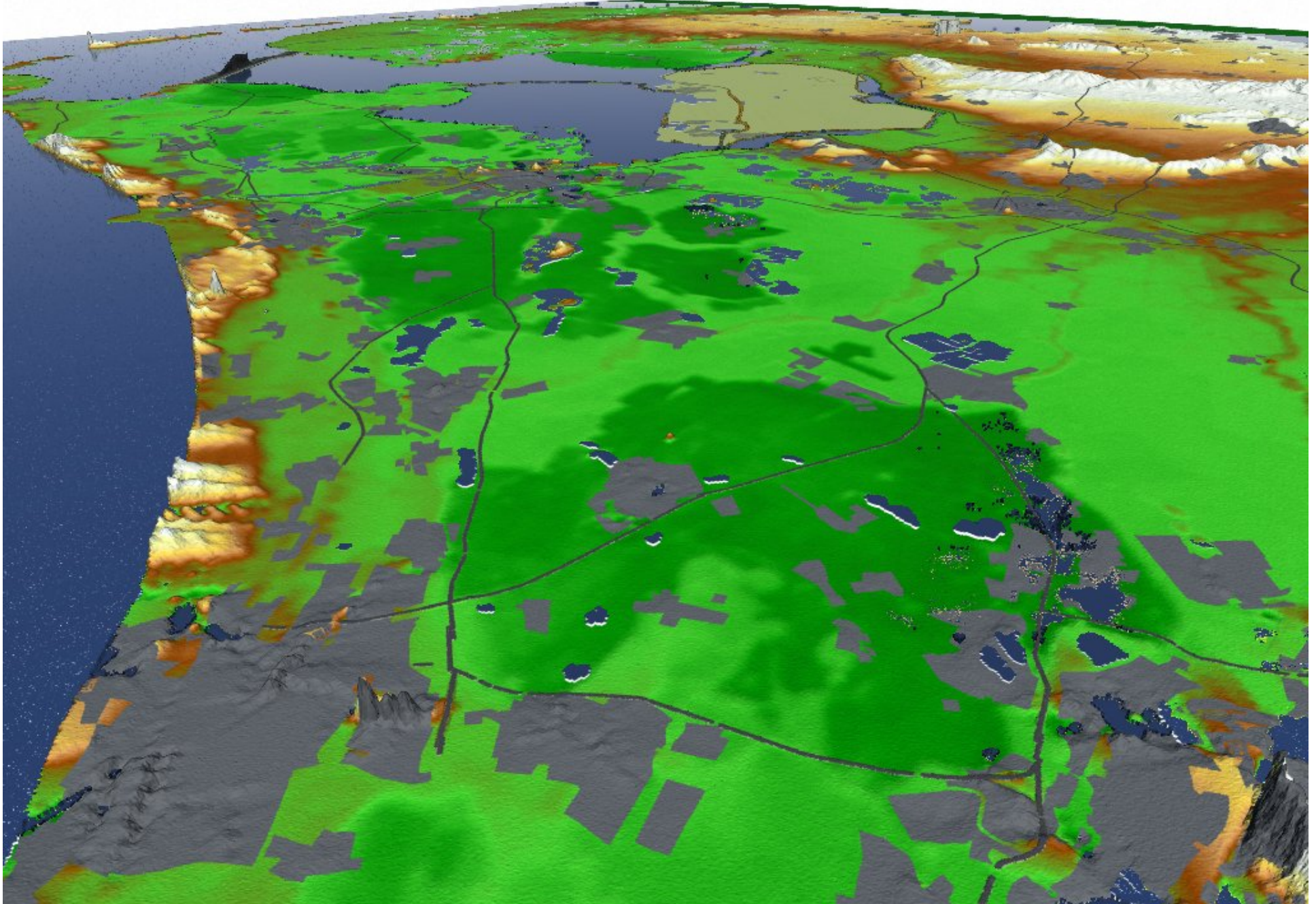


The Netherlands, at risk

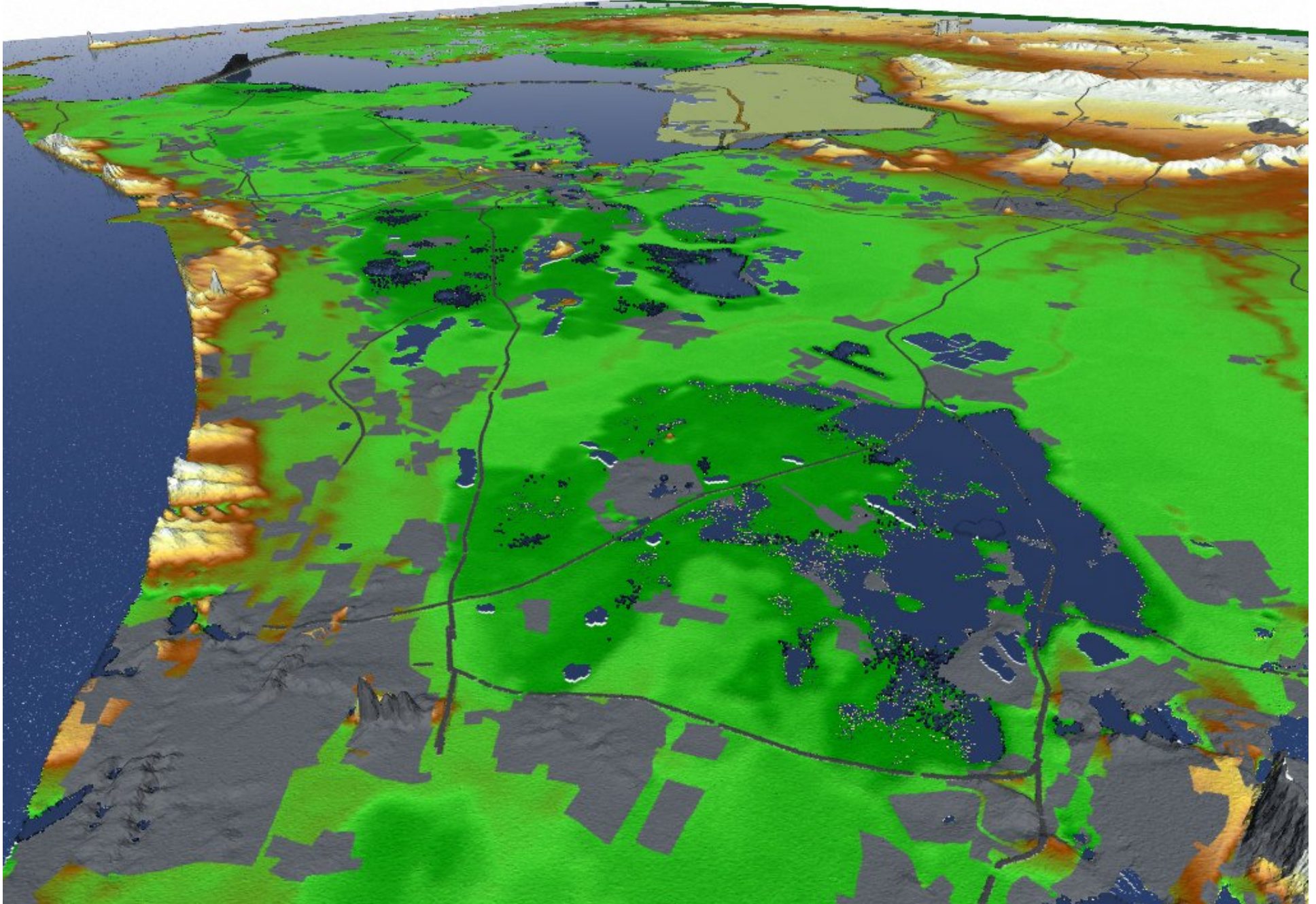


- 400 miles of rivers (Rhine, Meuse) draining NW Europe
- 60% of land at/below sea level
- 17 million people, 9 million of which live below base flood level
- GDP 600 bln euro (70% of which produced at/below sea-level)
- storm surge, wet weather, heavy river discharge, subsiding, changing climate. SLR: 1 – 2.5 ft ~2100
- water mgmt is a matter of national survival and an opportunity

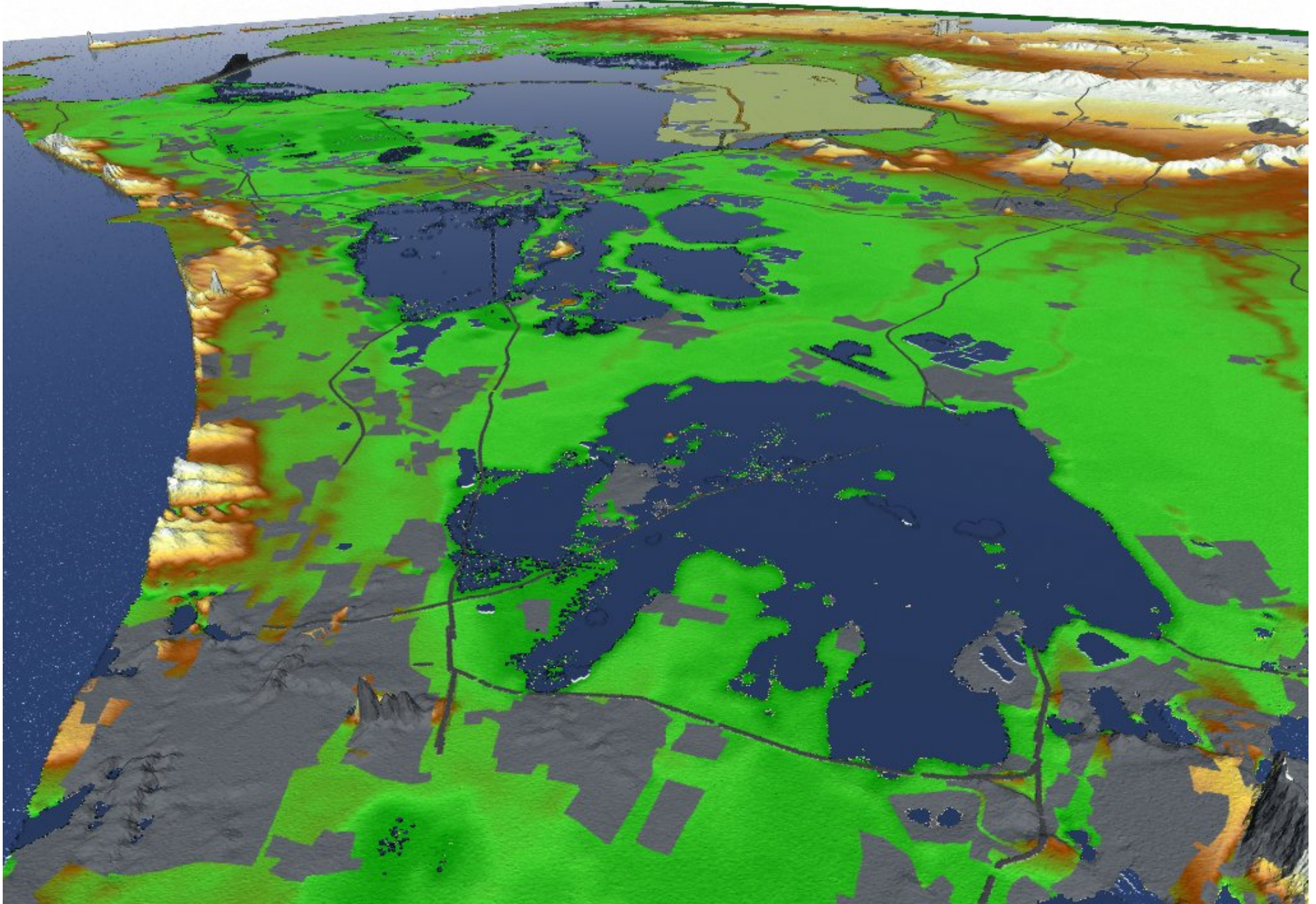
Area potentially flooded at water level 6.0 m below MSL



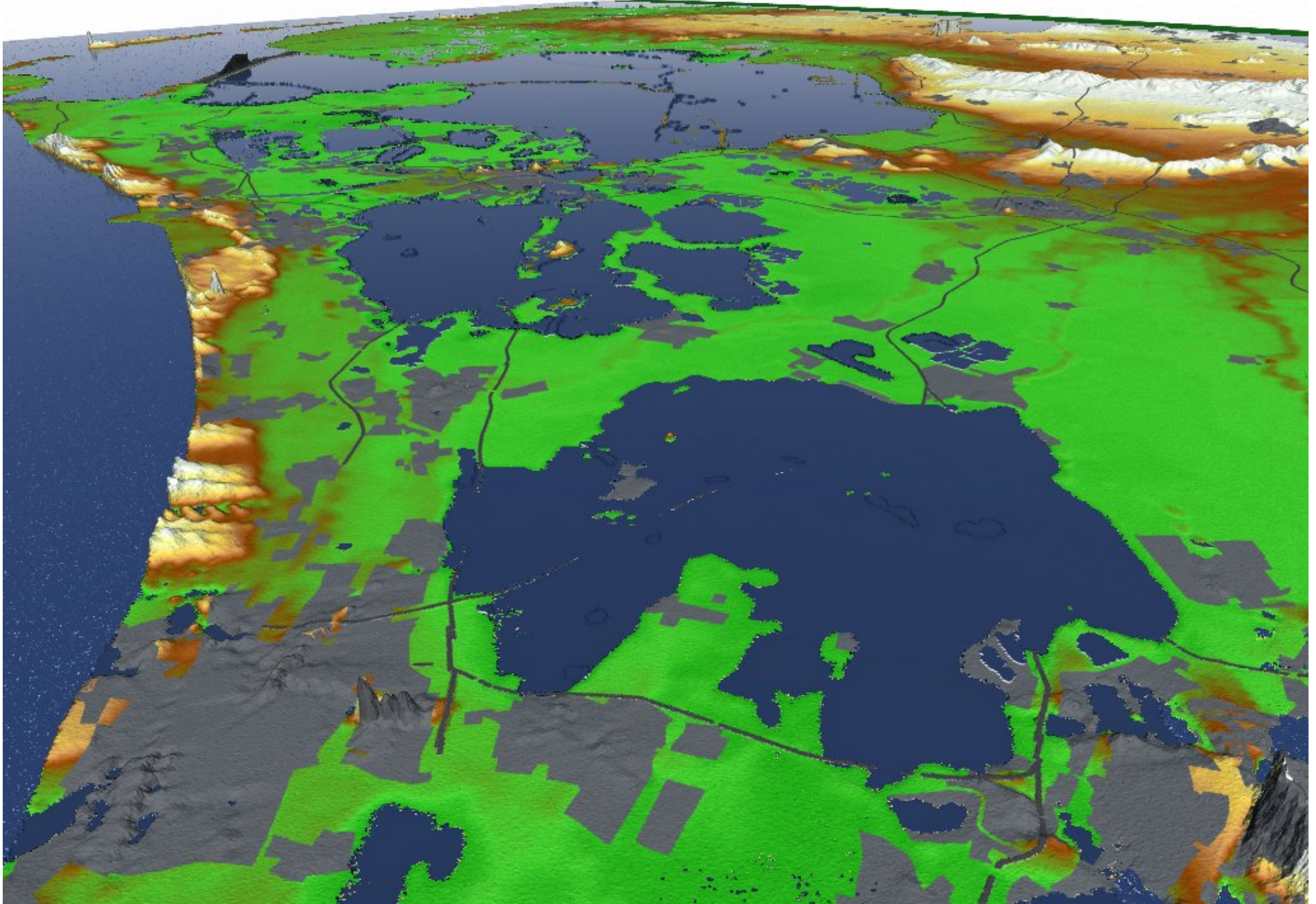
Area potentially flooded at water level 5.0 m below MSL



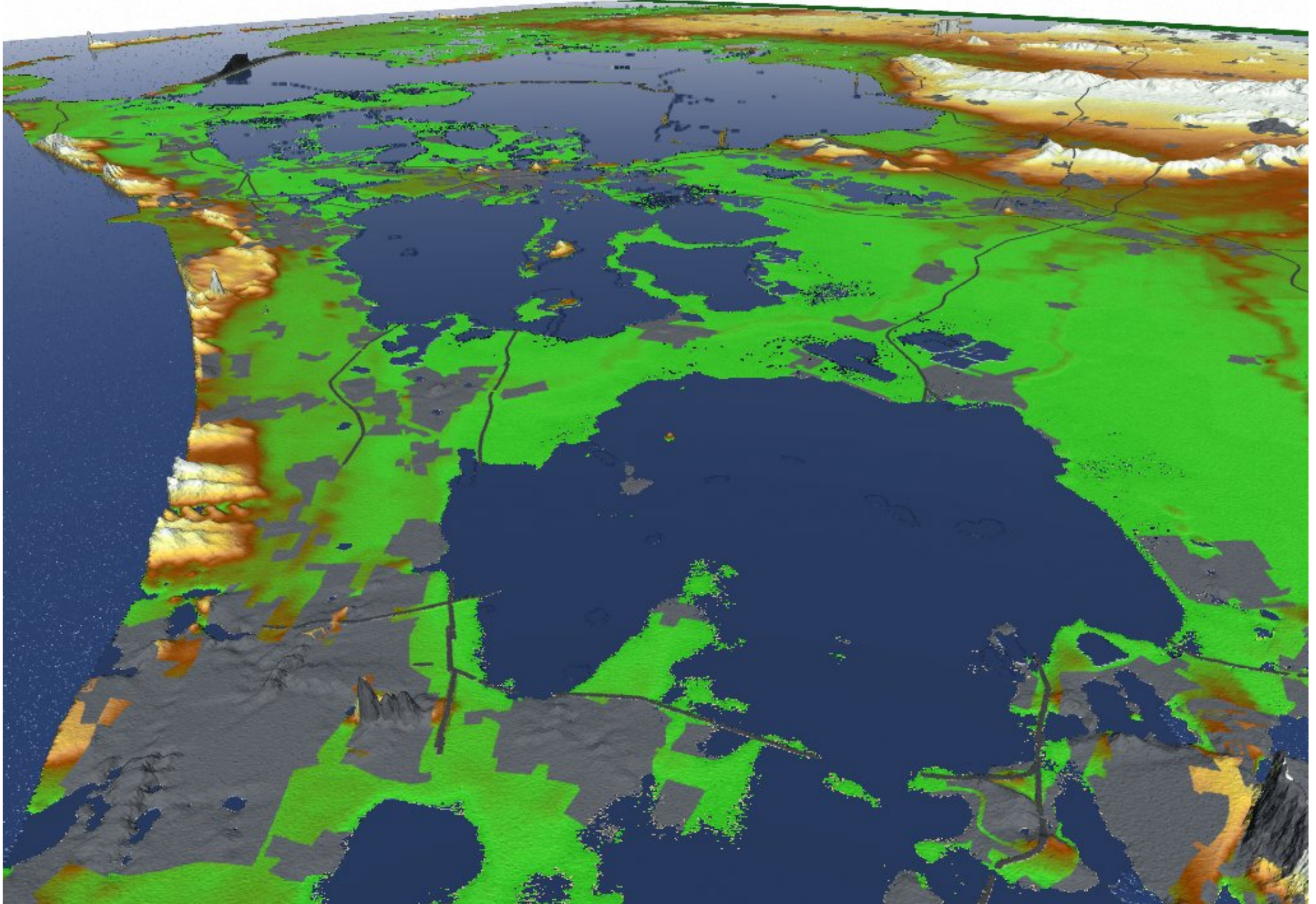
Area potentially flooded at water level 4.0 m below MSL



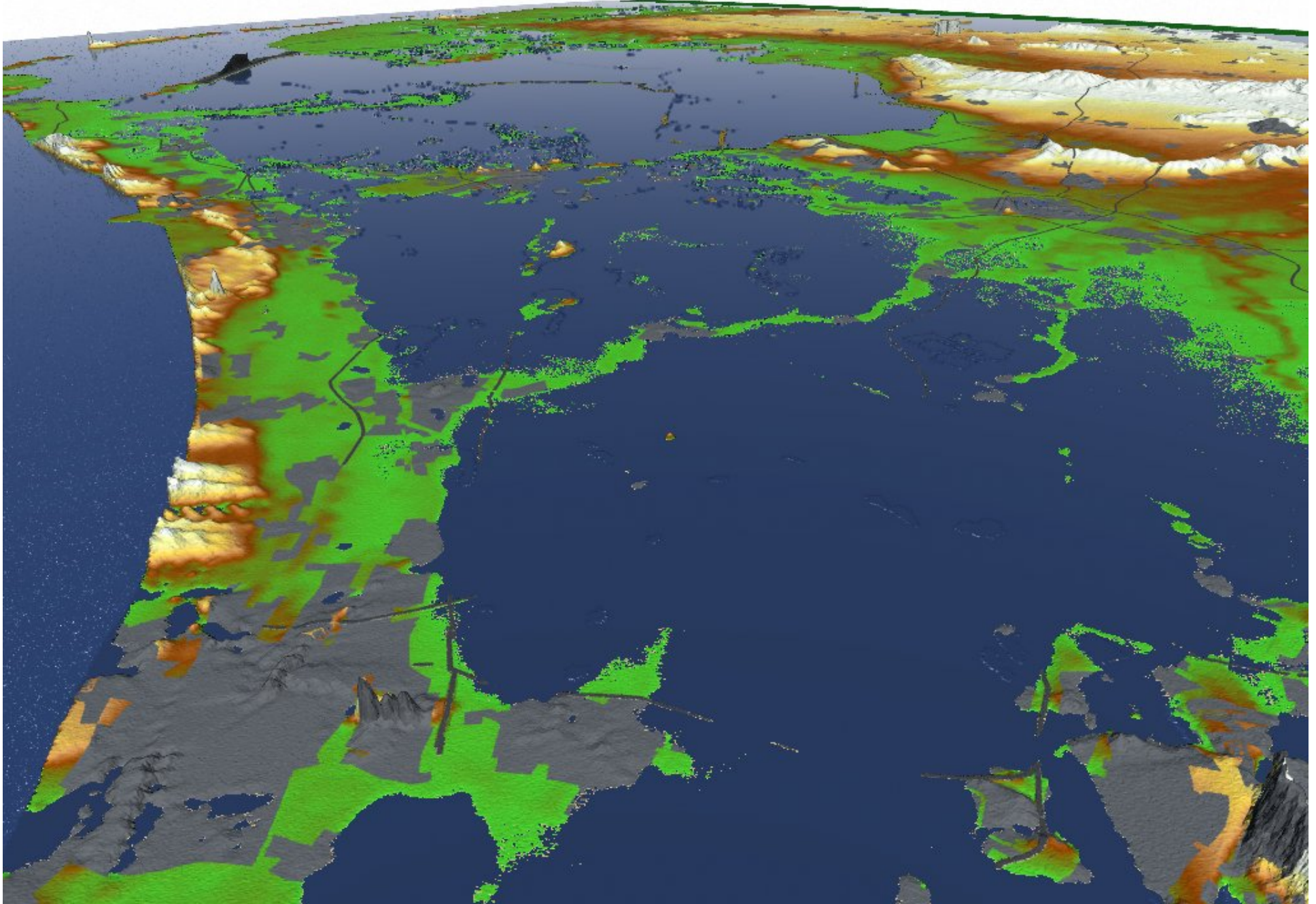
Area potentially flooded at water level 3.0 m below MSL



