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# R D REDESIGNING DELTA D

A watercolor illustration of a delta landscape, featuring a central dark blue area representing water, surrounded by lighter blue and green washes representing land and vegetation. The style is soft and painterly.

IABR  
3<sup>rd</sup> November 2022

It is about time in  
Delta Design to  
create a new Dutch  
condition





REDESIGNING  
DELTAS



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# REDESIGNING DELTAS

An initiative led by Delta Urbanism  
Interdisciplinary Research Programme,  
Delft University of Technology,  
the Netherlands.

The RDD Design Study's aim is to explore the potentials of the synergy between spatial design and engineering (design) of the Delta territory to create a sustainable and safe Delta. The knowledge gap we address is the lack of understanding of the mechanisms design thinking has to offer to generate interdisciplinary approaches. The scientific research question of the study is "How can spatial design support a transformative 'prospect for action' (handelingsperspectief) in delivering pathways to a resilient Delta future in which assertion (beweren/tekenen) and proof (bewijs/rekenen) are synergised?"

To this end 15 practice partners from the domains urban design, landscape architecture and engineering were invited to work on 5 design challenges specific for the Dutch Delta system. They were supported by experts representing various domains (covering social sciences and economics) to work in multidisciplinary groups delivering an interdisciplinary strategy that addressed the design question: What is a visionary future (and pathways to get there) on the Dutch Delta where life, work and recreation can be safe and sustainable in a climate responsive territory from a system perspective, considering the environmental and socio-economic challenges? How to envision and support this with plausible arguments on basis of sound principles and design strategies? The challenges are Limburg, Waal River Corridor, Rotterdam polder city, South-West Delta and the Rotterdam Coast.

The Design Study consisted of masterclasses, local ateliers, public presentations, and methodological workshops with the aim to reveal the impact of design thinking in creating new research directions and governance challenges.

Deltas worldwide are struggling with the challenges of climate change, increasing urbanisation and spatial pressure on rural areas. Unsustainable growth (urbanization) and shifting time horizons increase the urgency of the environmental crisis in deltas. In the Dutch Delta we are faced with the challenge of building a million more houses and goals to mitigate climate change by transitioning to renewable energy and increasing the biodiversity. Beyond that there is also subsidence as a major future risk to which the sea level is rising and changing weather patterns make the challenges even more urgent.

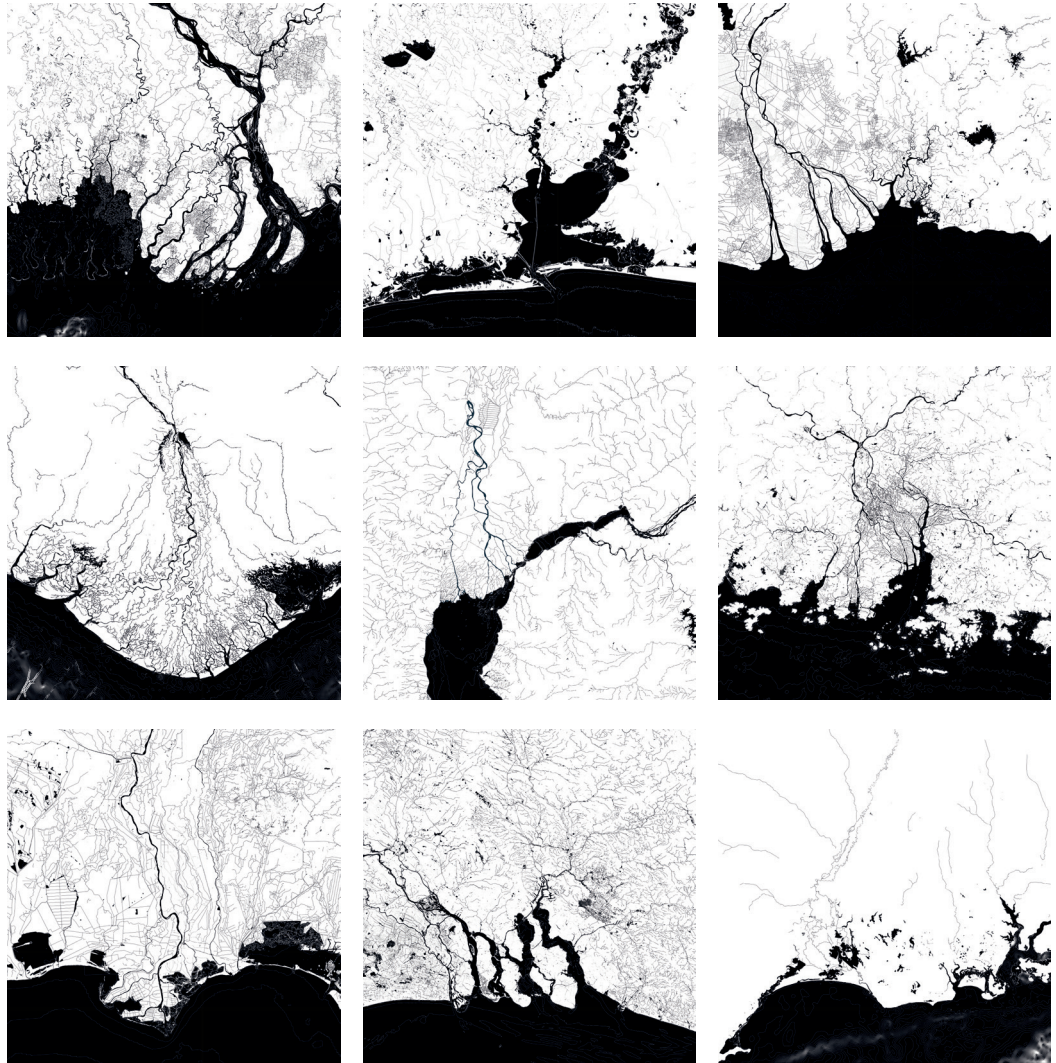


Figure 1: 9 Deltas objects of study.  
Ganges River Delta (India),  
Houston Bay (USA)  
Mekong Delta (Vietnam)  
Niger Delta (Nigeria)  
Paraná Delta (Argentina)  
Pearl River Delta (China)  
Po Delta (Italy)  
South West Delta (NL)  
Tana River Delta (Kenya)

# INTERACTIVE APPROACH

The design study is at the centre of the program in which practice was involve practice in a methodological approach with clear steps. They were given a shared scope: to deal with 2-3 meter sea level rise, climate adaptation, subsidence, sustainability transitions, housing shortage and boundary conditions of the context (social/economic/ climate scenario) for current and desired society.

The scope was explained further in four masterclasses, organized to give participants specialist knowledge input for their challenge. Topics included: the Dutch delta, international deltas, delta governance and delta economy.

This scope was first explored in a Sandpit setting. Sandpit is a (interdisciplinary design) methodology that is used to create a body of knowledge to be able to integrate and utilize knowledge of different nature. In the two-day 'Sandpit', the participants from engineering, urban design and landscape architecture firms are working together in defining the challenges and needs in the five geographical 'challenges' that represent different parts of the Dutch (delta) territory in the study.

Starting in (first disciplinary) groups to discuss these challenges, the practical experience from professionals in the field is gathered and used to build a preliminary understanding of the design-challenge(s) at hand, to further define the design brief and preliminary proposition.

The conclusions of the first day was the assembly of 5 teams, with each an urban, landscape and engineering firm, and division of the (defined) challenges over the teams. The second day the developed strategies were presented and

again in the disciplinary groups conclusions were drawn for the overall scale connecting the 5 propositions.

The collaborative approach was appreciated so much that the participants were interested in creating a manifesto as a group. This was done in an iterative approach, translation the position on the challenges to the system scale and these are brought together in one manifesto.

ReDesigning Deltas is focused on integration and academic consolidation of what is learned in the design study and to feed the study with the other lines of inquiry. The Synergy line of the program describes the outcomes of deliverables for their scope and validity, but also analyses and develops methods. H+N+S Landscape Architects has been commissioned to review the instruments of the Dutch Layers approach (a planning instrument) and the Casco Model (an instrumental elaboration of the Layers Approach).

Although both have become mainstream over the last decades, the question remains how they can be made instrumental for design of future deltas. H+N+S analysed the instruments (that originated from their offices) on their perspective and how they were used at the national (Belvedere, Ecological Main Structure, Room for the River) regional and local scale (VINEX and the Green-Blue Buffer in DELFLAND, with the design of Berkel-Rodenrijs).

The outcomes of the analysis of H+N+S were used in the methodology workshop of the Design Study, where a new interpretation of the Casco Model was used by the design-teams. This affected to the constitution of the 5 propositions and brought them together in the overall manifesto.

# DELTA MANIFESTO

It is about time in Delta Design to create a new Dutch condition. To arrive at resilient Delta in 2122 we need to manifest a new approach how to live in harmony with the dynamics of the delta. Beginning with the projection on the Water State Map 1873 the main properties of proposition for the 5 delta moments are drawn, acknowledging the time-lapse back in the era where more resilience with the dynamic delta system was tradition.

#WE ARE HERE TO STAY,  
AND WE TAKE RESPONSIBILITY,  
WE CAN CHANGE

#WE NEED TO KNOW MORE

#WENEEDDARETOMAKEPAINFULDECISIONS

#WE UTILIZE THE DELTA-PARADOX:  
REGULATION WITHIN THE DYNAMICS

#WE DESIGN THE DELTA BOTTOM UP

#THE DESIGN OF THE DELTA  
STARTS WITH THE SECTION

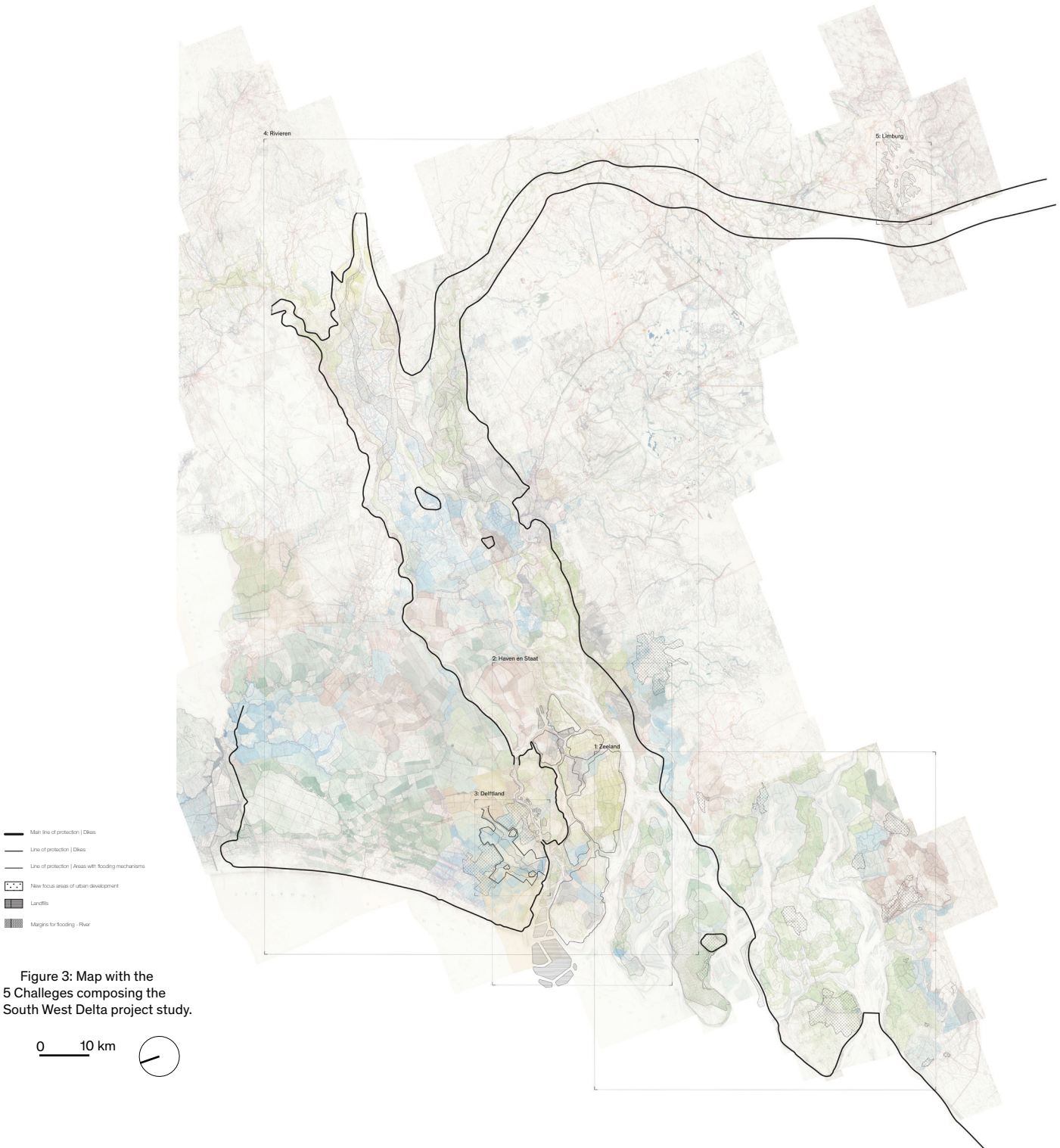
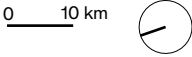


Figure 3: Map with the 5 Challenges composing the South West Delta project study.



PROPOSITION	POTENTIAL / CHALLENGE ADDRESSED	ELABORATION PROPOSITION
# 1  WE ARE HERE TO STAY, AND WE TAKE RESPONSIBILITY, WE CAN CHANGE.	If we decide to stay, that means that we have to take responsibility for the consequences. Now, there is a state of paralysis, doubts on who, what, how, and when responsibility and steps towards a safe and secure future should be taken. We have difficulties changing our controlled, conventionally structured business as usual into a new approach that responds to uncertainties and dynamics. The focus on dealing with uncertainties by creating evidence seems to become an end in itself whilst there are enough means to give way to the future.	We need to take cultural and political positions towards our state of being, a form of activism where we go by Bruno Latour: <i>“from a matter of fact, to a matter of concern, to a matter of care.”</i> The new attitude will not include the <u>‘but’</u> , but rather only the <u>‘what if’</u> question. This will create a new context for spatial planning practice that will revolve around transition management, indeterminacy, and (being at) extremes as guiding principles. We need to leave our comfort zone of well-known protocols and change to a new protocol that is aimed at transition.
#2  #WENEEDDARE-TOMAKEPAINFULDECISIONS	We have to understand that the Netherlands is not <u>Maakbaar</u> in the historical sense anymore. We have to accept that there is more than solely protection, and learn to make decisions with uncertainties.	To be able to change our ways we need to make painful decisions that will change social and economical relations to our delta environment. With the knowledge and experience that supported decision making up until now will lead to the same decisions. Doing it differently will be painful because it is deviating from what we know. Making decisions on the basis of uncertainties will be the only way in making decisions for the future.
#3  WE NEED TO KNOW MORE	There is a lot of sectoral knowledge and experience on the delta system, but it lacks integration and evaluation: how did the interventions in the past impact our future, and would we make these decisions with this knowledge again?	To be able to change our ways we also need to ask painful questions about what we know and what we need to know to be able to make other decisions. Current knowledge is based on certainties and the ability to predict and control. We are in need of another type of knowledge that is more focused on system processes and their mechanisms.
#4  WE UTILIZE THE DELTA - PARADOX: REGULATION WITHIN THE DYNAMICS	We are now regulating the water system top-down and controlling its dynamics. This leads to a set of ‘measures that one size fits all’ - approach whilst there are many morphological, social, and economical differences in the Delta.	We need to reason and regulate from the morphology, bottom-up from the soil and water system and their dynamic relationship of the delta as primary conditions and find our ways to live within these dynamics.
#5  WE DESIGN THE DELTA BOTTOM UP	We now design the Dutch territory top-down from the occupation layer, putting the economic conditions or the land use value first. This is in total denial of the value of the land and its carrying capacity and logic in which this land is part of the delta	The design of the Delta means to put the natural - ecological, soil, and water - system first. The dynamic soil and water systems are setting the stage for the occupation. This should be different in each landscape where the soil water system is different. It should also consider the scale and carrying capacity of these landscapes.
#6  WE START THE DESIGN OF THE DELTA WITH THE SECTION	There is a siloed and standard approach to the management of the delta territory. The delta is not approached as a system of systems in which territorial borders are diverse and operate on different scales.	The interdisciplinary design of the delta should be done through scales and disciplines from the section to the international condition, from the Cable to the Carboniferous. The urbanized delta is a hybrid place of interacting systems that need to be transformed in synergy.

EXPRESSION IN RDD PROJECTS				
<p><u>ZEELAND</u> Questioning the current Randstad centrality by proposing a New Amsterdam in Zeeland which would change the economical development in the Netherlands fundamentally.</p>	<p><u>ROTTERDAM PORT/CITY</u> Fundamental re-engineering of the territory prepared for any unforeseen future.</p>	<p><u>MIDDEN DELFLAND</u> Making a fundamental choice and separation in what areas are to be intensively urbanized and what is the contra-mal: nature as a highly dynamic and productive living area.</p>	<p><u>RIVEREN</u> Creating more space for the river in which the natural dynamics of the rivers are the new way of living and economy.</p>	<p><u>LIMBURG</u> The proposal is aimed at making the territory robust again by the landscape approach on a fine-grain scale.</p>
<p><u>ZEELAND</u> The design approach is tested in three scenarios: Seaward, Protect, and Accommodate. Accommodation is a strategy that is quite 'out of character' for Zeeland.</p>	<p><u>ROTTERDAM PORT/CITY</u> The expansion of Ring 14 will change the character of the urban river completely. The contracts with the industry in the port will include actions that are new.</p>	<p><u>MIDDEN DELFLAND</u> The new natural dynamics in the area will demand another building typology, transformation is needed by local people.</p>	<p><u>RIVEREN</u> Transforming the historical flood plain of the river area means a transformation of the living conditions which will replace land use and productivity into a new way of life.</p>	<p><u>LIMBURG</u> The area of Valkenburg needs to be adapted to the flow of the river which has a great impact on the current urban fabric.</p>
<p><u>ZEELAND</u> Project shows the impact of the range of three possible futures to be able to understand and learn how decisions create new relations.</p>	<p><u>ROTTERDAM PORT/CITY</u> The continued traditional protection of the port by raising land is included in principles of change through different land use contracts.</p>	<p><u>MIDDEN DELFLAND</u> To make the natural system productive in its more natural way we need to regain agricultural knowledge that was replaced by industrial and polder agriculture.</p>	<p><u>RIVEREN</u> The proposal is to give the rivers back their original natural dynamic and investigates how we can live in a productive way with this new dynamic. This brings together knowledge of different natures.</p>	<p><u>LIMBURG</u> Flood and drought are two sides of the same coin, how can they interrelate better in new geography, is the knowledge gap this proposal reveals.</p>
<p><u>ZEELAND</u> In Zeeland the three scenarios investigate the degrees of relation between defense and acceptance.</p>	<p><u>ROTTERDAM PORT/CITY</u> For this region the city is protected by dike ring 14, the port is protected by continuous raising, and other areas will become more dynamic with the delta system.</p>	<p><u>MIDDEN DELFLAND</u> The dynamic natural zone of Delfland is the main-frame that also regulates the urban zone. A clear line is drawn between the two environments.</p>	<p><u>RIVEREN</u> In the river area, three clear zones are projected, protection behind the dike, a new dynamic, inhabitable nature zone where also urban cores can be protected, and room for the rivers.</p>	<p><u>LIMBURG</u> The delta moment in Limburg is crucially different due to the landscape morphology. The main design perspective is the flow from high to low, and how the landscape is conveying this flow.</p>
<p><u>ZEELAND</u> Three dynamics are investigated and each relation is a base for a new qualitative prosperous environment.</p>	<p><u>ROTTERDAM PORT/CITY</u> Part of the project is about regulating the regional dynamic and making it more free and local. The other part of the region is reintroducing the delta dynamic with a less hard separation of land and water.</p>	<p><u>MIDDEN DELFLAND</u> Main map for the proposition is the soil water map of the area in which the gradient of land and water towards the larger water system is visible.</p>	<p><u>RIVEREN</u> The main inspiration map is the historical flows of the river system.</p>	<p><u>LIMBURG</u> The design for Limburg is much more nuanced than the other projects because of the nature of the soil and water system of the landscape morphology.</p>
<p><u>ZEELAND</u> The investigation aimed at three different sections between sea and land.</p>	<p><u>ROTTERDAM PORT/CITY</u> The relation between the system of the port and the system of the polder has been separated in this proposal to be able to manage the extremities in the hydrological system.</p>	<p><u>MIDDEN DELFLAND - RIVEREN</u> Both projects created a new regional section that clearly defined what is urban and what is nature. as an essential perspective in creating synergetic systems.</p>	<p><u>LIMBURG</u> Especially in Limburg the international aspect is crucial because the floods come from across the border.</p>	

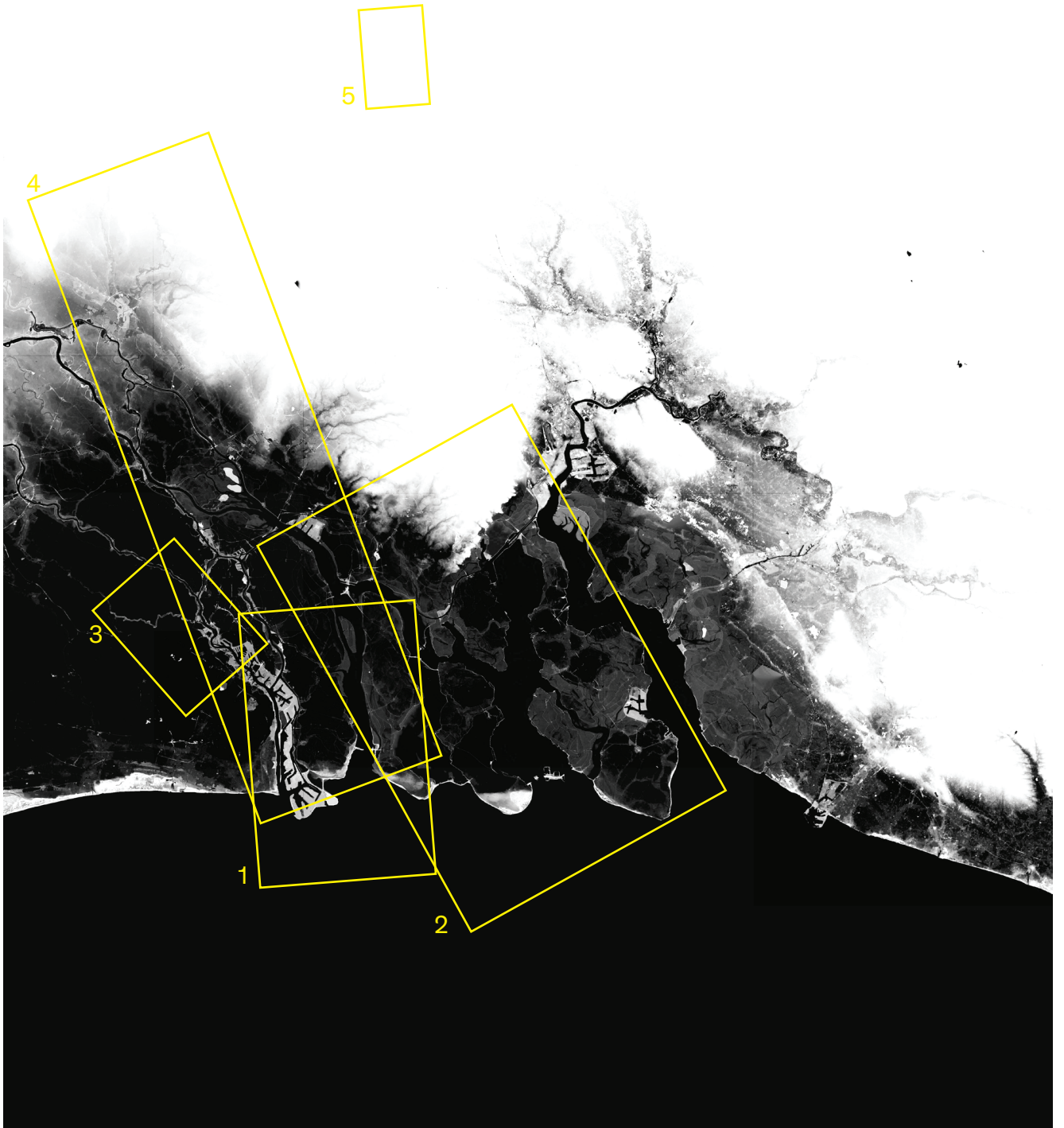
# 5 CHALLENGES

Table 1:  
System description,  
contextualization of the  
challenges in relation to  
each other.

	<u>Challenge 1</u>	<u>Challenge 2</u>	<u>Challenge 3</u>	<u>Challenge 4</u>	<u>Challenge 5</u>
	'Seaside' Rotterdam + port	Zeeland Zuidwestelijke delta	The low west, urbanised polders Rotterdam'	The rivers Waal transport corridor	The high east Limburg / Valkenburg
Issues	Fresh & salt, ecology, urbanisation, coastal defence, port	Fresh & salt, ecology, flooding, salinization, agriculture, energy transition, transport	Pluvial & fluvial flooding, urbanisation	Transport, drought, water discharge, drinking-water, ecology, agriculture, energy transition (in transport)	Drought, pluvial & fluvial flooding, demographics, urbanisation
Scale	Regional, local, section	Regional, local and impact on national level	Local Urban	Regional, section	Regional , local
Preliminary challenge	How can urbanisation and port development target to support responsive coastal zone management?	How can the Zuidwestelijke Delta develop to stay a safe region beyond 2100, considering the societal challenges they will face, aimed at the future societal values?	How can the urbanisation target function as a catalyst for a resilient water system?	How can the multiple regimes of transport and strategic drink water supply in rivers be synchronized together with the other functions along the river (agriculture, industry, recreation and so on?	What is the potential for the high east to respond to drought and shrinkage, or drought and densification?

Figure 2: Image of the South  
West Delta in the Netherlands,  
within 10m below the sea level.

0 10 km







# ROTTERDAM, FROM A PORT CITY TO A PORT ARCHIPELAGO + SPONGE WATERCITY

De Urbanisten  
LOLA (LOst Landscapes)  
Royal Haskoning DHV

# INTRODUCTION TO THE CHALLENGE

## TEAM PRESENTATION

The team working on the adaptation strategy for Rotterdam Port/City consists of LOLA Landscape Architects, De Urbanisten and Nanco Dolman.

### LOLA Landscape Architects

LOLA Landscape Architects researches and designs spatial transitions of existing cultural landscapes. With thoughtful ideas and targeted interventions, LOLA (LOst LANDscapes) wants to optimize those landscapes in beautiful, healthy and sustainable places. Part of this team is Eric-Jan Pleijster (1977), senior Landscape Architect and the co-founder of LOLA Landscape Architects. Eric-Jan believes in the use of natural processes to optimize landscapes and to create unexpected and memorable experiences.

### De Urbanisten

De Urbanisten is a renowned office for urban design and landscape architecture based in Rotterdam, The Netherlands. The office was founded in 2009 by Florian Boer and Dirk van Peijpe. Today, De Urbanisten consists of an international team of about twelve urban designers and landscape architects. The team is curious by nature, dedicated and highly motivated to contribute to a sustainable and attractive living environment for both people and other earthlings. A strong focus on climate adaptation and ecology is present in all projects of De Urbanisten. And ever since they started, De Urbanisten participated in Delta-designs for the Rotterdam Port/City.

### Nanco Dolman

Nanco Dolman is lead expert in Water Resilient Cities at Deltares with a MSc in Civil Engineering from Delft University of Technology (1998) and a BLA in landscape architecture from Amsterdam Academy of Architecture (2008). As one of the Dutch front runners in Water Sensitive Urban Design (WSUD). Nanco is specialized in bridging water resilient design and engineering in making cities less vulnerable to water extremes, urban heat, degrading environments, and on-going population growth.

# ROTTERDAM PORT/CITY

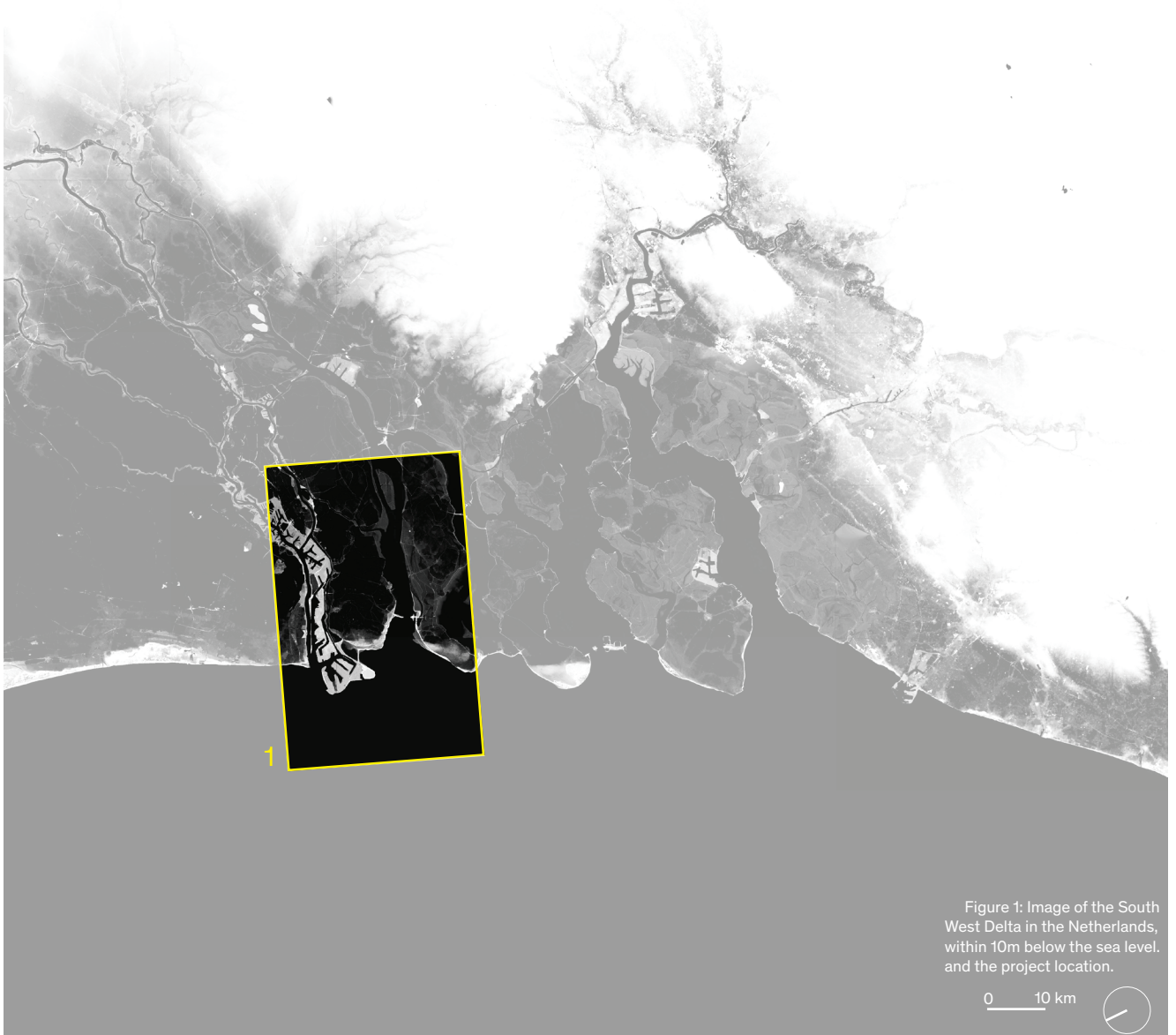


Figure 1: Image of the South West Delta in the Netherlands, within 10m below the sea level, and the project location.

0 10 km



# DISCOVERY / ANALYSIS

## DEFINITION OF THE CHALLENGE PROBLEM STATEMENT

Figure 2: Canal A Rotterdam,  
Jogan Hendrik Weissenbruch,  
1870

Figure 3: Achterhaven te  
Delfshaven, Herman Cornelis  
Adolf Paradies ,1880

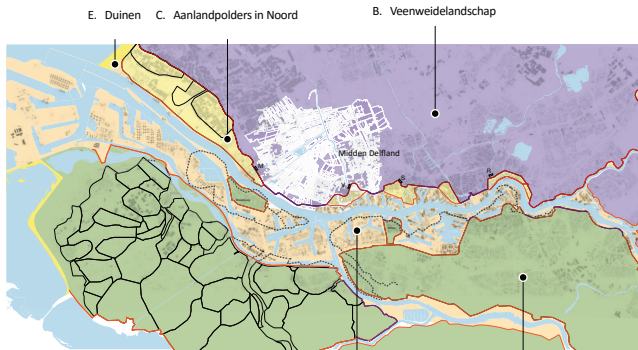


Figure 4: In de verte de  
Leuvebrug, Gerrit  
Groenewegen, 1782



The predicted sea level rise will present a multitude of challenges in the coming decades toward 2100. First, we must cope with spatial challenges like salt intrusion, fragmented nature, sedimentation, subsidence, serious floods, and droughts. Next, the functional challenges, as we move toward a post-carbon economy. To achieve this, a critical shift of the existing industry is necessary, and we need more and improved diversified housing and working areas. Finally, we face infrastructural challenges, necessitating new and clean transport modes, and rethinking of our transport routes.

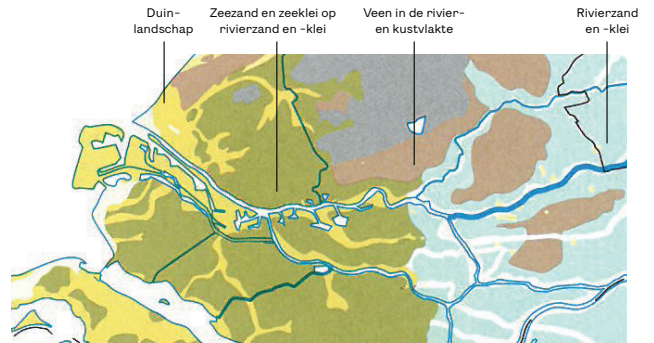
# CULTURAL LANDSCAPE AS A SOLID BASE



Global division of main landscape typologies.  
Berno Strootman Framework River as a  
Tidal park. Strootman + Urbanisten, 2012



Height map of the Rotterdam region (Source: AHN)



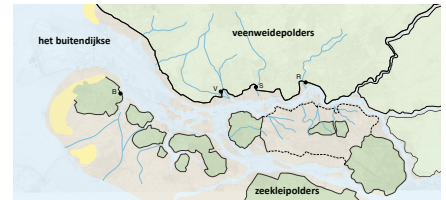
Geological map of the Rotterdam region (Source: De Bosatlas van ondergronds Nederland)



Historical map (1820) + Current main dike system

# ANALYSIS

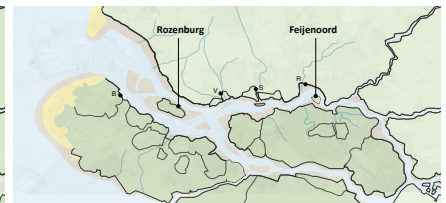
## PORT AND CITY STARTED IN A VERY CLOSE RELATIONSHIP



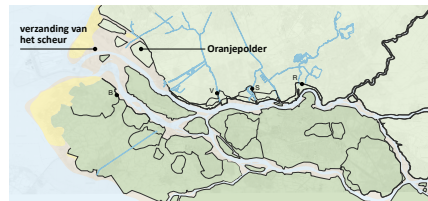
1380: aaneengesloten Maasdijk in noord / zeekleipolders (ringpolders) in zuid



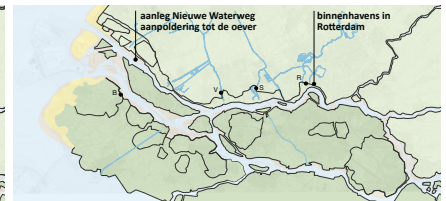
1570: kleinschalige inpolderingen, wisselende invloed van zee en rivier



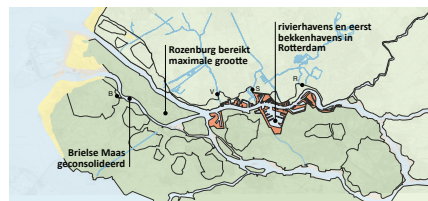
1690: kleinschalige inpolderingen, wisselende invloed van zee en rivier



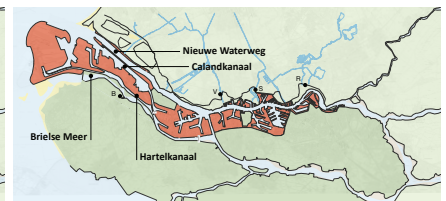
1850: Maasmond grotendeels ingepolderd, wisselende invloed van zee en rivier



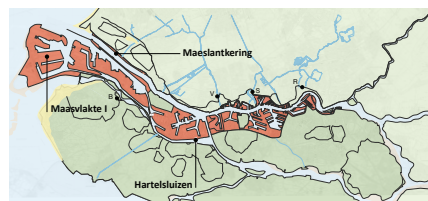
1890: aanleg nieuwe waterweg (1872), kleine aanlandpolders, havens



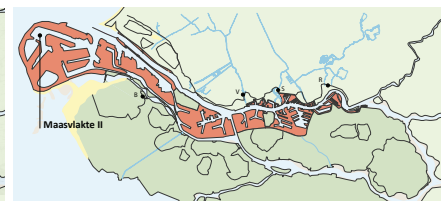
1940: aanlandpolders, kanaalhavens



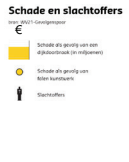
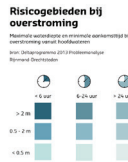
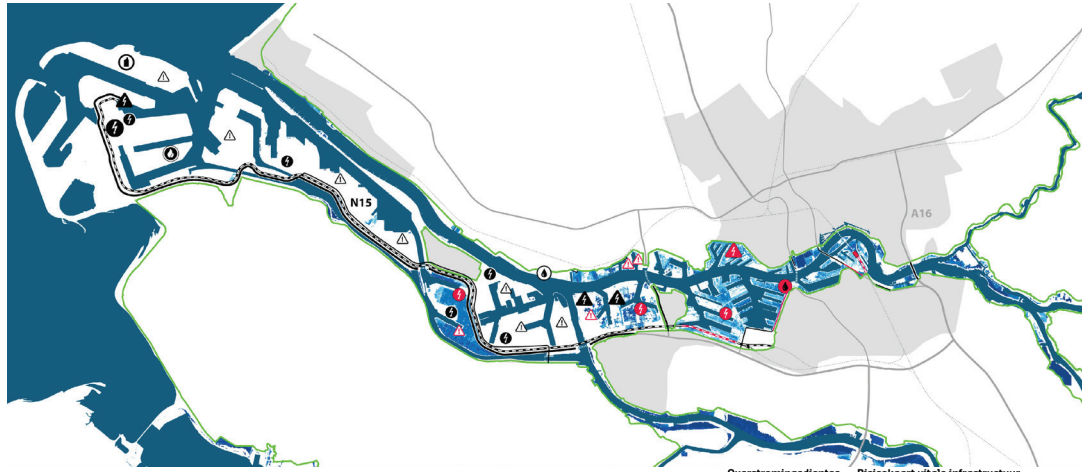
1971: voltooiing Europoort/Caland-/Hartelkanaal, afdamming Brielse Maas



2008: uitbreiding haven met Maasvlakte 1, Hartelsluizen, Maeslantkering



2015: uitbreiding haven met Maasvlakte 2



### Overstromingsdieptes

Maximaal systeem (zonder maatregelen)

van Dijkwa



### Risicokaart vitale infrastructuur

mogelijk overstrombaar / kwetsbaar

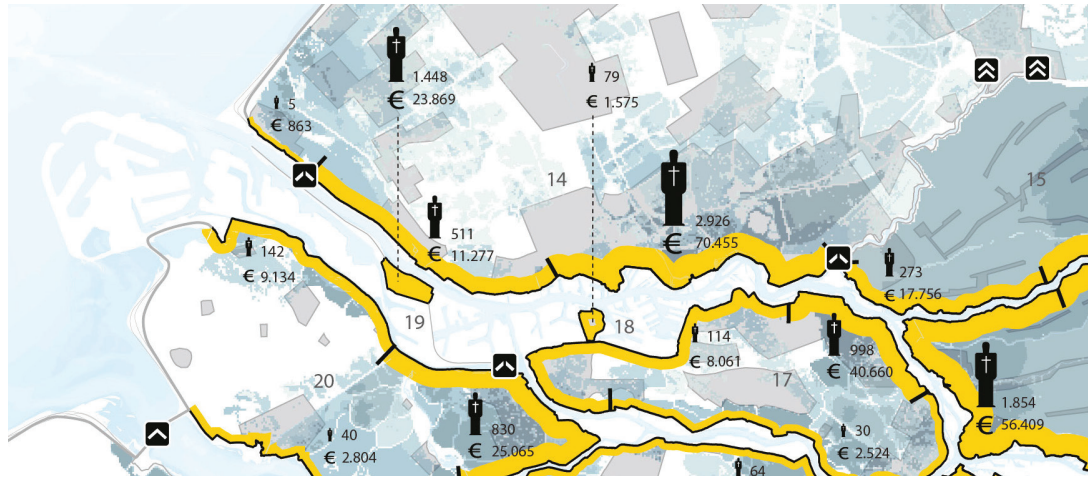
niet overstrombaar / kwetsbaar



### Knooppunten vitale infrastructuur

- schade en/of overstromingsrisico
- schade en/of overstromingsrisico
- vervalst met een vermogen groter dan 250 MW
- geocompressie
- afvalwaterzuiveringsinstallatie
- alle bereikt \*
- station

1. www.brw.nl  
2. Structuurelementen 2012-2015  
3. www.wa.nl



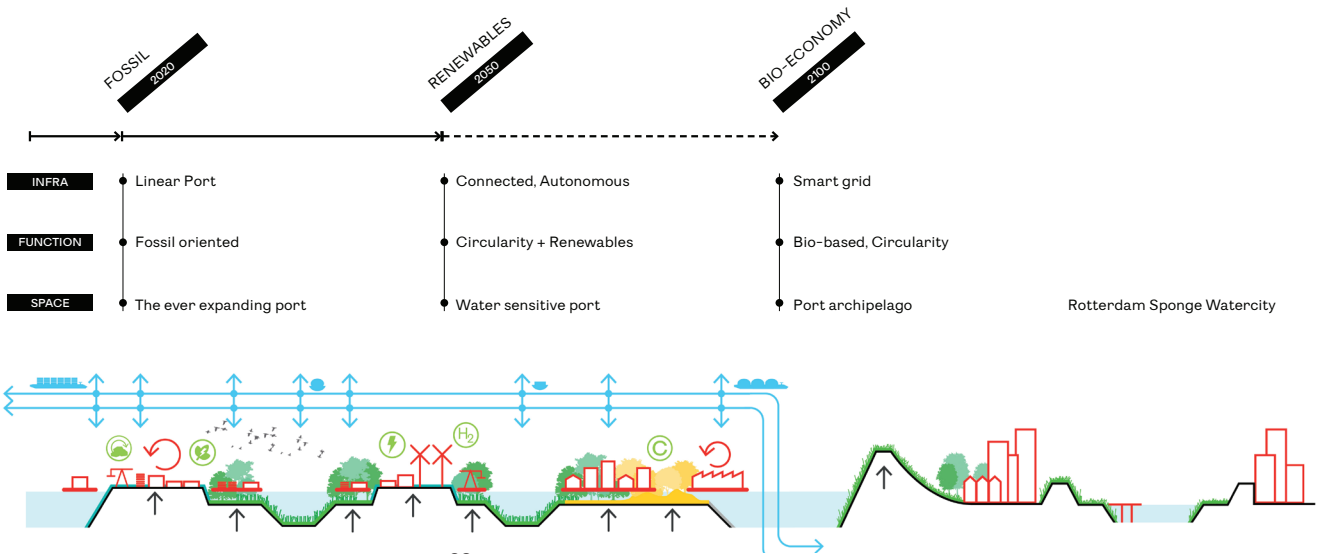
# DESIGN AND DEVELOPMENT

## CREATING THE PROPOSITION SKETCHING

For the City of Rotterdam, we propose a protective strategy in which the city can safely continue to thrive as its own water supply catchment based on a closed freshwater cycle. Concerning the city's port, we put forth a coping strategy based on a spatial, functional, and infrastructural transition. The aim is to restore the water balance between the urban areas and its environment. Thinking in terms of optimal use of space, and multifunctional water and 'livable city' solutions, unlocks the concept of 'the city as a sponge': the 'collection, storage and use of water', in order to relate all water and climate challenges. The city as a sponge contributes to the resilience of the landscape in which it lies, including the quality of the living environment and biodiversity.

Figure 5: their safety strategies differ (HWBP - 2013)

Figure 6: A new 3-fold coping strategy for the port in relation to the city of Rotterdam



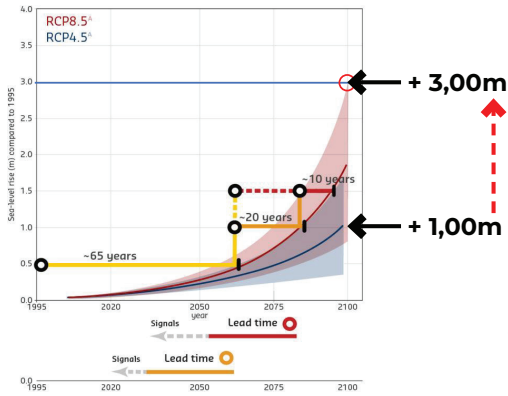
## PROJECT PHASING

Figure 7: The move from moderate sea level rise prediction to more extreme scenario's

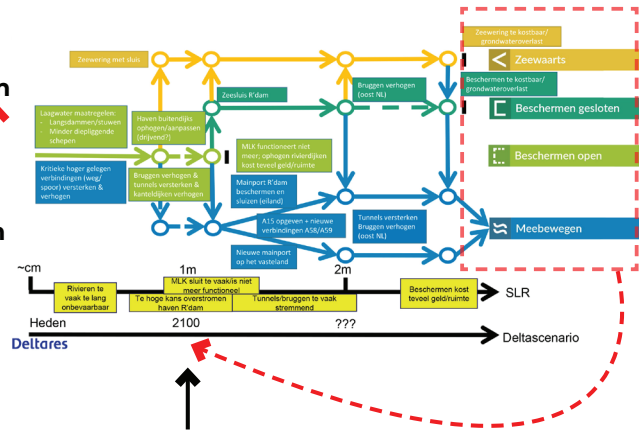
For our proposal, we refer to the existing base layers, that show differences in height, landscape type, geology, and refined secondary dike structures. In our vision map, we propose different flood safety strategies for the port area and city of Rotterdam. The port completely opens its shipping connections with the sea, which moves further south towards the Haringvliet and the river for transportation continuing to the hinterland. This creates a large estuary and a self-sustaining port island that can move further into the sea. The city receives delta dike protection and becomes a self-sufficient and circular freshwater sponge city with the New Meuse river as its central water body closed off by two double locks.

Figure 8:

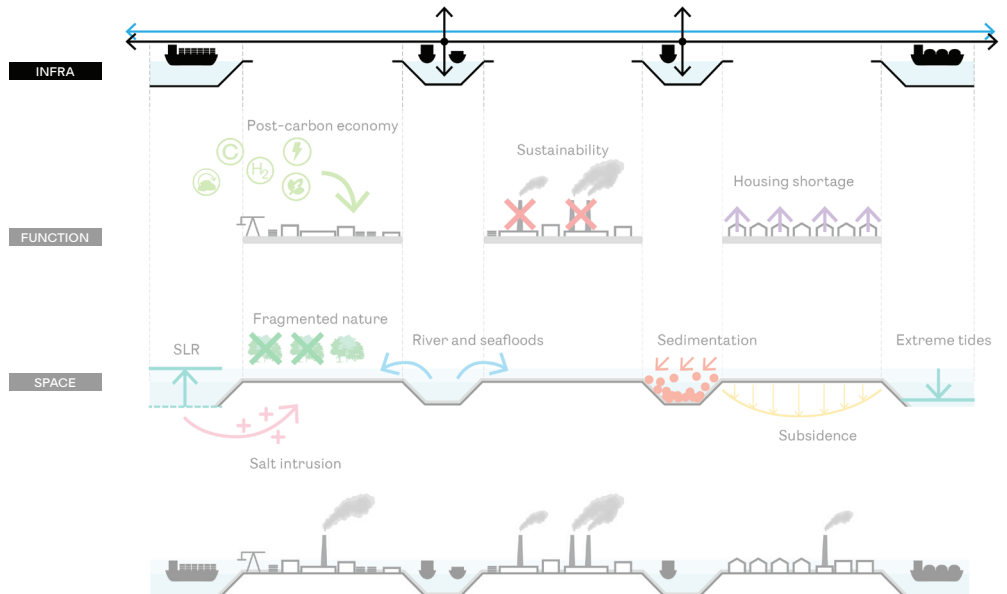
- Infrastructural challenges
- Functional challenges
- Spatial challenges
- Extreme sea level rise will offer a multitude of tough challenges



Potential situation of 2300 already could occur in 2100



Rethink transport routes, new clean modes of transport needed



# FINAL PROJECTION

## PROJECT MANIFESTO IN FORM OF IMAGES

Figure 9: Impression of live  
on the Meuse and the city could  
look like in 2100

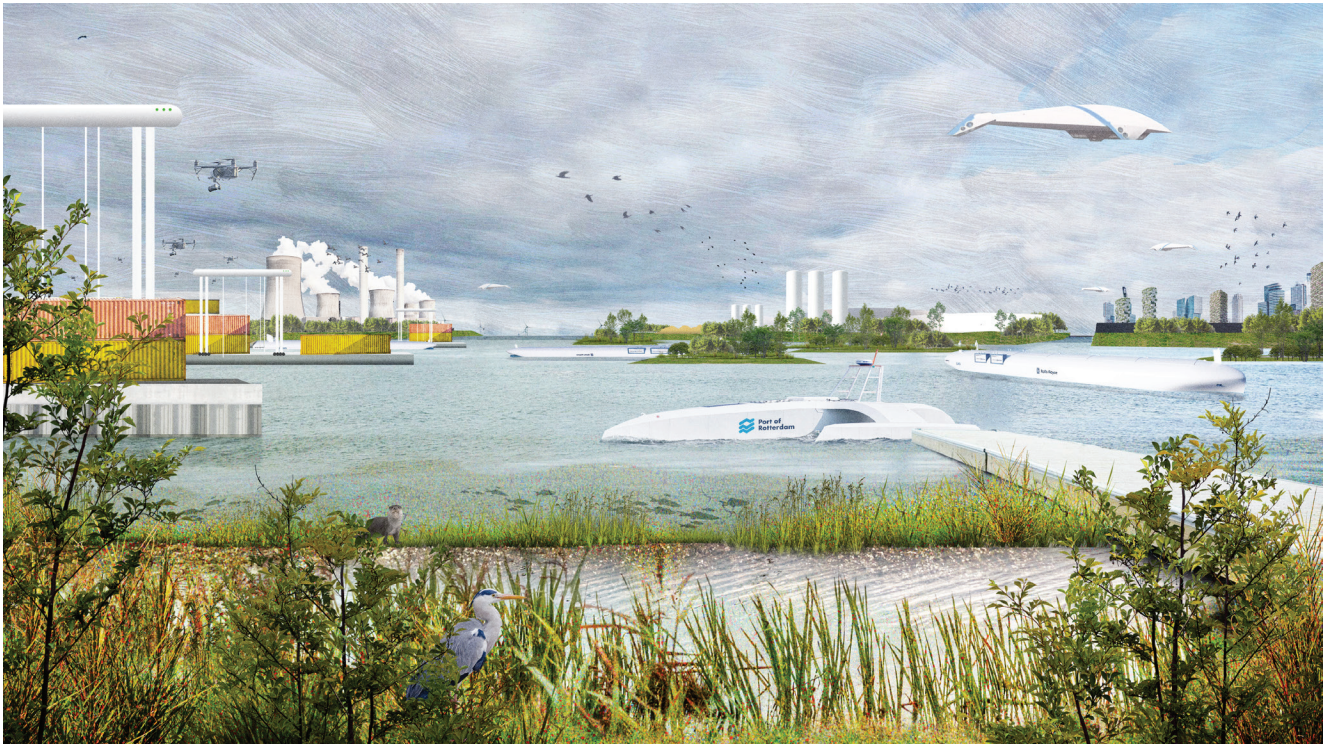
## ROTTERDAM SPONGE WATERCITY

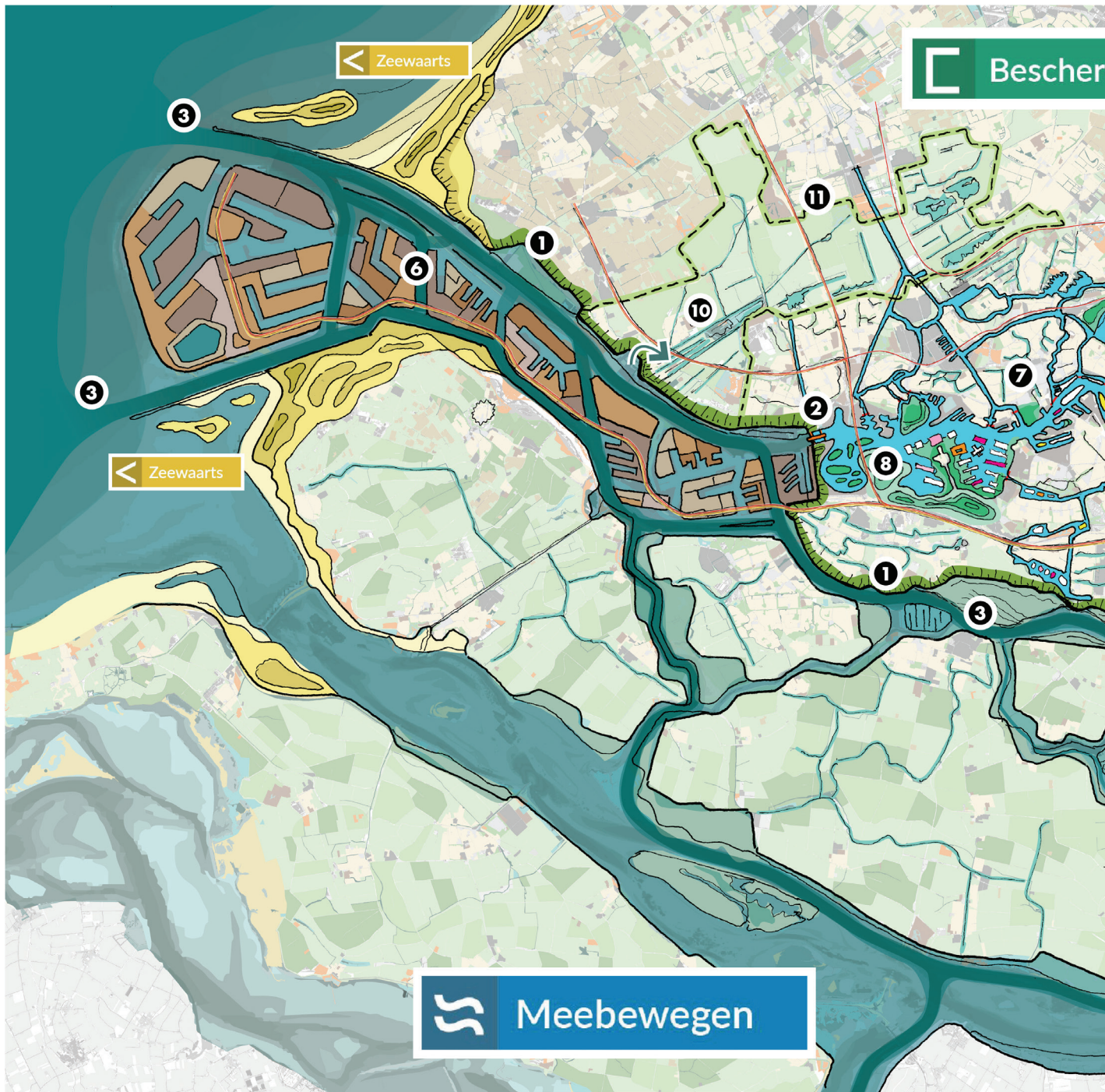


# ROTTERDAM, FROM A PORT CITY TO A PORT ARCHIPELAGO + SPONGE WATERCITY

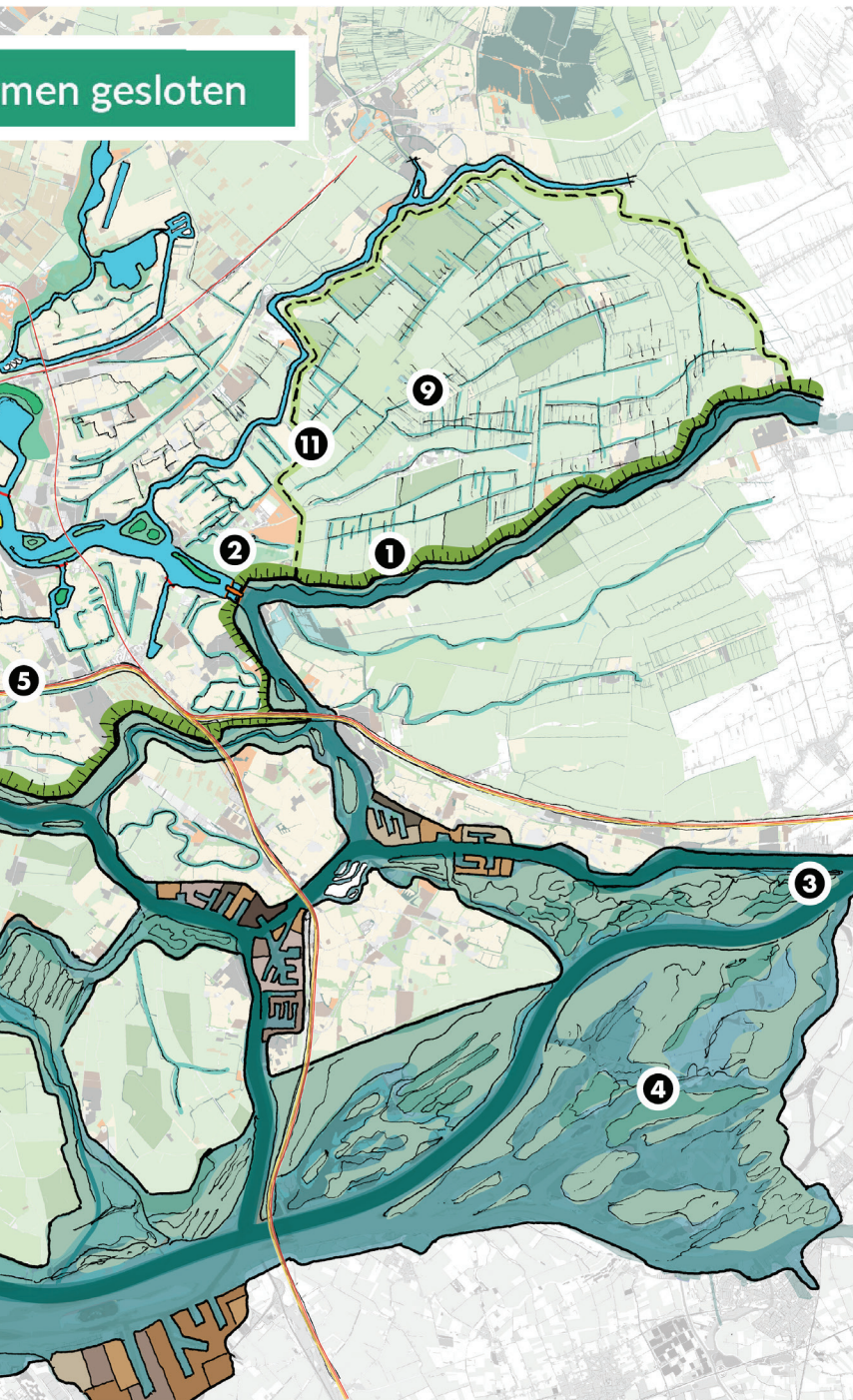
Figure 10: The future port in 2200 is a living part of the estuary serving both economy and ecology.

## THE PORT OF ROTTERDAM ARCHIPELAGO





men gesloten



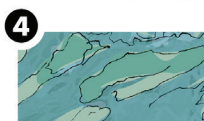
The delta dike  
(flexibility to grow  
in the future)



New  
sluices



Main  
waterway



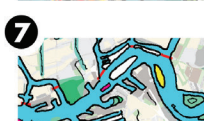
Tidal  
estuary



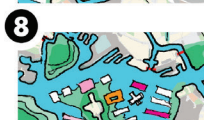
Multimodal  
transportcorridor



Organic cellular  
harbour (incremental  
transformation)



Watercity -  
Watermachine suppor  
city as a sponge



River as  
central park



Peat  
marshlands



Controllable  
overflow to  
climate buffer



Compartment  
dikes

# ROTTERDAM SPONGE WATERCITY

## FINAL VISION

Figure 11: City of Rotterdam cross section existing situation of the old Meuse river and its dikes in the south, and the New Meuse in the center.