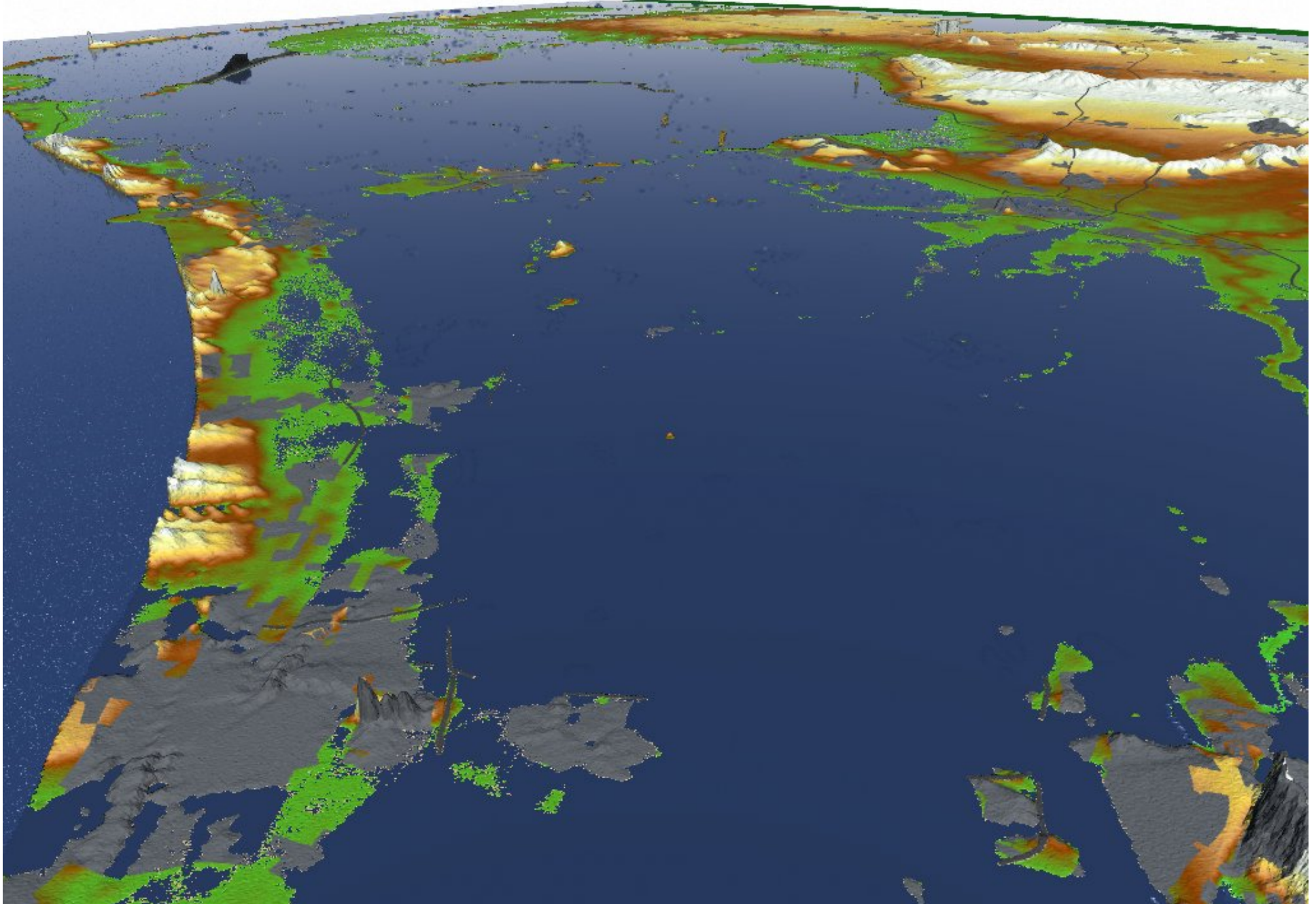
Area potentially flooded at water level 2.0 m below MSL



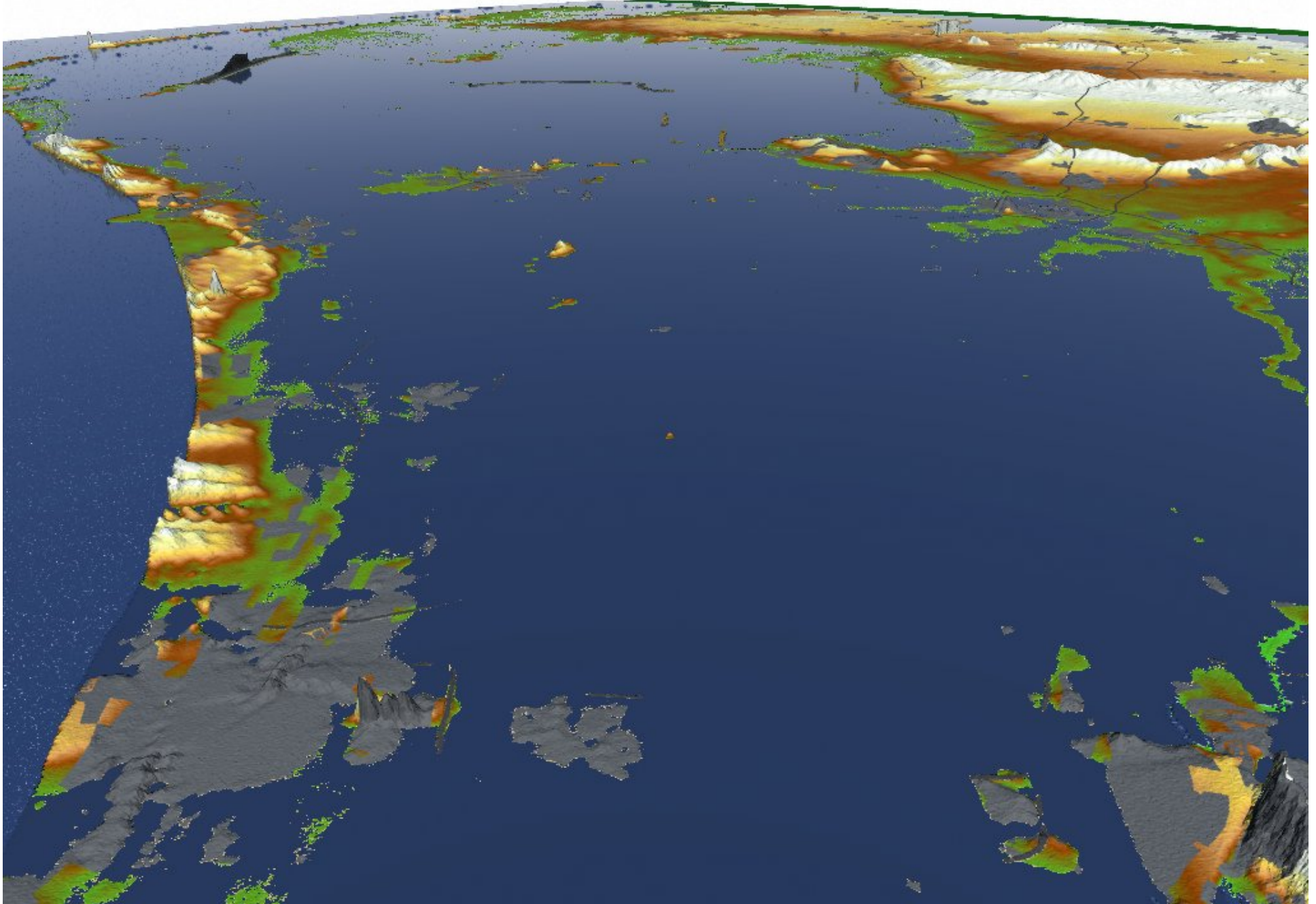
Area potentially flooded at water level 1.0 m below MSL



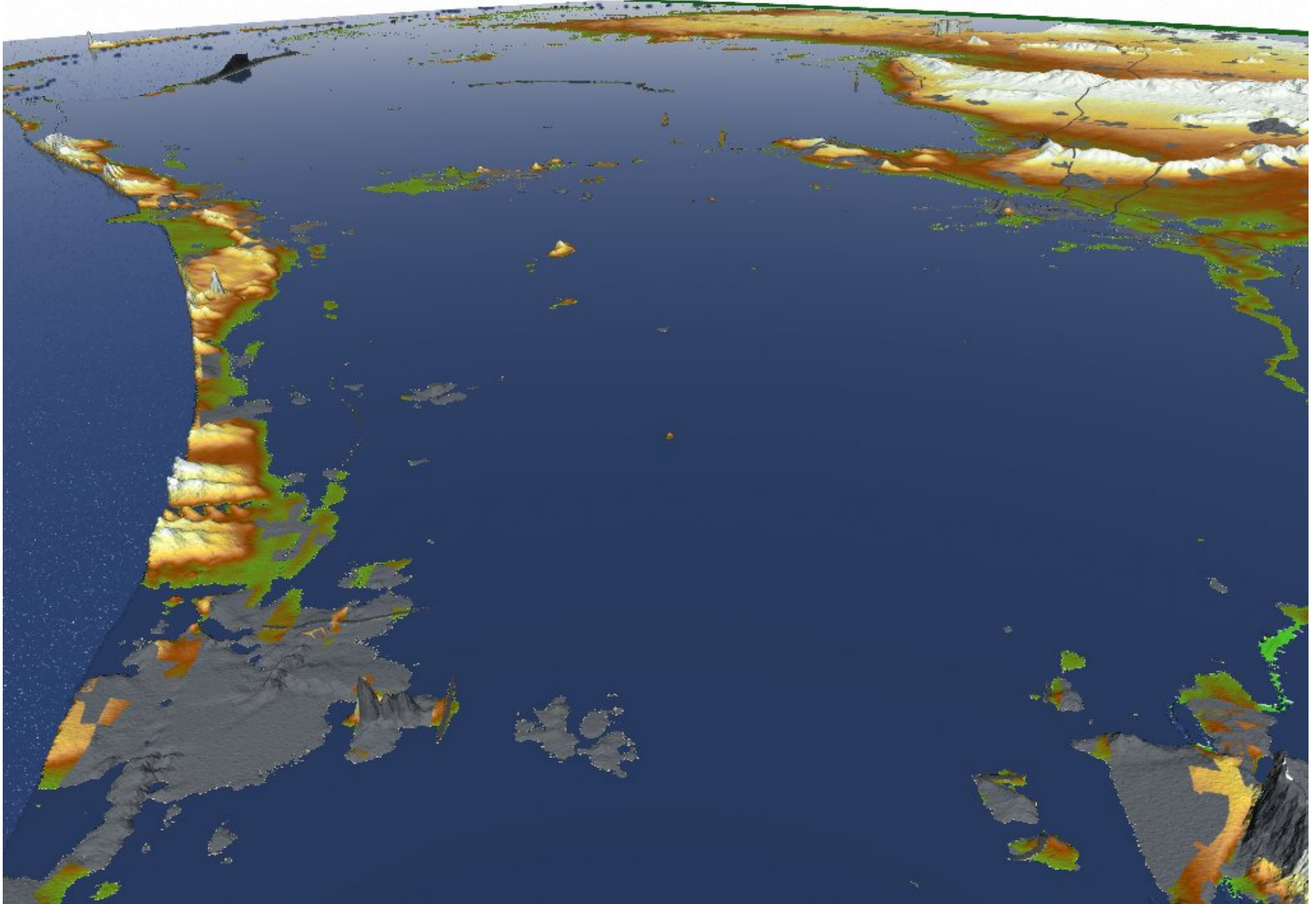
Area potentially flooded at water level 0.0 m below MSL

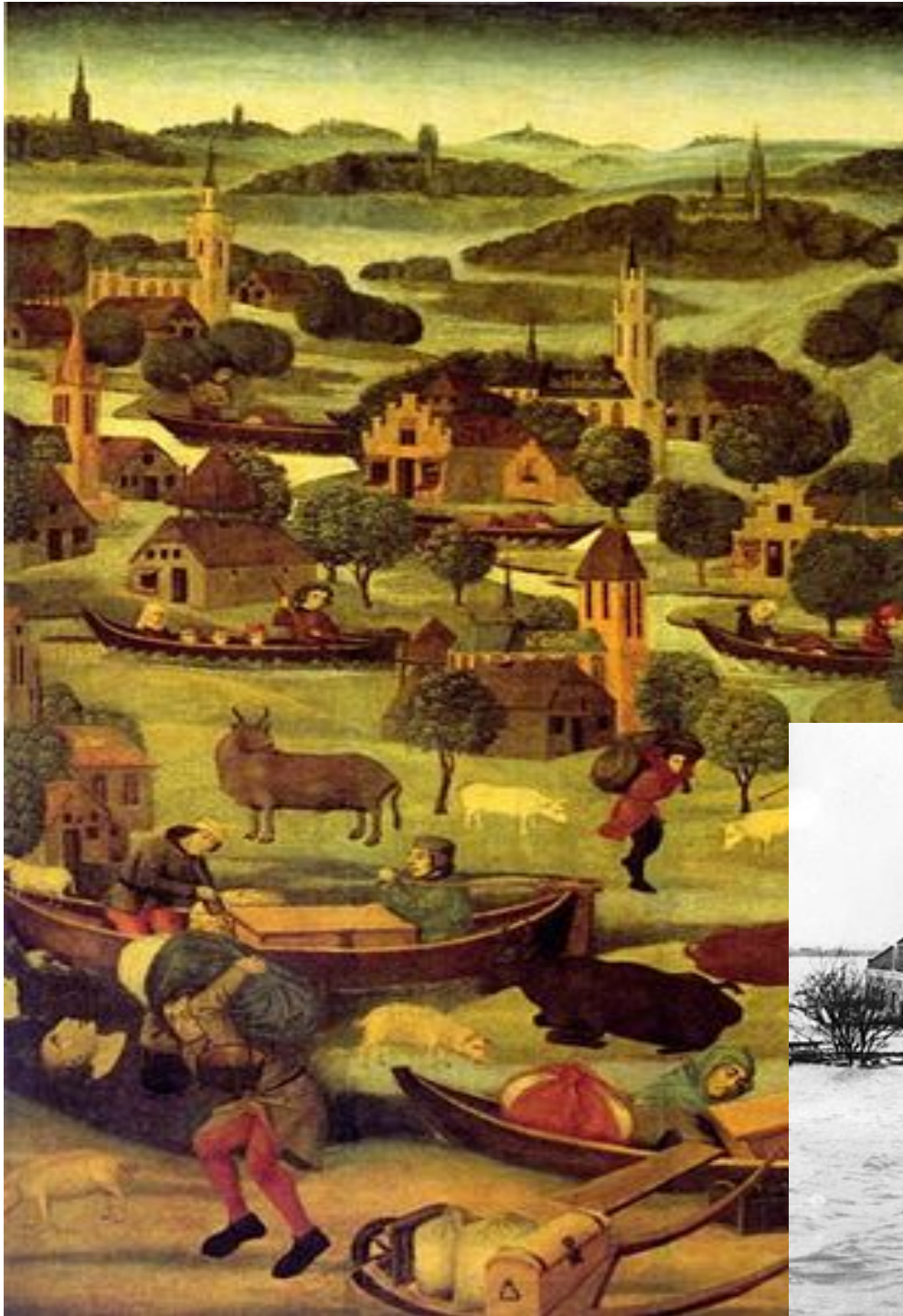


Area potentially flooded at water level 0.5 m above MSL



Area potentially flooded at water level 1.0 m above MSL



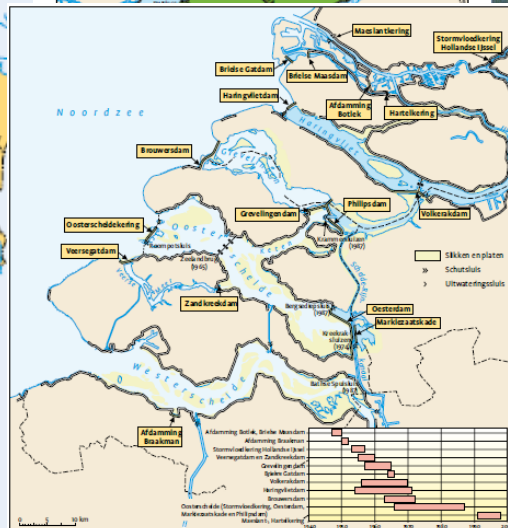




Focus of past mitigation: shorten the coastline

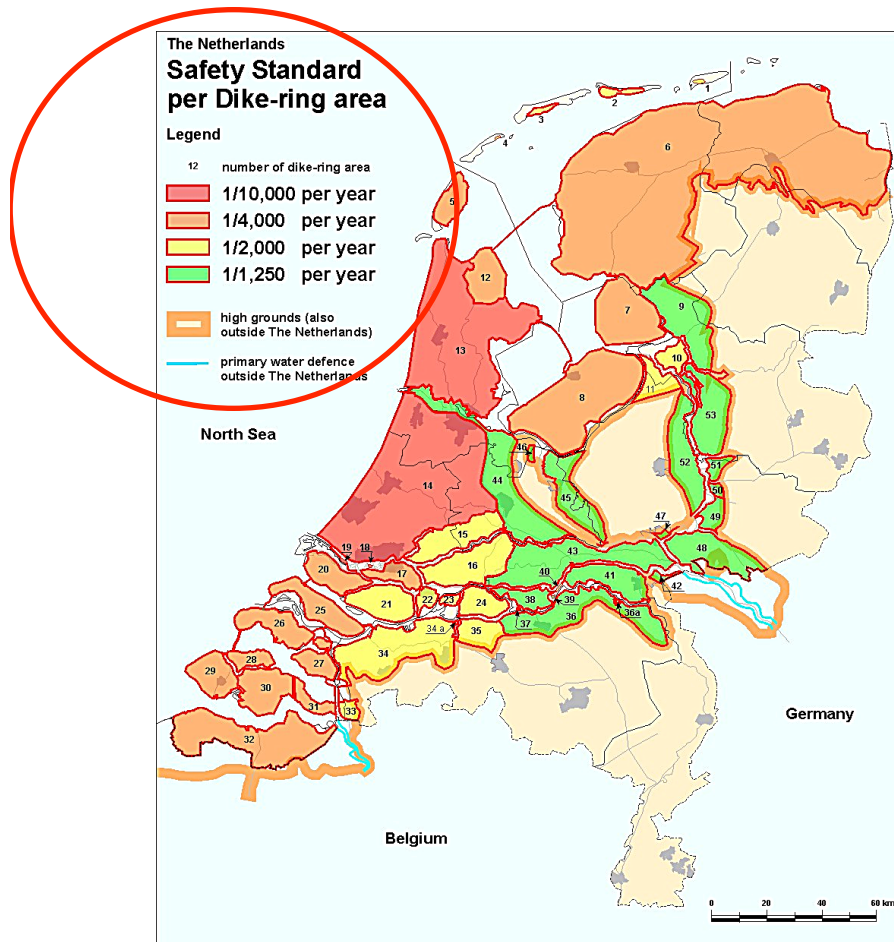
300 → 45 km

750 → 50 km





1958 flood risk/safety standards established



“Never Again” mentality

Risk = Consequences x Probability

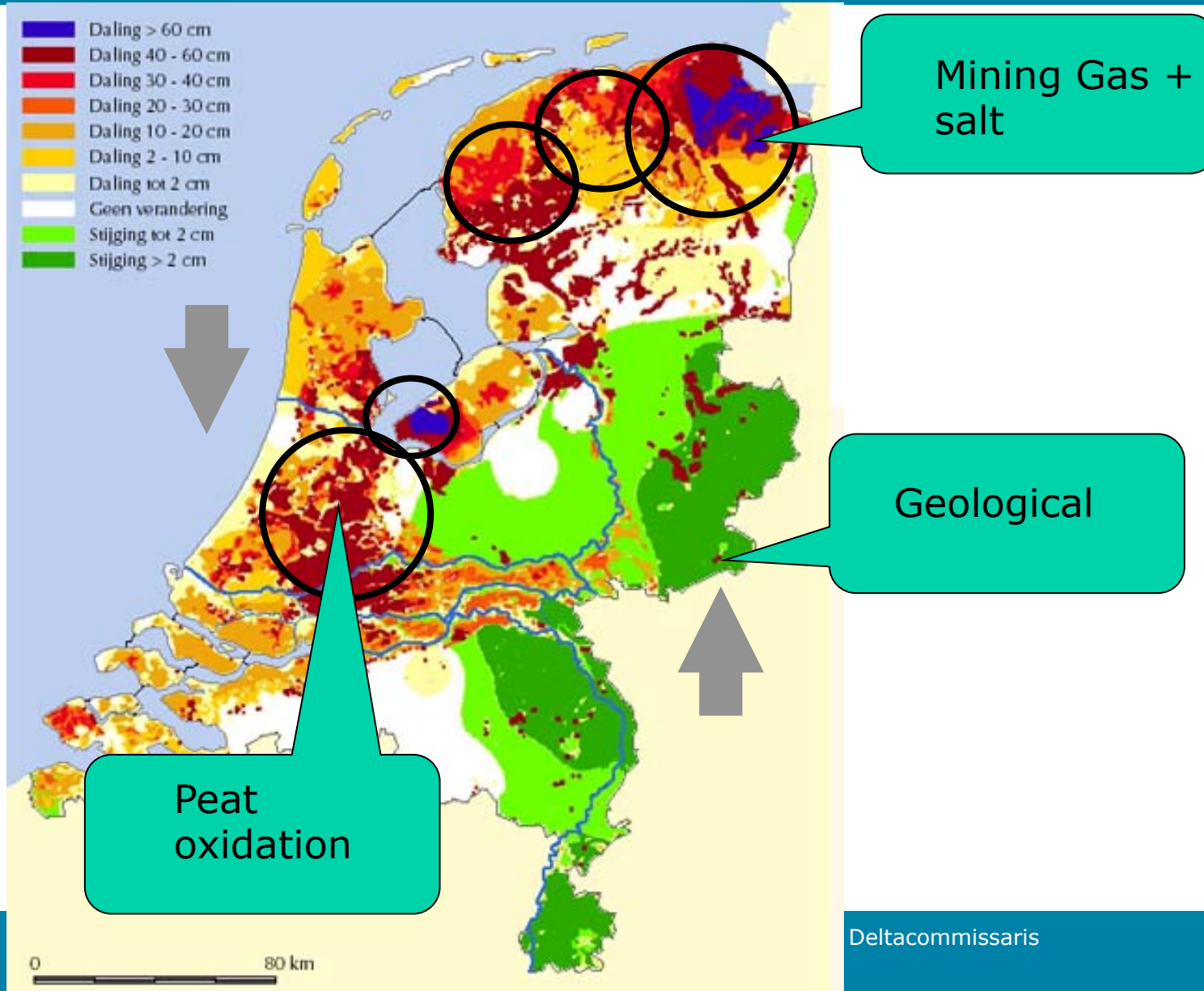
Areas with most risk have highest levels of protection: 1/1250 to 1/10,000

One size does not fit all (1/100)

Cost-Benefit Analysis for all major infra projects (models recently updated because of demographic and econ changes)