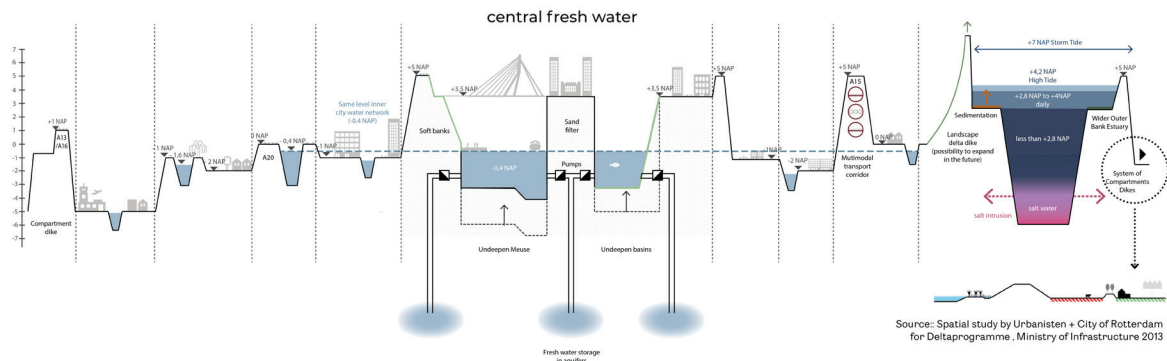
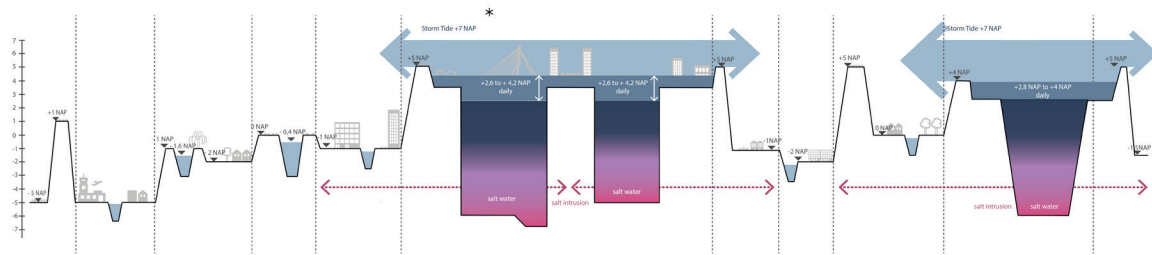
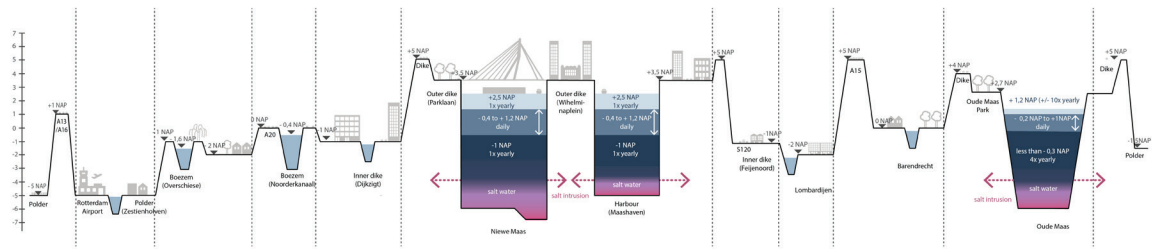
Figure 12: Projection extreme climate scenario IPCC

Figure 13: Proposal section - isolating the New Meuse from the tide + connecting to inner city waters

For the city of Rotterdam and the entire northern part of it, we propose to shorten the dike line with a substantive delta dike, that creates a highwater protection from the coast towards the Utrechtse Heuvelrug. This means closing dike ring 14, which includes the entire Randstad area and its elaborate freshwater system. We also propose to include the center of the New Meuse river and the island of IJsselmonde to create a freshwater core within the city's water system. This allows the city to grow and to use the potential of this central water body. Due to the closure, more housing is possible in "former" port areas outside the dykes, such as canals and houseboats. We close this part of the New Meuse off for commercial shipping, that is going towards the hinterland, this shipping moves more south. Furthermore, we make the polders around the city wetter, to be able to cope with floods and droughts better.

In the first schematic section, we show the existing situation of the old Meuse river and its dikes in the south, and the New Meuse in the center (which we want to close off where it is more urbanized). Also, we see the latest highway extension (A13) next to the airport on the left side of the section, which borders the polder of Midden-DELFLAND. In between, you see the city's differentiated water system, and ground levels.

Three-meter sea level rise will result in daily tidal floodings of all the outer dike areas in the city. In addition, a storm tide would cause a massive flood that would need a substantial increase in dike heights and widths everywhere. We choose to do this only in the south, on the right side of the section,



Source: Spatial study by Urbanisten + City of Rotterdam for Deltaprogramme, Ministry of Infrastructure 2013

Figure 14: Cross section proposal - situation during peak rain event

where there is more space, which offers the opportunity to turn the New Meuse into a central freshwater body. Next to a durable storm flood protection, this provides us three main benefits. Firstly, is the possibility to develop and densify in relation to the water, secondly is to make a generous public space with recreational values for people, and also creates more natural banks and islands, and thirdly is to introduce an intelligent water machine that can combat massive droughts and extreme rain floods. Where the port moves west, a huge potential for densification appears, where the water can be used more intensely due to the boat traffic on the water is absent for a significant part. Also, we can soften waterfronts and make them more accessible and greener as well as intelligent fresh urban water system supports the city as a sponge.

Figure 15: Cross section proposal - long term storage of rain water in the city

As a sponge city Rotterdam needs to absorb 70 mm on all paved surfaces within two hours (green polder roofs, wadis, rain gardens, water squares, soil improvement, storage under roads, etc.). Additionally, the collected rainwater can be buffered locally in the city, such as the so-called 'urban water buffers'. Collecting rainwater (rainwater harvesting) has great potential and can meet the water needs of the city of Rotterdam (residents and companies) in both a wet and average year. In a dry year, the amount of rainwater is insufficient to meet the water requirement.

Figure 16: Cross section proposal - situation during periods of drought

During a peak rain event, the city collects all its rain via a connected open water system, and this is transported to the New Meuse as a central water buffer that can approximately



handle 9 million m<sup>3</sup> of water. Following the rain, the water is redistributed to the open water network, and stored in underground seasonal water buffers in the deeper aquifers under the city. Along the New Meuse, there will be a larger concentration because of the filter capacity of the outer dike areas, which mainly consist of sandy soils.

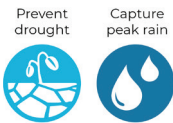
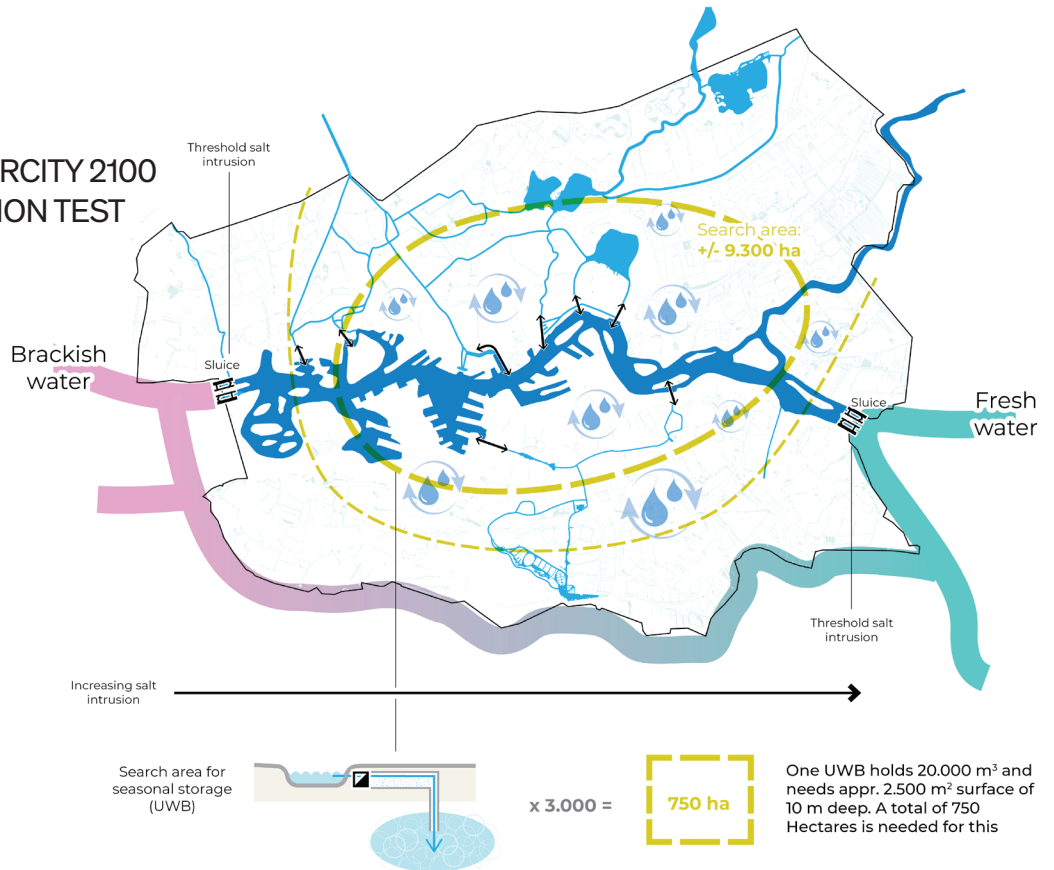
In dry periods, the water of these buffers in the aquifers is pumped up again and redistributed through the open water system into the entire city. We tested this in a global calculation predicting the water demand in 2100 in an extremely dry year, in a moderate, and in a very wet year. In doing so, Rotterdam can supply its own water by optimal circulation as we calculate it, in a dry year we approximately need 16 million m<sup>3</sup> of water, and this would be provided by storing the surplus in a wet year and then bringing that back up into the city.

To retain water from previous “wetter” years and seasons, Rotterdam needs about 3,000 urban water buffers (as shown on the map within the dotted yellow area), which can store 20,000 m<sup>3</sup> within the least salt intruded areas. Interestingly we partly disconnect the New Meuse, meaning that the salt intrusion will mainly come from the south and slightly from the west so that we can focus on the New Meuse becoming the most central freshwater buffer that we have and that has the least effect of salt intrusion.

Figure 17: Water balance  
Rotterdam Watercity 2100 -  
Rough calculation test

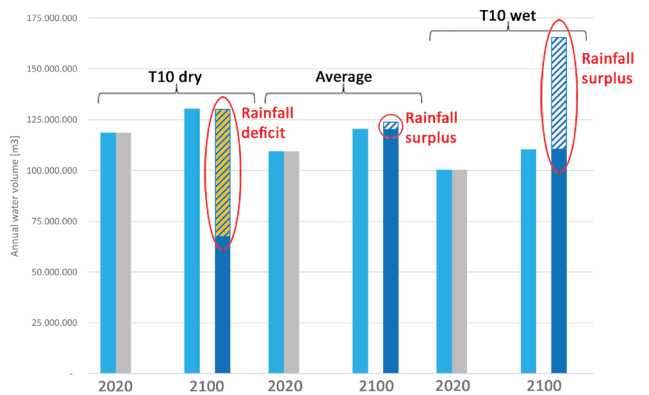
Rotterdam Watercity can supply its own water by optimal circulation. In a dry year approximately 60 million m<sup>3</sup> of water is needed. This will need 3,000 Urban Water Buffers (UWB) under the city

# WATER BALANCE ROTTERDAM WATERCITY 2100 ROUGH CALCULATION TEST



- Water demand (potable + non-potable)
- 2020 ■ Water supply 0 - imported water
- 2100 ■ Water supply 1 - rainwater harvesting - use
- 2100 ■ Water supply 2 - waste water effluent - reuse

**Supply = demand \***



In dry periods, the region can also help with supply of fresh water during long periods of drought. Potentially, the polder of Krimpenerwaard can become vital for the Rotterdam Water city, to supply in its freshwater demand by using it as a pre-treatment ecosystem service and if desirable the effluent of the wastewater treatment can be transported there.

Figure 18: The polder of Krimpenerwaard is vital for Rotterdam Watercity

Currently the polder is peat land and prone to subsidence, due to agricultural reasons the low water levels are maintained by pumping out the water. When we begin pumping out less in this area, the water levels can rise again. This will stimulate peat growth through peat-forming vegetation serving as pre-treatment of fresh water and subsequently stimulate carbon sequestration, since wetland soil appears to be the most effective (on land) in CO<sub>2</sub> storage. With the 12,000 hectares that the polder has, it can store 8 megatons of CO<sub>2</sub> yearly. Comparatively, the city of Rotterdam now produces only 3 megatons of CO<sub>2</sub>.

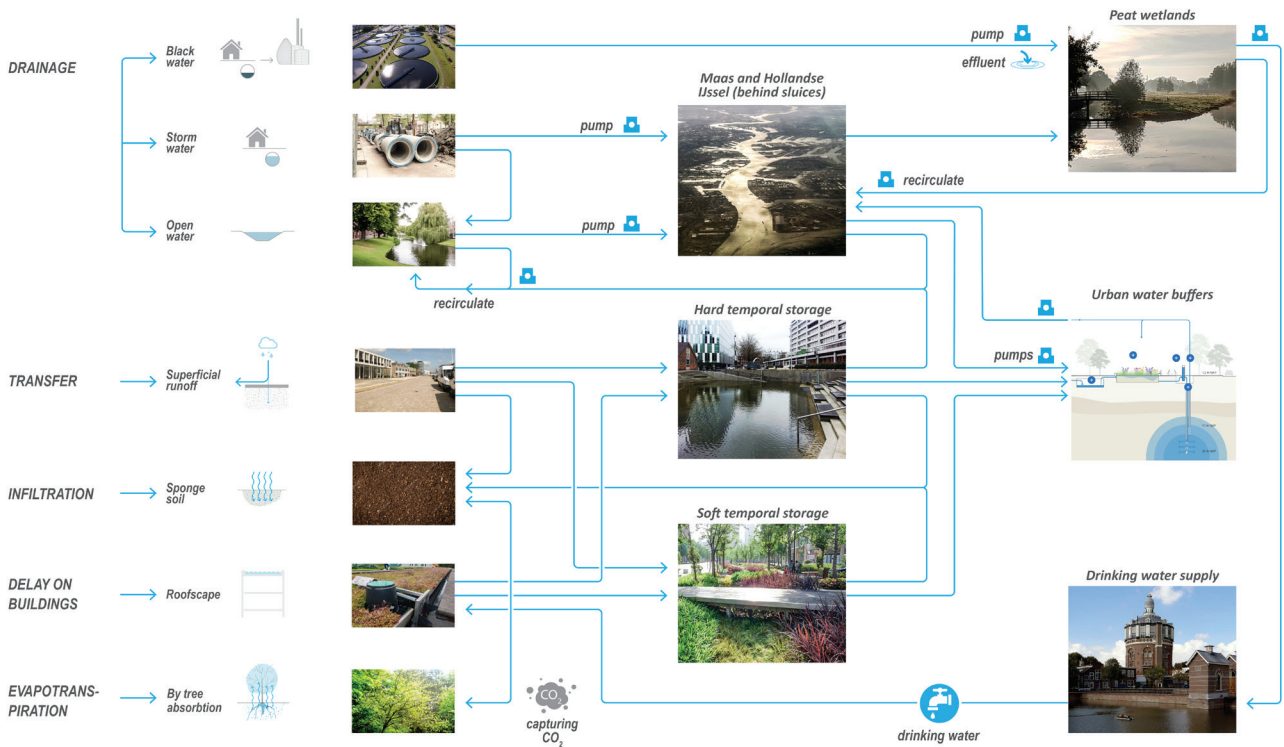
To supply Rotterdam Watercity with its own drinking water.  
Polder Krimpenerwaard can be used as a purification device.  
If needed also the effluent of RWZI can be cleaned here, mainly for circling back into the open water system.

The wetland of Krimpenerwaard is also suitable for Carbon storage, with a potential maximum wetland surface of 12.000 Hectare it could annually capture more than 8 Megatons !  
Rotterdam currently annually produces 3 Megatons - Estimated annual wetland carbon capture is 686 ton/ha



The following scheme shows how the complete closed freshwater cycle of Rotterdam could look like, with the existing base layers on the left, the modalities to collect and recirculate in the middle, and the long-term storage, cleaning, and supply on the right.

Figure 19: Schematic overview of a closed freshwater cycle in Rotterdam





## THE PORT OF ROTTERDAM ARCHIPELAGO

The Port of Rotterdam has always had a unique adaptation strategy. The post-war port areas were each raised several meters above sea level to ensure the safety of the ports and continued port activities. Each time a new port expansion was constructed, it was not only closer the North Sea, but also raised higher than the ones in the past. We propose to use this unique transformation strategy as a coping mechanism for climate change and sea level rise, ensuring the continued activities of the port as an important economy for Rotterdam, the Netherlands and Europe.

By having relative short contracts and short maintenance cycles, the existing and new port areas can adapt themselves gradually over 20-30-year renewal cycles to the sea level rise, the climate crisis, and the energy transition. We propose to develop the port areas during these renewal cycles step-by-step into islands, for this allows to create more space for biodiversity and natural processes. This way, the port becomes truly part of the estuary water system and depends upon. The port could transform from an ecological dead zone into a natural steppingstone and safe haven for both land and marine ecology.

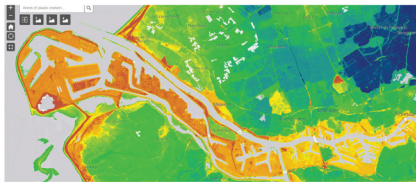


Figure 20: The height map shows how the port area increases in ground level the further it moves west, into the sea.



Figure 21: Within the port area, each plot has its own level and flood defence strategy

This is a fitting landscape for the port that wants and needs to transform from a filthy fossil-based industry to a clean bio-based economy. This goes beyond the electrification of the port and its activities, but aims for the port to receive, store, and recycle renewable materials, such as woods, cellulose, etc. The port itself will continue to be a noisy place with ‘a

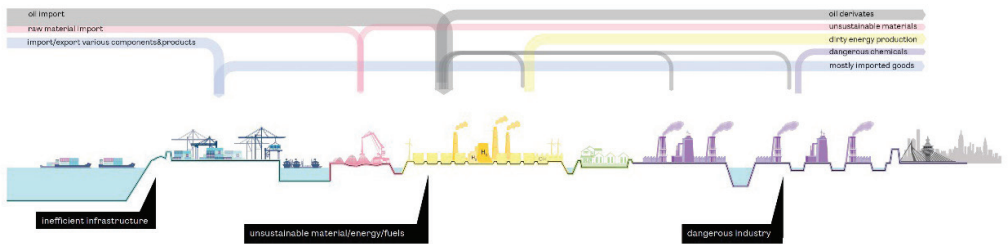
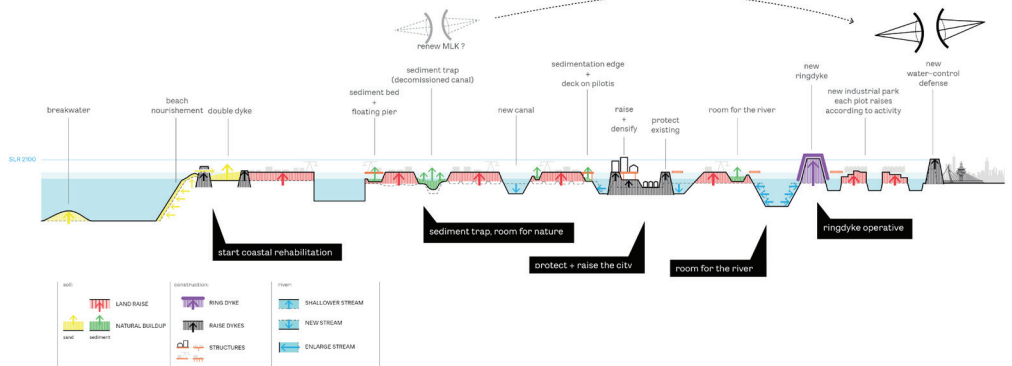
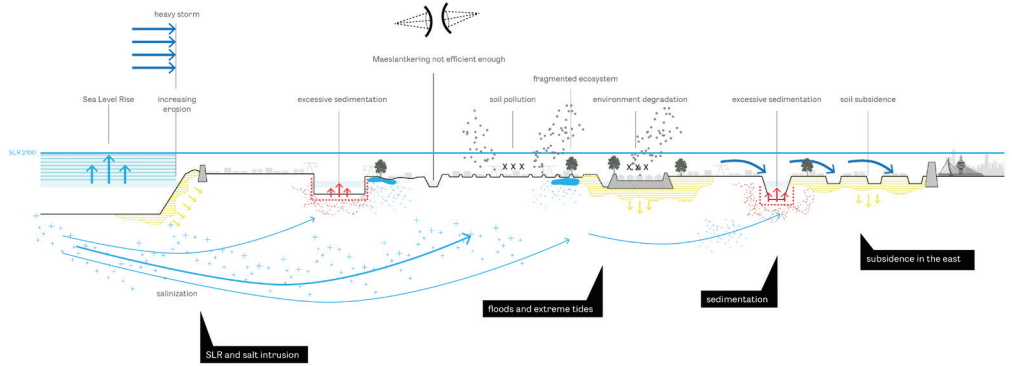


Figure 22: From business as usual to sea level rise adaptation strategy: the individual ports can have their own adaptation strategies.

license to operate', big ships and cranes, but with clean technology in a natural environment.

Not only will the port change to adapt to the sea level rise, climate crises and new economies, but also a shift in transport. Due to the melting glaciers in the Alps, and could entirely molten this century, the water levels in the Rhine, Waal and Meuse are declining. The continued inland transportation of goods over water is uncertain. An alternative is the railway, but it is not suitable for the future port as there is relatively limited technological development of the rails as a transport system for goods. The ideal option is automated autonomous transportation over roads. A new road system, dedicated for transporting goods, could be a solution, delivering goods from the port to the last mile and vice versa.

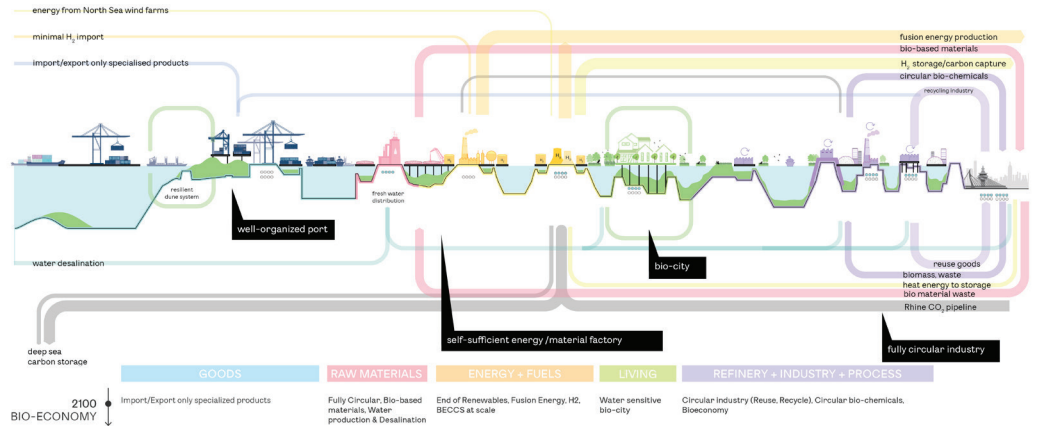


Figure 23: From a fossil-based port, to a bio-based port, making a new port economy out of renewables.

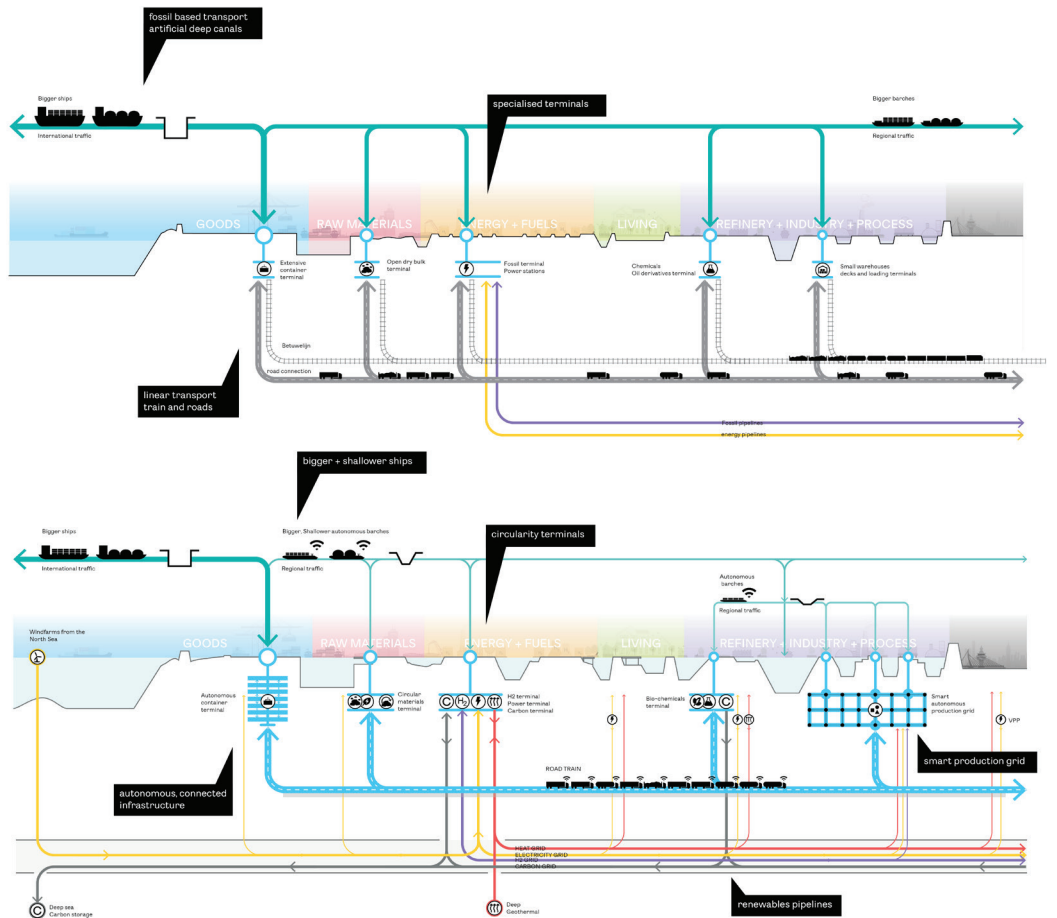
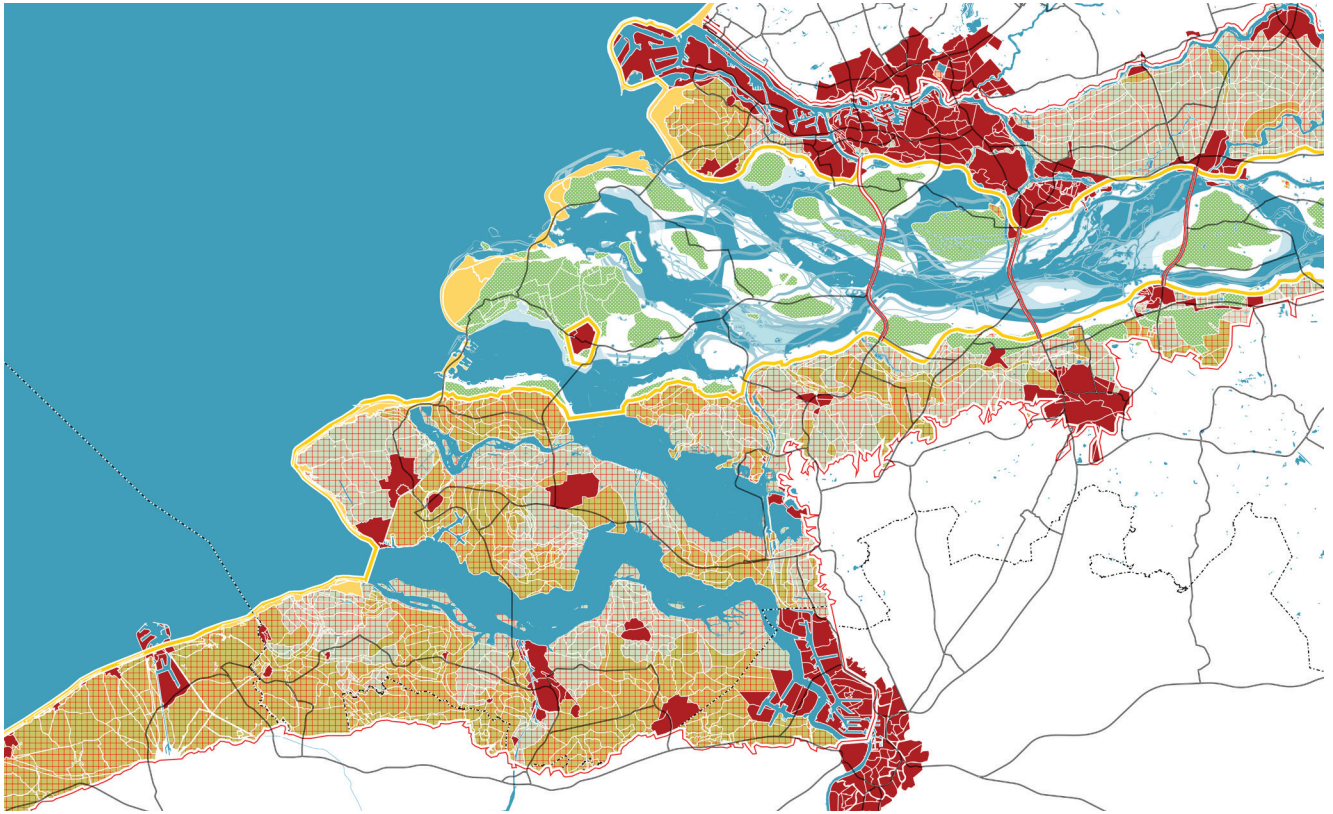


Figure 24: From a linear port, to an autonomous transportation hub: a future where autonomous vehicles connect the port to the hinterland, freeing the rivers of boats.





## ZEELANDIA

A provocative, though  
appealing, spatial  
concept for  
the Netherlands

Studio Hartzema  
Feddes/Olthof  
Witteveen en Bos

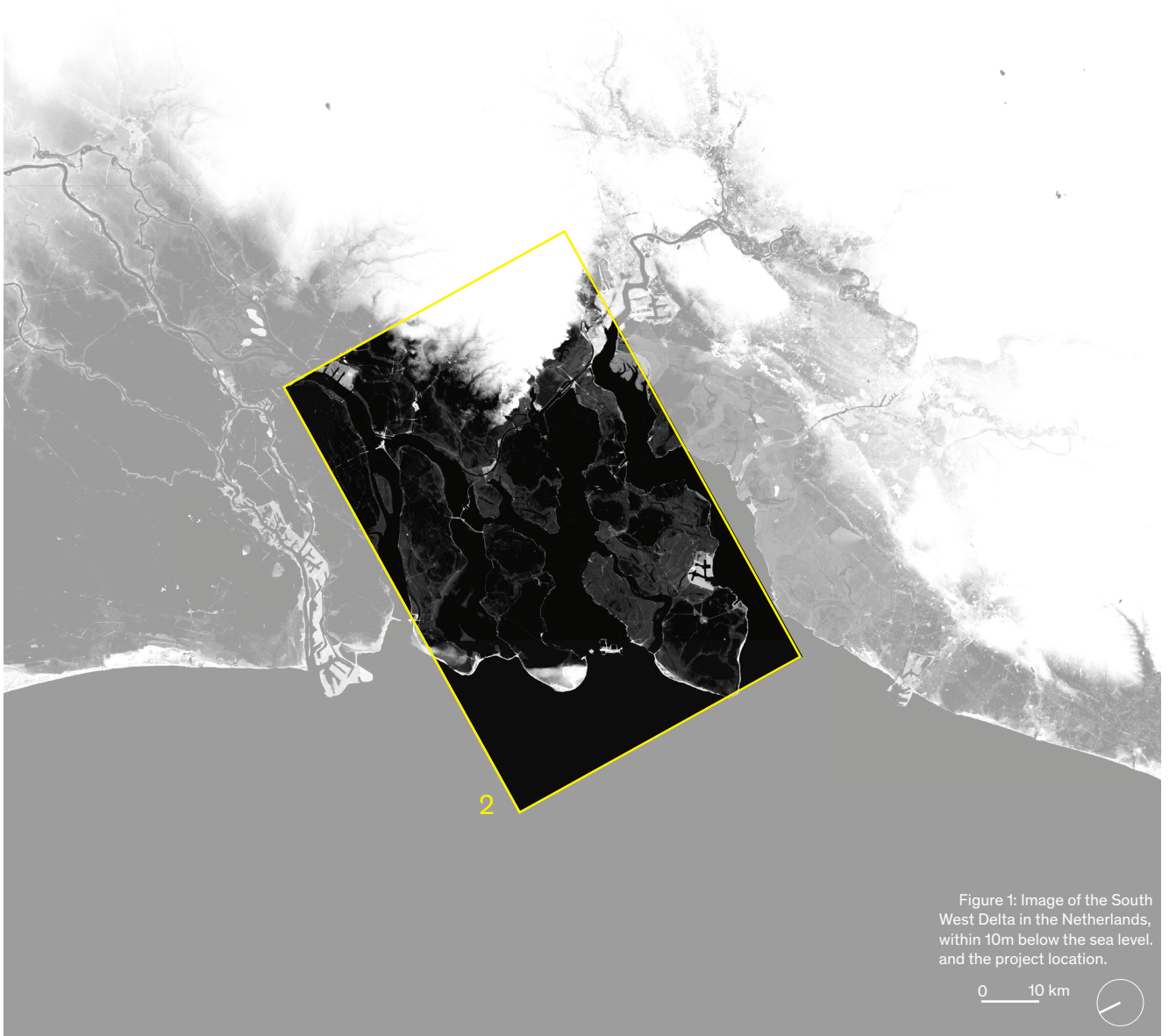
# INTRODUCTION TO THE CHALLENGE

## PROJECT PRESENTATION

Climate change, global warming and associated sea level rise are as urgent as they are elusive. Climate skepticism and climate fatigue are therefore both lurking. In this study, a hypothetical sea level rise of 3 meters was used, without knowing the (im)probability of this. In any case, it is a change with enormous impact and therefore relevant to be able to recognize a gradual change as a fundamental reversal.

In exploring and understanding the impact, team Zeelandia has calculated how much the South Pole needs to melt in order for the world's oceans to rise by 3 meters. The answer is shocking. With an average ice pack of 2200m, a fully melted South Pole would cause a global average sea level rise of 58m. If 5% percent of land ice were to melt, the North Sea would rise to the 3m+NAP that has been included in this design study.

# ZEELAND



2

Figure 1: Image of the South West Delta in the Netherlands, within 10m below the sea level, and the project location.

0 10 km





## ZEELANDIA

Zeelandia is a green metropolis, flanked by Rotterdam and Antwerp as it tops the new urban banana located on Netherlands' higher grounds. Depending on the chosen scenario for water protection the land use and the scale of interventions in the landscape will vary.

Zeelandia is using the sea level rise to investigate the spatial potentials of the Southwestern delta of The Netherlands. The mouth of our river area is considered a spatial laboratory. The character and the pronunciation of the landscape is presented through its waterworks, food production, energy production, nature and habitation that reinforce each other in reciprocal relationships.

Zeelandia experiments with a flexible collision between urbanity, nature, agriculture and energy production. Building a new and proud monumental landscape that unites sea and land.

Figure 2: Zeeland seen from the sky

Figure 3: Future map of the Netherlands



# PREAMBULE

Climate change, global warming and associated sea level rise are as topical as they are elusive. Scepticism and sluggishness are therefore both lurking. In this study, a hypothetical sea level rise of 3 meters was used, without knowing the (in)probability of this. In any case, it is a change with enormous impact and therefore relevant to be able to recognize a gradual change as a fundamental reversal. As an exercise and eye opener, calculated is how much the South Pole needs to melt in order for the world's oceans to rise by 3 meters. The answer is shocking. With an average ice pack of 2200 meters thick, a fully melted continent would cause a global average sea level rise of 58m! If 'only' 5% percent of Antarctica's land ice were to melt, the North Sea would rise to the 3m +NAP (Nieuw Amsterdams Peil) that was used in this design study.

Figure 4: Netherlands in current situation and with sea level rise

Figure 5: Antarctica compared to the sea

Figure 6: Sea level rise due to melting of Antarctica



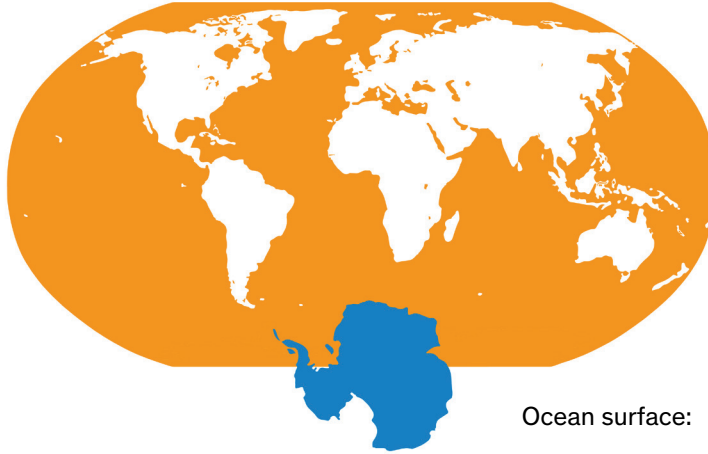
Current Netherlands  
NAP+0m



Future Netherlands 2100  
NAP+3m



Future Netherlands  
NAP+58m



Ocean surface: 362.200.000 km<sup>2</sup>  
Antarctica surface: 14.200.000 km<sup>2</sup>  
Land ice: 21.000.000 km<sup>3</sup>





Holland as the dominating cultural factor in the Dutch tradition made land a commodity. Something that can be traded. In contrast to this, the tradition in the Southwestern delta, where the land is made and reclaimed by human hands from the sea, land about pride.



# ANALYSIS

## NEW ROADS FOR THE WATER

The rivers of Northwest Europe all flow towards the North Sea. A territory of 285,000 km<sup>2</sup> (7x the Netherlands) drains through our country. In total, approximately 20,000m<sup>3</sup> of water is

discharged from the Rhine, Meuse and Scheldt at peak times. Of this total amount of water, about 10% goes via the IJssel and the IJsselmeer towards the North Sea. The remaining water passes through our main rivers. Today, the vast majority of this is discharged via the Haringvliet and Nieuwe Waterweg (Port of Rotterdam).

The sea level rise turns this situation completely upside down. The biggest challenge will then be to let the rivers discharge their water to the North Sea. The sea is coming further and further into the land. Today the water that enters the Netherlands at Lobith is approximately at 12m +NAP, From here it has 150km to reach the North Sea. With a sea level rise of 3 meters, the runoff will be blocked 40km inland. At high tide and in the event of a major storm, the water level can rise to 8m +NAP. That is over half of the country, at the height of the city Tiel!

An extra complexity is that, in order for the port of Rotterdam to be future proof, a barrier and a lock will have to be constructed in the Nieuwe Waterweg. Therefore, the rivers' discharge must run around the port and the city. In

Figure 7: The Netherlands as drainage basin of North-West Europe

Figure 8: Oyster farm. By Jeroen Hofman, 2010



**1**

Amount of days that it takes for the water of the rivers Rhine, Meuse and Scheldt to reach the Netherlands

this study, three scenarios were identified to protect the Netherlands from the high seas, to allow the rivers to discharge and the Port of Rotterdam to operate; Full defence, Seawards and Superdelta.

Systematically, choices have been made in the past that have resulted in a landscape that shows itself more powerful and resilient every decade. The interplay of dikes, dams, windmills, vast fields and the ever-present threat of the raging sea form an impressive interplay.

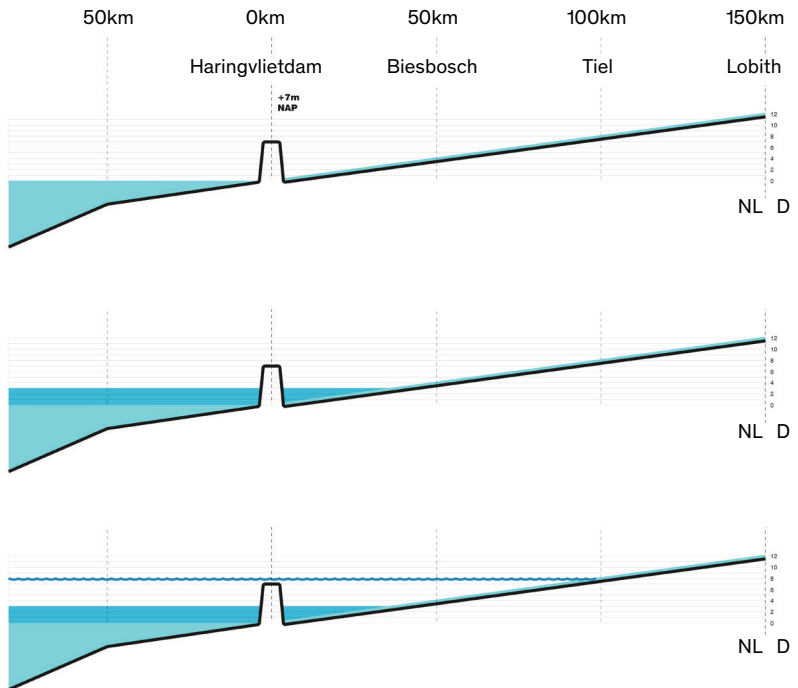


Figure 9: Current section of the Netherlands

Figure 10: 3m sea level rise

Figure 11: Sea level rise plus storm

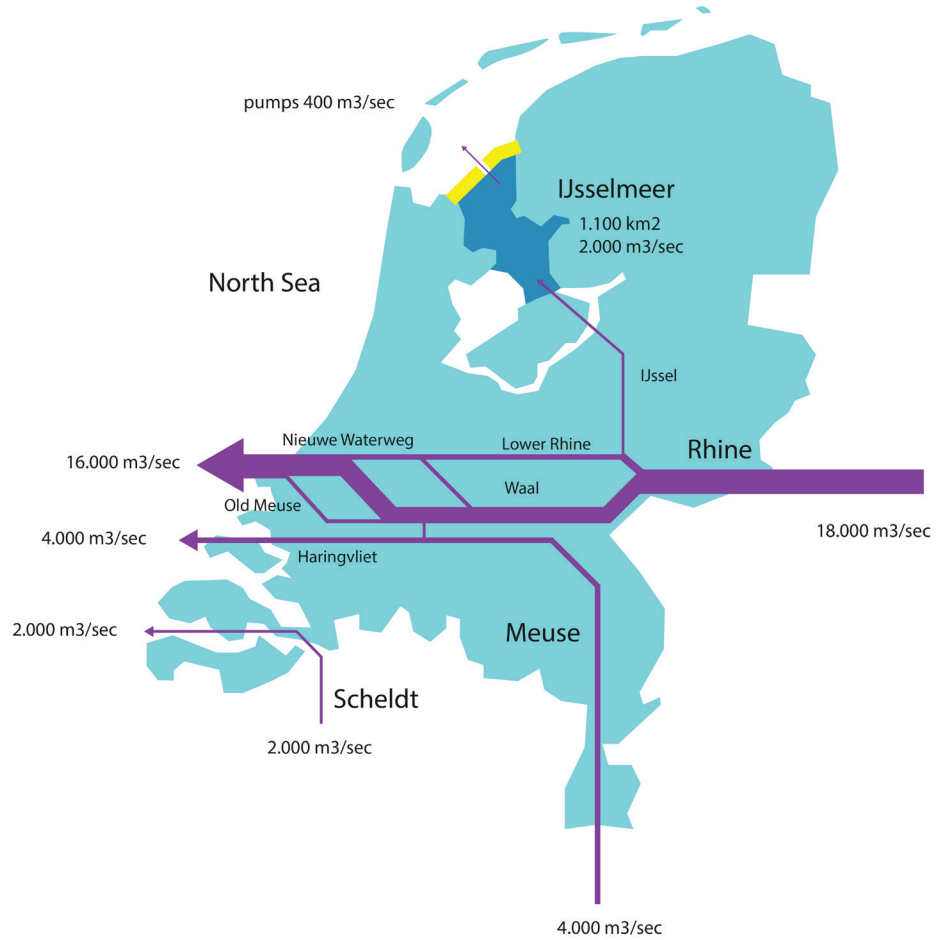
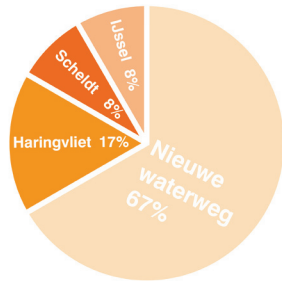
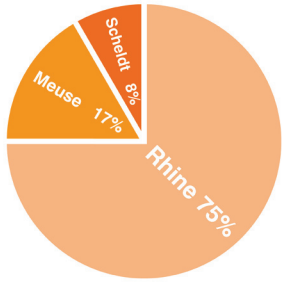


Figure 12: river inflow

Figure 13: river outflow

Figure 14: current river flow scheme

## RENEWED OPPORTUNITIES FOR SPATIAL DEVELOPMENT

The Netherlands is changing. Fixed values are under pressure, and we get uncertainties in return. The Netherlands is a vessel full of contradictions. Our country is becoming full, more mobile, wetter and drier, more and more people have an opinion about this. All changes will have to be resolved within the same limited space. This requires smart ideas, innovative solutions and clear choices. And that's not for the first time. Our country has a long tradition of dealing with change. Our territory is unstable and faces many challenges and our adaptability is phenomenal. Just like our urge to control the situation. In the rich Dutch planning tradition, change and progress usually work together.

At the same time energy and climate issues, the empowered citizen and the political mainstream are not balanced by a common narrative. Where the feeling starts to prevail, that things get stuck for lack of direction. Change seems to be equal to paralysis due to lack of values, to the lack of a goal.

Zeelandia wants to make the planning more accurate, holistic and idealistic. An exercise in the reversal of our planning tradition. It results in a new manmade territory based on coalitions and resilience. Both the scale of the Southwestern delta and its nature makes it a fertile ground to overcome contradictions and close new deals. An imaginary grid has been laid over these layers that gives direction to the discoloration of the land use.

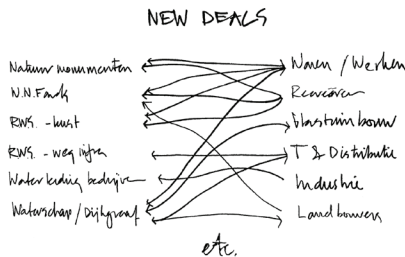


Figure 15: Collaboration instead of division

Figure 16: Broadacre city



LA 115 115

We foresee the rescaling of agriculture, an increase of energy production, residential development and recreational possibilities. The promise of a spatial symbiosis all in combination with the incremental presence of water and natural (re)development of the delta.

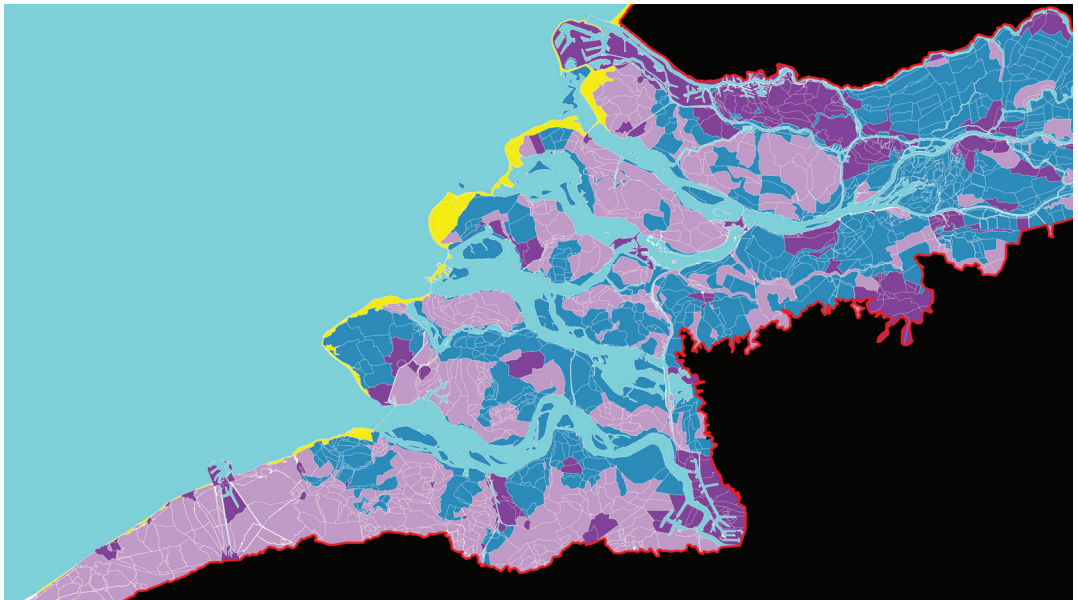
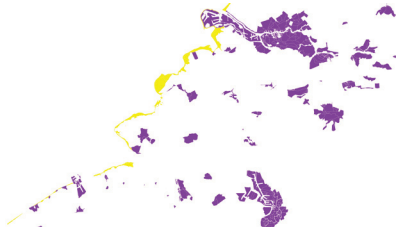


Figure 17: components of the regional framework planning



The tipping point in the planning is approached optimistically because there is a broad understanding of larger themes with a spatial impact, with sea level rise leading the way. No moralism or scepticism is needed to study the effects of change. We think that in our pragmatic nature lies not to ask why, but to decide how. It's about vision and ideals. In return we get back our certainties. Our fundamental, unbiased sense that the future of our territory and its potential are in our hands. The Southwestern delta for this research delimited by Dike-ring 14 (the protective water barrier surrounding the Randstad) in the north and the 3-meter contour line in the south. Within this width the delta was explored on the basis terrain height with a distinction was made between higher soils (above 3m +NAP) and soils below current sea level. The latter is very suitable for becoming part of the natural environment or water. In between is an occupation layer. Soil between 0m and 3m +NAP that, depending on spatial choices to be made, connect to the fixed layer or are added to the natural environment.

In the approach of Zeelandia the combination of watermanagement and the local pride supports the synergy between self-confidence and a progressive attitude. The water guides the land use and spatial development in response to the societal challenges.

Figure 18: fixed elements

Figure 19: areas above NAP

Figure 20: areas below NAP

# FINAL PROJECTION

## SCENARIO'S

For the test phase of the spatial design research, three water scenarios were investigated, based on a sea level rise of 3 meters:

- Full defence, the raising of all existing sea barriers to 10m +NAP
- Seawards, creating a large offshore Battery Lake
- Superdelta in which the sea can penetrate the land up to the German border.

The three distinct water scenarios lead to different forms of spatial development, and each expresses the future of the Netherlands and specifically the Southwestern delta in its own way.



## FULL DEFENCE



Figure 21: dikes in planview

The current delta height of dikes and other barriers is the Delta-height of 7m+NAP. With a sea level rise of 3 meters, the sea barriers should be raised to 10m + NAP. This part of the operation is relatively clear. In the Southwest delta, the dikes, dams and barriers will have to be raised over a length of about 100 km. The existing open connections with the sea, the Westerschelde and the Nieuwe Waterweg should be closed to protect the land behind. The port of Rotterdam can continue to function through a lock in the Nieuwe Waterweg. Due to the closure of all estuaries, approximately 15,000 to 20,000 m<sup>3</sup>/s of river water will have to be 'put over' the dikes at peak times. This requires the energy equivalent to the consumption of one million households. A power that can only be supplied with a nuclear power plant. The average energy consumption is equal to that of 70,000 households. The defensive act allows the status quo in the Southwest Delta to be maintained. The separation between land and sea remains intact, with the chances of interaction between the two decreasing due to sea level rise. The land use in this scenario more or less follows the current use.

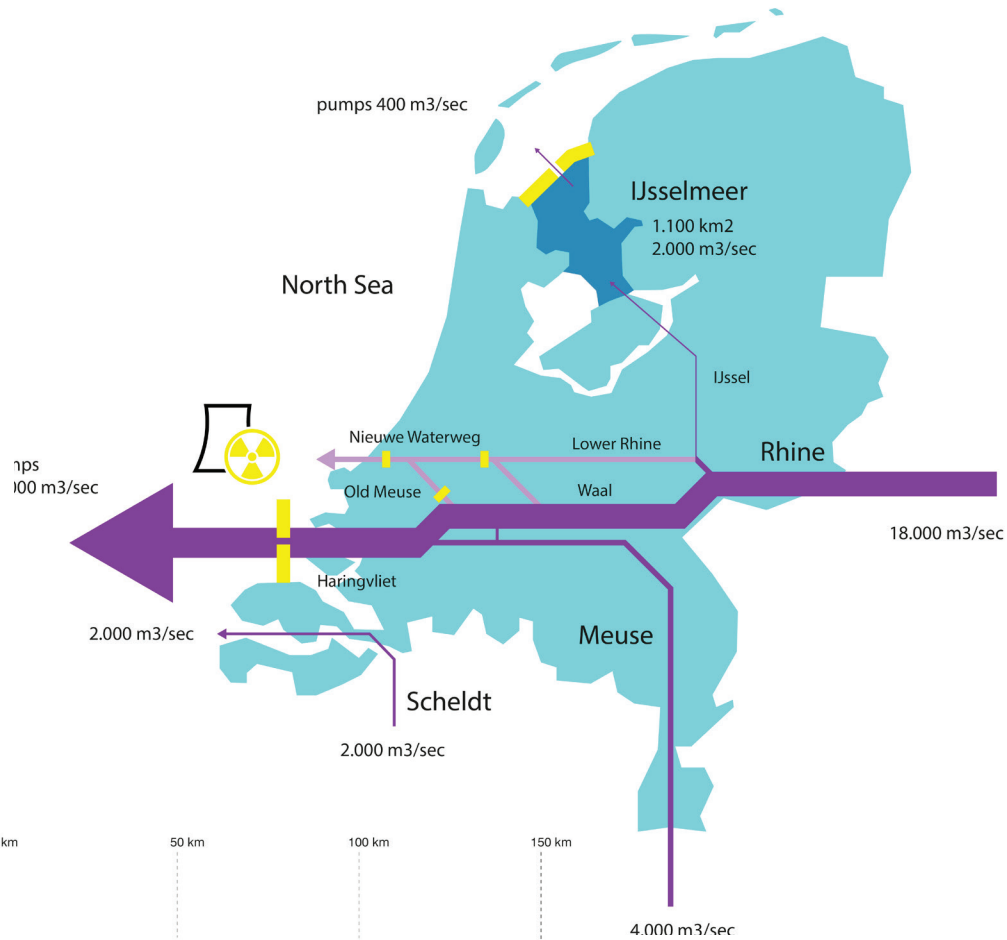
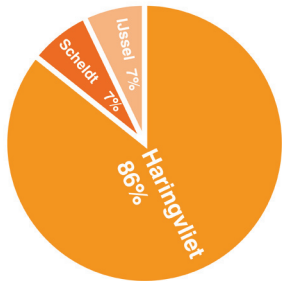
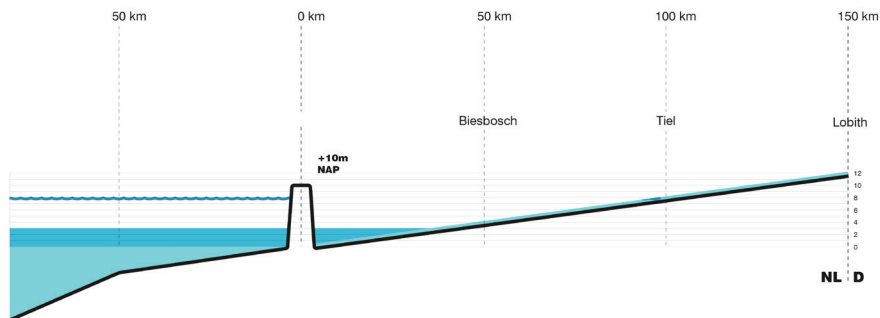


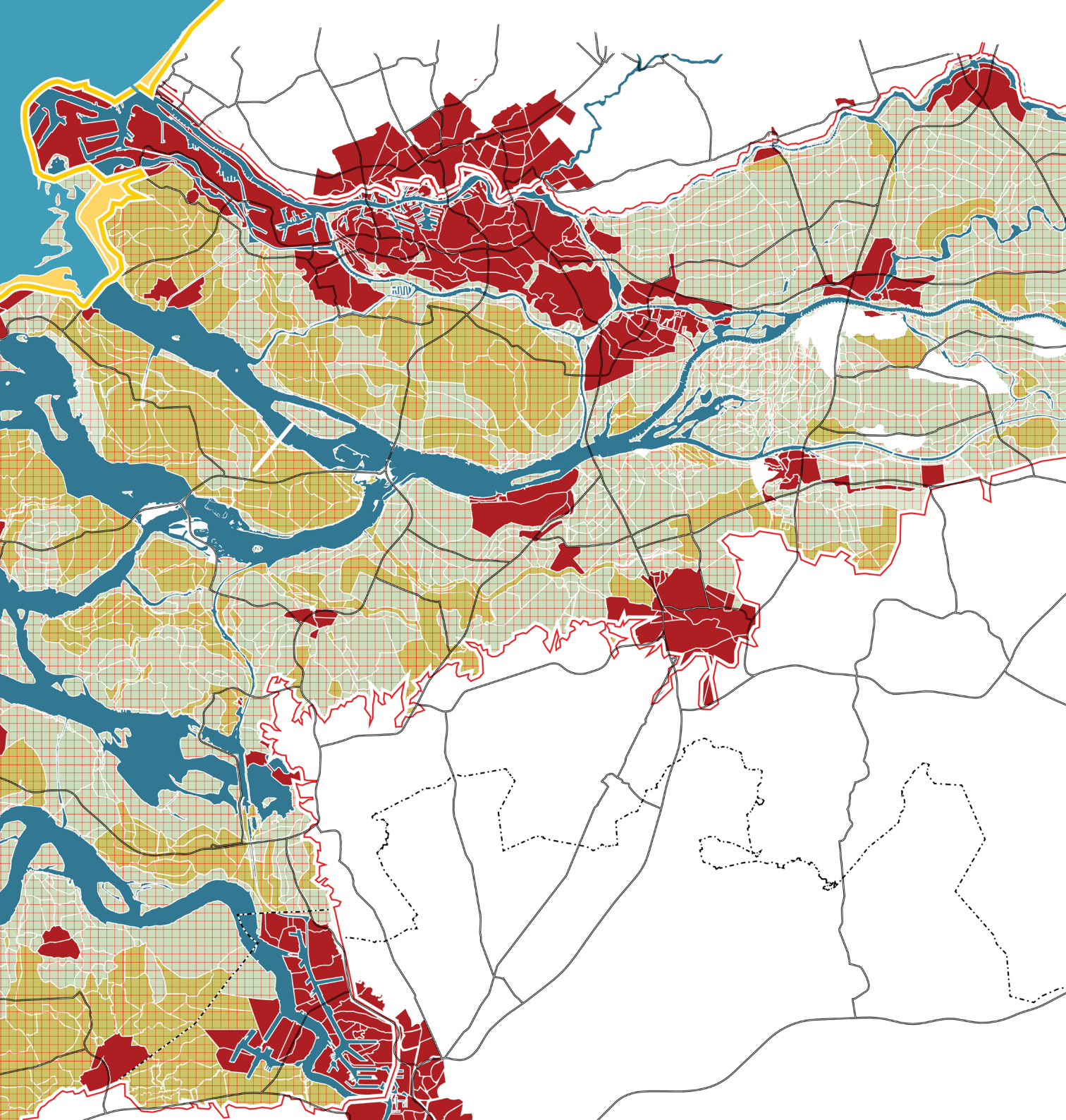
Figure 22: river outflow

Figure 23: river flow scheme

Figure 24: in section







## SEAWARDS



Figure 25: dikes in planview

With the construction of an offshore Battery Lake creates a two-for-one situation; the entire energy transition and storage is combined with climate adaptation. A large, 10m high ring dike encloses an offshore lake of about 200 km<sup>2</sup>. The Lake is located within the Dutch waters and outside the main shipping routes to the port of Rotterdam. Given that the North Sea is about 35m deep, the construction requires innovative construction method (caissons sinking, etc.). On the one hand, this 100km long dike protects the southwestern delta behind it. On the other hand, it provides water storage at high tide. At low tide, the lake flows empty into the North Sea. In addition to pumping stations for extreme situations, turbines are also being constructed in the dike for tides and energy and/or sweet-salt osmosis. After all, the Battery Lake will also serve as a super battery that can be pumped full in case of surplus energy and can flow empty for energy generation.

The ecological connection between the sea and the rivers will be created in a technical way, in gradual brackish transition areas, so that fish migration becomes possible. Battery Lake marks the next step forward for the Netherlands in the process of reclaiming land at sea. The intimate and renewed entanglement of land and sea is the epitome of engineering and faith. This scenario is based on the manufacturability of the landscape, and builds on the proud attitude whereby large-scale and technical solutions form a robust and powerful landscape.