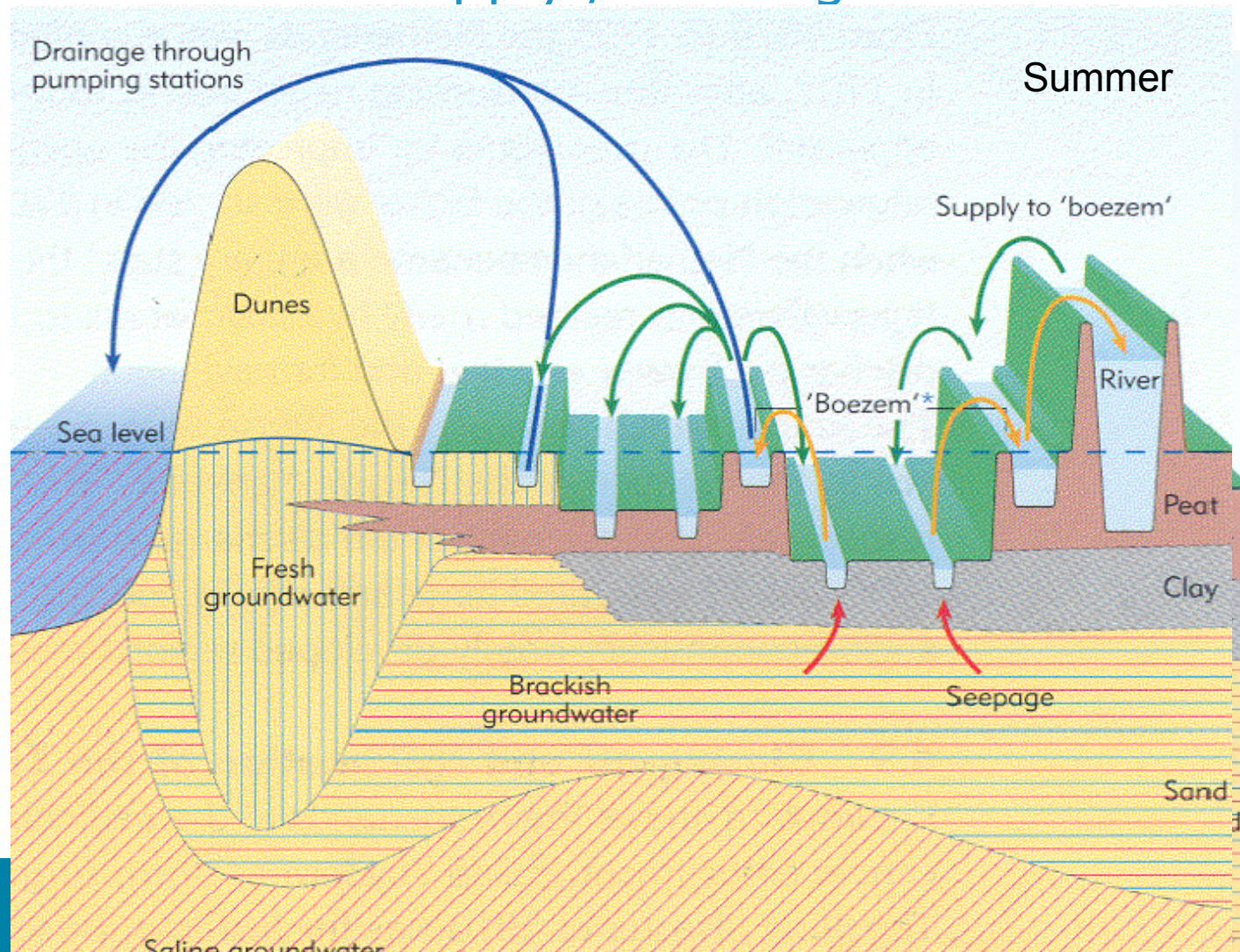
1/10,000 NL = 1/500 US Gulf Coast

Subsidence





Intricate water supply / drainage: summer and winter





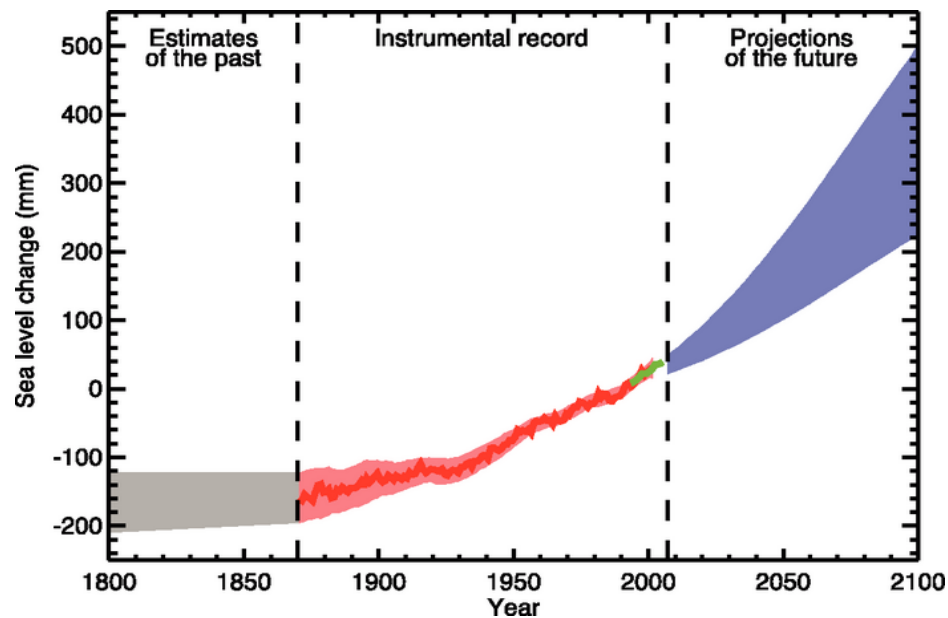
After 800 years:
We're safe!





Rising seas

- Increasing sea level
- Increasing population and economic value in coastal zones world wide



IPCC, 2007



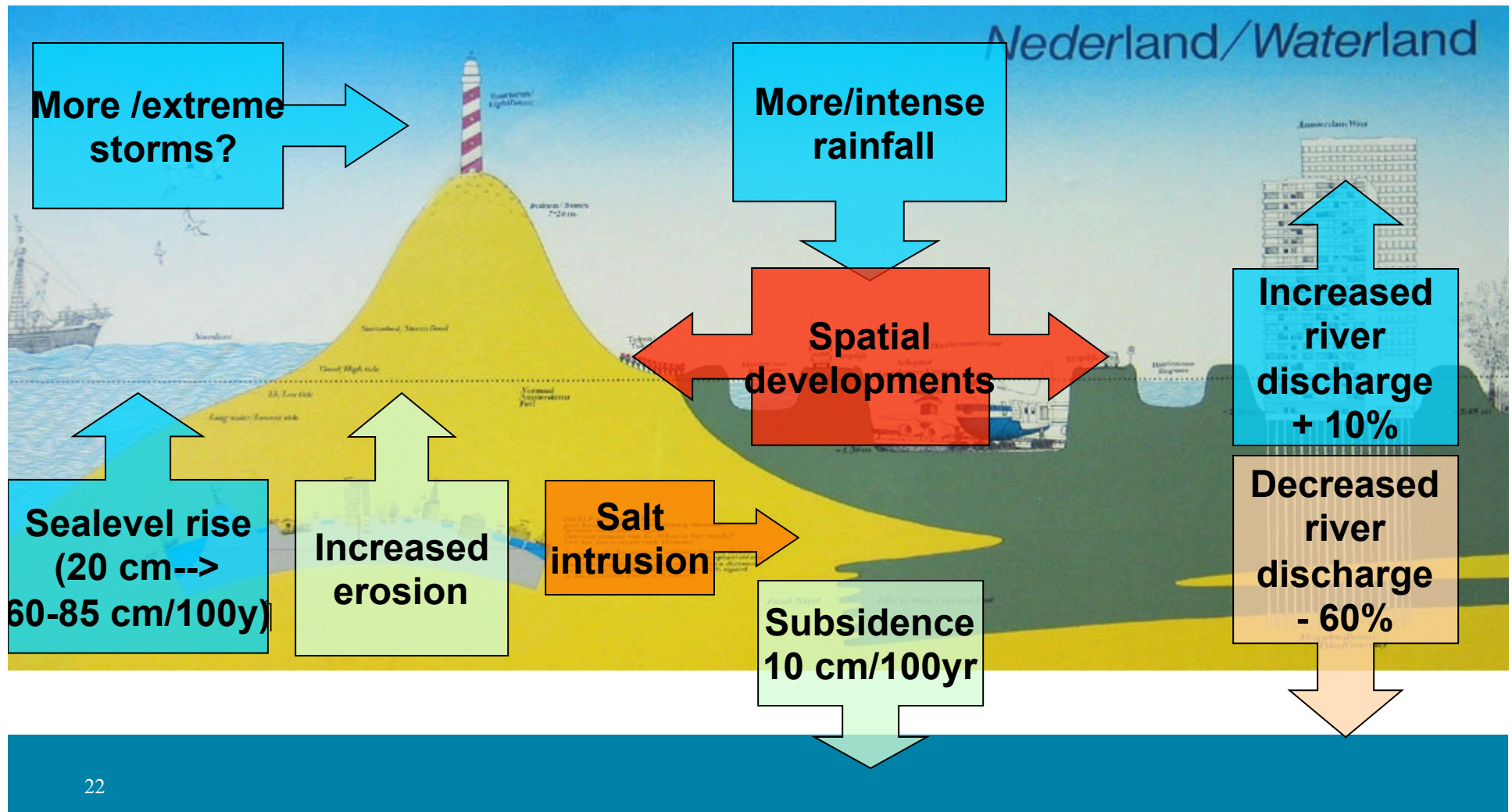
Photo: Stephen Wilkes

National Geographic , Sept

2013



The Delta Under Pressure: challenges (not unique)





American Security Project (bipartisan think tank)

- In 1990s: US Govt spent \$85b on hurricane relief
 - 2000-200L: \$288b
- Hurricane Sandy: 117 dead, +\$60b damage
- Hurricane Katrina: 1,800 dead, +\$150 damage
- 50% U.S. population lives within 50 miles of the coastline
- 39% US population lives in coastal counties
- Is there urgency?

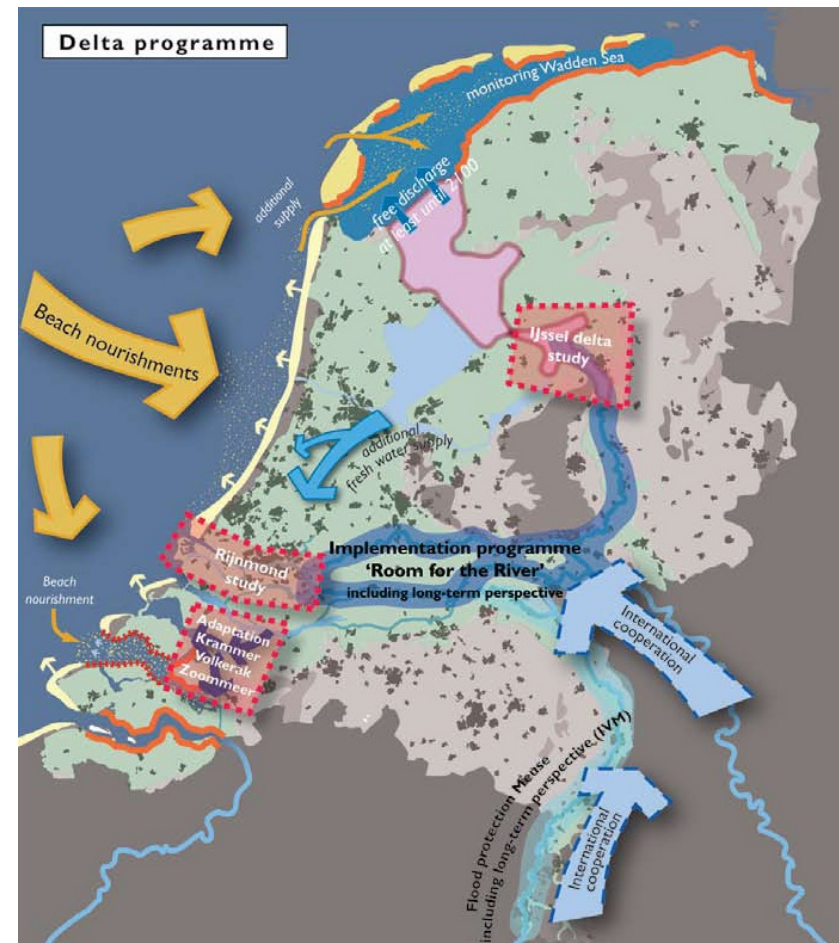


Delta Commission, 2008, three challenges:

Fresh Water Supply

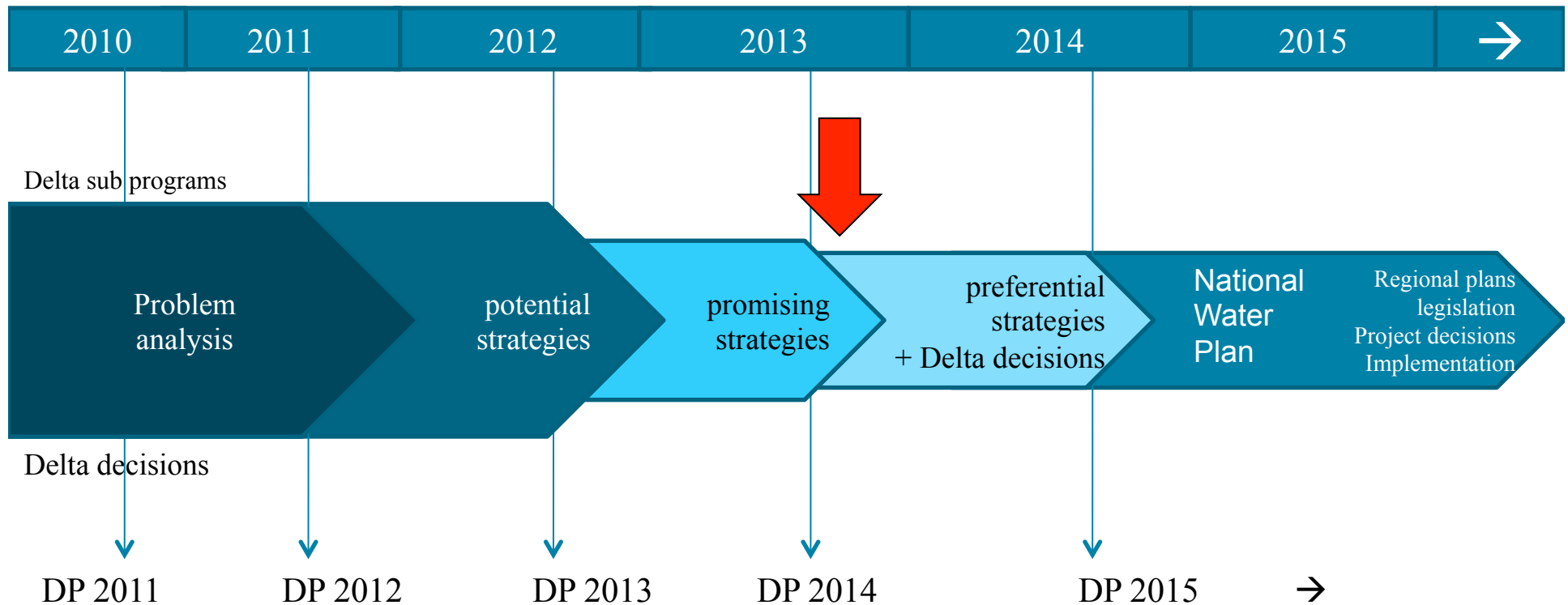
Flood Risk Management

Manage / plan investments:
over / underinvestment
will be costly



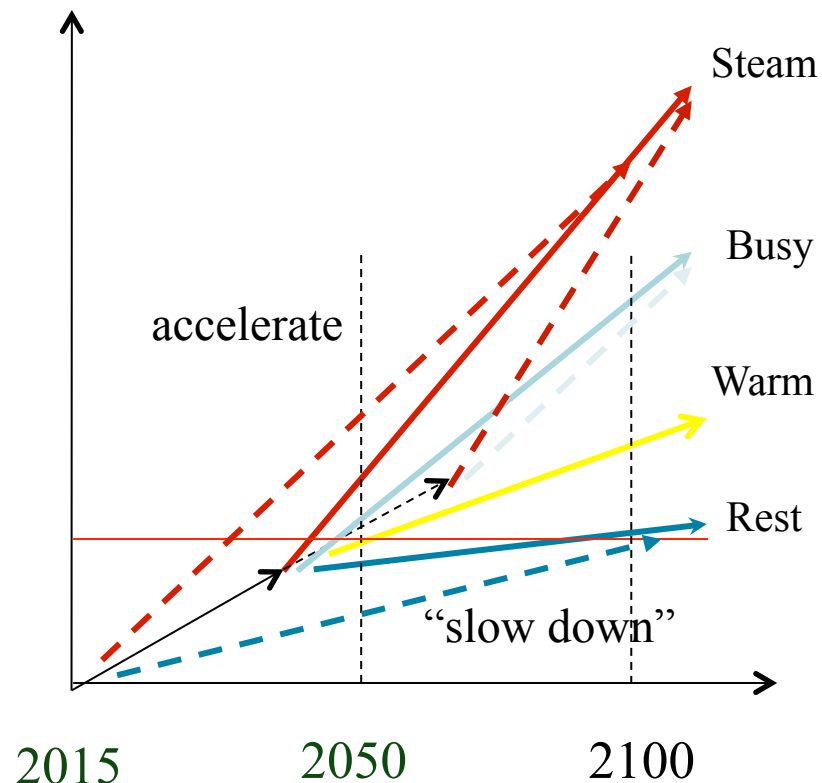


Strategy development and decision making





Development of adaptive strategies



Adaptive strategies:

- View short term decisions (in physical domain) through lens of long term water challenges
- Link plans to other (short term) investment agenda's ("aging infra")
- Able to speed up or slow down, or flexible to change to another strategy

→ Spatial reservations for future dike enforcements, water discharge or storage



Projects (relevant to the US?)

- Building with Nature (Sand Engine)
 - Relevant to US east coast and US Gulf coast
- Coastal retrofits: Scheveningen / Katwijk / IJsselmeer Dike
 - Relevant to NY, NJ, VA, NC, Fla
- River flooding retrofits: Zutphen, Nijmegen, Noordwaard
 - Relevant to Sacramento/San Joaquin, Mississippi/tributaries (and many other US rivers)
- Urban retrofits: Rotterdam, New Orleans
 - New York, Boston, Norfolk, Miami, Tampa, Houston, San Francisco, Seattle

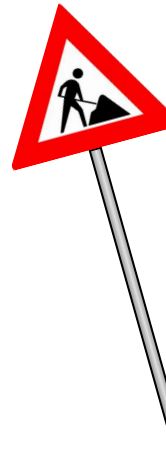


Building *with* Nature?



let nature do
part
of the work ...

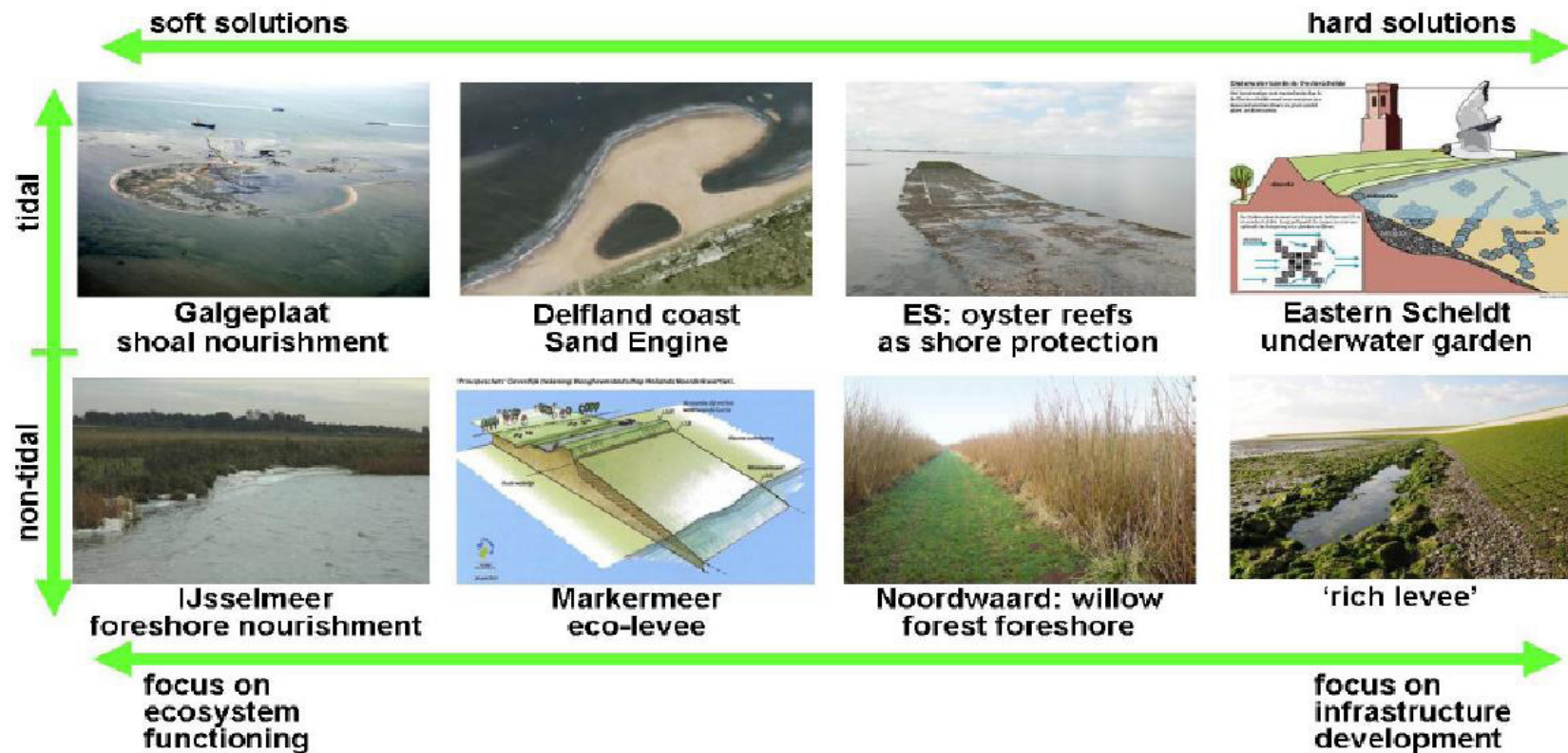
while creating new
new eco-opportunities



young dune formation



Building *with* Nature (eco-engineering)



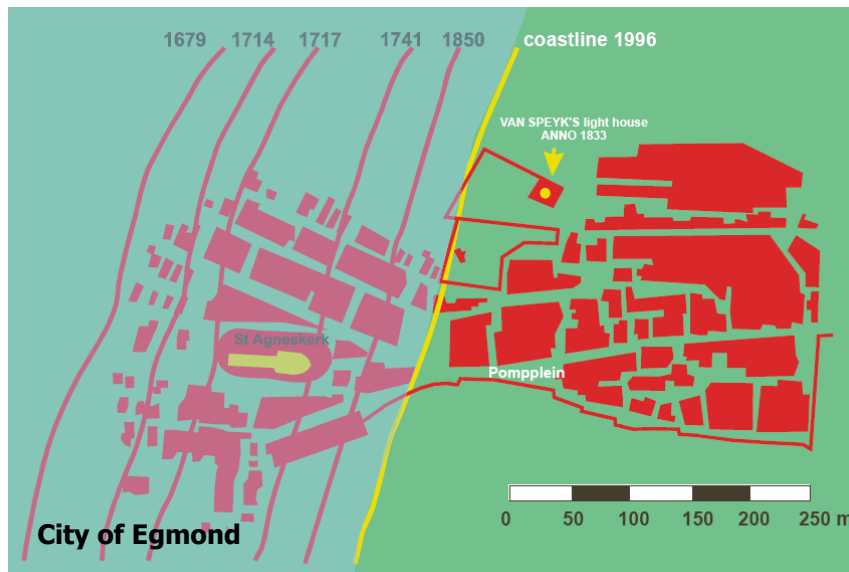


Dutch Context, coastal erosion

Shortage of natural sediment

Consequence: Structural erosion, 1996 coastline fixed

Solution: Nourishments





Development of nourishment strategy

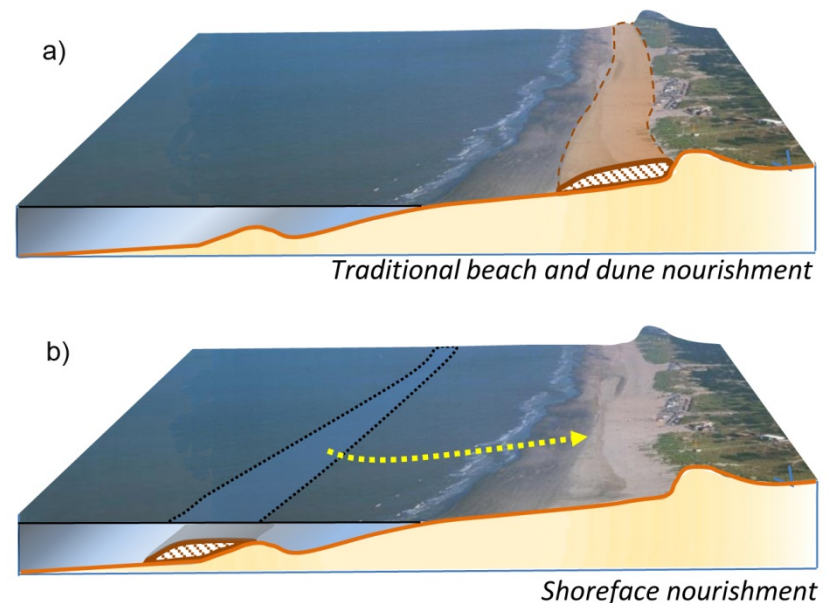
Increase in volume

Annual added sand volumes:

- Since 1990: 6 mln m^3/yr
- Since 2001: 12 mln m^3/yr

Prospect future : 40-85 mln m^3/yr !!

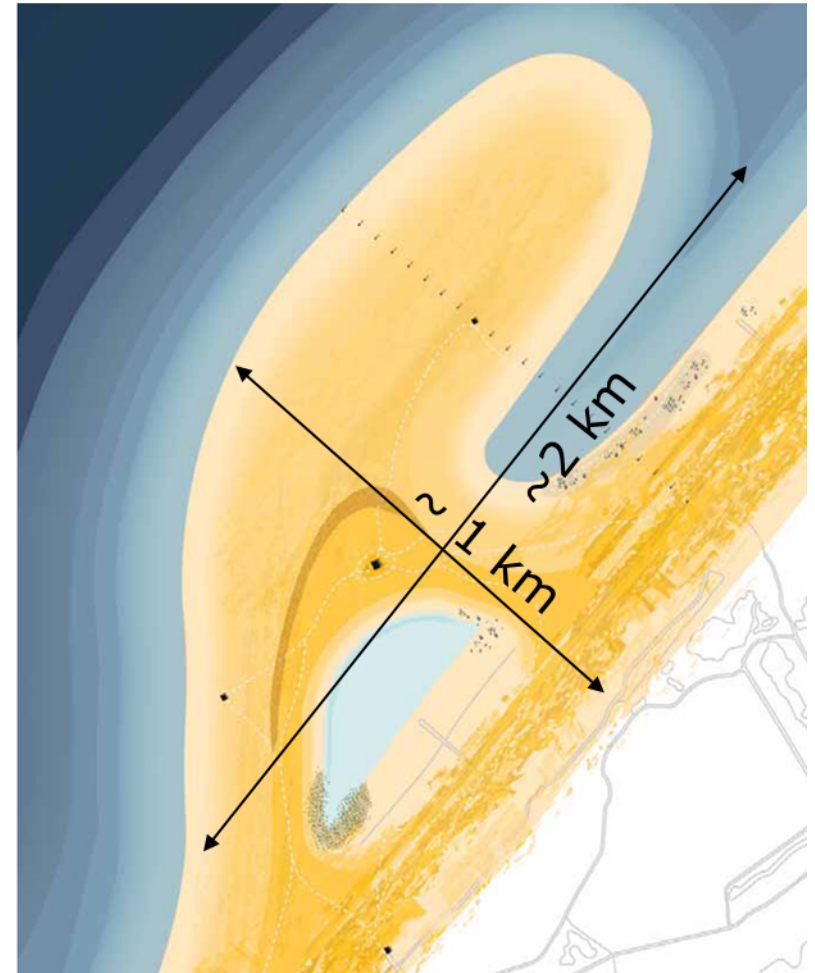
Change in design





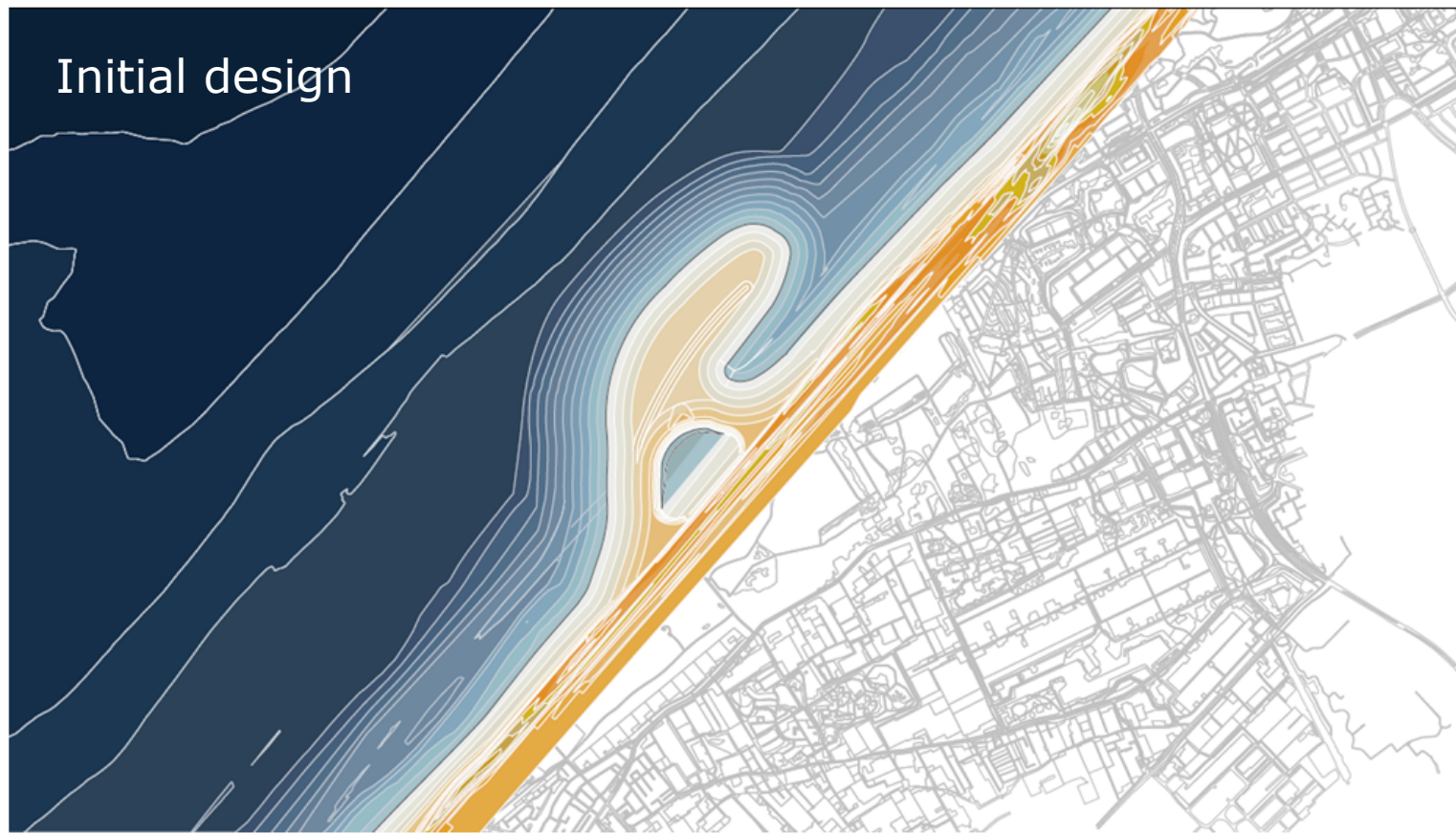
The Sand Engine

- 70 M Eur, 21 M m³ of sand
- enhanced safety against flooding
 - first: wave attenuator; later: wider dune buffer
- cheaper per m³ compared to traditional nourishments
- longer period between nourishments
- recreation potential
 - swimming, surfing, beach recreation





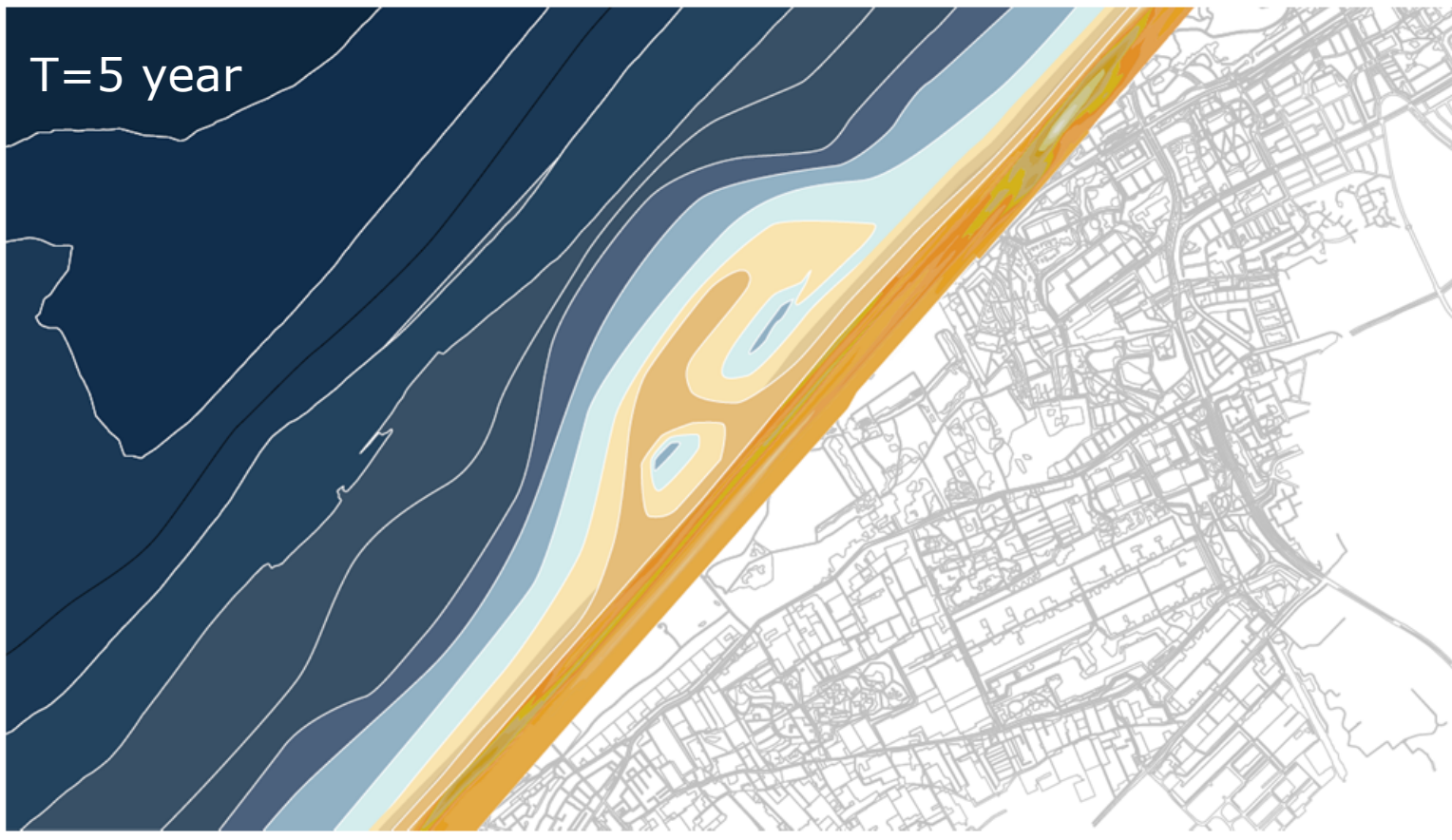
Deltares (Delft3D) numerical model forecast





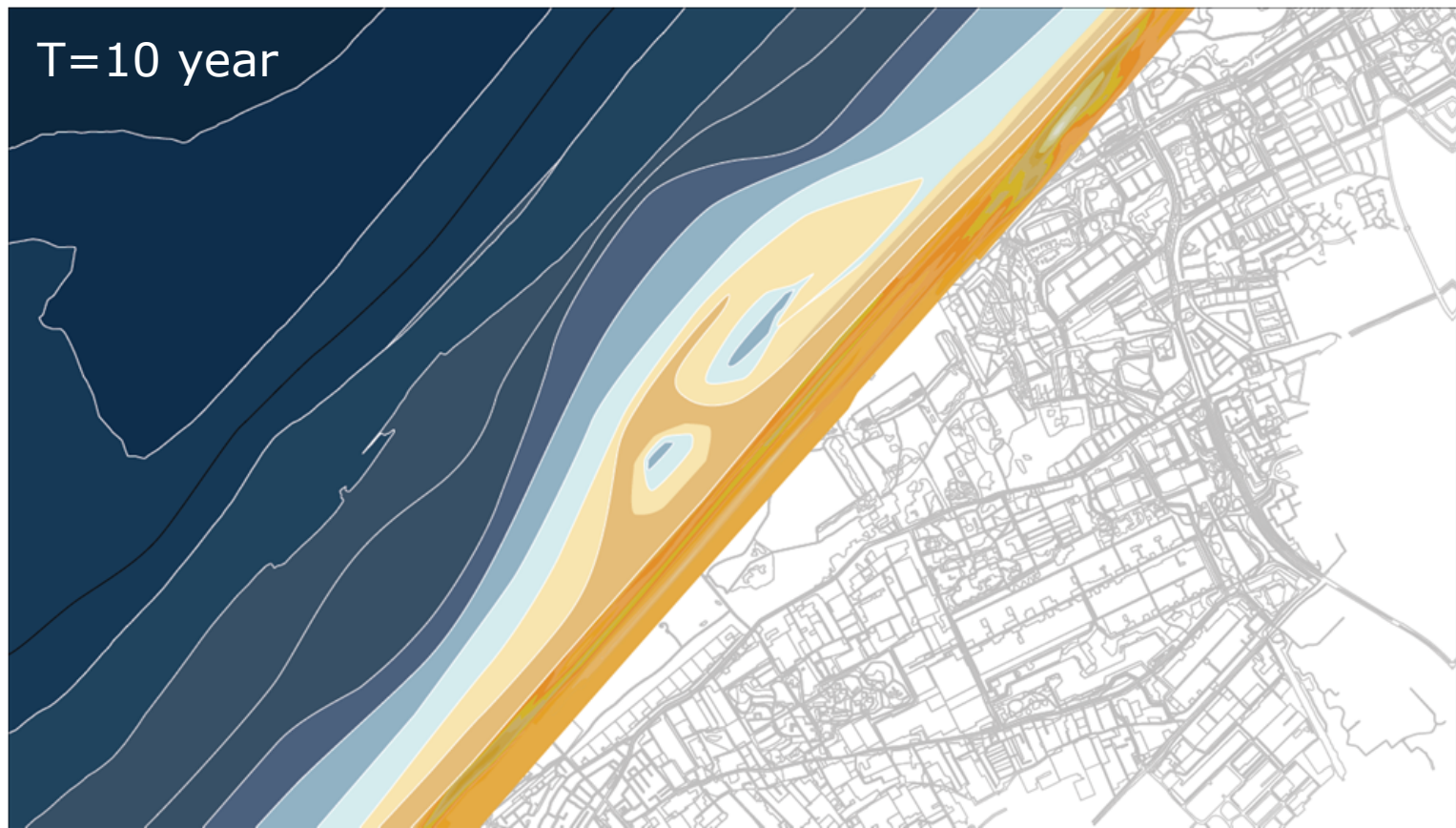
Predictions morphological behavior

Deltares (Delft3D) numerical model forecast



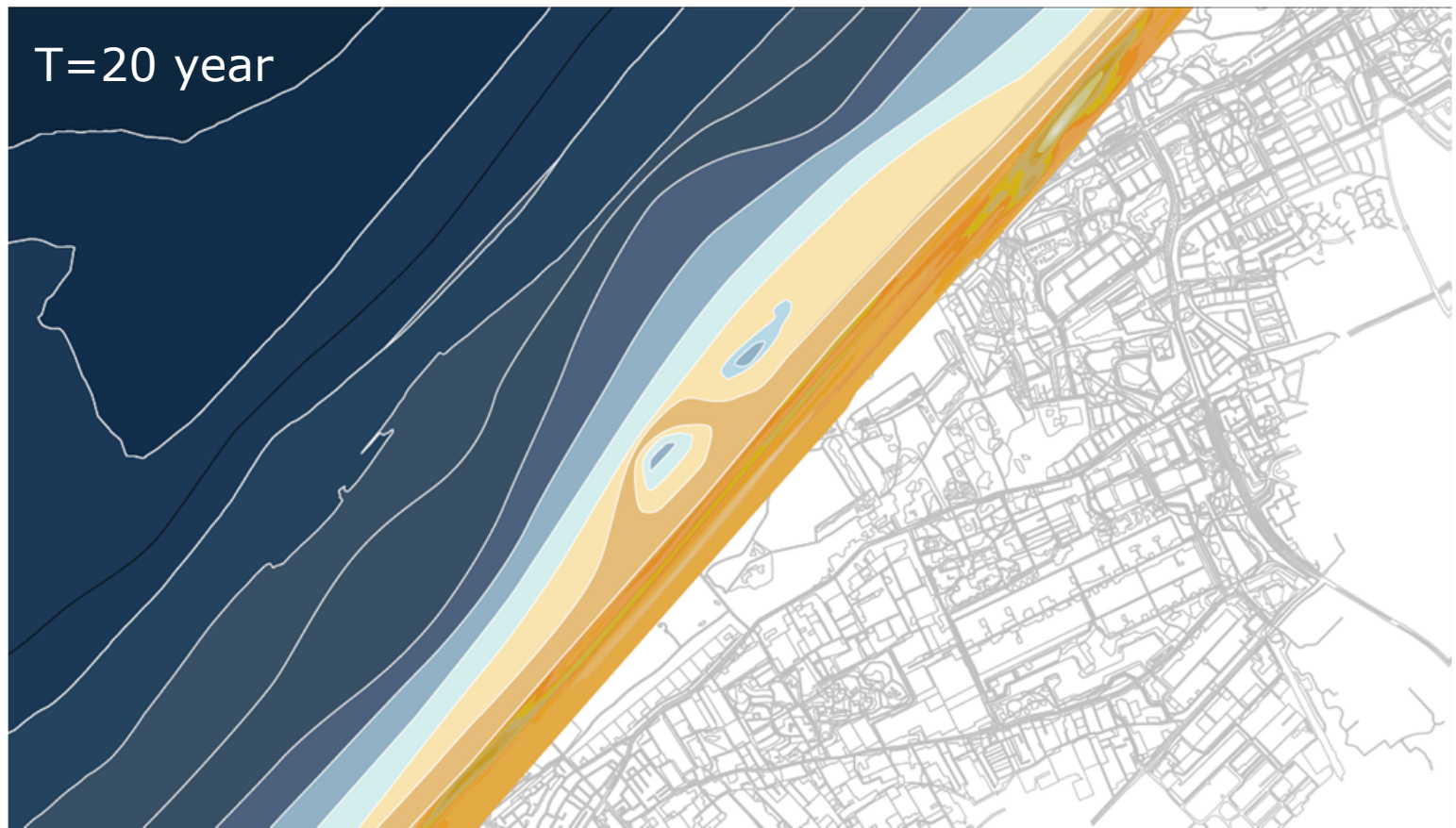


Deltares (Delft3D) numerical model forecast





Deltares (Delft3D) numerical model forecast





Constructed peninsula





Oct. 2011, after 3 months



Deltacommissaris



Jan. 2012, after 6 months





July. 2012, after 1 yr





July. 2013, after 2 yrs



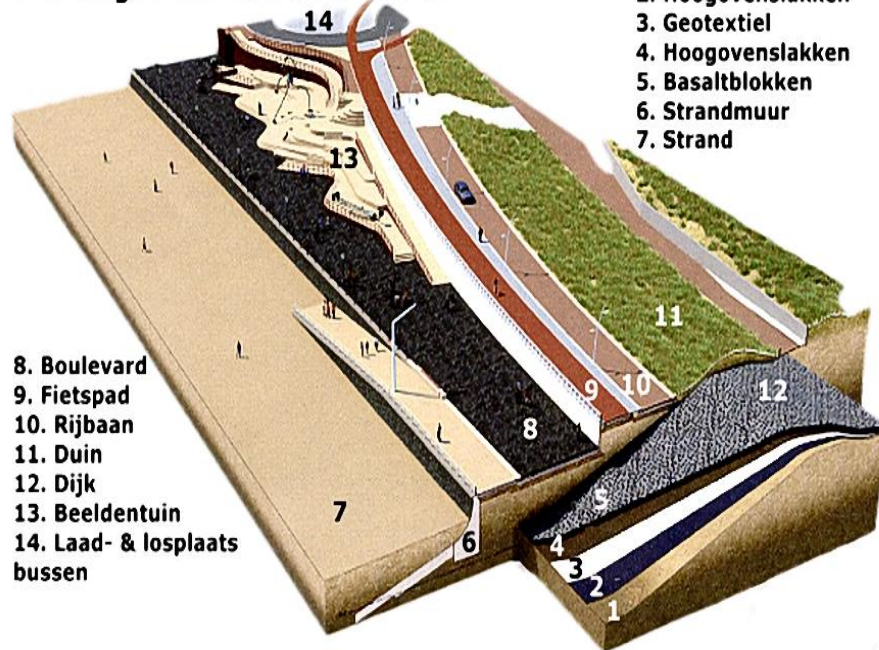
Deltacommissaris



Scheveningen Boulevard (7km / 4m)