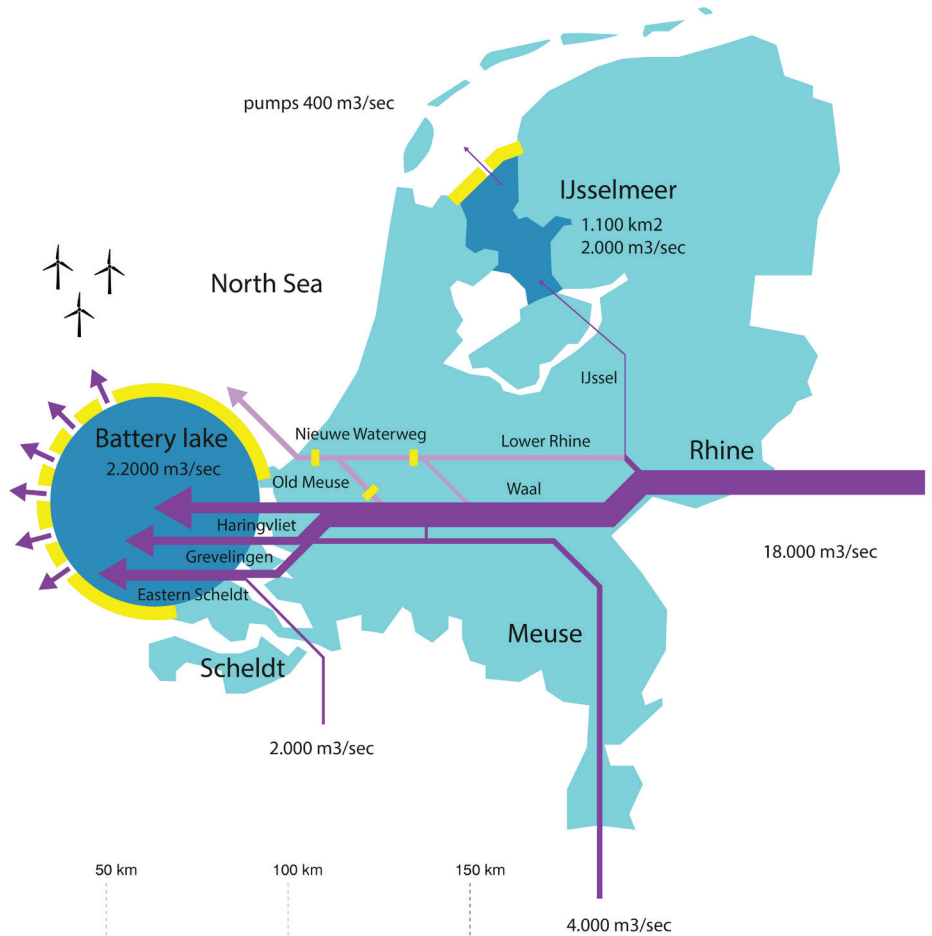
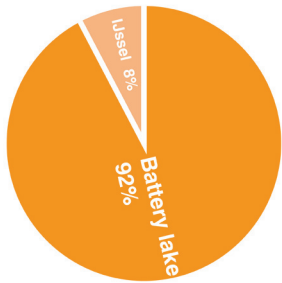
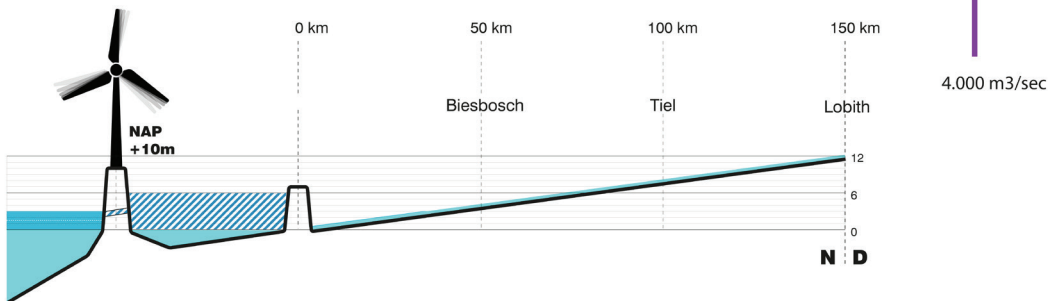


Figure 26: river outflow

Figure 27: in section

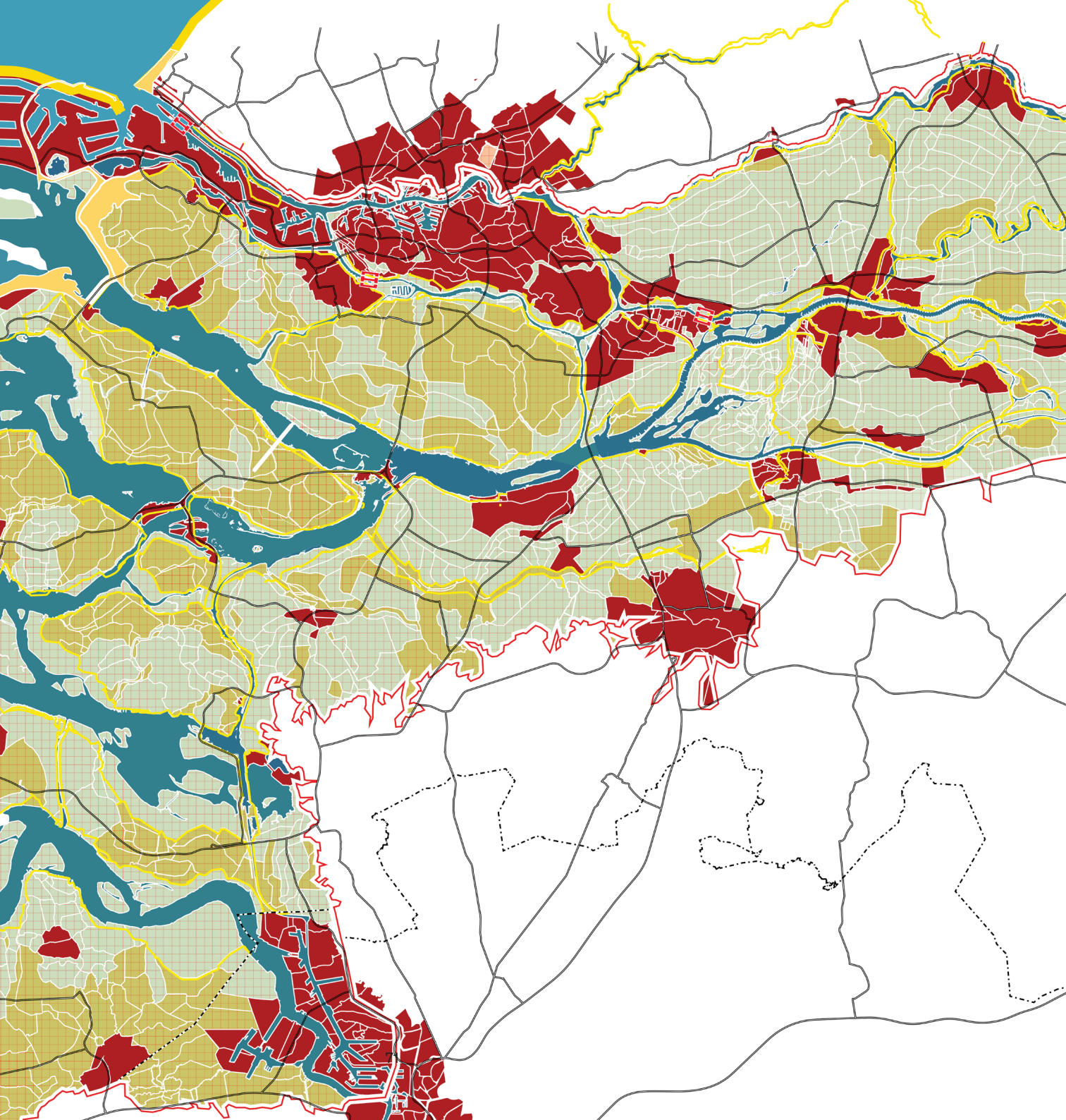
Figure 28: river flow scheme





五

70



## SUPERDELTA



Figure 29: dikes in planview

The Superdelta scenario is based on the partial opening of the connections to the sea. Along the major rivers, all dikes are raised so that sea and river water are given space. Depending on high and low tide, storms and peak discharges from the rivers, Super delta flows full and empty. In total, over a length of approximately 350km, the existing dikes must be raised from 7m+NAP to 10m+NAP. Between these dikes a natural and dynamic green-blue wadden landscape is created, wetlands of international importance for birds, fish and other animal species! In this wadden landscape there is also room for aquaculture and other innovative forms of food production. The habitation and use of this river area is limited to places where flooding can be absorbed or by means of safe havens; fortifications that are protected as islands in the water in case of calamities. The landscape of the Superdelta is a natural phenomenon within an increasingly urbanized Netherlands. The crossing from north to south revives the awareness of the power of nature and the way in which our country knows how to deal with it. The land use in this scenario embraces the new relationship with the new nature. Moving along instead of against moving. A diverse landscape, in which nature, small-scale agriculture, recreation and adaptive living go hand in hand. The Delta as the new national park of the low countries.

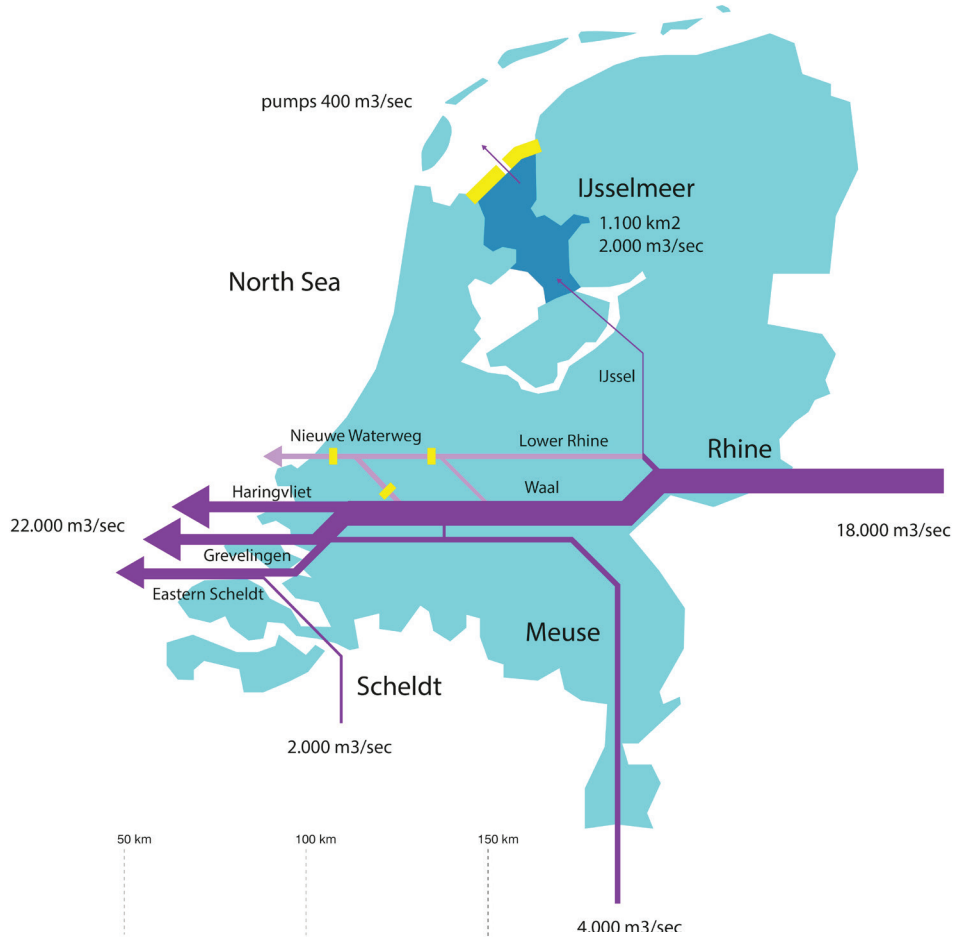
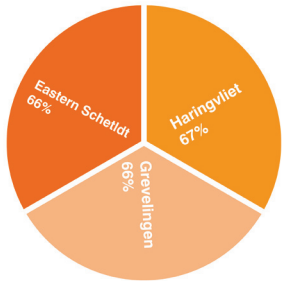
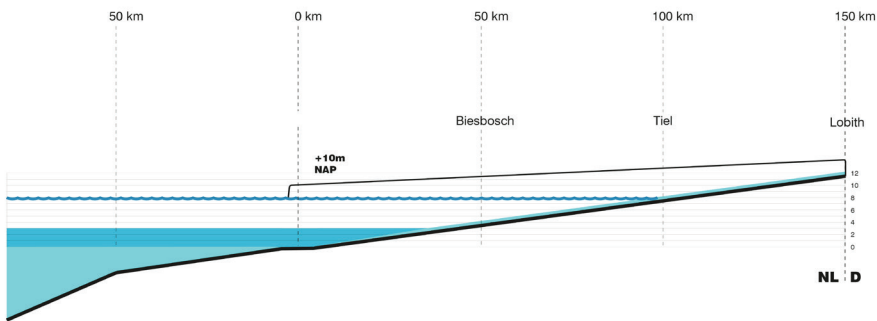


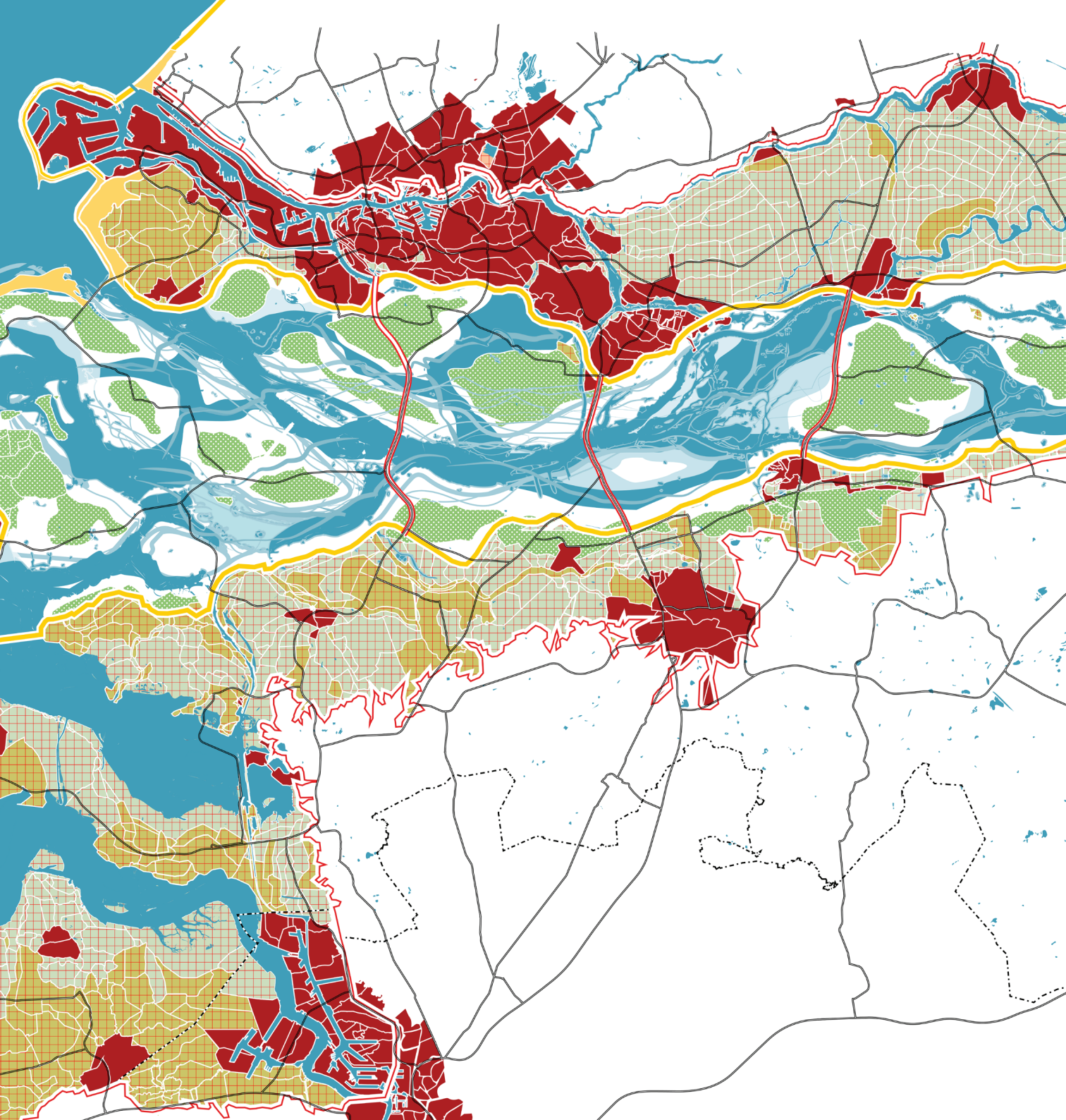
Figure 30: river outflow

Figure 31: in section

Figure 32: river flow scheme







## CONCLUSION

In contrast to common practice in the Netherlands where soil is a commodity, in the Southwestern delta, where the land is made and reclaimed by human hands from the sea, there is room for pride and progress.

From the fundamental and critical choices to make from the scenarios of water management the layout takes different directions. From there, considering a complex of challenges

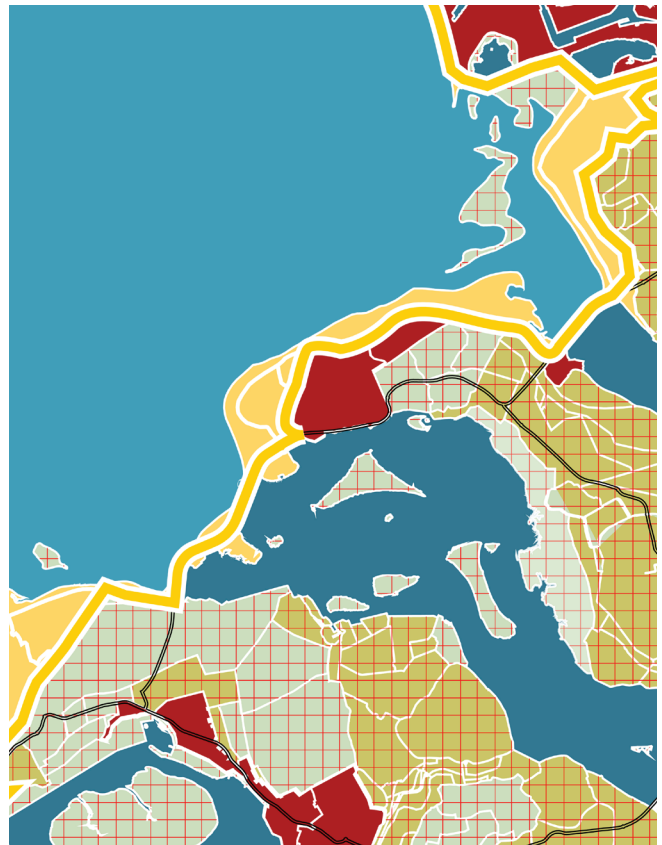
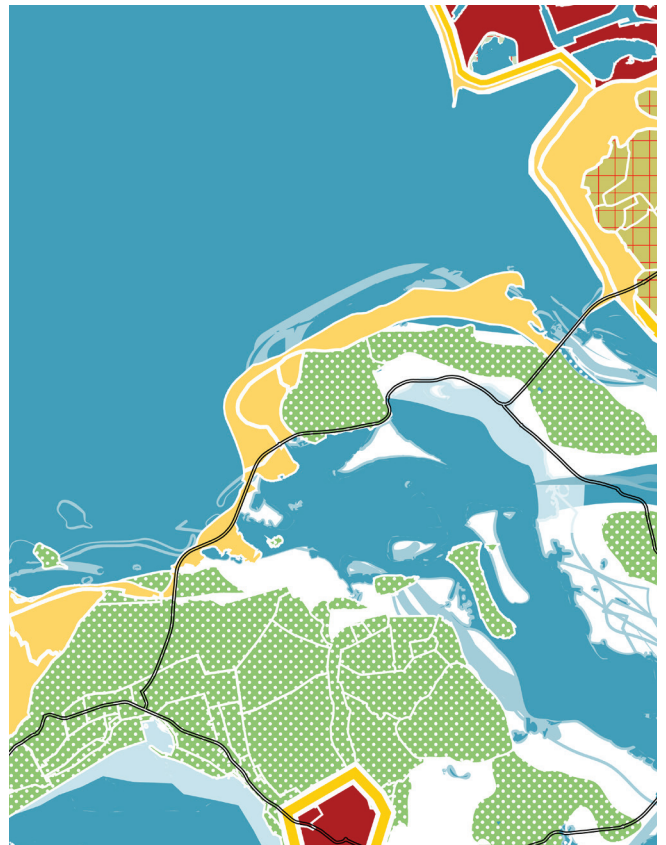


Figure 33: full defence  
Figure 34: seawards  
Figure 35: superdelta

and social forces, possible futures for the Southwestern delta can be mapped out.

Various ways in which forms of land and water use coexist and reinforce each other. We think it is a way in which both the necessities and the possibilities of a new future-proof planning tradition become apparent. A promising spatial laboratory in which the possibilities of the outlines of the Netherlands are made visible and imaginable.







## NATIONAL PRODUCTIVE PARK DELFLAND

ZUS [Zones Urbaines Sensibles]  
Flux  
Sweco

# INTRODUCTION TO THE CHALLENGE

## TEAM PRESENTATION

ZUS, Flux en Sweco have teamed up in this project, re-searching the Midden-Delfland area as a case study for the creation of the Manifesto: Redesigning Delta's.

ZUS is an office for research and design in architecture, urbanism, and landscape design. In this project they take the position of urban designer, looking into the interface between landscape - and city development. Flux Landscape is an office for landscape architecture, analyzing the natural- and manmade systems within the landscape. Sweco as an engineering bureau gives measurable facts and figures, working on realistic implementation of the concept.

## PROJECT PRESENTATION

The project focusses on the landscape of the Midden-Delfland area, surrounded by the cities of Rotterdam and Delft. It envisions a future for Midden-Delfland in 2122 and touches upon questions that are urgent and critical.

Should we build housing in polders below NAP? How is the water system in a deep polder under pressure of sea level rise and peak rains. What does the future of the airport look like? What does it mean for the current built environment and expansion plans? What does drought and soil subsidence mean for agricultural areas and how will this influence the desired functions in the future? What does it mean for the infrastructure where the important north-south connection is being constructed with the extension of the A16 to the A13?

# MIDDEN DELFLAND

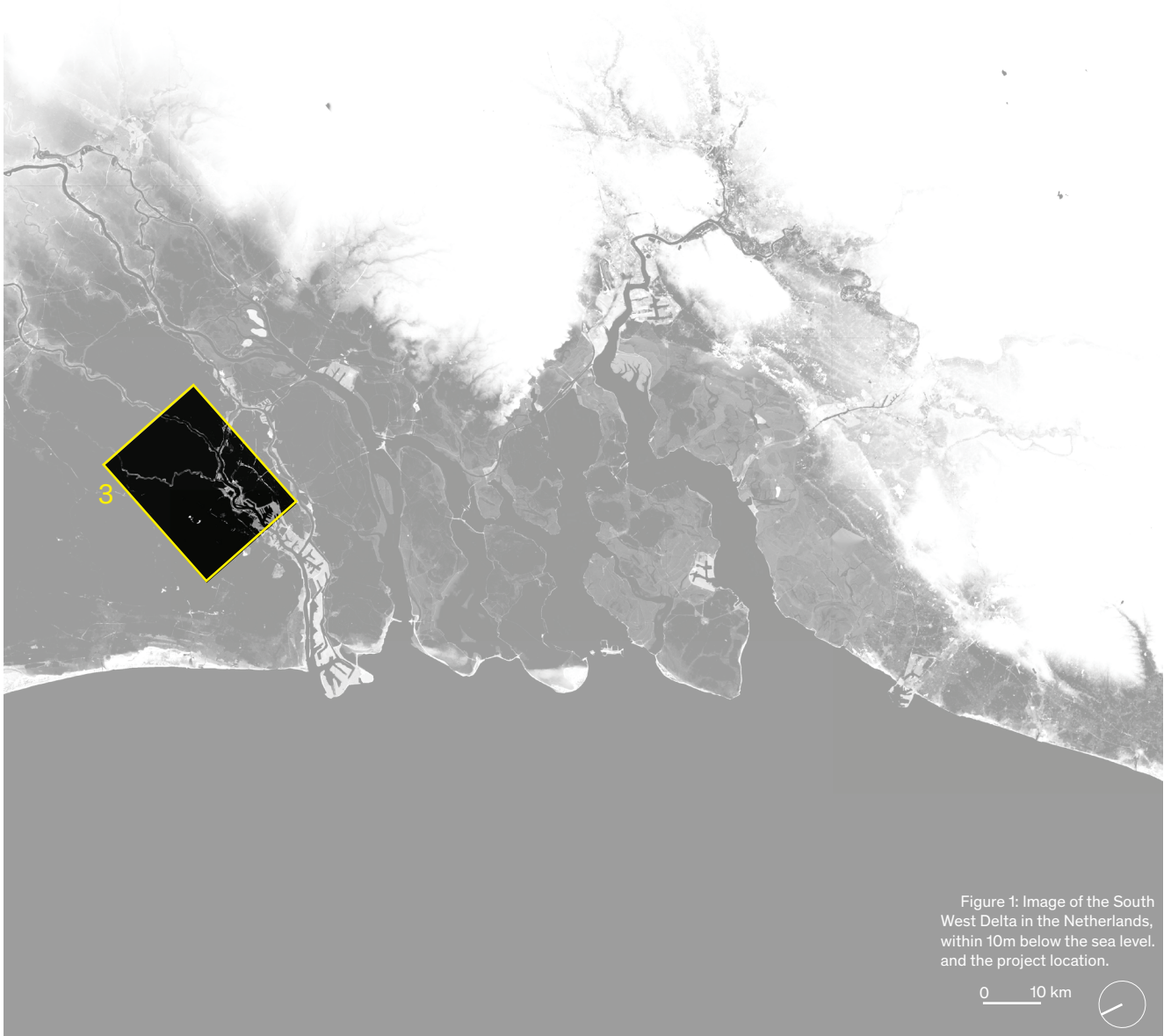


Figure 1: Image of the South West Delta in the Netherlands, within 10m below the sea level, and the project location.

0 10 km



# DISCOVERY / ANALYSIS

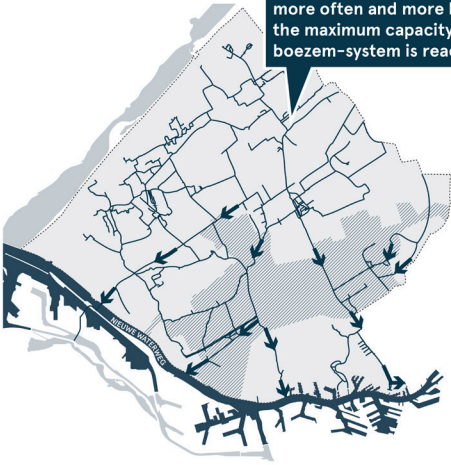
## DEFINITION OF THE CHALLENGE PROBLEM STATEMENT

Midden-DELFLAND is a peat meadow landscape surrounded by the large cities of Rotterdam, Delft and The Hague. It is currently one of the most densely populated and industrialized areas of the Netherlands. The pressure on the vast open territory in these cities is vital to meet the housing needs.

The claim for space that comes with urban development is large: for housing, logistics, agriculture, infrastructure and generating energy. In addition, the rural area faces major challenges in the field of biodiversity, energy and climate. It all comes together in the landscape of Midden-DELFLAND, designing the 'National Productive Park DELFLAND'

Due to the existing large amount of paved surface, there is significant strain on the water drainage system of Midden-DELFLAND. The (boezem)canals can be seen as the highways of the water system. In times of heavy precipitation, the water is drained to the Nieuwe Waterweg as quickly as possible. In times of drought, the water is pumped up again from Lake Brielse and returned via the same canals to the Midden-DELFLAND. This system is no longer future proof. The Boezem system has reached its maximum capacity. If we want to keep living in the cities lying below sea level in 2100 we will have to change our system drastically and design an integrated solution.

When precipitation will occur more often and more heavily, the maximum capacity of the boezem-system is reached

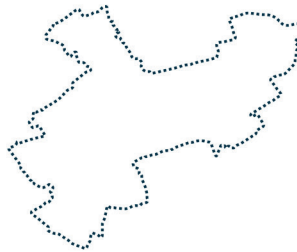
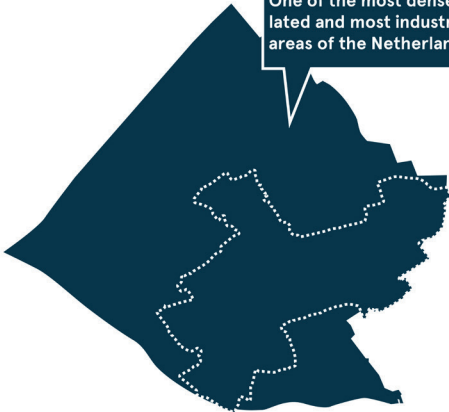


Brielse Meer is the drip of Westland, risk on letting in brackisch water. Water storage is necessary!

Delfland =  
40.000 ha

Midden Delfland =  
10.000 ha

One of the most densely populated and most industrialized areas of the Netherlands



x 1.4 Million inhabitants



x 30.000

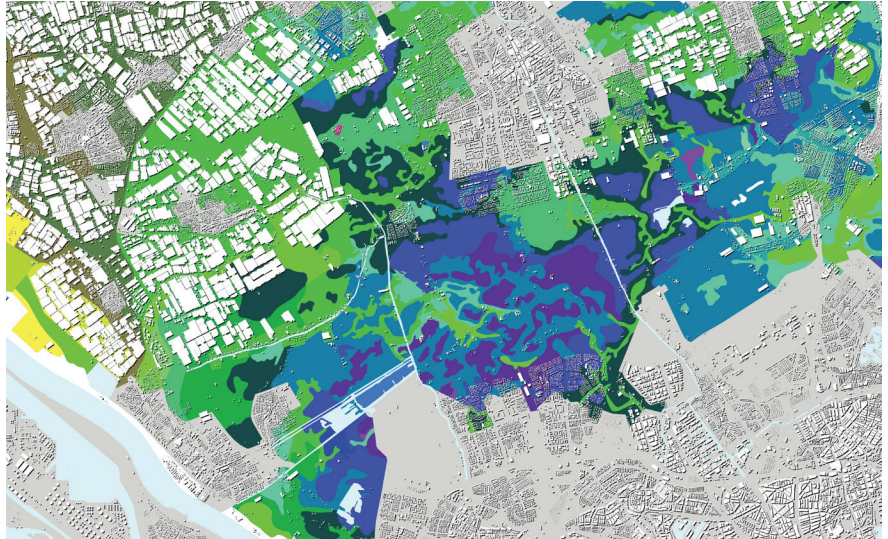
40.000 Companies

## ANALYSIS

- Veengrond
- Zeeklei
- Rivierklei
- Duinzandgronden
- Tuineerdgronden

### HIDDEN DYNAMICS

Although the landscape is seen as a peat meadow area with the typical narrow plot structure and as land use predominantly cattle ranching. The soil map shows that the landscape is much more diverse and dynamic. With catchments of old watercourses consisting of marine clay and river clay.



### VISIBLE IN THE TOPOGRAPHY

Dynamics are visible in the elevation map. These old waterways are also visible in the elevation map. This shows that these are higher than the surrounding landscape. This is because the peat landscape is declining, but other soil types are not, or not as rapidly.