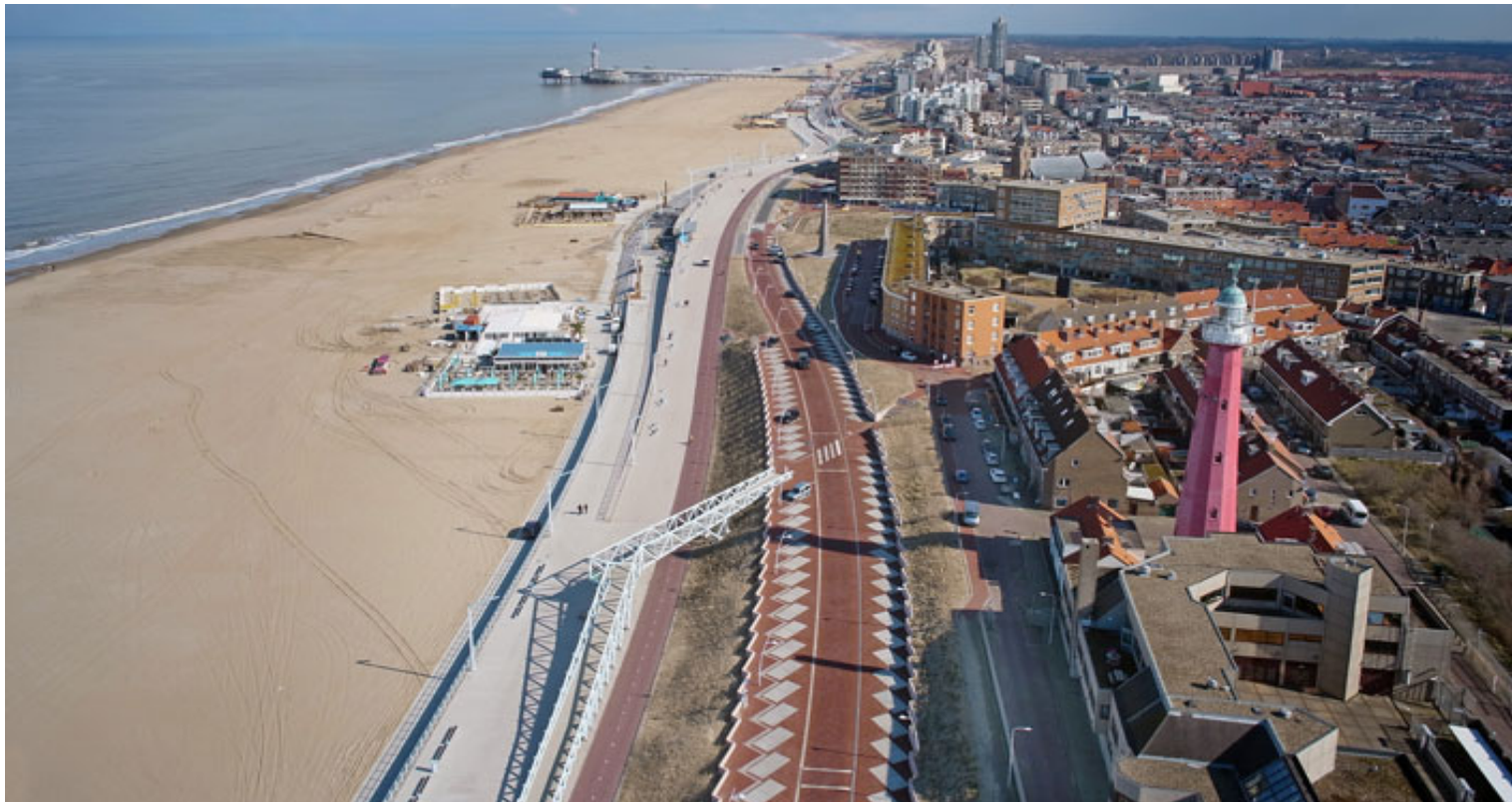
raise protection to standard (1,10000), 2006 “weak link”
don't disrupt commerce /use
improve urban amenity

De dijk-in-boulevard





Infra on sea-side of dike removable / collapsible









Katwijk



bosch slabbers



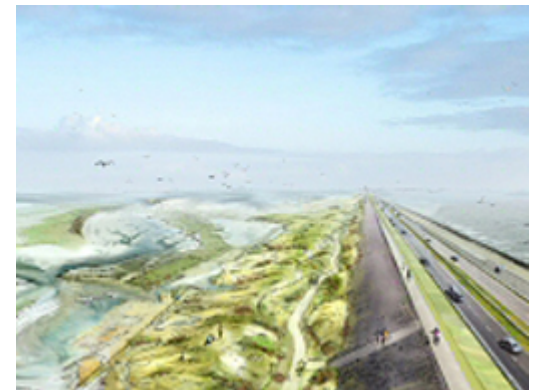
bosch slabbers





Renovated *Afsluitdijk* (20m km enclosure dike)

80+ years old, renovate (lift) and improve functionality
300 mln euro, improve top and sides, no regret additions
safety until 2050, probably until 2100
Green infra on both sides (higher safety + eco services)





Coastal Threat: We're safe!

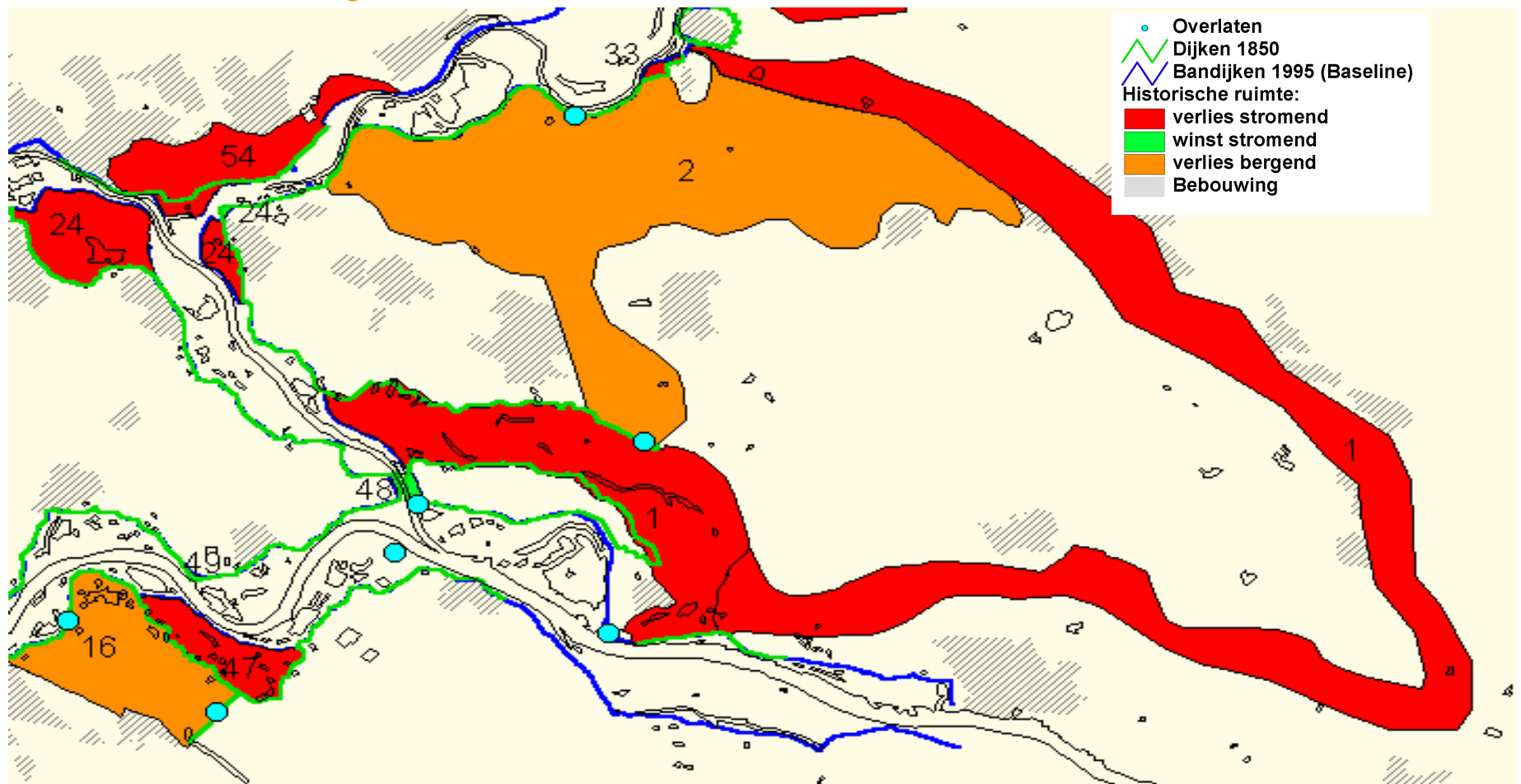


1993 / 1995: the wolf at the back door





restriction of discharge capacity
loss of flood storage areas



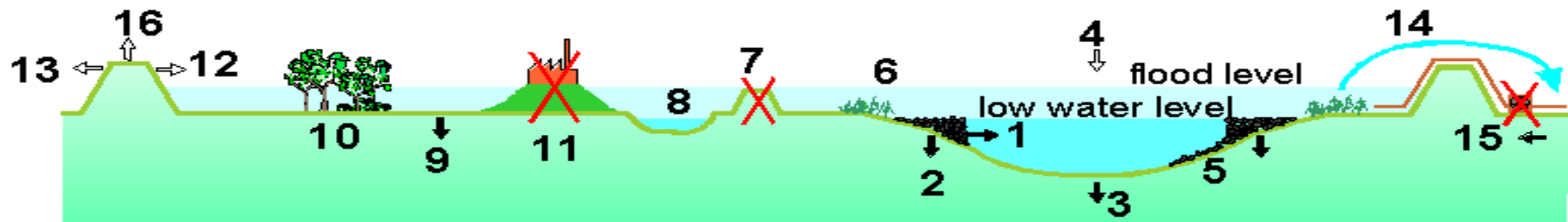


Room for the River: 2006 - 2015

- Design discharge increase: 15,000 m³/s to 16,000 cms (possibly 18/20,000 m³/s)
- Continual heightening / reinforcing dikes is costly, unsustainable, and increases overall risk. Dike heightening only as a last resort
- \$3 billion, 35 projects: urban, agricultural/rural, wetland restoration
- Equal goals: flood risk reduction *and* spatial quality enhancements
- Driven by local stakeholders + modelling tools: “what do you want?”
- From *flood resistance* to *flood accomodation*



Instead of raising levees:



Flood reduction by:

2 - lowering groynes

3 - deepening main channel

7 - removal embankments

8 - side channels

9 - lowering floodplain

10 - changing vegetation

11 - removal of obstacles

13 - displacement main river dike

14 - retention behind dike

15 - stopping lateral inflow





▲ huidige situatie



▲ belangrijkste ingrepen



▲ inrichtingsplan

Room for the river | IJssel River | Zutphen - Cortenoever

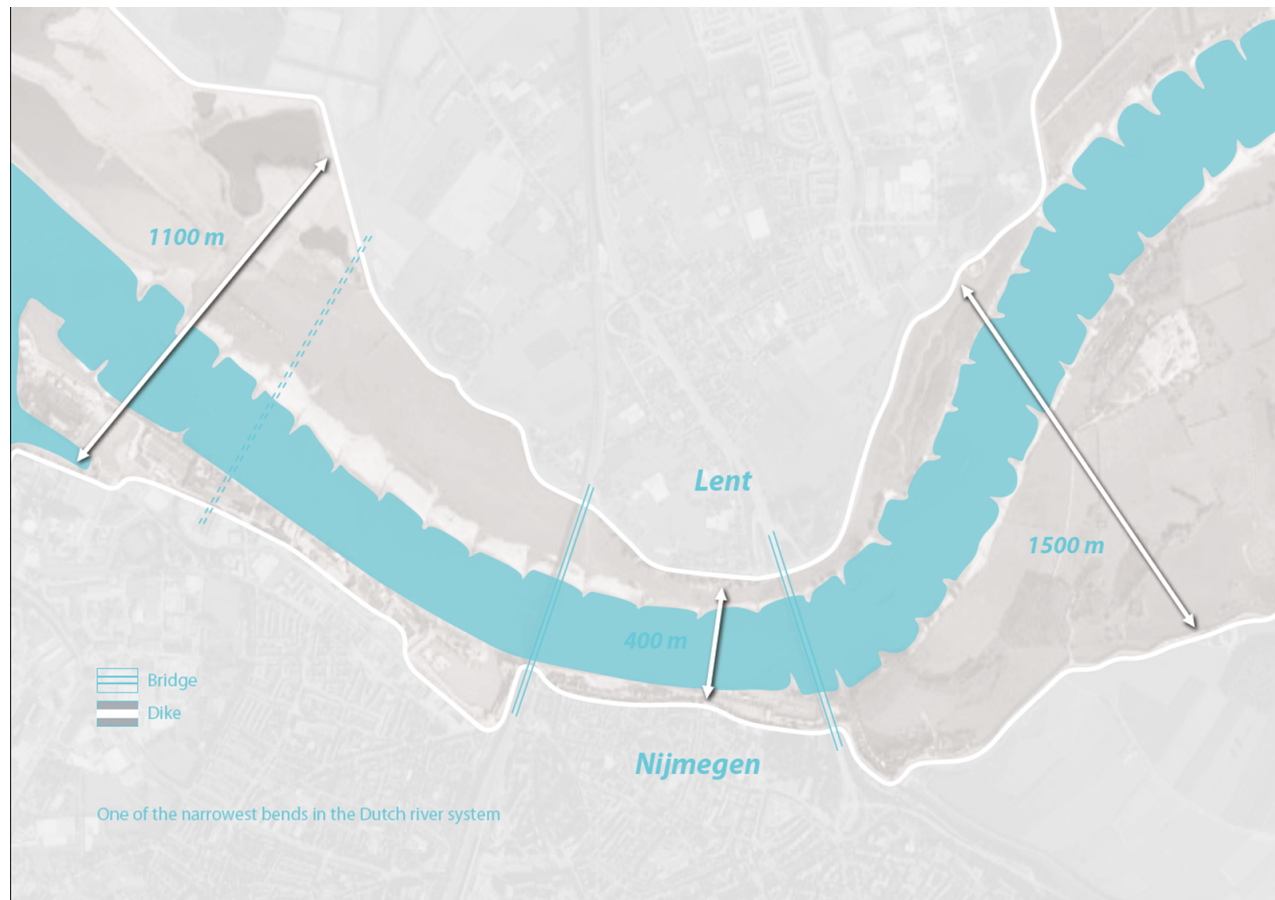


Best possible living situation in waterflooding



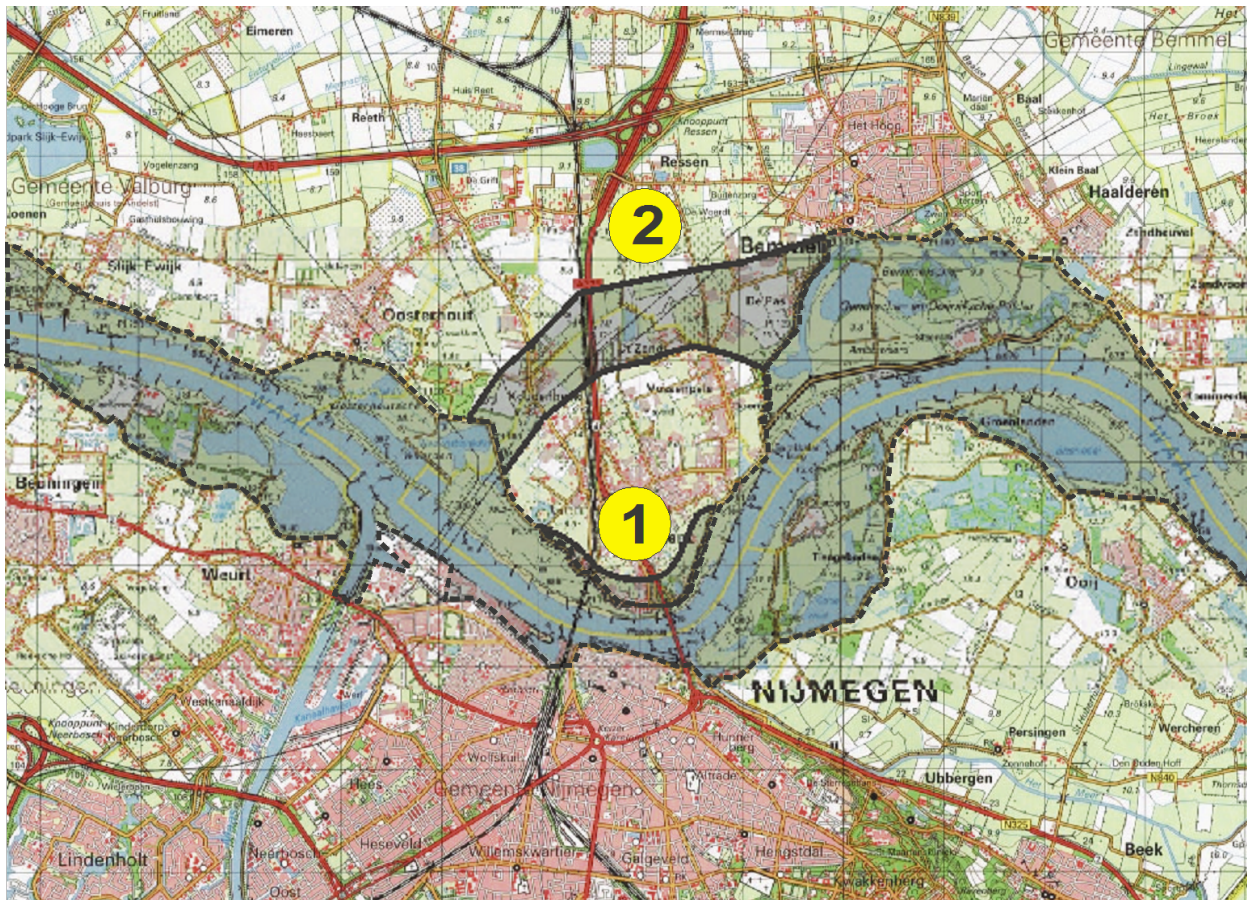


Nijmegen floodplain bottleneck





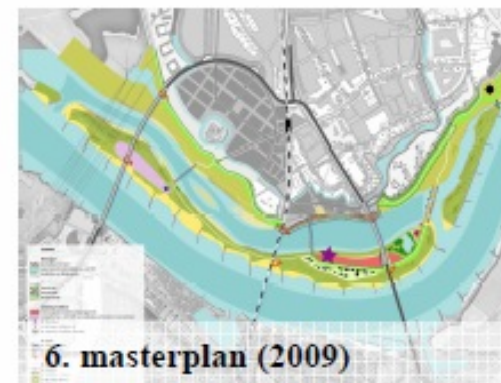
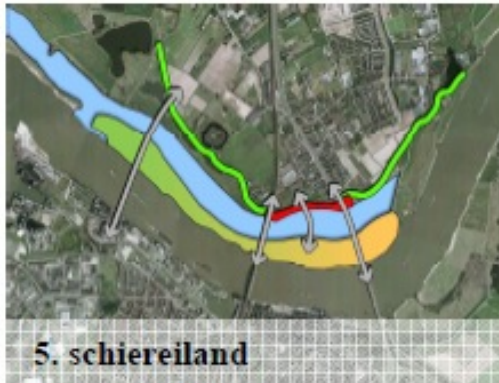
Options: bypass? Combined functions?

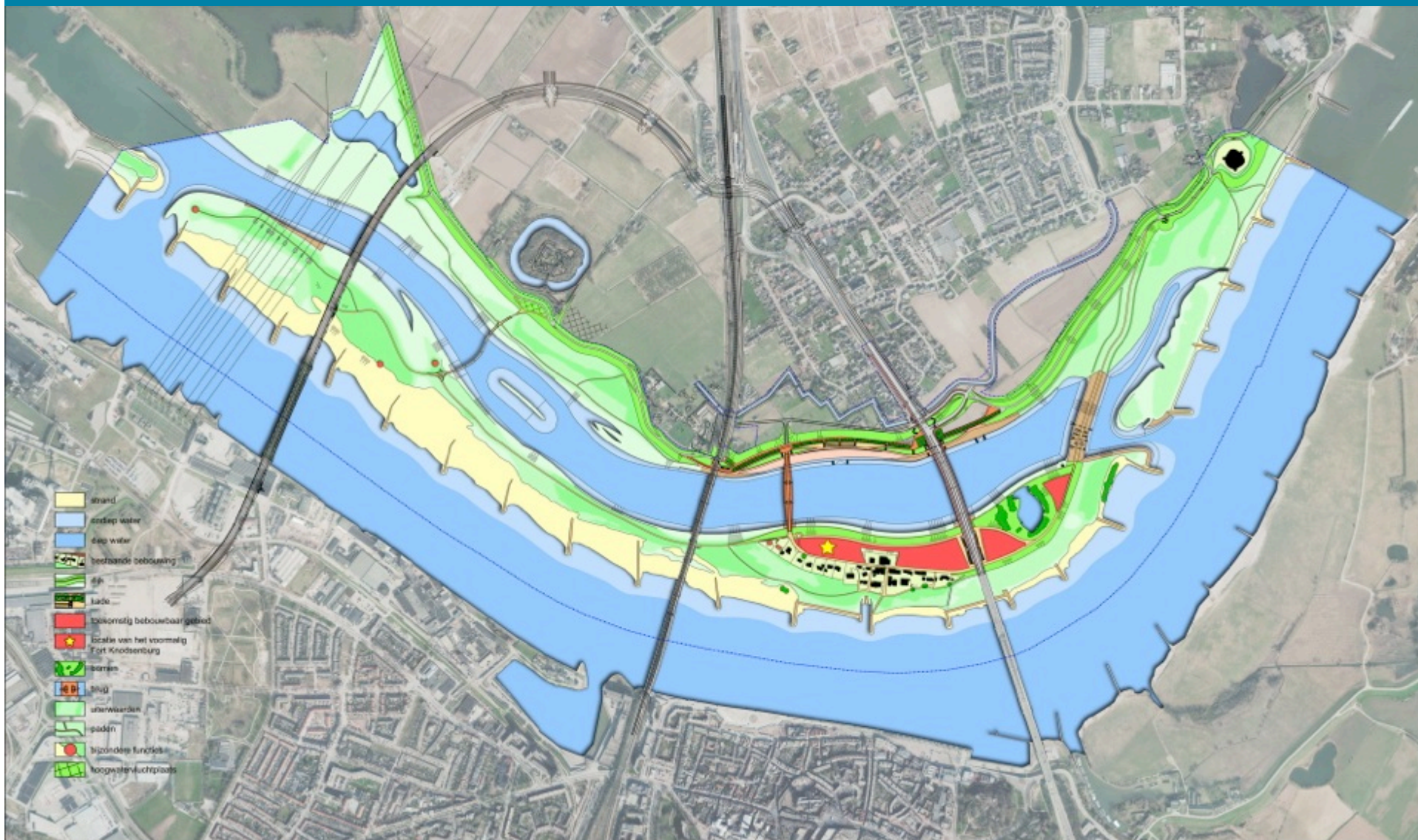


R3294 Nijmegen02



Dike set-back: safety, increased storage / flow, new development opportunities (400m euro)

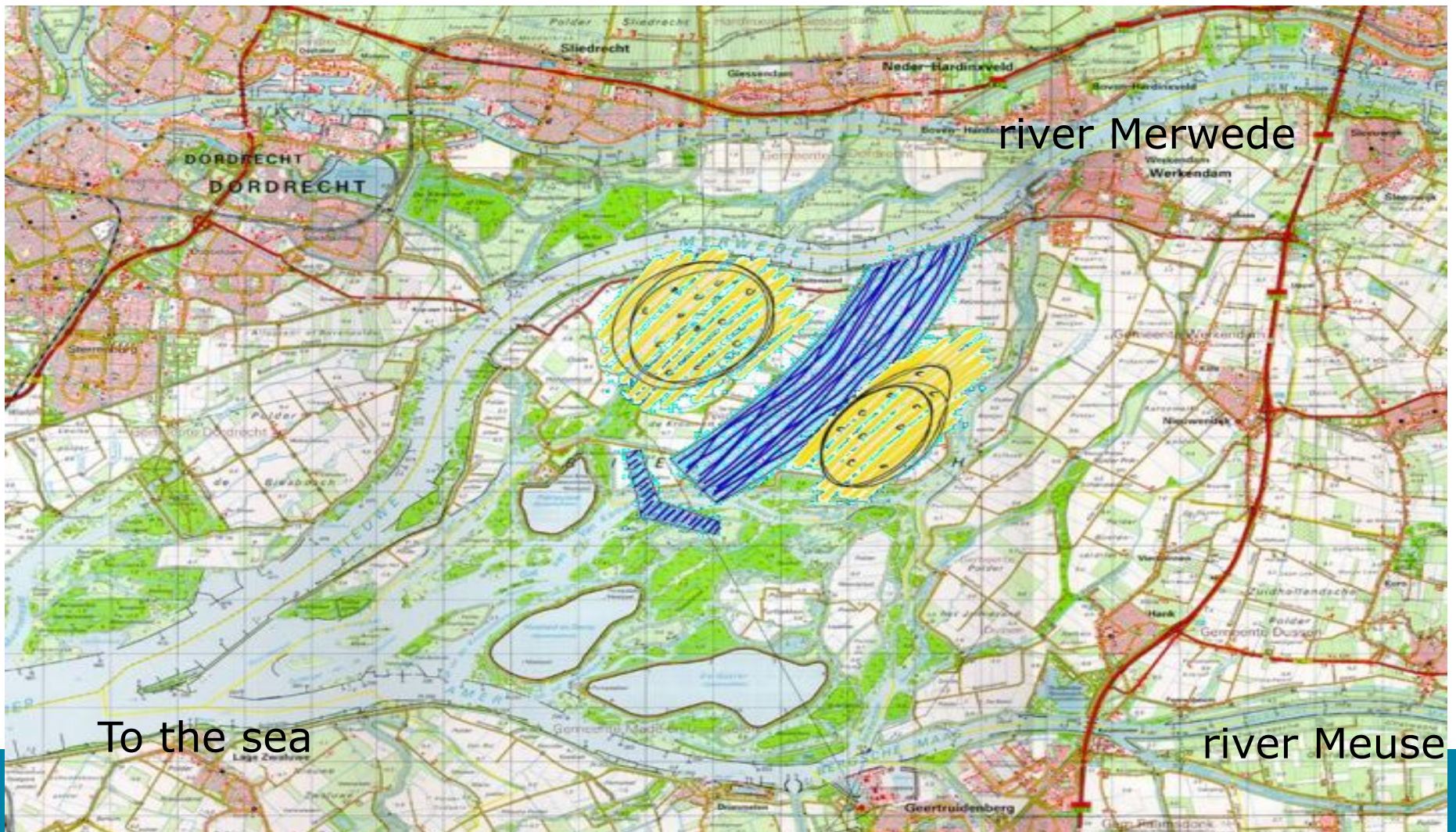








Noordwaard de-poldering (managed retreat)

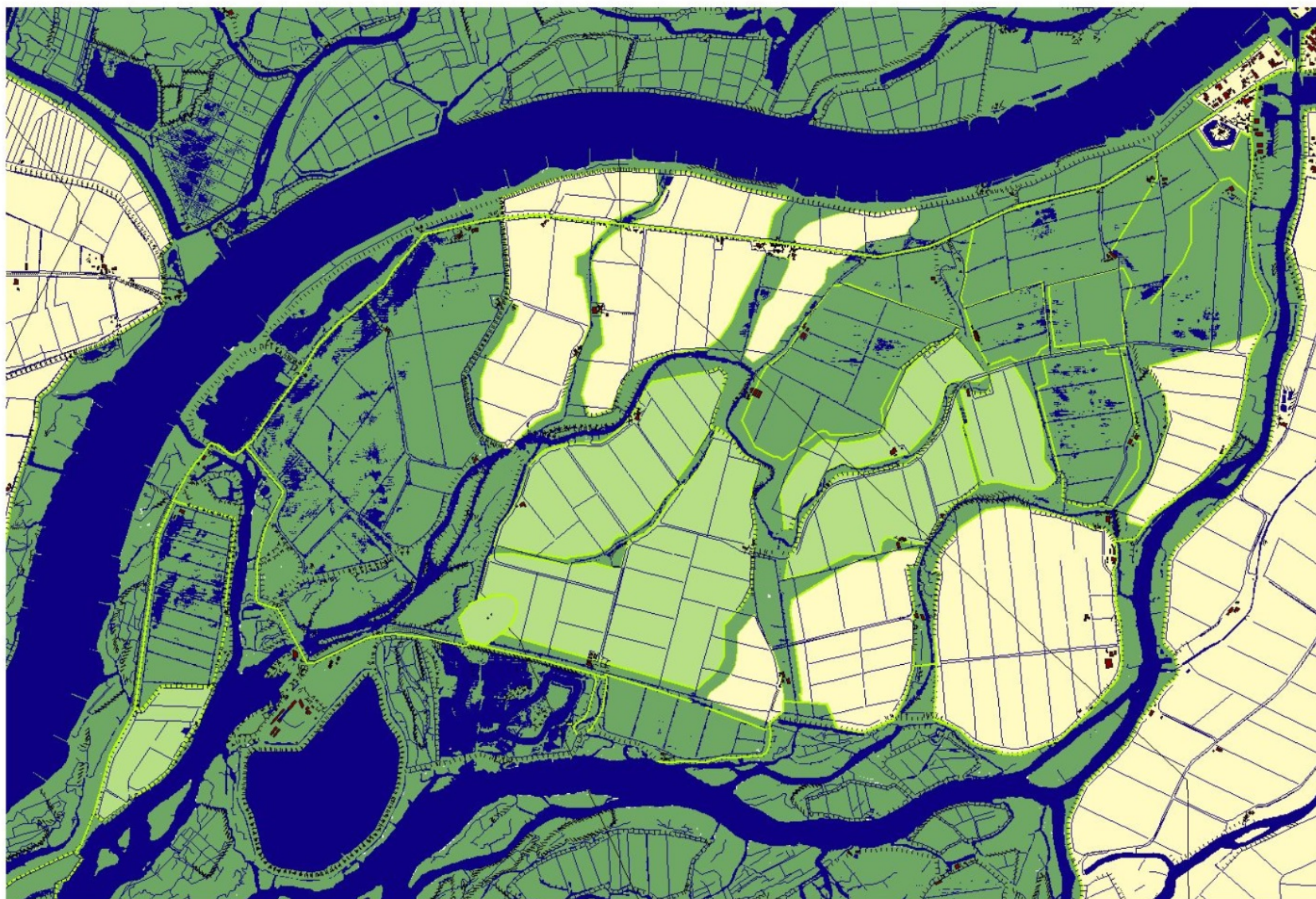




Noordwaard de-poldering: restoring the flow

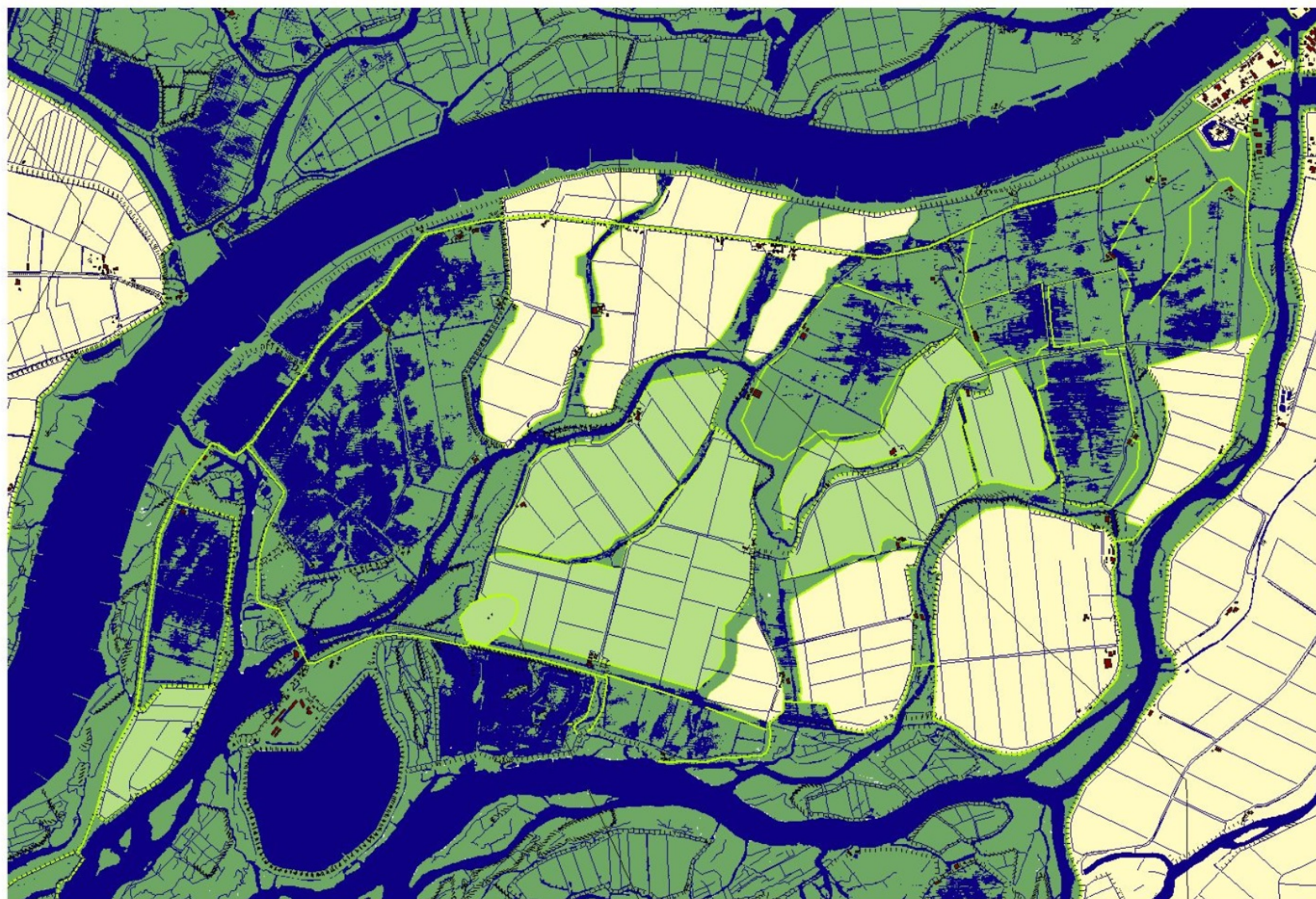
150 families (+/- 400 people), 11000 square acres





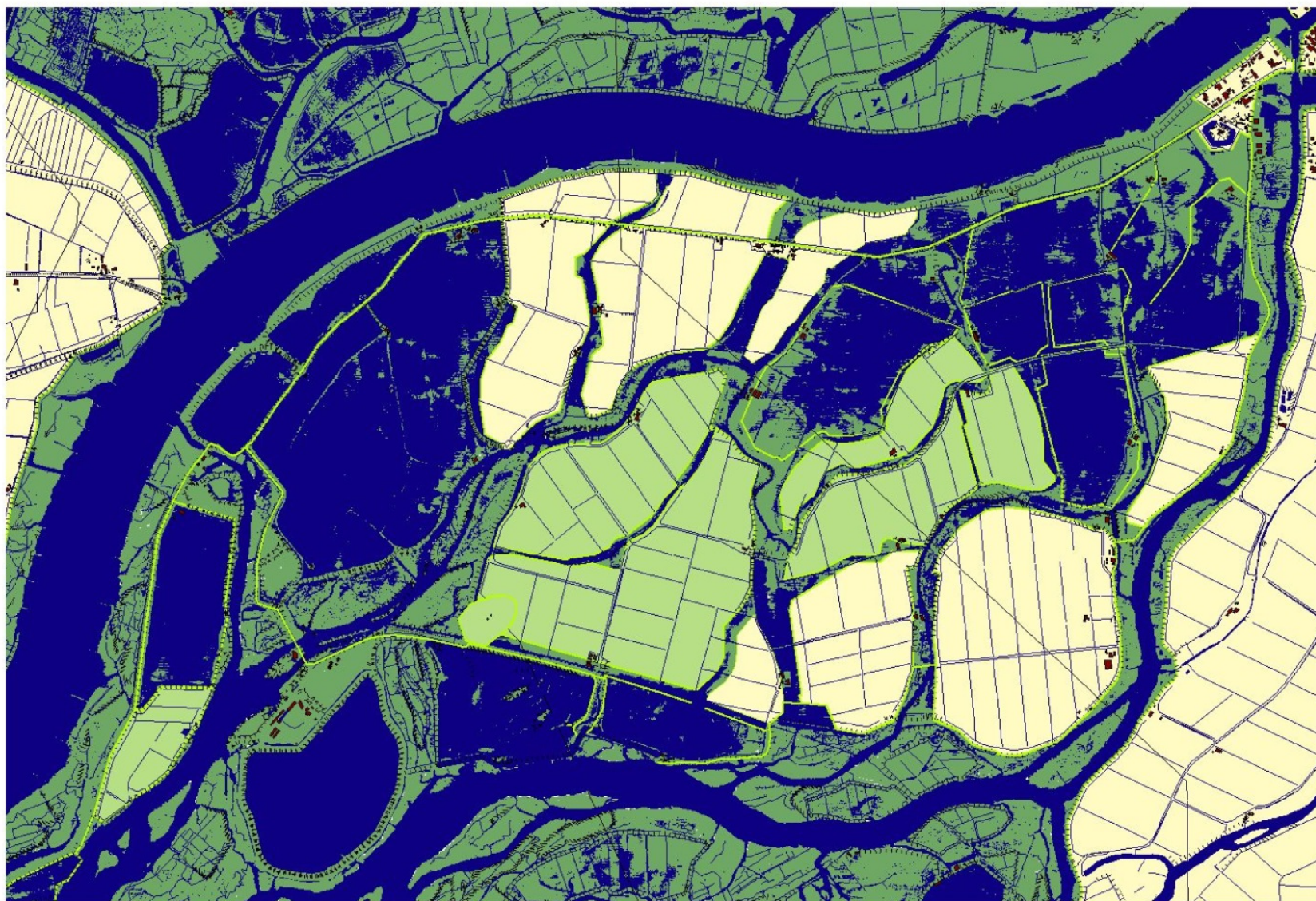
Noordwaard bij extreem laag water (0,20 m + NAP)

0 500 1000 Meters



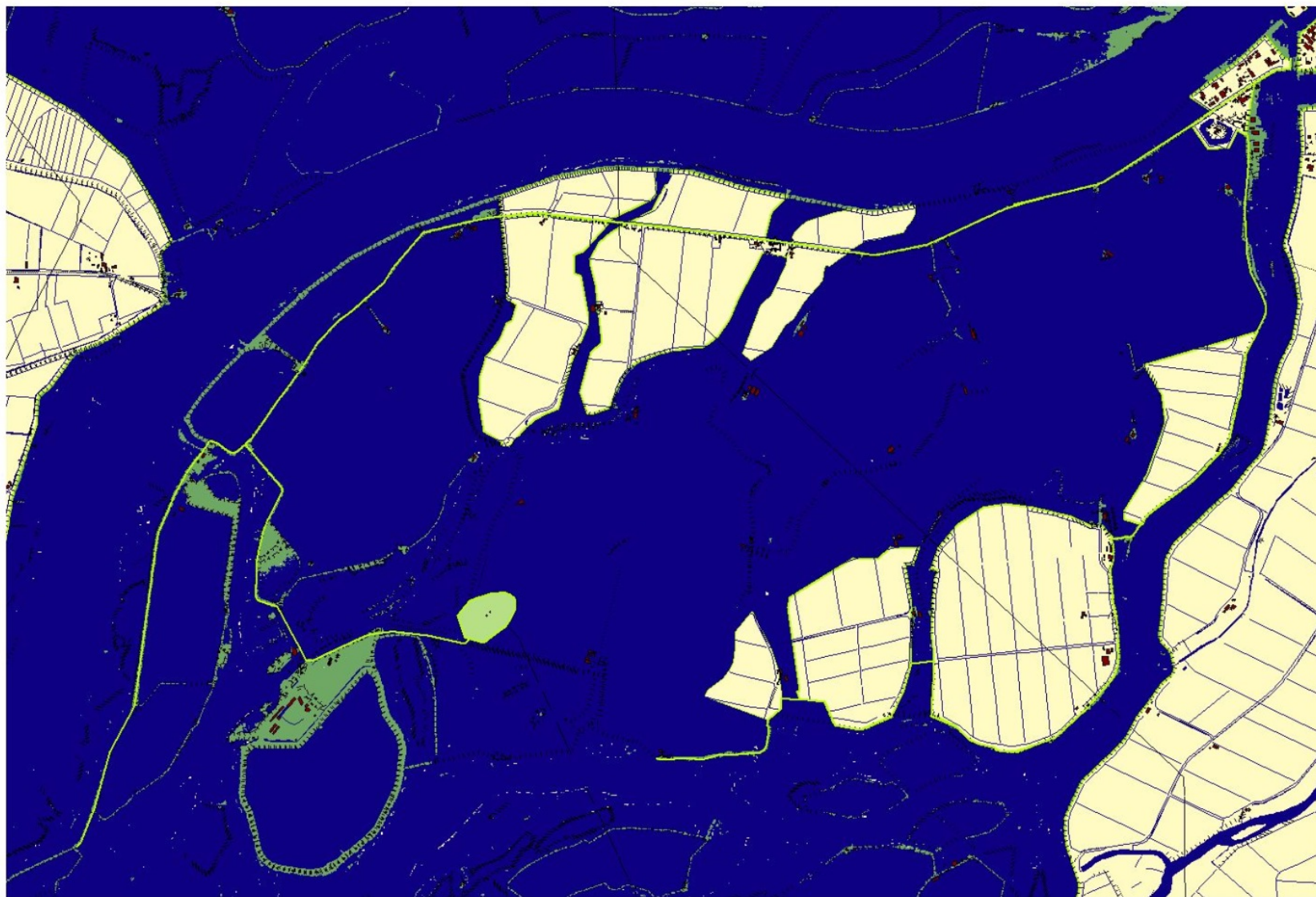
Noordwaard bij gemiddeld laag water (0,40 m + NAP)

0 500 1000 Meters



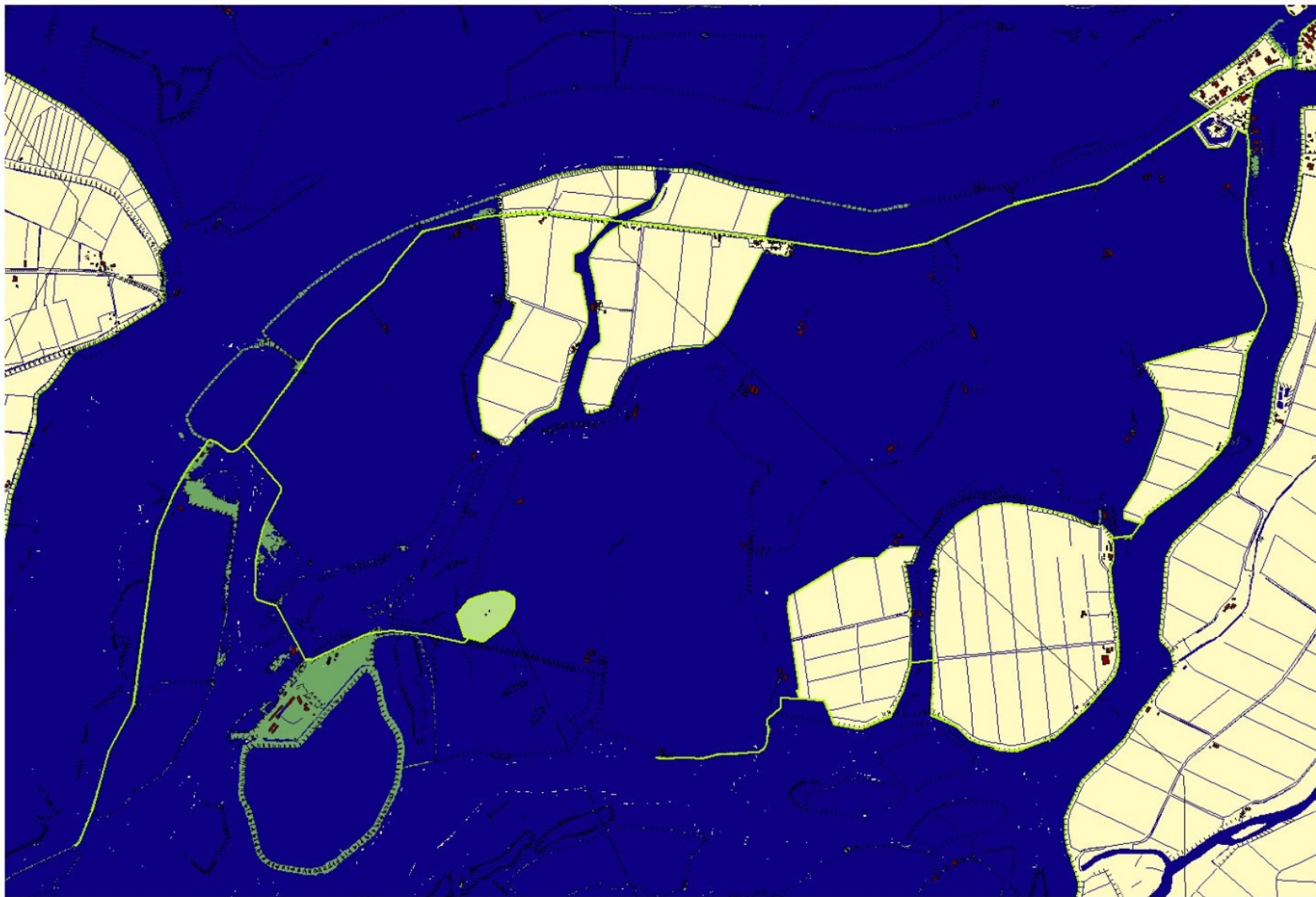
Noordwaard bij gemiddeld hoog water (0,70 m + NAP)