- Water
- Gemaal

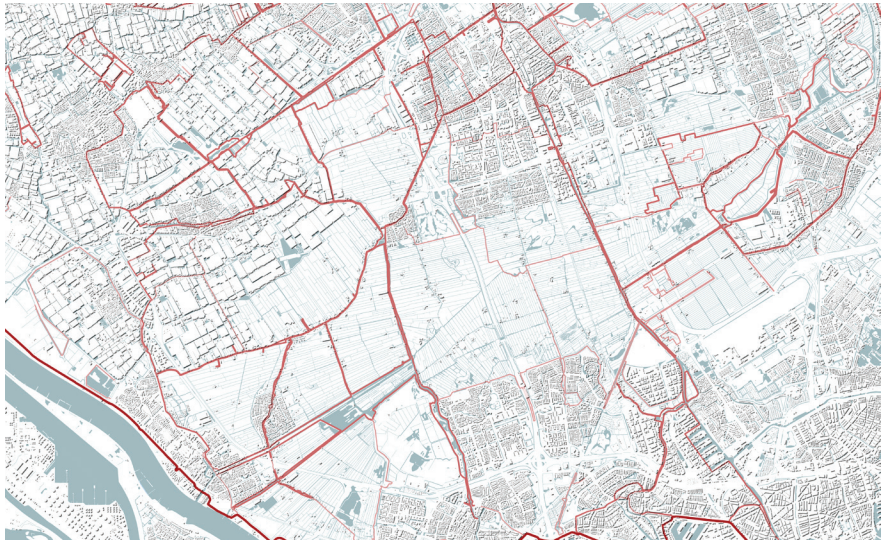
### WATERMACHINE

For centuries the watersystem was adapted to our needs. This resulted in a watermachine that pumps the water in and out of the land using a lot of energy and a complex system of dikes, canals, ditches, sluices and water pumps.



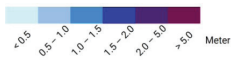
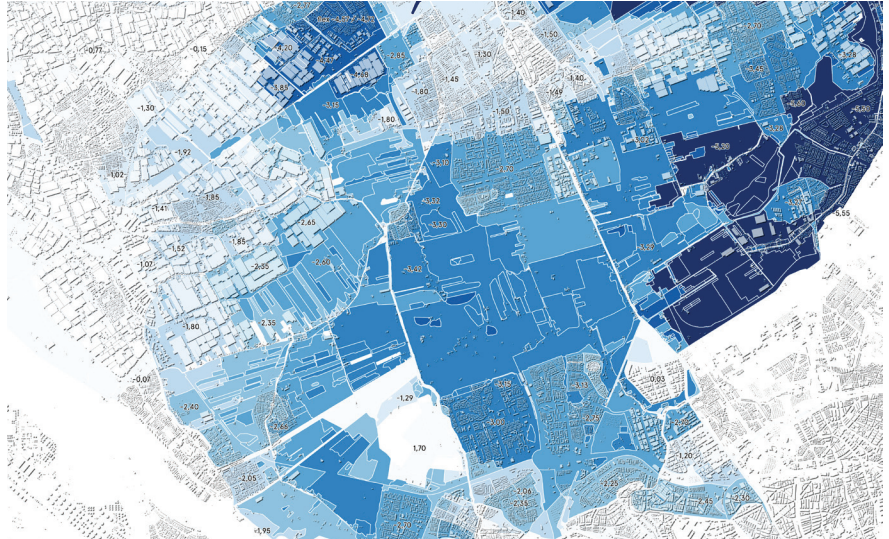
### 160 KM EMBANKMENTS

Part of the watermachine are a large number of dikes. All these dikes request maintenance, due to the consequences of climate change they have to be heightened or reinforced regularly.



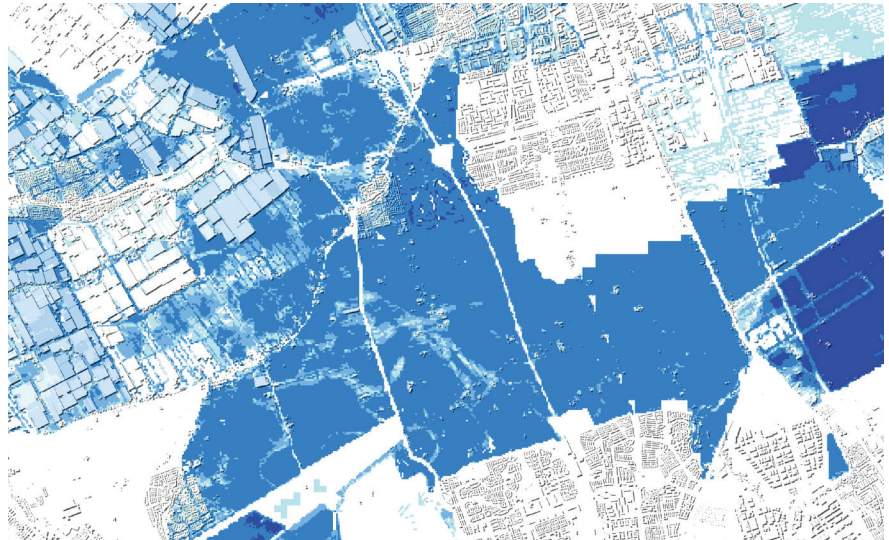
### 122 WATERLEVEL SECTIONS

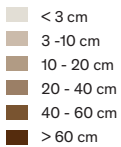
The 122 level sections are also a result of the complex water system. Each level section is located between weirs, locks or pumping stations and has its own water level.



### CHALLENGE: DEPT OF FLOODING

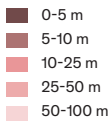
Midden DELFLAND is vulnerable for flooding. It is a low-lying area in the west of the Netherlands in some locations up to 6 meters below NAP. Likewise, also in this map the height difference visible between the old watercourses and the peat landscape.





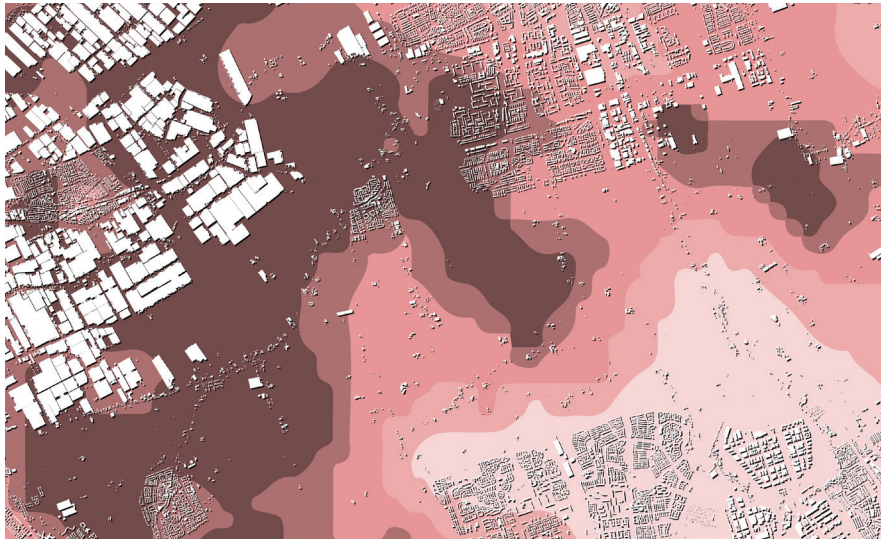
**CHALLENGE: LAND SUBSIDENCE FORECAST 2100**

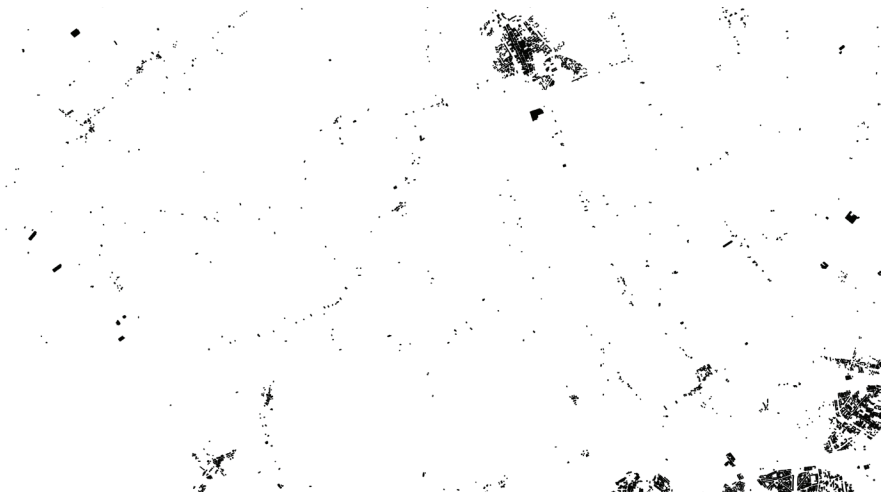
The peat soil is declining rapidly in some cases even 1 centimeter per year. Due to the declining landscape greenhouse gasses including CO<sub>2</sub> are released which contributes to global warming.



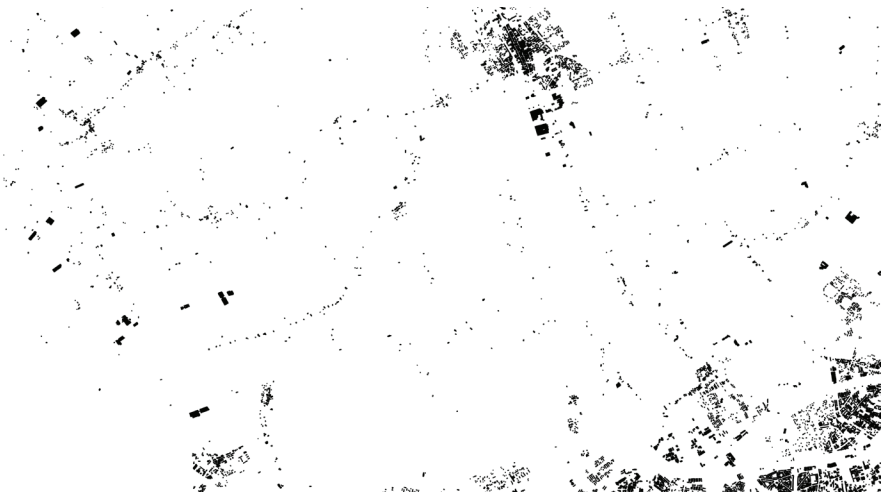
**CHALLENGE: SALINIZATION**

In times of drought, salinization is caused by infiltrating brackish groundwater or pressure from the penetrating seawater. This is visible in the greenhouse area where a lot of freshwater is extracted from the ground for cultivation. Freshwater is needed to provide counterpressure against the salt water seepage.





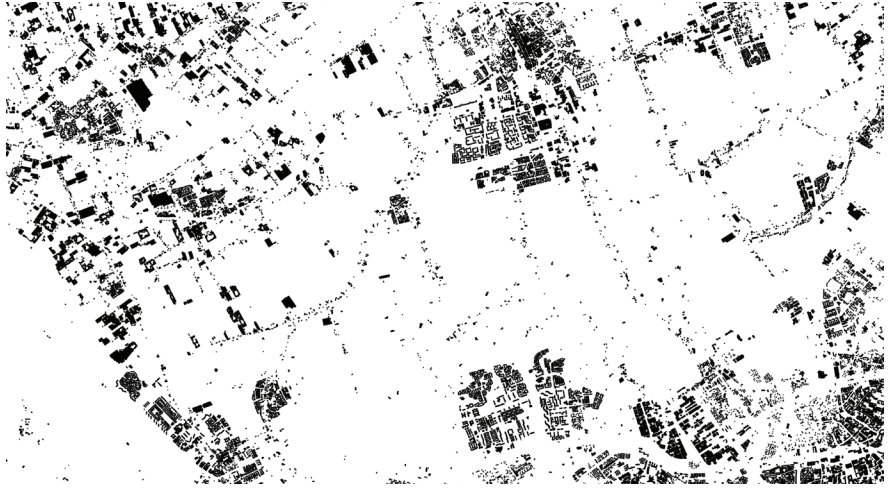
1900



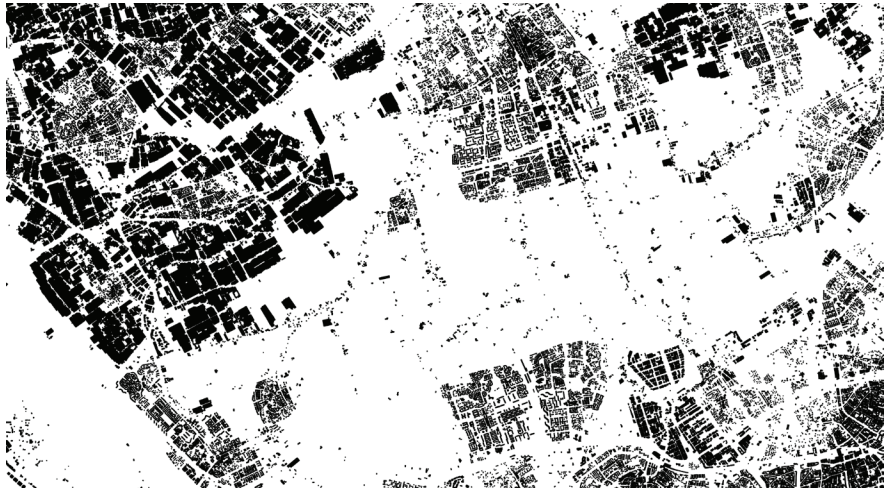
1960

#### +1 MILLION

Landscape under pressure from further urbanization. The maps clearly show how the Midden DELFLAND area has been almost completely built up in 100 years. Due to the housing shortage and the limited space in the city, open areas on the outskirts of the city are vulnerable to urban expansion.



1980



2020

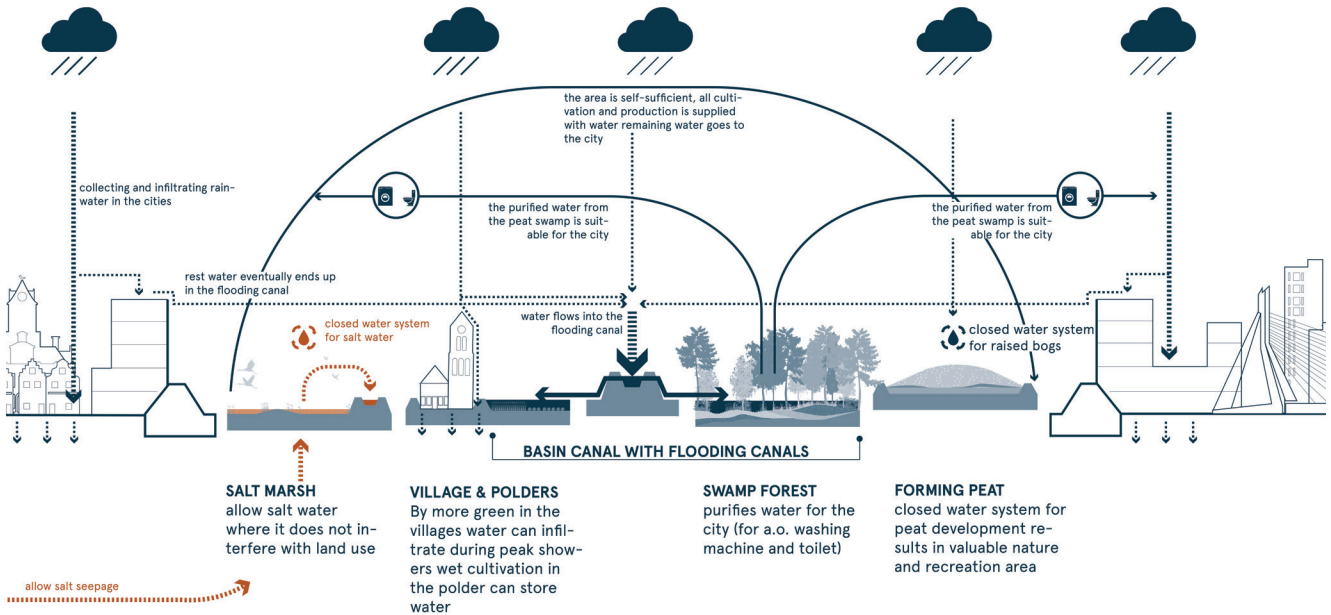
## PRINCIPLES OF THE PROJECT

With the expectation that weather conditions will be increasingly extreme due to climate change, the valuable water should no longer be discharged. Instead, it should be stored to be used in times of drought. It is essential to redesign the boezem-system in such a way that the boezems get more space and become green-blue infrastructures connecting with the surrounding urban areas. Simultaneously, hotter summers will increase the drought in the surrounding cities, population growth will densify within the cities and will raise the necessity for surrounding nature, water and air. Midden-DELFLAND should become a green lung and a sponge for the livability of surrounding cities.

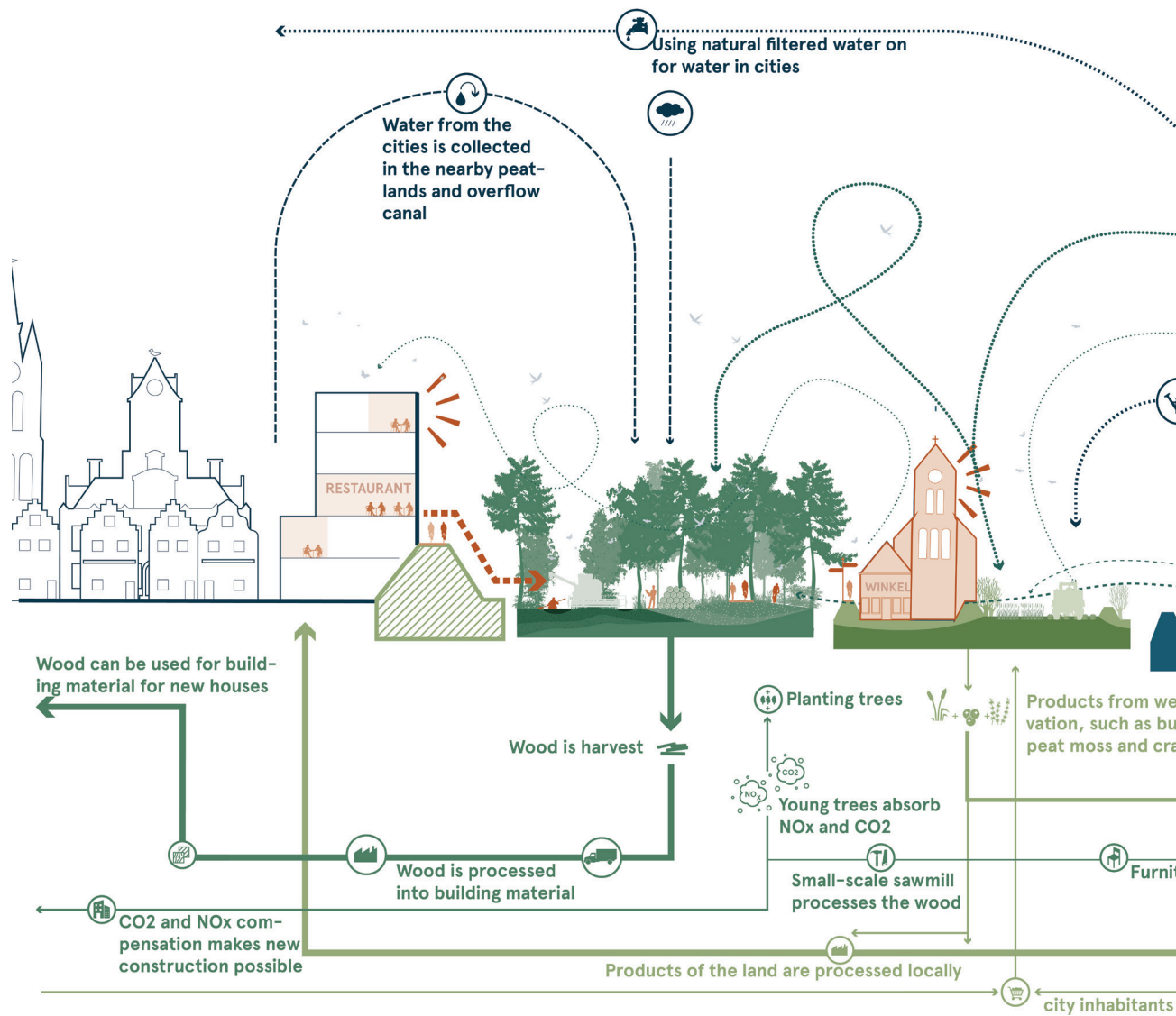
The new 'National Productive Park DELFLAND' will service the surrounding urban areas in various ways. Based on the morphology of the underground, several zones for different type of production and innovative land use are assigned. The various morphologies and typologies in the landscape form the basis for the land use and will result in a waterbuffer and filter, new forms of agriculture and nature preservation, while the area is maintaining its recreative use.

The distinct form of the park directs the densification of city edges. Some borders will be further densified, closer to nature, the boezem-system, infrastructural nodes and amenities. We envision the Zestienhoven Airport has lots of densification potential. The new highway connection of the A13-A16 forms an existing dike to protect the lower-lying Zestienhoven polder from the dynamic system in the Midden DELFLAND area.

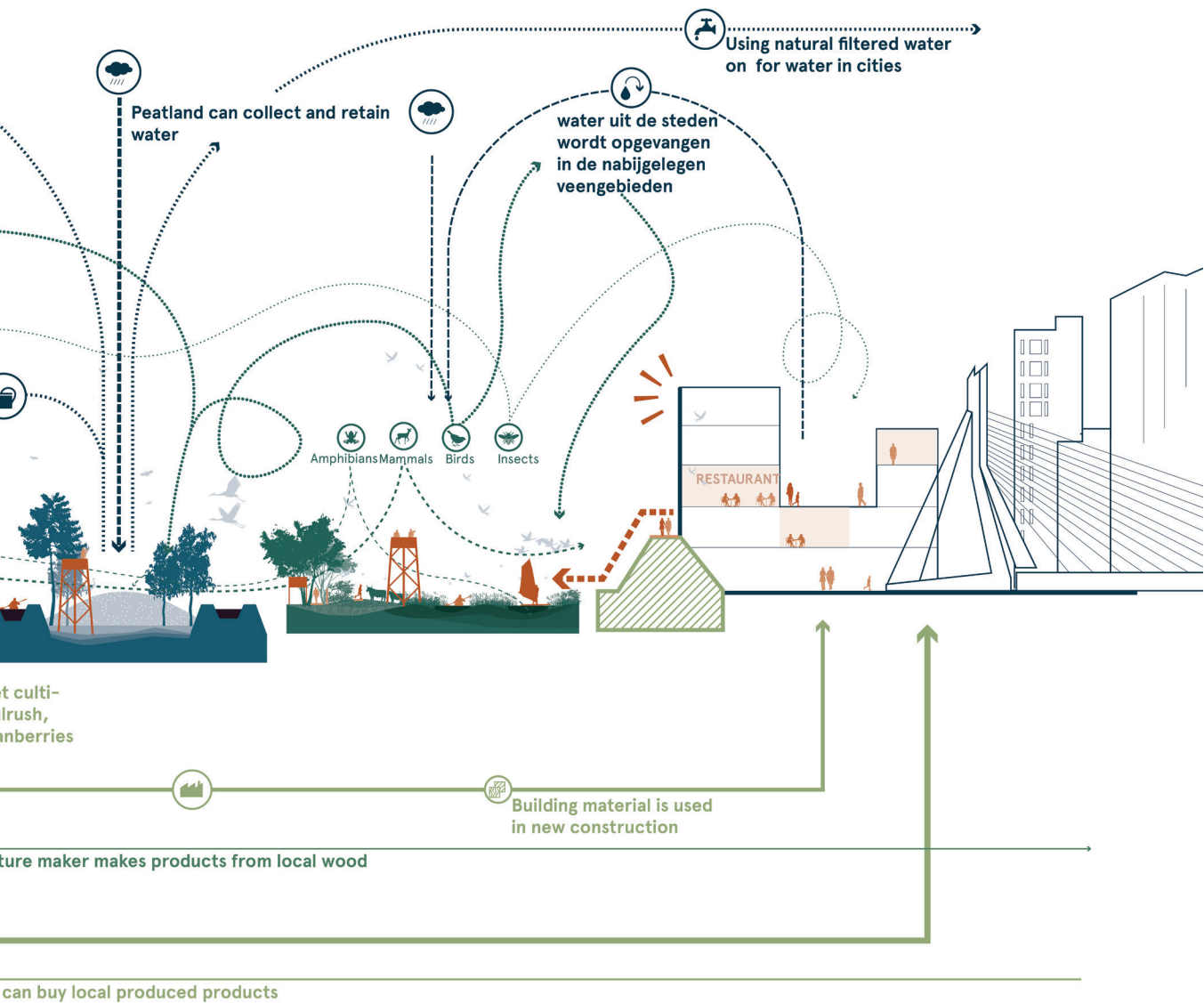
Yield national productive park DELFLAND



A self-sufficient water system with more space for the basin canals in the form of a flood canals.



National productive park DELFLAND; a green lung for the city



# DESIGN AND DEVELOPMENT

## CREATING THE PROPOSITION SKETCHING

The project envisions a casco, based on the existing boezem-system to relieve the boezem-system from water during peaks, and inverse its traditional purpose so that it can feed the buffered water back to the city during droughts. All low polders adjacent to the Boezem Canal will be designed in such a way that they can collect the water in times of heavy rainfall. At specific locations along the canal, the dike will be lowered so that water can flow to the surrounding low-lying polders.

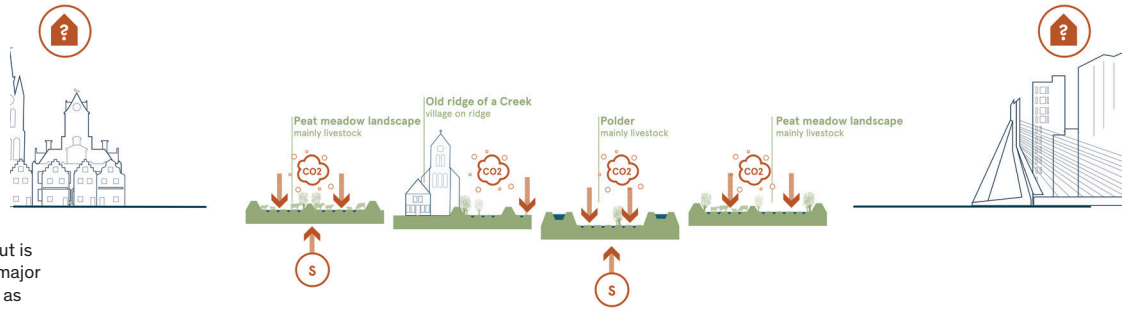
The landscape casco and landuse is determined by the topography and morphology to create floodable areas around the boezems. Next to the floodable areas are the 'movement' zones. Within these zones there can be different functions, based on the morphology of the site, that demand innovative living to anticipate and mitigate predicted problems. Thus, creating a casco within a casco.

Instead of making the landscape suitable for the land use, we start from the soil and adapt the land use accordingly. This could be a wetland in the peat area, a production forest on the clay and new forms of natural agriculture on both soil types.

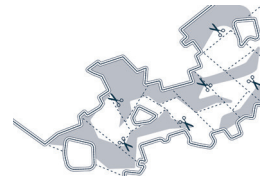
SKETCH  
Plan "Woudaapje"



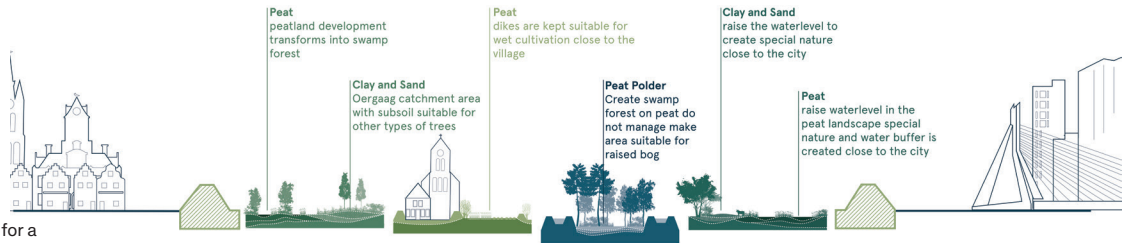
# PROJECT PHASING

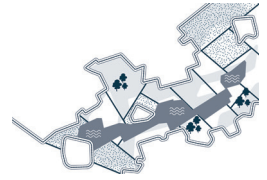


Step 1. Dikes move to the edges around the cities and cultural historical elements using the natural cascading topography as base for the landscape

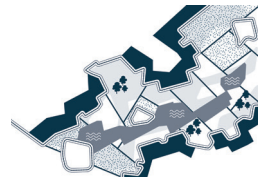
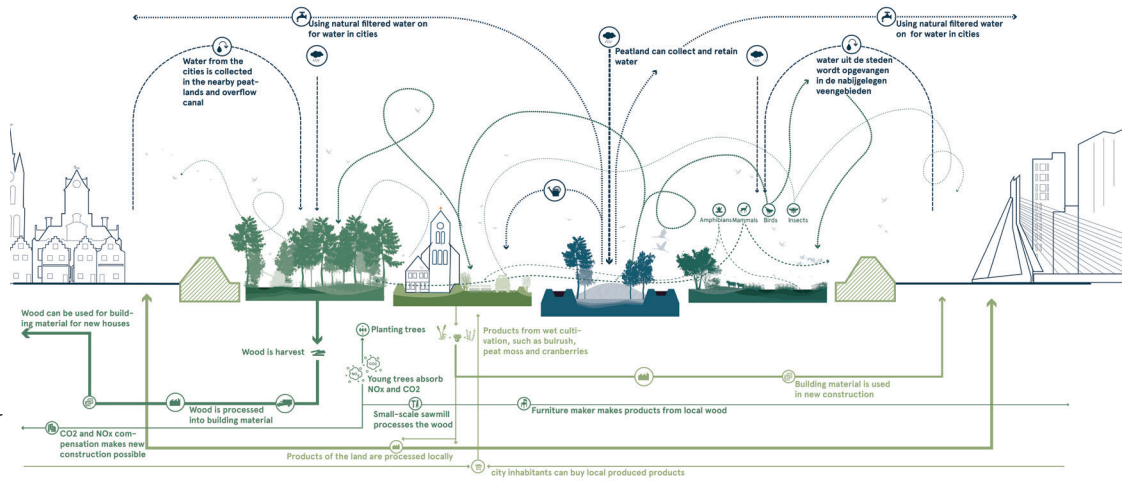


Step 2. A new division for a cascading system based on the current soil build-up

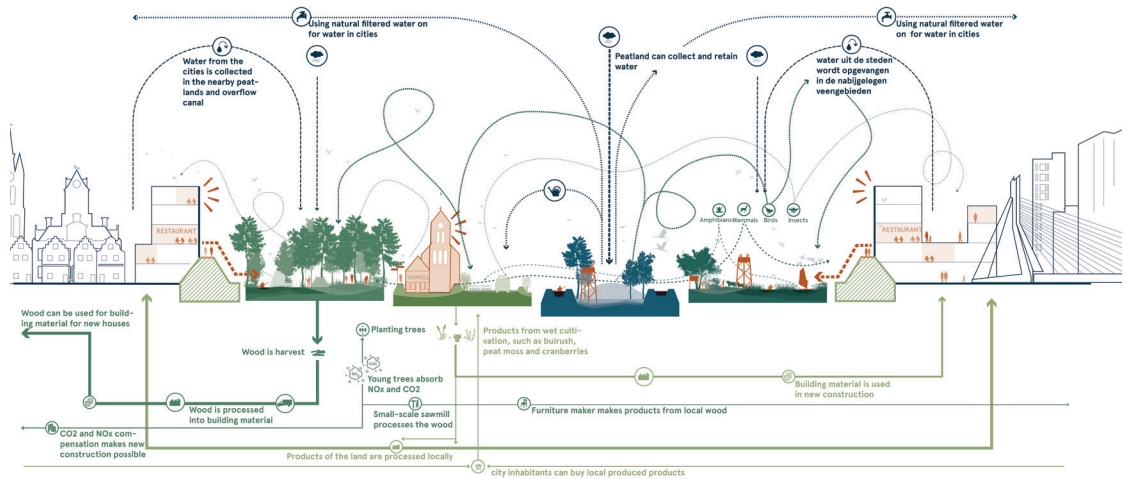




Step 3. The National productive Park DELFLAND as a green lung, storing CO<sub>2</sub>, water, wood production, nature and recreational value for the city

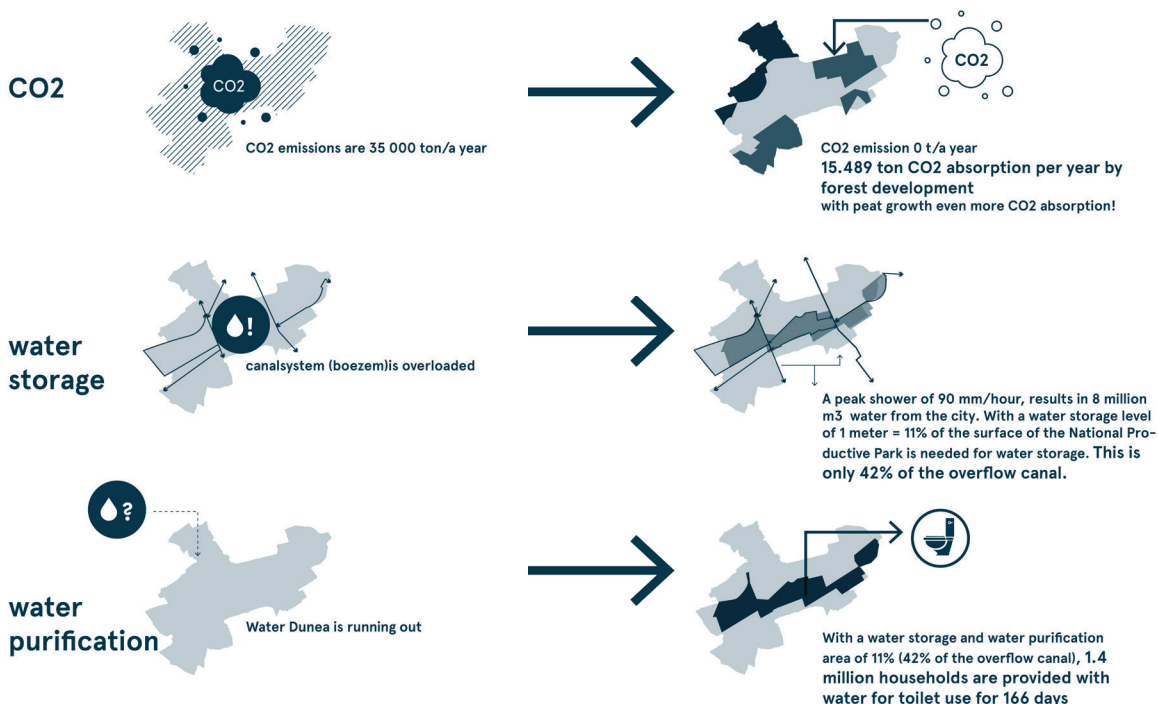


Step 4. New city fringes with green blue recreational connections between city and park.