0 500 1000 Meters



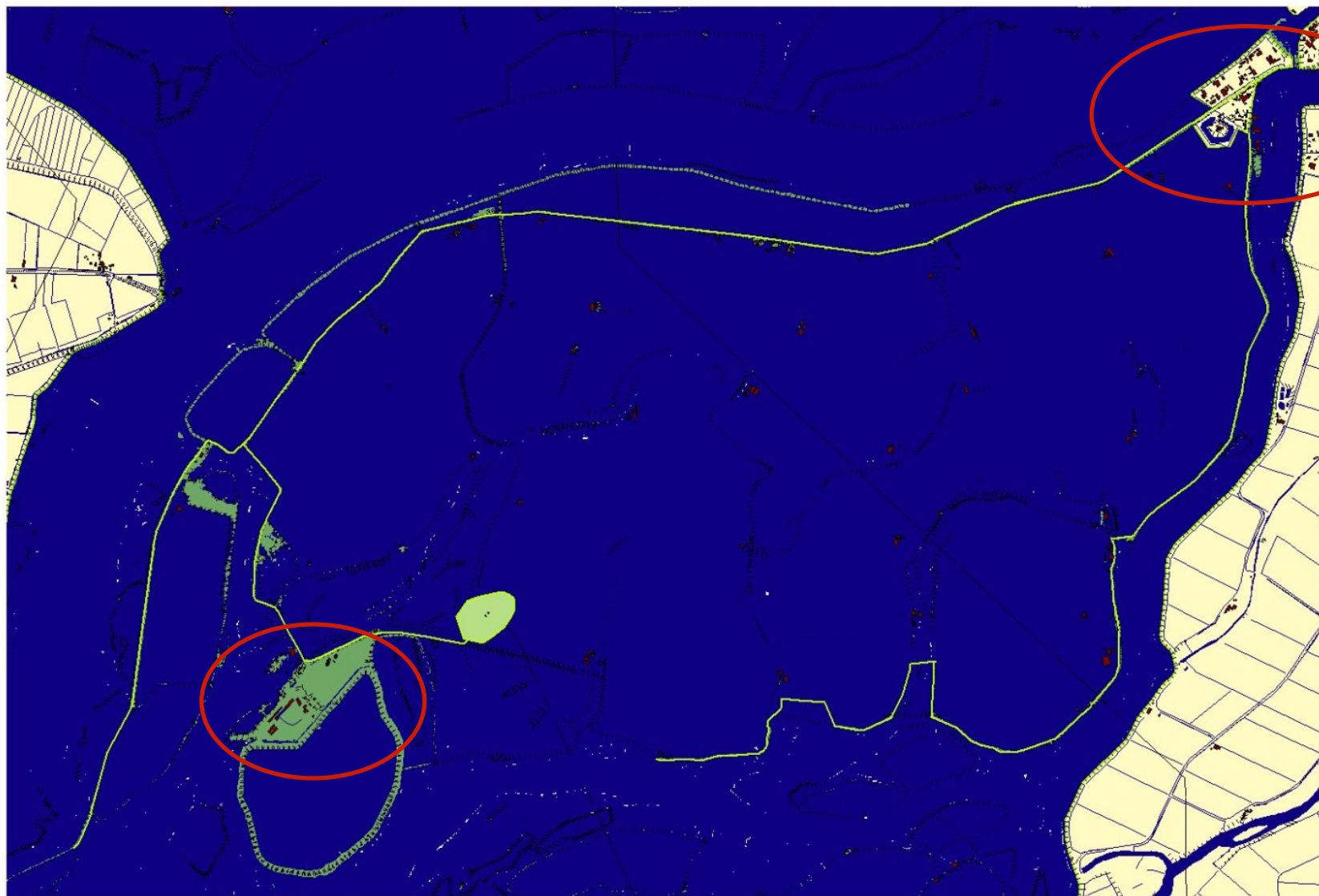
Noordwaard waterstand 1x per jaar (2,00 m + NAP)

0 500 1000 Meters



Noordwaard bij hoge waterstand (3,00 m + NAP)

0 500 1000 Meters

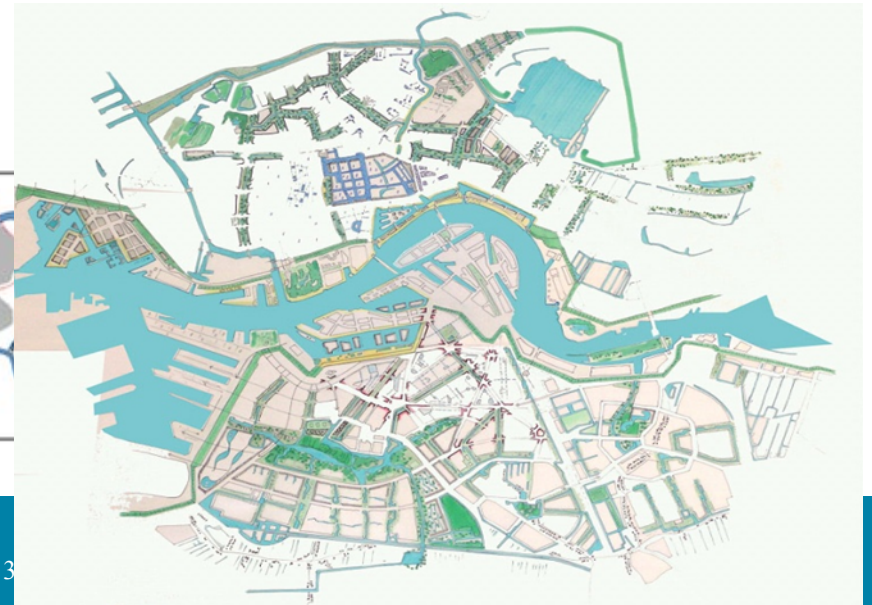


Noordwaard bij extreem hoge waterstand (3,50 m + NAP)

0 500 1000 Meters



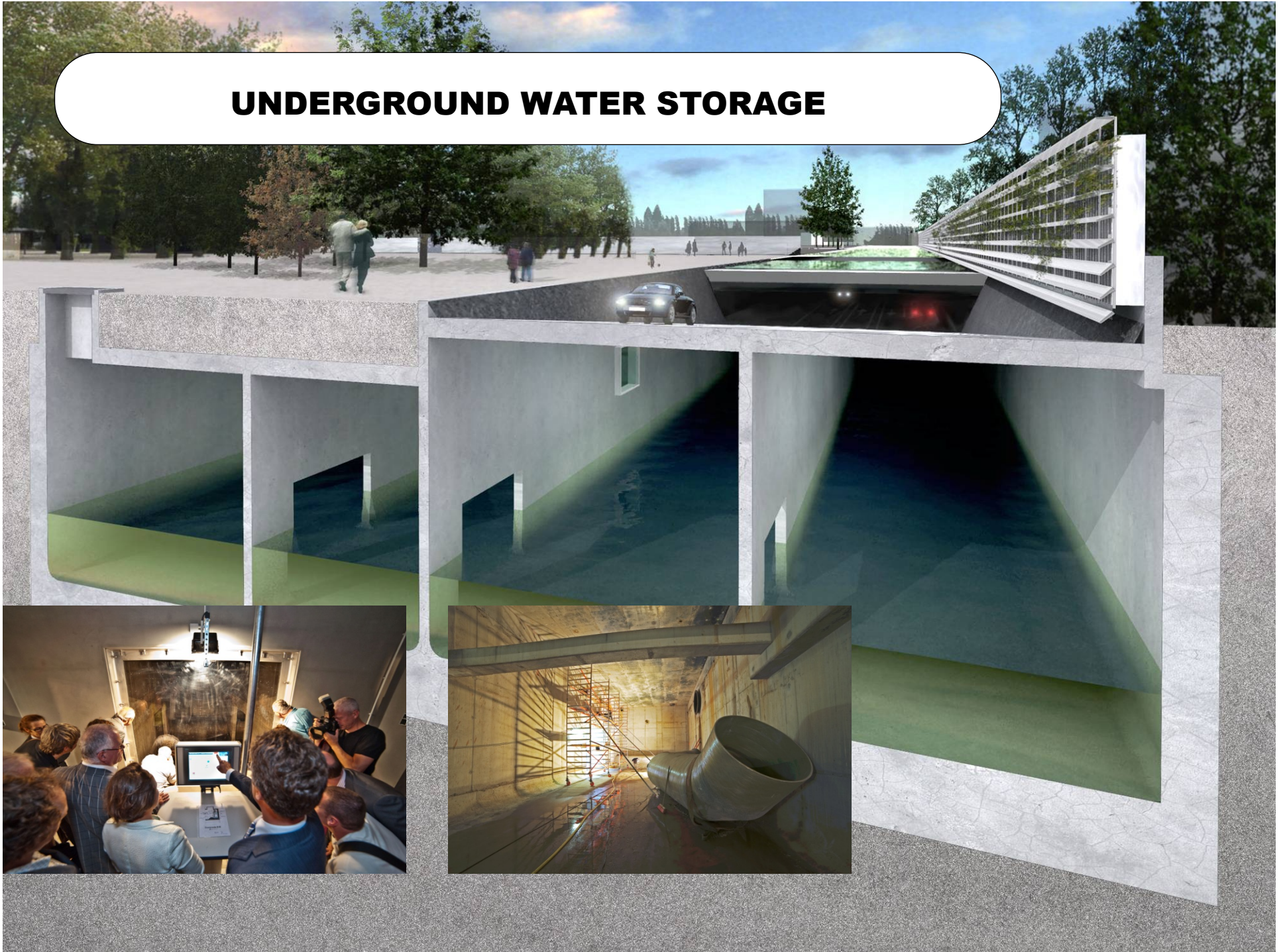
Rotterdam: 4 threats (or lemons for lemonade?)



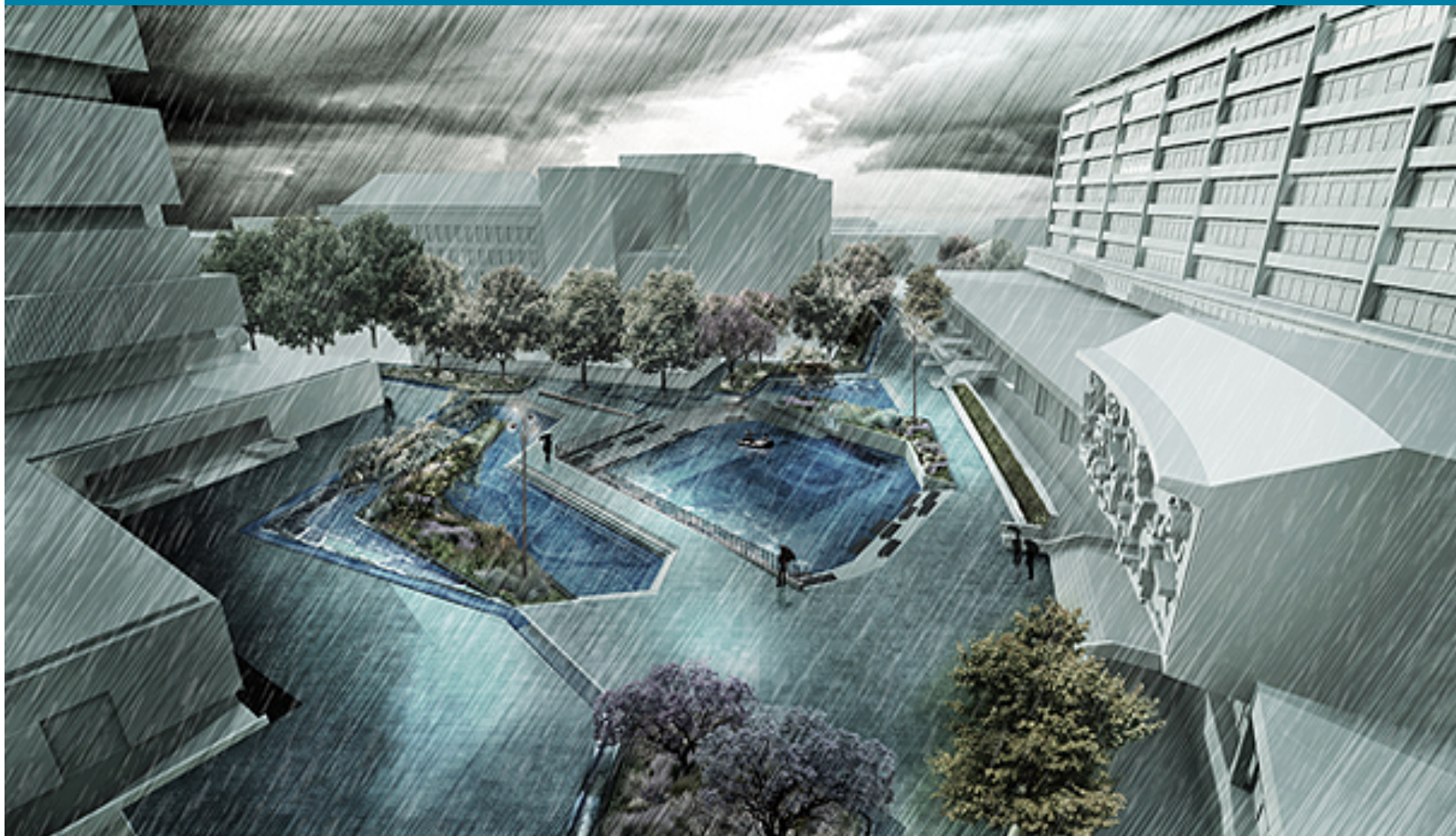
URBAN FLOODPLAIN

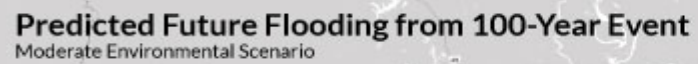


UNDERGROUND WATER STORAGE



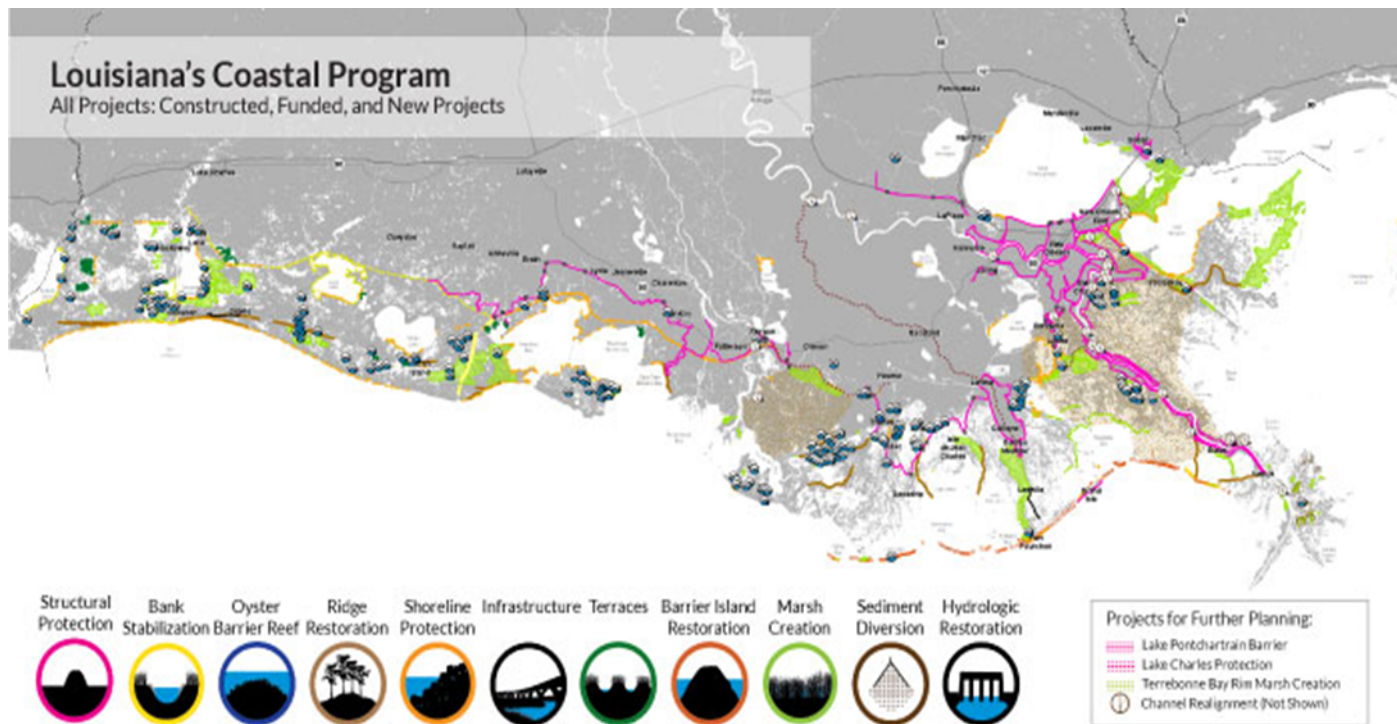






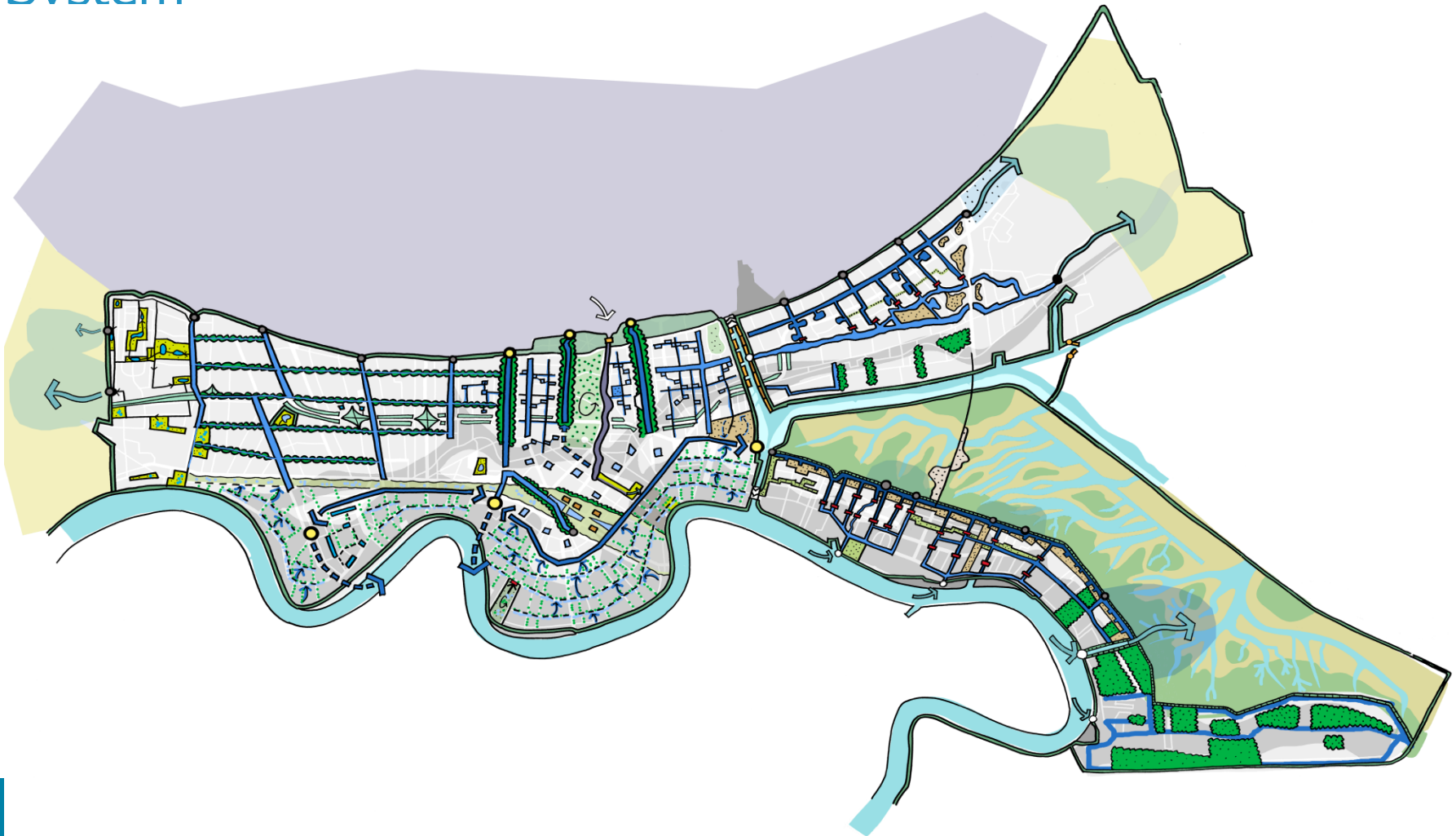


2012 Coastal Masterplan





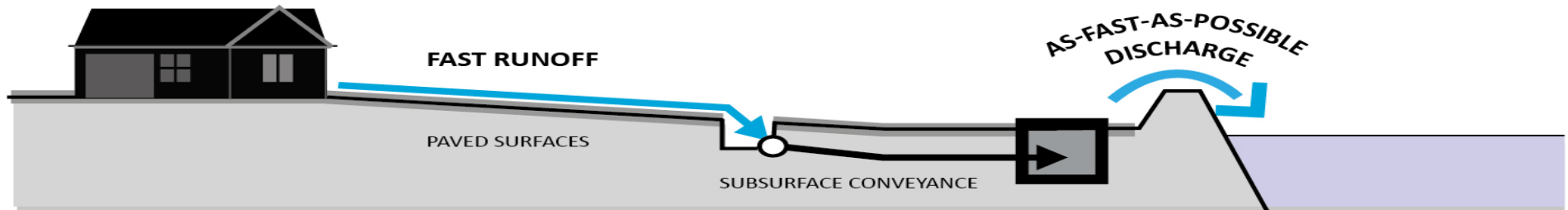
New Orleans: Urban Water Plan for a Living Water System



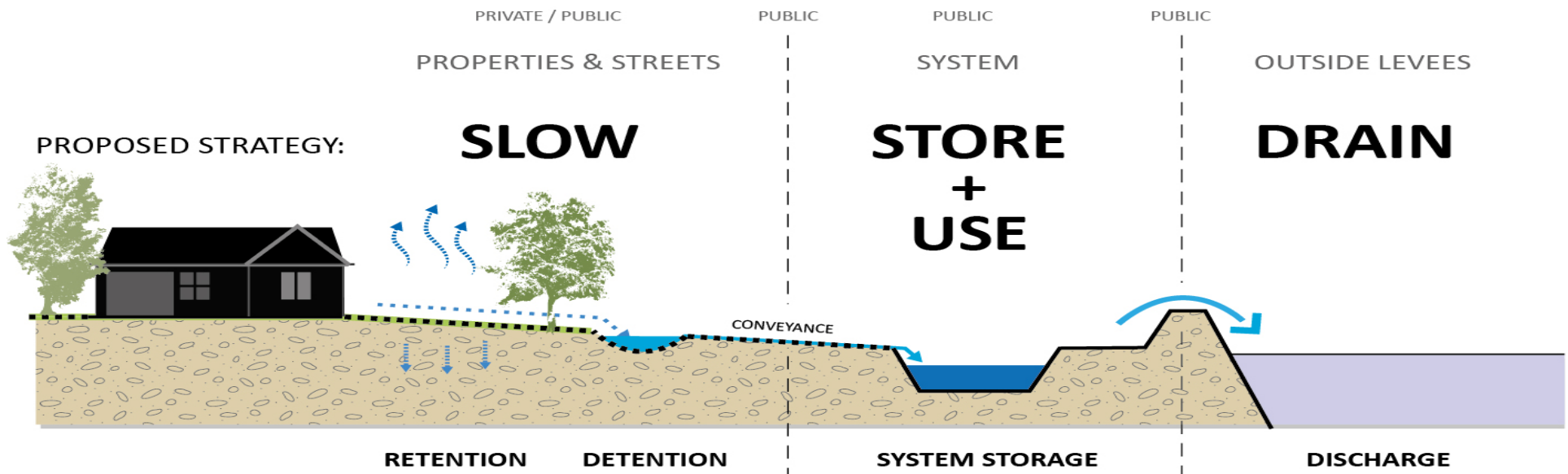


CURRENT, TECHNOCRATIC SYSTEM:

PUMP & DRAIN



PROPOSED STRATEGY:





LIVING WATER, BUOYANT LAND

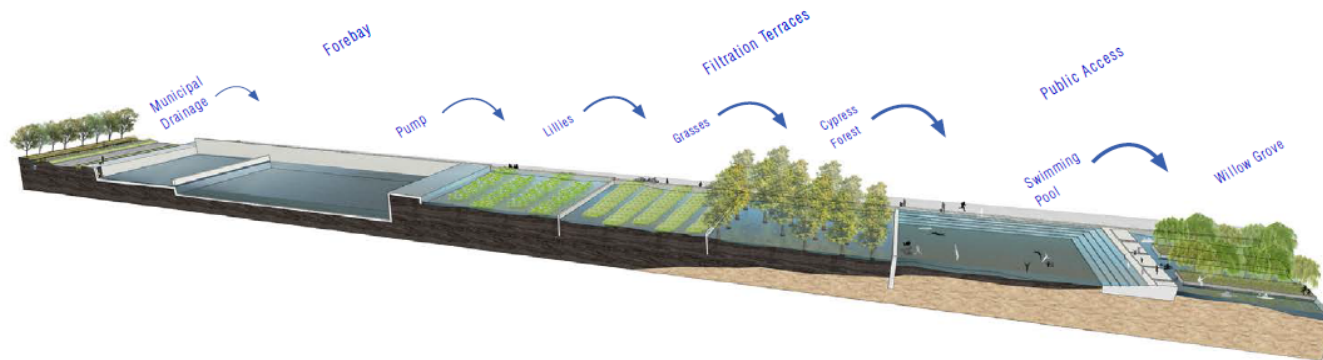
Mirabeau Water Garden



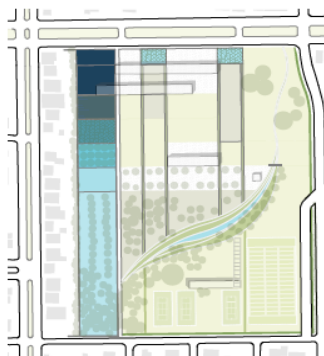


LIVING WATER, BUOYANT LAND

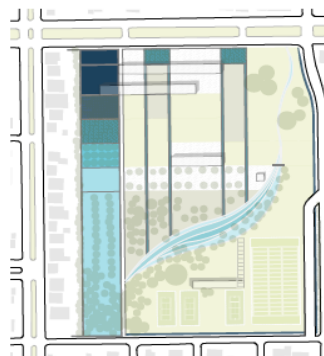
Mirabeau Water Garden



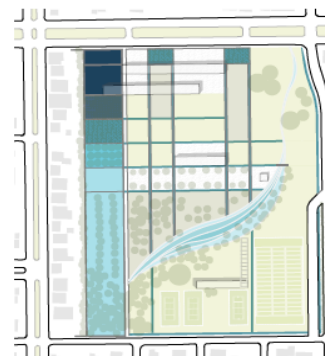
DRY CONDITION



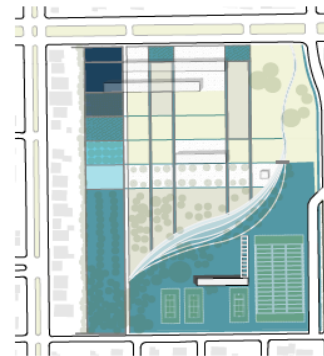
LIGHT RAIN EVENT

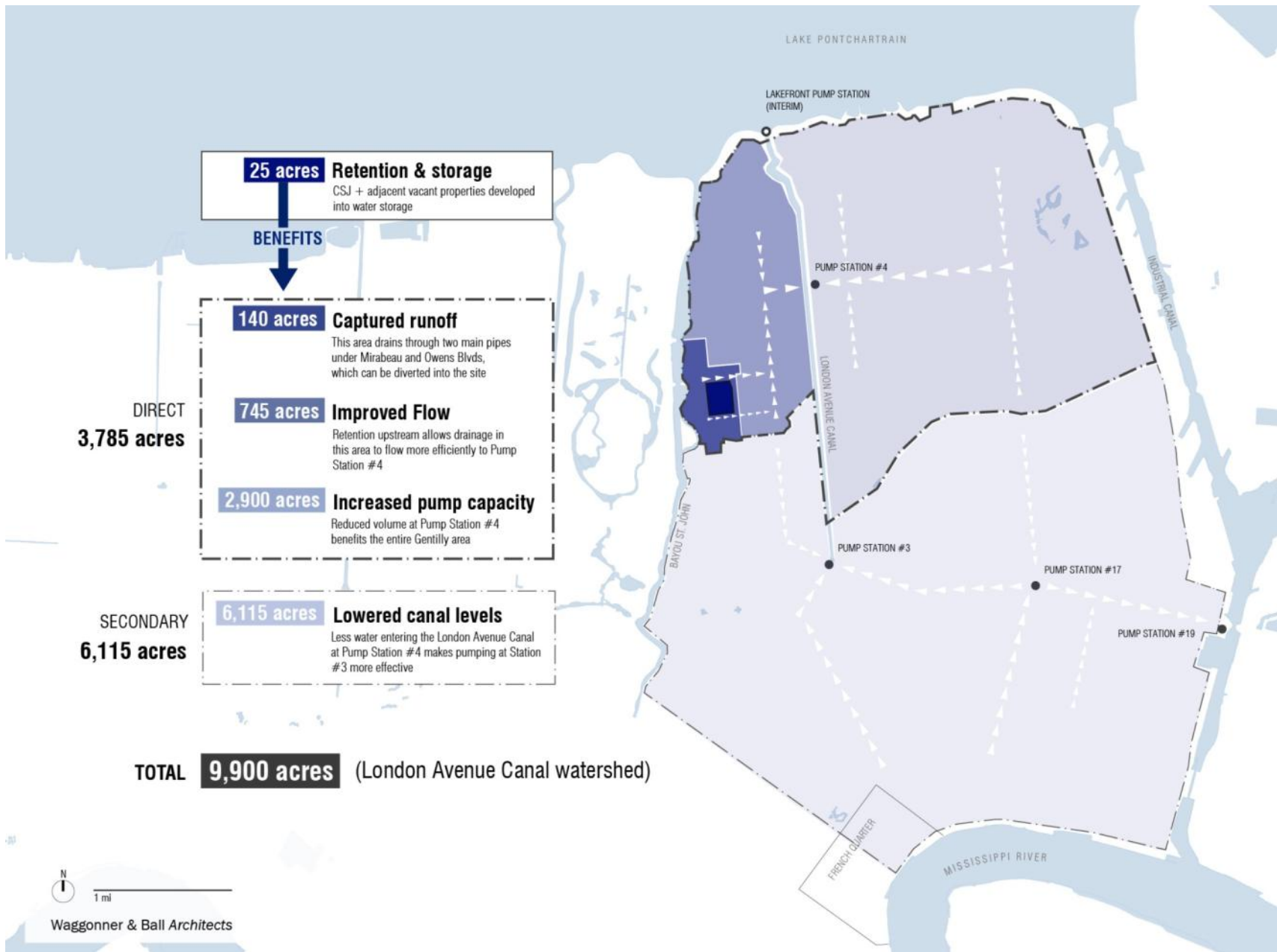


AVERAGE RAIN EVENT



EXTREME RAIN EVENT





FILMORE DRAINAGE IMPACT



Greater New Orleans Water Management Strategy



LIVING WATER, BUOYANT LAND

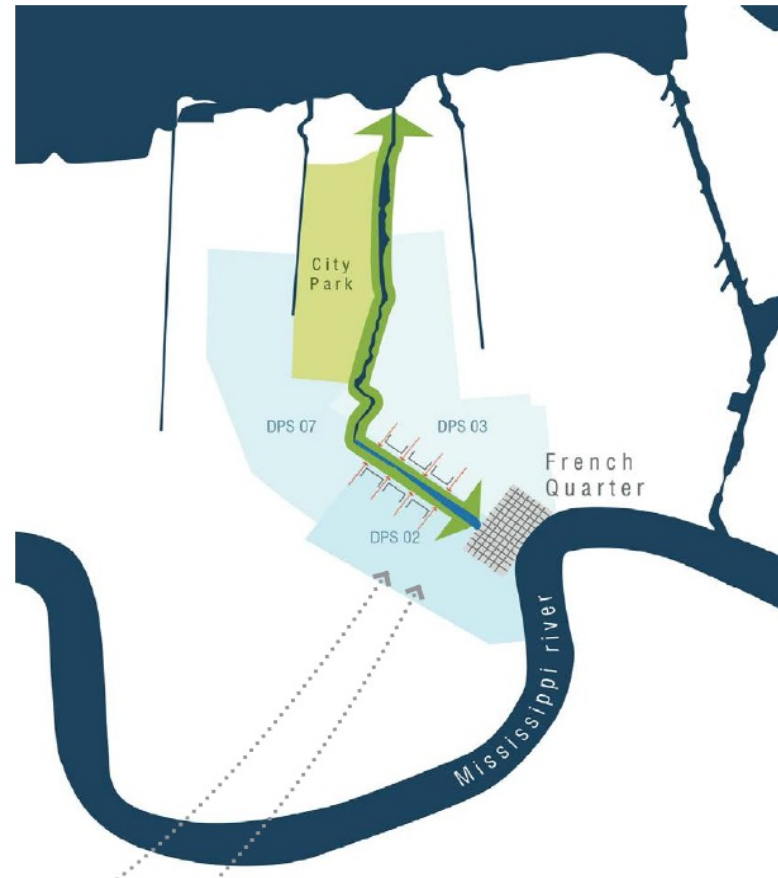
Mirabeau Water Garden





LIVING WATER, BUOYANT LAND

Lafitte Blueway: Historic Water Identity





Lafitte Corridor today





LIVING WATER, BUOYANT LAND

Lafitte Blueway: Dry Condition





LIVING WATER, BUOYANT LAND

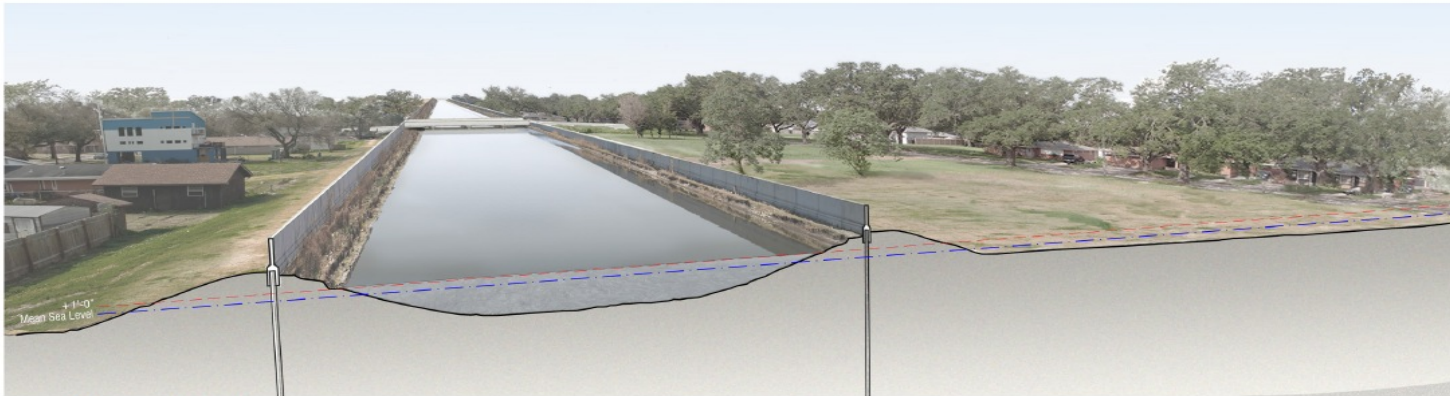
Lafitte Blueway: Wet Condition



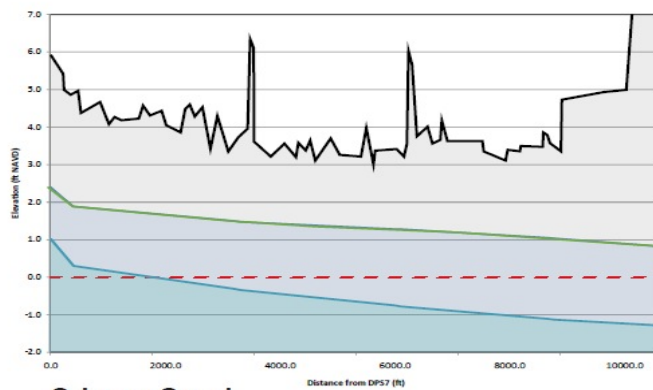


LIVING WATER, BUOYANT LAND

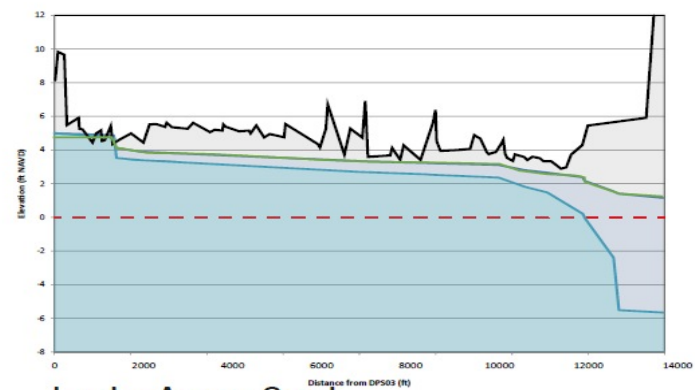
Outfall Canals: Existing Condition and Tests



Orleans Canal



Orleans Canal

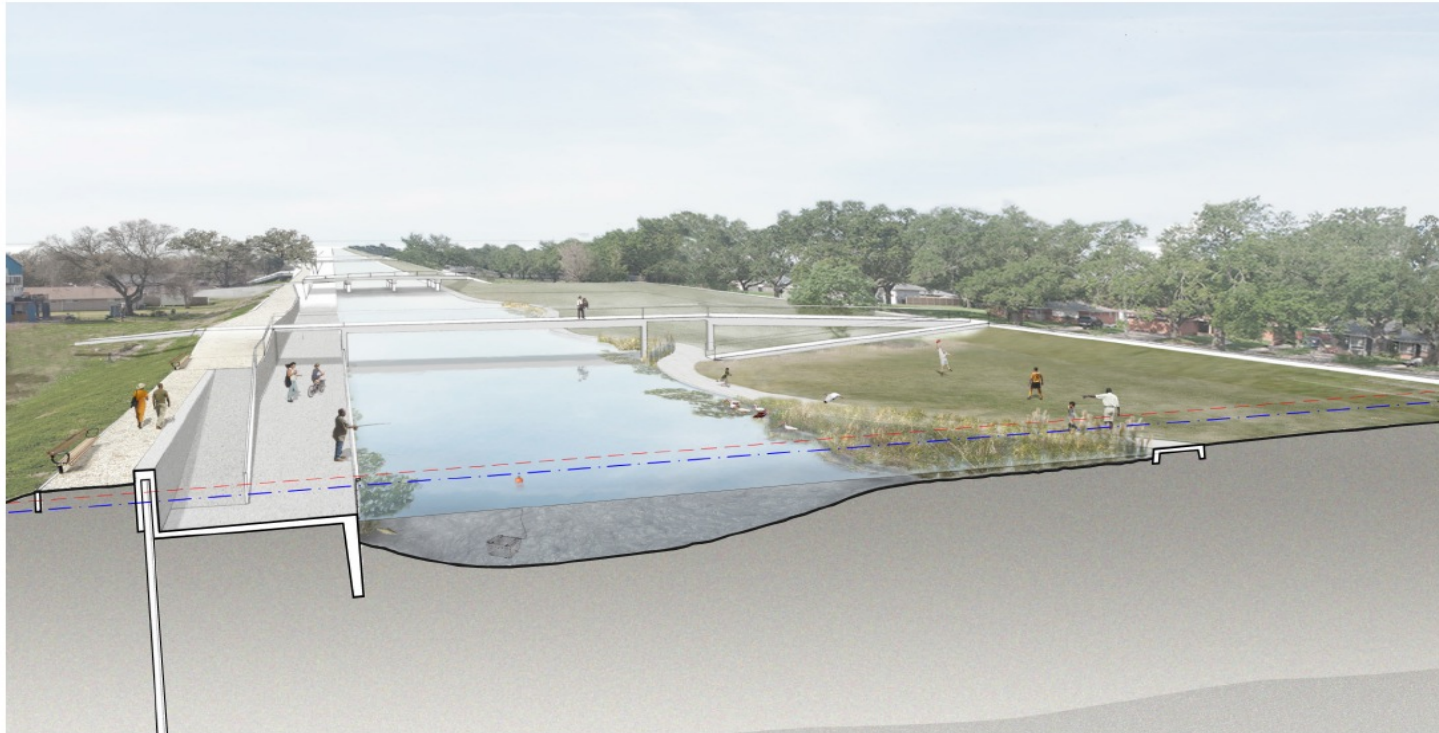


London Avenue Canal



LIVING WATER, BUOYANT LAND

Outfall Canals: Proposed Condition



Orleans Canal



Uptown to Bucktown: Hoey's Basin/Monticello Canal



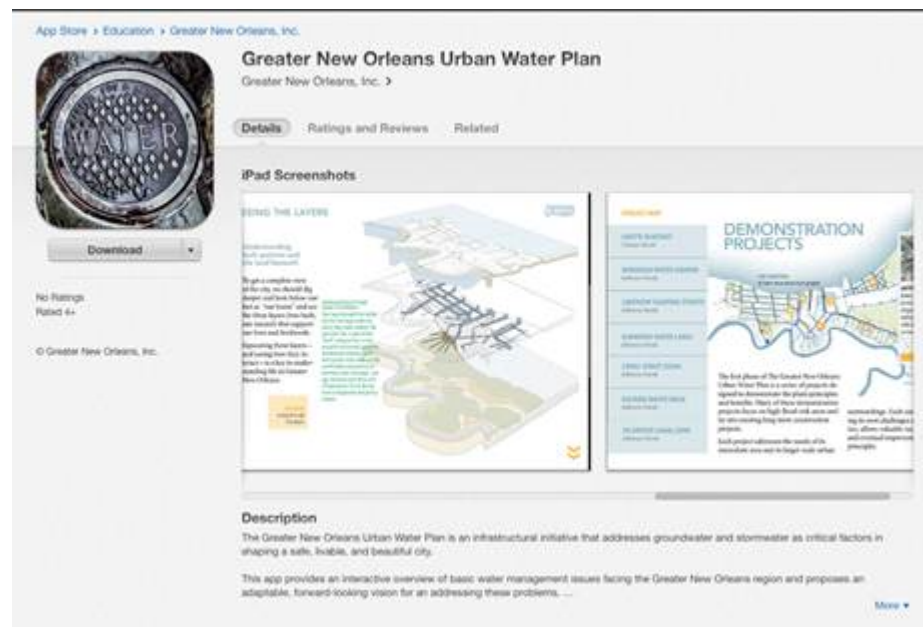


Uptown to Bucktown: Hoey's Basin/Monticello Canal





...the New Orleans project has an App!





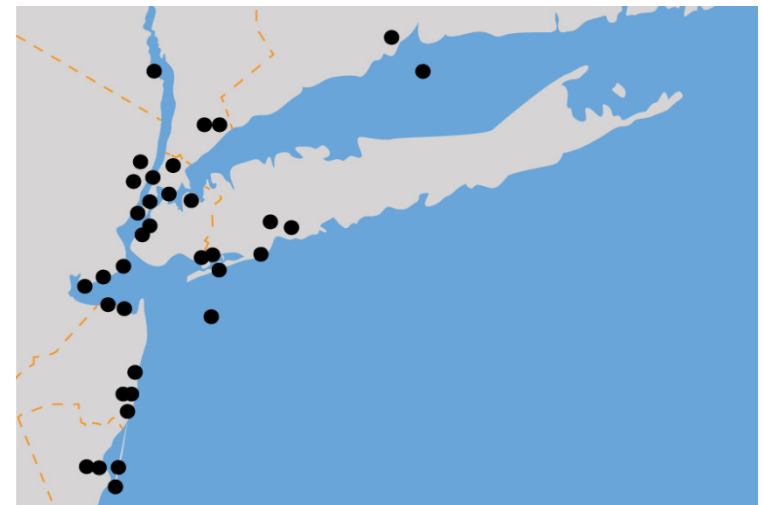
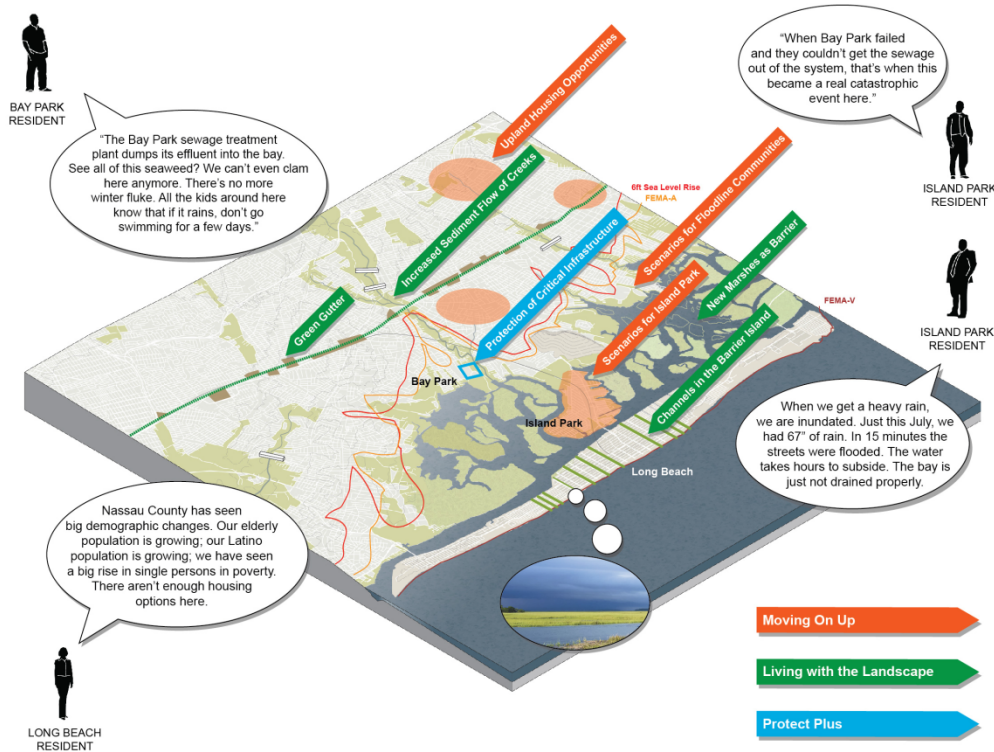
Dutch – American Collaborations

- Post-Katrina Louisiana (coastal, hard infra, urban)
- Mississippi River Floods (St Louis)
- Los Angeles River
- SLR in San Francisco Bay (early-stage)
- Integrated Delta Management (CA Bay Delta)
- Galveston (Hurricane Ike)
- SLR Norfolk
- SLR Miami
- Sandy



Sandy TF + Rebuild by Design

www.rebuildbydesign.org





Thanks!

- Dale Morris
- Royal Netherlands Embassy
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