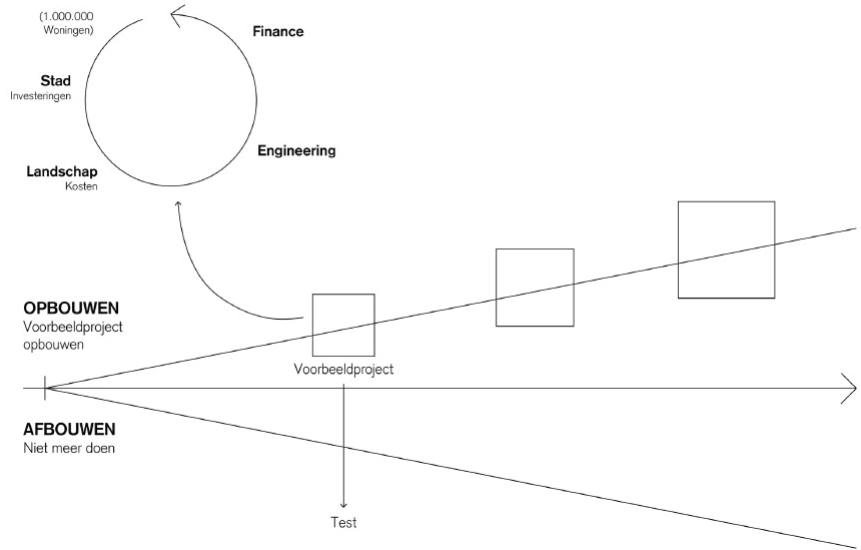


**ACTIONS/POLICIES/  
PROJECT FRAMEWORK/  
CRITICAL ASPECTS**

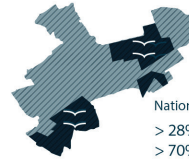
Overall, investments in climate adaptive landscapes are merely considered as costs that must be generated through public funding. On the other side surrounding cities take advantage of the increased safety and value of this landscape and profit through the extrapolation of real estate value. Traditionally a GREX (ground exploitation) is limited to the urban development zone. Therefore, within these times of necessary adaptation, we propose the EX(tended)GREX, which considers the natural and the urban system as a whole, as a reciprocity of mutual benefits. Applying this instrument will create bigger and faster action on climate adaptation.



Method - extended GREX

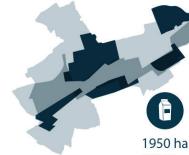


Nature



National Productive Park Delfland = Nature!  
> 28% is completely natural  
> 70% is nature inclusive

Food production



1950 ha wet cultivation  
2015 ha nature farmers  
= a more diverse yield of products from the National Productive Park Delfland

Wood production



1721 ha of forest yields 4.3m<sup>3</sup> wood per ha/y with sustainable wood management  
= total 7,400m<sup>3</sup> wood per year  
= 121 houses per year made of wood

Current situation vs. National Productive Park DELFLAND - numbers based on indicative calculations, will need to be specified.

# FINAL PROJECTION

## PROJECT MANIFESTO

The development of the National Productive Park DELFLAND starts with the notion of urgency. With many simultaneous crises we need to come to grips with problems that the Rotterdam region faces now and in the future, and thus make statements that are bold and immediate.

National Productive Park DELFLAND is a concept in which new city edges are designed for Delft and Rotterdam with room for densification. Leading to a simplified water system with less dykes, pumps and sluices. The land use will be based on the existing landscape morphology. The revenue that the densification of the cities generates will be appropriated for the construction of the National Productive Park DELFLAND. Strengthening the natural value of the space in between the cities. With opportunities for increasing biodiversity, supplying raw materials and food and solving issues such as flooding, subsidence and the threat of salinization. By means of this approach, the area can be saved from further housing development and a green area is created that can perform as a lung for surrounding urban areas.

National Productive Park DELFLAND is an attractive landscape park in which various functions are integrated. There are recreational routes that connect city and park. Important cultural-historical elements are preserved in the park like old villages, churches etc. The park plays an important role in purifying household wastewater, retaining rainwater and by 2100 providing clean drinking water, food production, and a forest for the storage of CO<sub>2</sub> and the production of circular building materials.



During peak rainfall the park keeps surrounding urban areas dry and provides water for a livable city in drier times, by adjusting the boezem-system. The housing assignment is an integral part of the development of the National Productive Park DELFLAND. Mixed use developments will be located on the edges of the park and form an attractive façade towards the park. Rotterdam and Delft both can expand in this way with a metropolitan frontier facing the National Productive Park DELFLAND. The National Productive Park DELFLAND build upon traditional landscape methods that the Netherlands has known for ages, adapting them to the needs of the future, acknowledging the logic of the existing soil layers.

View on Delft from the  
National Productive Park  
DELFLAND



Left  
1. View on Delft,  
current situation.



Right  
2. Dike around  
cultural-historical  
villages. Elevating the  
A13.

Left  
3. Allow natural dynamic  
systems



Right  
2. Densifying city  
edges

Left  
5.. Dynamic productive  
and recreational  
landscape



Right  
6. landscape reset,  
ever changing  
landscape during peak  
rainfall floods or after  
harvest.

View on Rotterdam from the  
National Productive Park  
DELFLAND



Left  
1. View on Rotterdam,  
A16 being build on a new  
dike.



Right  
2. Elevating the A13



Left  
3. Allow natural dynamic  
systems



Right  
2. Densifying city  
edges, on the location of  
Rotterdam/ the Hague  
airport













Left  
5.. Dynamic productive  
and recreational  
landscape



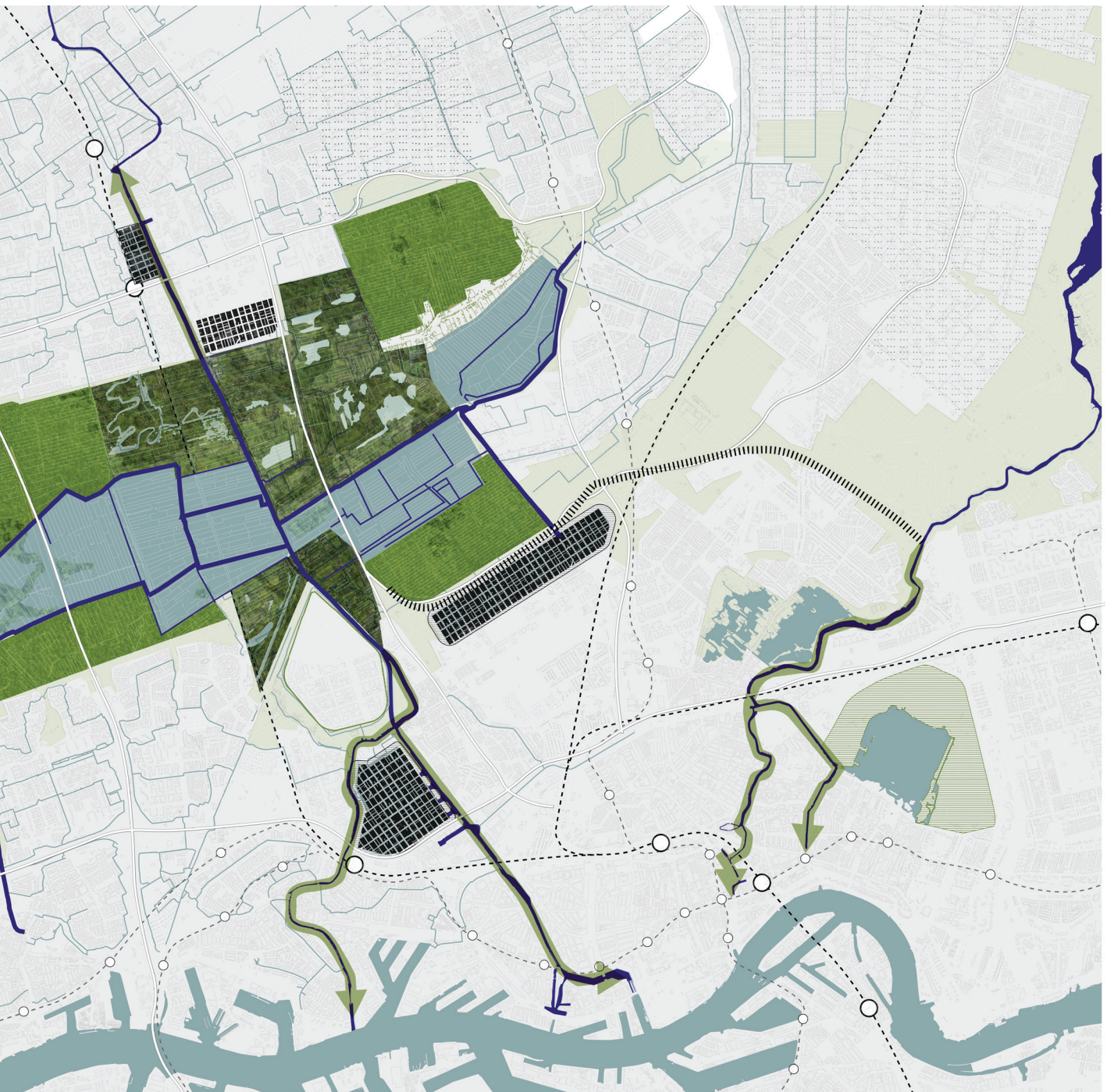
Right  
6. landscape reset,  
ever changing  
landscape during peak  
rainfall floods or after  
harvest.



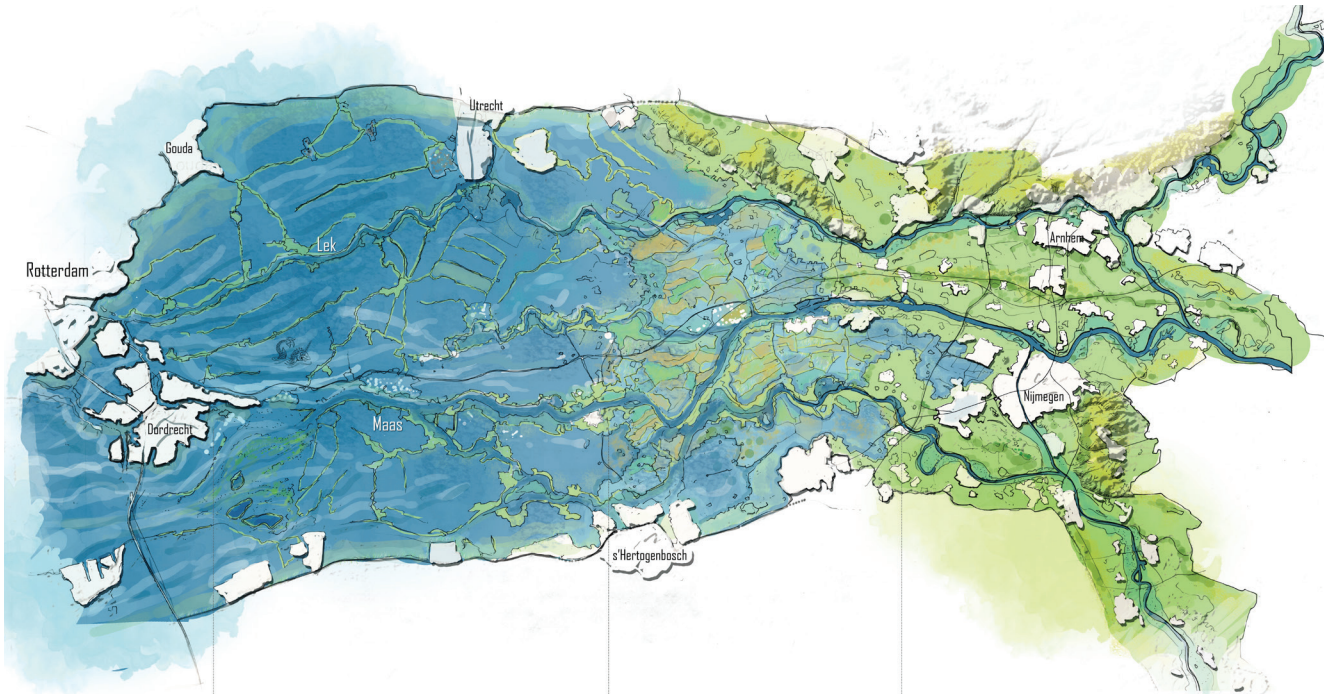
-  Boezembuffer; mainly waterstorage and reeds
-  Boezem
-  Peetlands: new forms of natural farming, wet fields
-  Peet+clay lands: natural reserves, wetlands for birds
-  Claylands: woodproduction, fruitpicking forests
-  Dike around lower parts of the existing urban areas
-  Urban area's
-  Public transport nodes
-  Designated areas for urban densification and waterbuffer within the city
-  Boezem as a green blue infrastructure in the city

Vision National Productive  
Park DELFLAND









## BREAKTHROUGH!

Forward thinking by introducing the North-Sea in the Maas-Waal Corridor combined with a retreat and re-poldering strategy.

FABRICations  
Bosch Slabbers  
Tauw

# INTRODUCTION TO THE CHALLENGE

## TEAM PRESENTATION

FABRICations, BoschSlabbers and TAUW have teamed up to create a retreat strategy for the Maas-Waal corridor.

FABRICations is a knowledge-intensive design practice for designing better cities. The office researches and designs architecture, urban planning and regional strategies for healthy urban ecosystems.

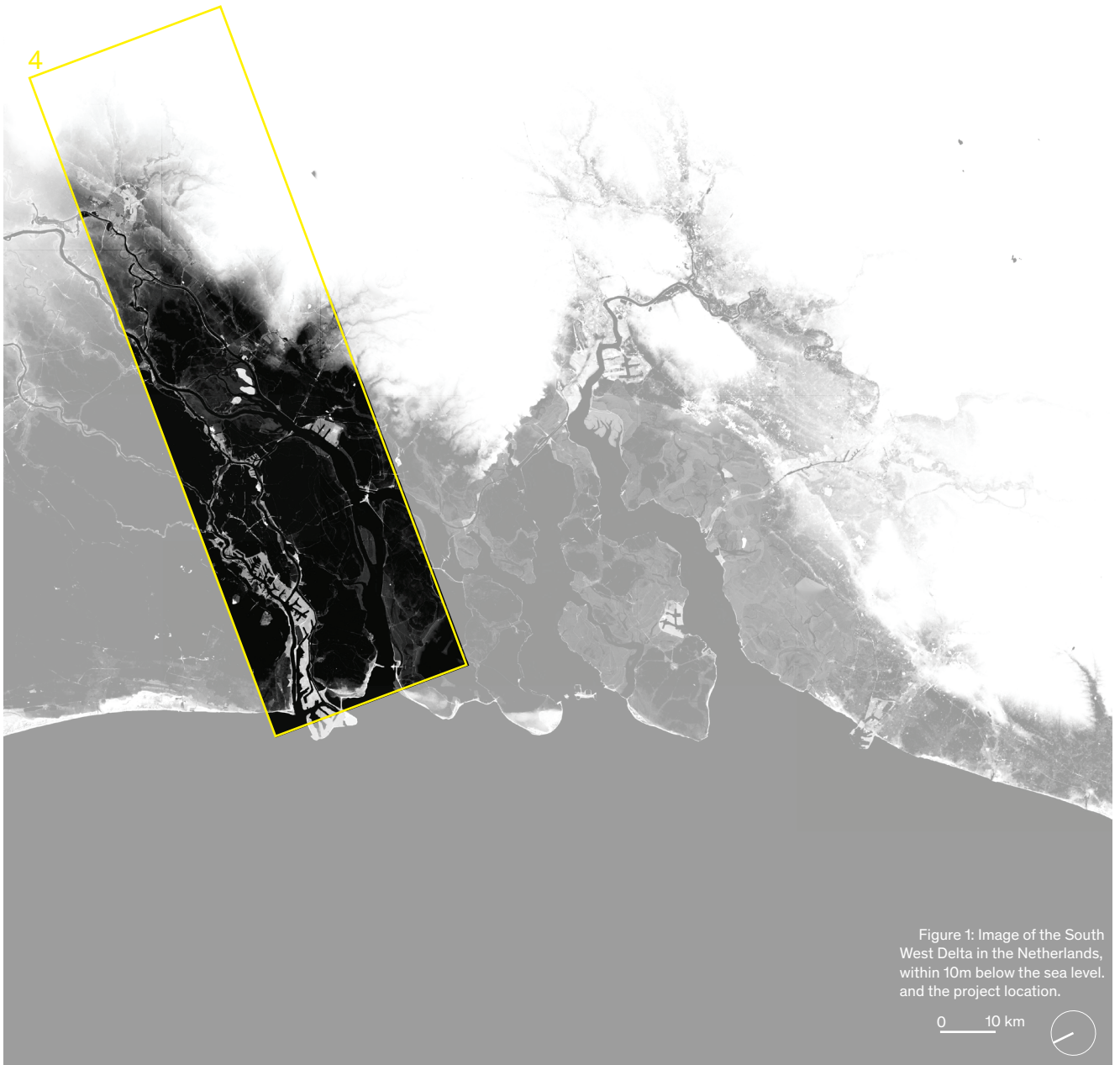
BSLA:BoschSlabbers landscape architects consists of 35 enthusiastic professionals who read a landscape like an exciting book. We believe that three challenges are important in every assignment: Global challenge, local contribution. The natural system as a basis and engine. Connecting people with their landscape.

TAUW is a European consultancy and engineering firm with a strong position in environmental advice and the sustainable development of the living environment.

## PROJECT PRESENTATION

The project builds on finding certainty within extreme climatic projections. Sea level rise projections have been rising year by year, what certainty do we have that it won't rise further in the years to come? How might this guide our strategic thinking on the Dutch delta? This project investigates the step-by-step retreat of our urban network in the Maas-Waal corridor. Not based on steps in time, but on steps of sea level Rise. Through the catastrophe of losing an area with a long history to the sea actually lie new chances for occupation, throughout the Netherlands. If we gradually leave the corridor, nature will get more space and solve many of our natural goals. De Veluwe, now being important nature on higher ground, will then be available for urbanization. At the same time the retreat will provide new land and possibilities for different kinds of land-use in a detailed polder-patchwork. Daily floods are welcome whereas some areas will be protected against regular floods.

# RIVEREN



# DISCOVERY / ANALYSIS

## DEFINITION OF THE CHALLENGE PROBLEM STATEMENT

THE SYSTEM IS GOING TO COLLAPSE,  
HOW ARE WE GOING TO GUIDE THE DISASTER.

The future of our Dutch river corridor is uncertain. The further into the future, uncertainty increases, the wider the bandwidths fan out in our models for sea level rise, rainfall deficits, subsidence and housing challenges. How do we know if we can trust on a conservative scenario or whether we should start from the extremes? And what if.... the most extreme scenario becomes reality? What is the future perspective for the Dutch river corridor? And how can we guide this transition step by step? These are the questions we ask ourselves in this spatial exploration.

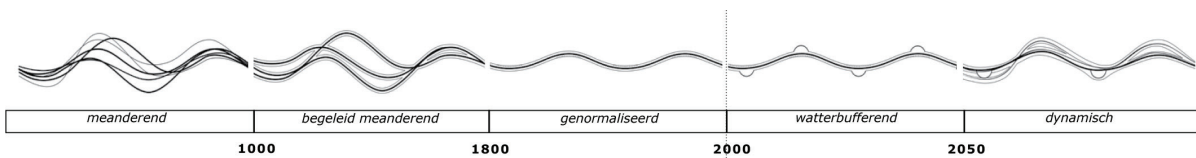
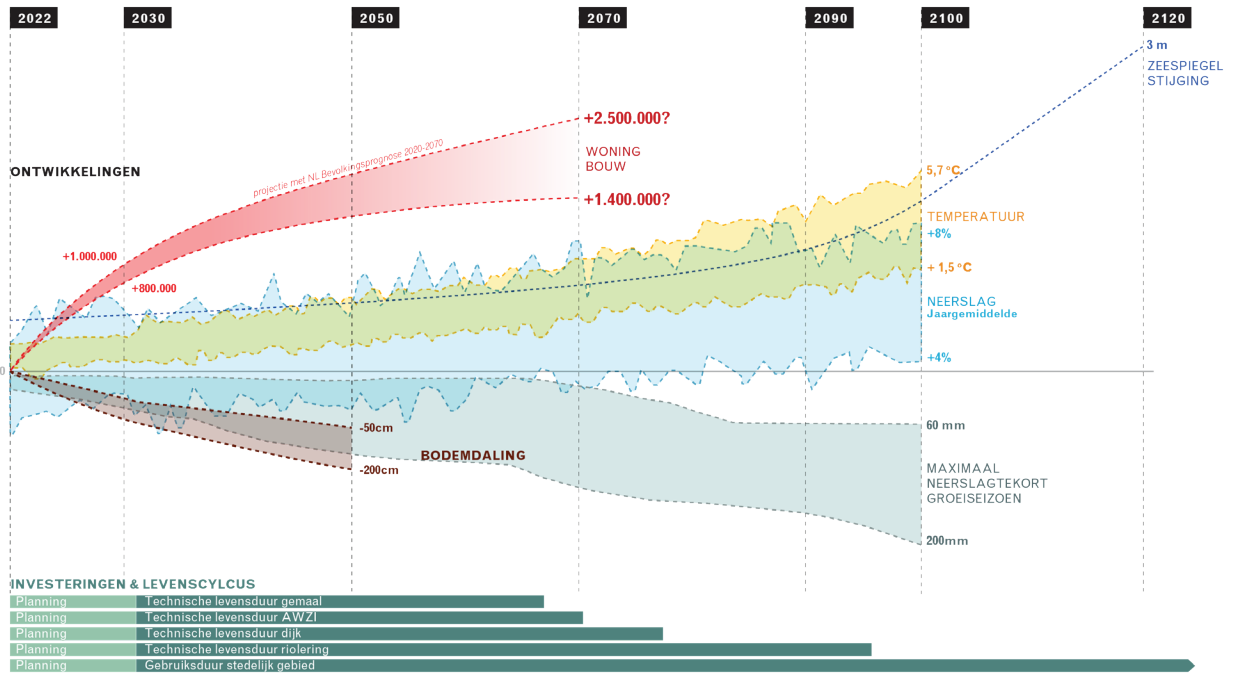
Strategic water management in the Netherlands has a long history. Rivers have slowly been pressed into a tight corset of control over the centuries. Meandering rivers were first guided and then directed and later normalized. But the narrow corset provided a hyperventilating system with high peaks in a narrow flood plain. In the meantime, the paradigm change has been made: more room for the river system. In the future - we argue - we will move towards water management that is even more dynamic.

Figure 2: Increasing trends and uncertainties as related to the lifetime of investments in water management.

Figure 3: After years of control and damming off of the water flow we've reached a breaking point after which the dynamic of the river will be revalued. This seems to be the only possible future at the face of extremer climatic conditions, the water has become uncontrollable.

Source:

M. Van Laarhoven (2017),  
Stromende kracht, een visie  
voor de rivierdelta als één  
aaneengesloten natuurgebied.  
Afstudeerpresentatie Academie  
van de Bouwkunst, Amsterdam.



## ANALYSIS

Although the contemporary result of 1200 years of steering the river landscape today consists of thin blue threads, the river area in our delta has the spatial memory of many millennia. If we look at the location of the river courses over the centuries, we see a wide fanning, braiding river system in the subsurface: the natural urge of the water is strong, and wide.

Our starting point in this exploration is an extreme scenario. We state that the continuation of building a closed system of many dike rings and Delta Works will not work in the long term. Eventually, the inevitable system crash will happen, the river system will return to its natural flow: an open system between hinterland and sea. The only middle way we have left is to guide this 'crash', by focusing on a half-open system, by guiding this disaster-in-slow-motion. Because... we have 100 to 150 years.

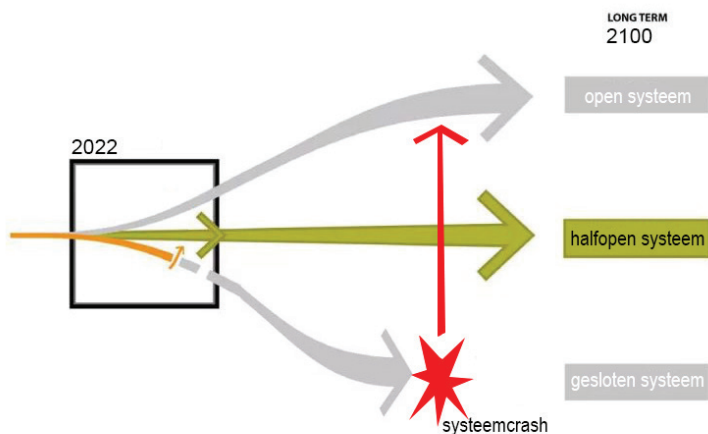


Figure 4: Future scenarios for the Dutch delta all lead to one possible end. Either before or after a system crash we will go from a closed system to an open system. Our strategy seeks certainty by focusing early on a half open system.

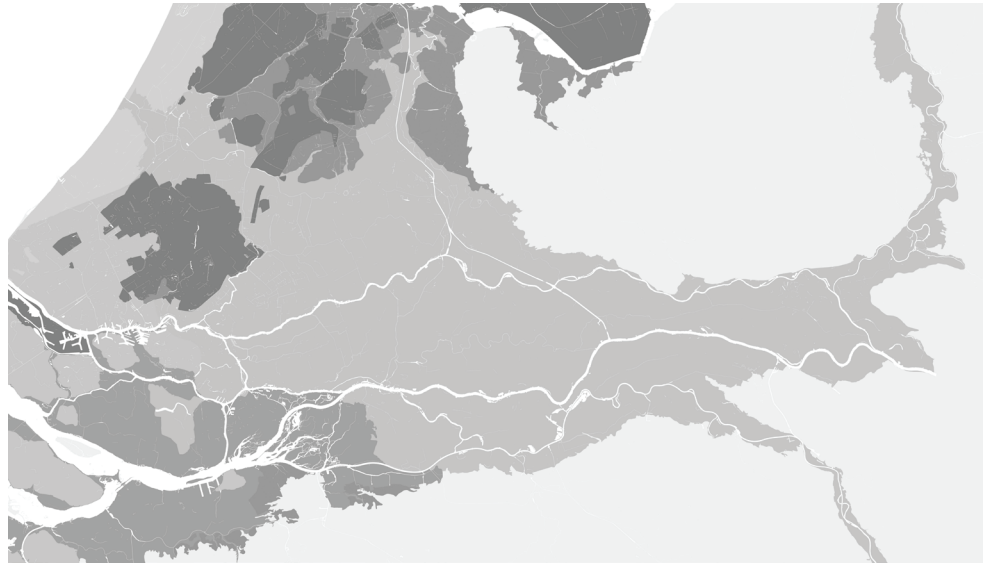


Figure 5 and 6: What does the river want to do? Above we see the result of a constrained river system, below the historic positions of the river.

Based on:  
 K.M. Cohen, E. Stouthamer, H.J. Pierik, A.H. Geurts (2012) Digitaal Basisbestand Paleogeografie van de Rijn-Maas Delta / Rhine-Meuse Delta Studies' Digital Basemap for Delta Evolution and Palaeogeography. Dept. Physical Geography, Utrecht University. Digital Dataset. <http://persistent-identifier.nl/?identifier=urn:nbn:nl:ui:13-nqjn-zl>  
 &  
 Rensink, E., H.J.T. Weerts, M. Kosian, H. Feiken, D. Jansen & B.I. Smit 2019: Archeologische Landschappenkaart van Nederland, versie 3.0, Rijksdienst voor het Cultureel Erfgoed, Amersfoort.



## CONCEPT

### GUIDING INVESTMENTS TO THE MOST IMPORTANT PARTS, WORKING WITH REGIMES RIVER AREA IS MORE LEFT TO FATE, RETREAT STRAT- EGY

We start with a situation after the disaster happened. The Netherlands is flooded, all land below 3 meters NAP is under the influence of water, as well as wide zones along the river. The higher sandy soils remain dry and habitable. [1].

What do we want to protect as a minimum? If the resources are available, the BV NL will be deployed from the point of view of National Interest. Dijkkring 14, including Rotterdam and the Utrechtse Heuvelrug, is at the top of the list. Around this are robust dikes that are protected at national level. The entire intermediate area is a 'buffer area' under the potential influence of the river. Sea reaches up to NAP+3m (Wijk bij Duurstede/Geldermalsen/ Den Bosch) [2]

If there is more money available smaller dike rings can also be protected. The principle is to spend only euros in the places that are sustainable and do not make any disinvestments in places that also stay behind due to other unsustainable issues. Only a few and temporary investments will be done in the river area, linked to the lifespan of this investment.

Reasoning back:

- +3m: protect the high grounds and dike ring 14+ (BV NL). Around this, robust dikes are protected at national level. The entire intermediate area is a 'buffer area' under the potential influence of the river. Sea reaches nap+3m (Wijk bij Duurstede/Gelremalsen/DenBosch)
- +2m: larger and smaller dike rings still exist in river area
- +1m: Only few and temporary investments in the river area, linked to the lifetime of this investment.

Figure 7: Four regimes of spatial planning guided by certainty: the sea (will remain the sea), safe higher grounds (will remain safe), bathtub Holland (will remain to be our core economic zones) and the tidal/riverine zone (will cater a type of occupation that learns how to live with the dynamism of water)



**1. Flooded Netherlands**

Regimes:

- Safe higher grounds
- Sea



**2. Holland**

Regimes:

- Safe higher grounds
- Sea
- Bathtub Holland



**3. River corridor**

Regimes:

- Safe higher grounds
- Sea
- Bathtub Holland
- Tidal zone

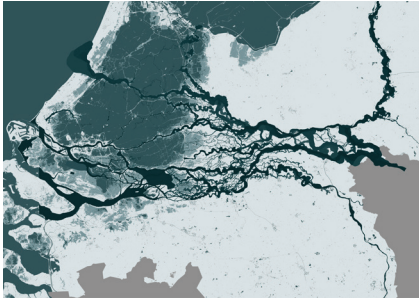


Figure 8: The historic flow of the river becomes a guide for the future of the river system.

Based on:  
 K.M. Cohen, E. Stouthamer,  
 H.J. Pierik, A.H. Geurts (2012)  
 Digitaal Basisbestand  
 Paleogeografie van de Rijn-  
 Maas Delta / Rhine-Meuse  
 Delta Studies' Digital Basemap  
 for Delta Evolution and  
 Palaeogeography. Dept.  
 Physical Geography. Utrecht  
 University. Digital Dataset.  
<http://persistent-identifier.nl/?identifier=urn:nbn:nl:ui:13-nqjn-zl>

1. Retreat strategy to slowly evacuate and transform the area. The challenge is therefore both about evacuation and about a rebuild-by-design

Dutch spatial planning is currently sector-based in which agriculture, water management and the economy are under the jurisdiction of different ministries. Spatial developments do not take the subsurface into account. However, the importance of spatial planning grafted onto the soil water system is becoming increasingly urgent due to climate change. Different areas require different policies, so we propose four regimes for spatial planning: of the sea, the rivers, the bathtub of central Holland and the higher hinterland (the higher sandy soils of the Netherlands).

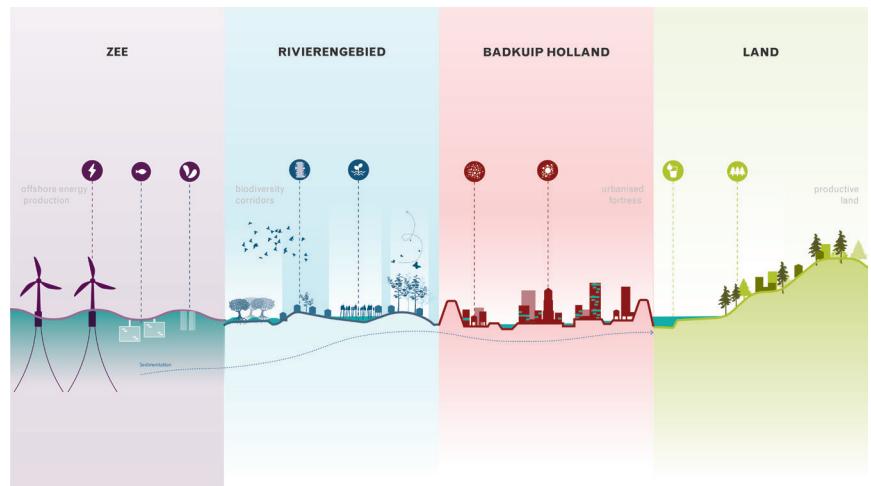


Figure 9: Four regimes guide the type of occupation that will take place.

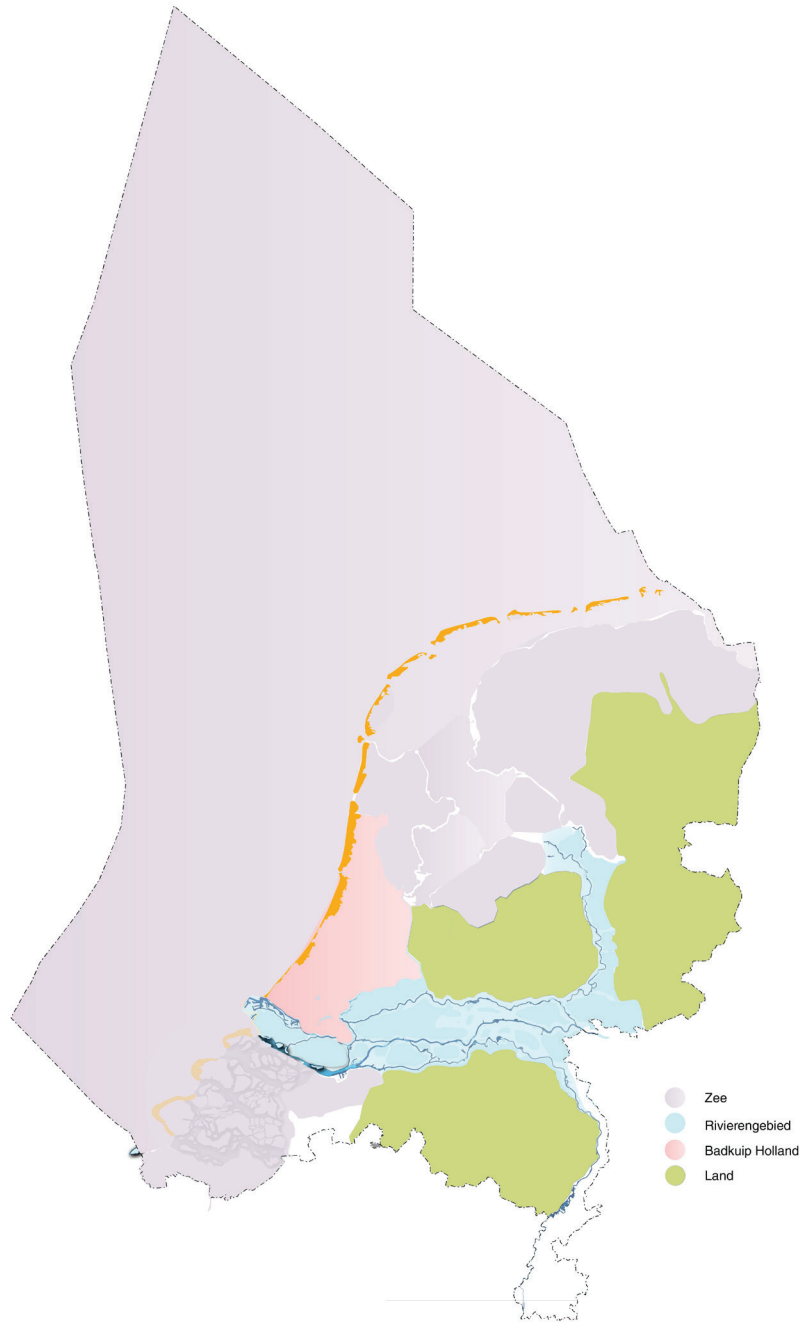


Figure 10: New Netherlands divided in four planning regimes that guide investments and development.



Figure 11: Retreat strategy: step-wise retreat based on the amount of mean sea-level rise. In orange are temporarily protected villages. In green extra water retention zoning.

By means of these regimes, different (spatial) policies can be pursued for the specific landscapes of the Netherlands. The following guidelines apply to the river landscape. The natural system is leading, keep what is affordable and use what is free. We propose to see the Rhine-Waal corridor as a large Delta, from the sea to Arnhem and make the influence of the sea visible and tangible. By reserving an area of 8 km in width with extra overflow space of the rivers, there is enough space for the water to flow at high peak discharge. Given that this 8 km zone is wide, flood heights are kept low. From the west, the sea comes inland and causes salinization of the landscape. We can continue to use the land. However, this requires a way of rethinking of the current polder use. We organize the polders differently by taking the levels of the various polders and arrange them with crops that are resistant to the influences of the water. Wet crops in polder areas that are often or always under water. Fruit and vegetables agriculture and wood production forests in the parts where it remains dry. Salty crops in the polders that lie in the new tidal area. Parallel to this, the area is slowly being evacuated and the high surrounding grounds are becoming the new places to live.

The context that this brings to national spatial planning is that it will be done on the basis of the local characteristics and not a one size fits all policy. If we start to view the river corridor as a new delta zone, this also requires a specific policy.

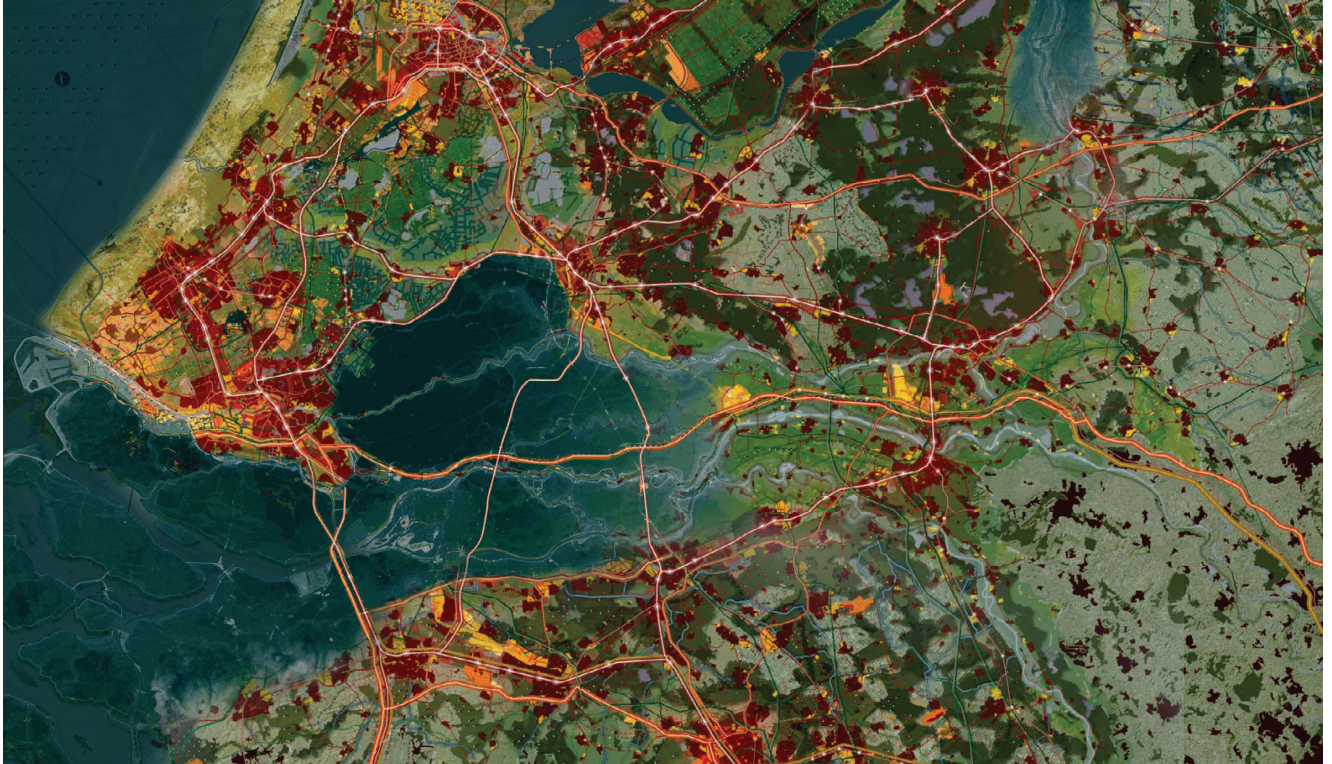


Figure 12: The Netherlands  
in high tide.

## ANALYSIS

WHAT IS REALLY THE PROBLEM, TOO MUCH WATER DURING PEAKS, THE SQUEEZE DETERMINES THE INFLOW AND BANDWIDTH (8 KM)

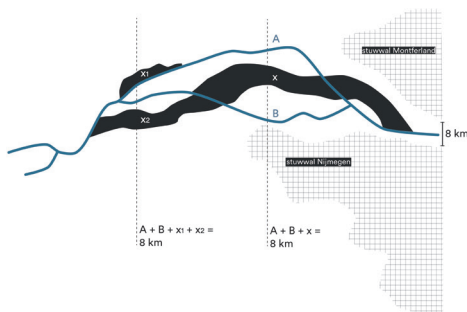
Dutch had, both top-down and bottom-up initiatives (governance)

In order not to ensure that the delta zone changes into a large wide river during large rain showers, more space for the rivers is needed. We do not know exactly how much space the river will need in the future, but the passage between the moraine at Nijmegen and the moraine at Montferland has a width of 8 km. The Waal hyperventilates and needs at least a width of 4km instead of the current 1.5-2km. In the future, that will be more. When the river is widened the water levels will be low during the peak, which allows land use, living and recreation in the area.

We propose to free up a zone of 8 km wide over the entire bandwidth of the rivers, this will be realized in phases.

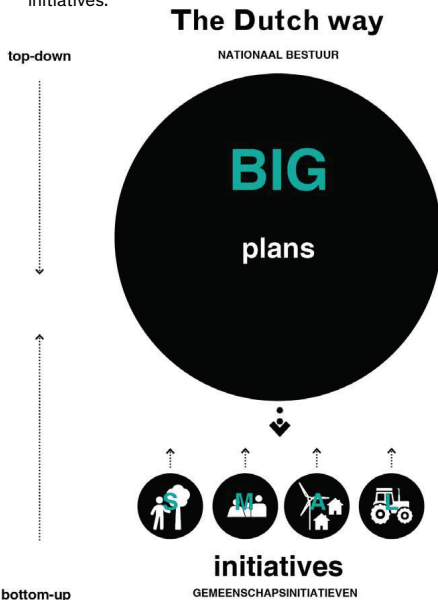
The polders in the Delta Zone will have to adapt to the new situation. The various water influences will have to be dealt with adaptively. For example, salinization and tides come from the sea. While large amounts of water enter our country

Figure 13: River plus extra space needed for the water to flow to. 8 kilometers based on the moraine at Nijmegen and the moraine at Montferland.



## DUTCH HAD, BOTH TOP-DOWN AND BOT-TOM-UP INITIATIVES (GOVERNANCE)

Figure 14: The planning regimes will be based on the Dutch way. Big plans from national government coupled with local and communal initiatives.



from the East via the rivers. By redesigning the polders, this production will continue to run and will be of use to the BV Nederland. Think of salty crops in the new sea polders, wet crops in the tidal area and the overflows of the rivers.

In parallel, a relocation strategy must be devised for people now living and working in the delta zone, not everything can continue to exist.

The Netherlands is a country of big plans and local input. From Delta Works and village initiatives. This 'Dutch way' is crucial for the future. Due to limited resources and great river dynamics, a choice must be made. National governments work top-down and provide basic needs and a limited number of safe super dike rings.

On the other hand, residents outside these national dike rings are expected to be more self-reliant. If you want to live and survive here, you need each other. Communities among themselves ensure a certain degree of security here on the basis of local initiatives and their own investments.

## PRINCIPLES OF THE PROJECT

From the analysis we distillate the following principles for the future in 2100:

- In the long term, the Rhine will become - just like the Meuse - a rain river with erratic peaks instead of constant supply and the sea rises faster than expected. In addition, thinking in the future with a time scale is not relevant, only thinking in the scale of meters of sea level rise can relate to time.
- This makes the natural system leading; that means that the play between sea and rivers, salt and fresh, sand and clay, dry and wet becomes our organizing principle. In addition, in the river area, the subtle height differences per polder and flood probability offers opportunities for different types of land use. The credo is: preserve what is affordable and use what is free; "water and sand"
- Spatial design can only take place within dogmatic conditions of the soil-water system: which must comply with the 'Z(ee)Diploma'; we live on the higher sandy soils and spatial investments are geared to the soil-water system. At the same time, a repurposing/ relocation of the capital in existing built environment arises
- Administratively and organizationally, the Netherlands is classified per water region, with each region having its own spatial planning regimes. Sometimes these are at national level and compelling (in case of high investments), sometimes flexible and non-binding. Then the direction and responsibility are placed on initiatives from below;

- A Delta Zone of value; in the estuary where sea and rivers communicate with each other, an area of international importance becomes an area where delta nature coexists with production landscape. In a changing society where plant-based food and space for greenery is essential for a healthy lifestyle, this area acts as a food production area, recreation area and energy supplier for the hard urban edges that lie safely behind dikes or high on the sand. The fertile soils bring great responsibility to continue producing raw materials and food. In addition, sediment is an important raw material that we would like to welcome. Sediment stimulation from Germany and from the Dutch moraines (Montferland, Rijk v. Nijmegen/Kleef, Veluwe, Heuvelrug) offers opportunities for replenishing the little natural sediment present.

- Although the most important transport goes via the urbanized ring around the delta edge, there is one crucial transport corridor along the A15 and Betuweroute that connect the ports of Rotterdam with the hinterland. Due to the changing river discharges, transport by land becomes more important than by water. Where the Waal initially remains as an important corridor, water transport is becoming smaller in scale.

# DESIGN AND DEVELOPMENT

## CREATING THE PROPOSITION PROJECT PHASING

1. 2022: Drawing hard lines between 'safe' and 'free'. Reserve space in the Rivierengebied in the lowest and relatively undeveloped parts. Building ban/rules in (low parts of) river area. Demotivation policy: no maintenance and new roads, etc. Powerbed 1,5-2km wide
2. 2050: New sand cities arise on young heathlands like the Peel and Drenths plateau. Forestry as living environment with attractive environments (concrete-free wood construction). Also 'blue green for dark green scheme' to make building on Veluwe and Heuvelrug possible. The chain of cities on the sandy ridge originates on the Brabantse wal. Solid infrastructure bundling on east-west lines (A12 corridor, A59 corridor) with rail, pipelines, superhighways. The first 'green rivers' will flow along during peak discharge, in the summer agriculturally in use. Seasonal recreational homes arise in river areas. Zaltbommel and Den Bosch are partially demolished, as well as parts of bottleneck Arnhem-Zuid. The sea reaches NAP+1 and is still banned in southwestern delta.

Figure 15: Through leafy sand towns, a new city on the edge of the Delta has emerged in eastern Netherlands: Den Bosch by the Sea



Figure 16: In a changing society where plant-based food and space for greenery is essential for a healthy lifestyle, this area acts as a food production area, recreation area and energy supplier for the hard urban edges that lie safely behind dykes or high on the sand. Depending on the elevation and protection level, different landscapes emerge.

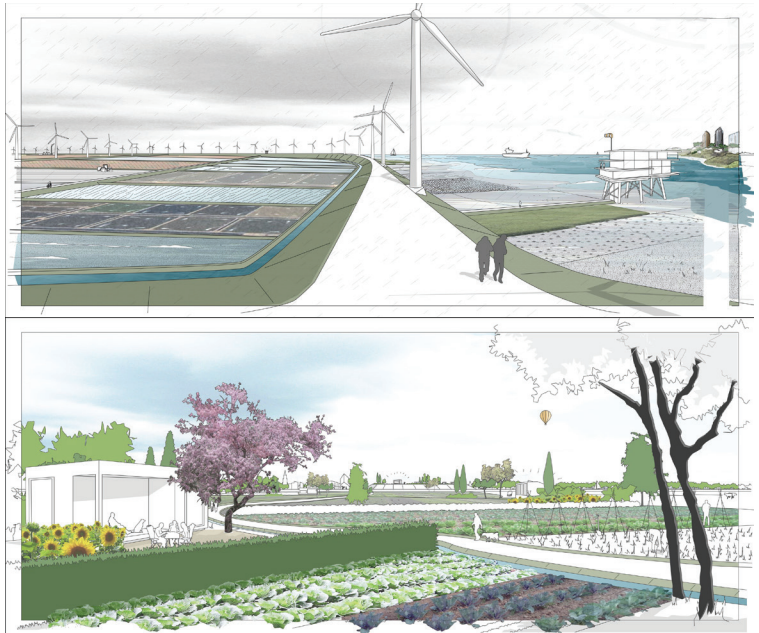


Figure 17: 2150: Sea reaches NAP+3m (Wijk bij Duurstede/ Gelremalsen/DenBosch line). Large parts of the river area are under water influence. Only dyke ring14+ and the high lands are protected at national level, partly through robust dykes.

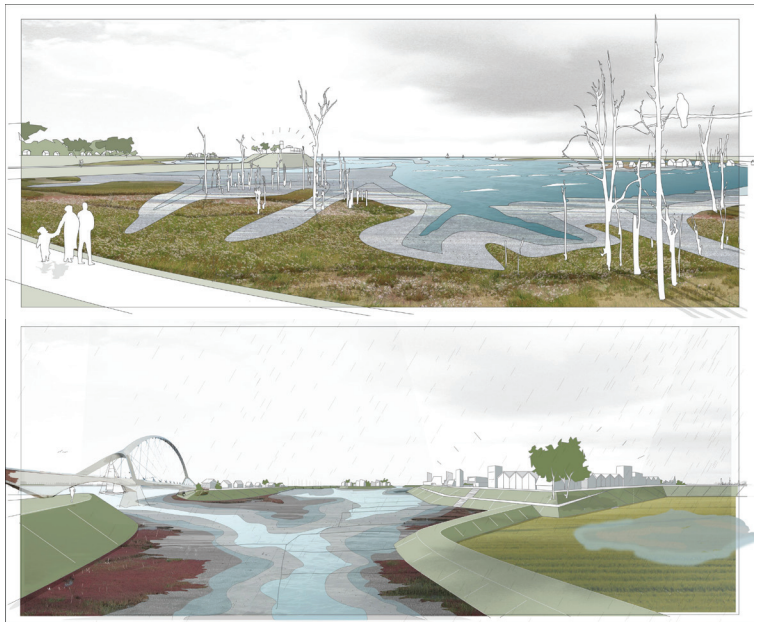


Figure 18: There is 1 crucial transport corridor along the A15 and Betuweroute connecting the ports of Rotterdam with the hinterland over a super dyke.

3. 2100: Many green rivers added: The Rhine is bent to the south between Kesteren and Tiel. Waal is connected to the Meuse, the water flows mainly south of Zaltbommel to the West. The Meuse flows further south via the Beerse Maas from Beerse Overlaat to Waalwijk. Tiel and Gorkum are remain with local low dike rings. Historic centers of Zaltbommel and Den Bosch are still within a UNESCO wall as cultural-historical relics. Sea reaches nap+2 and penetrates. The estuary of Rivers and Sea is a dynamic whole that 'breathes'. [Image 240622\_RDD\_Groene river mega infra}
4. 2150: Sea reaches NAP+3m (line Wijk bij Duurstede/ Gelremalsen/DenBosch). Large parts of the river area are under the influence of the water. Only dike Ring14+ and the high grounds are protected at national level, partly by means of robust dikes. The entire intermediate area is a 'buffer area' under the potential influence of the river and the sea. Adaptive agriculture (seasonal cultivation) has established itself there. Seasonal homes and pole dwellings are possible due to the very wide stream plain and thereby low water levels during peaks. Banks remain largely dry. A wide elongated nature reserve has arisen, the Delta Zone, where the entire range of species from beaver to seal occurs. Forests in the stream plain provide wood resources for construction, agricultural pioneers grow rice and grains on the fertile floodplains of soil. Through leafy sand cities, a new Randstad on the edge of the Delta has arisen in the east of the Netherlands.

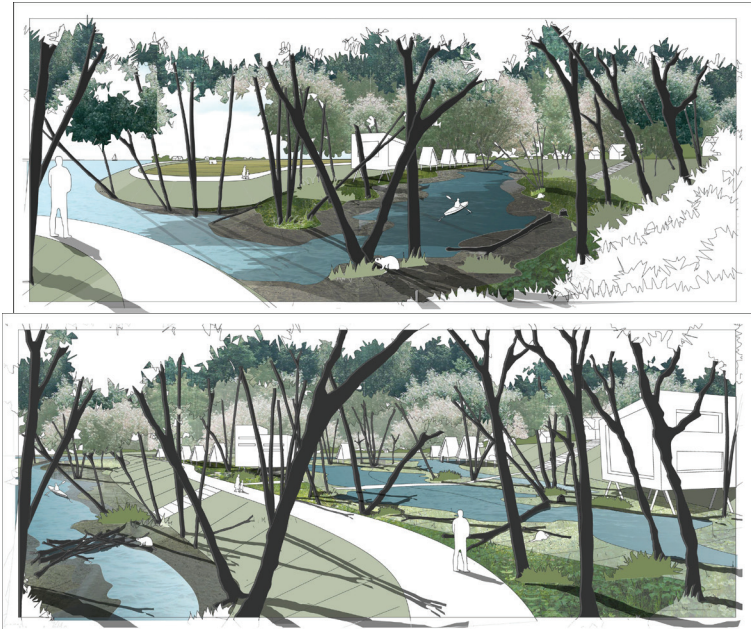


Figure 19: Seasonal housing and pole housing are possible due to the very wide catchment area and hereby low water levels during peaks



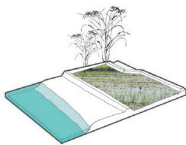
1x per 1 jaar nat



1x per 5 jaar nat



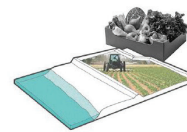
1x per 10 jaar nat



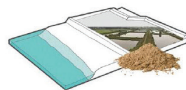
Rijst productie



Dynamische natuur



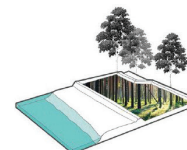
Voedselproductie



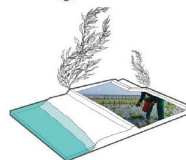
Vloevelden



Ooibossen



Houtproductie



Kelp productie

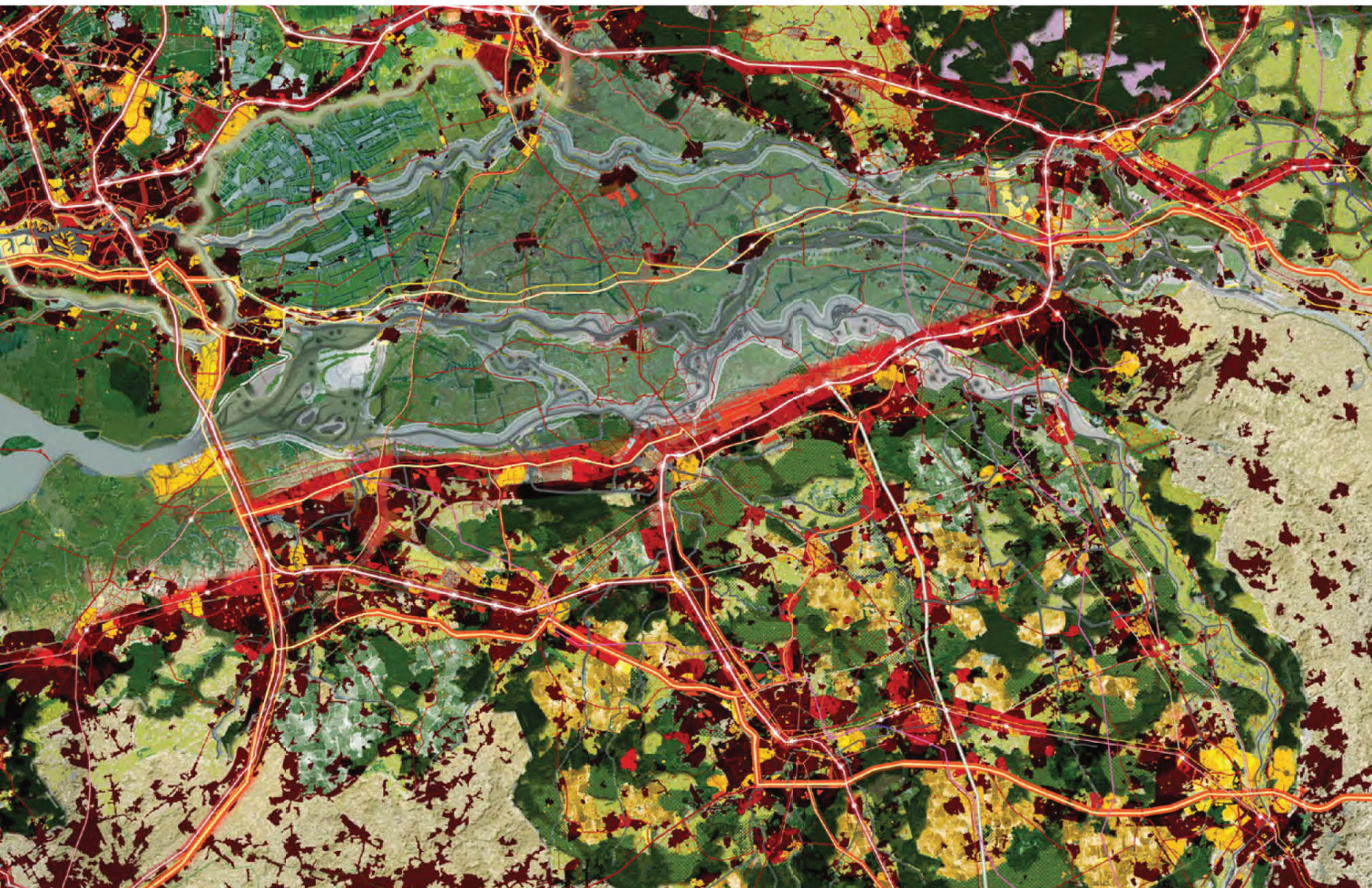
# FINAL PROJECTION

## THE NEW DUTCH CITY



Waterveiligheid en ruimte  
voor water en rivieren

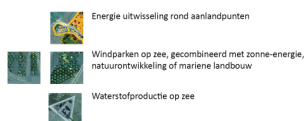
- Brede dynamische kuststrook nabij grote steden
- Extra bescherming grote steden met compartimenteringsdijk
- Randstad beschermd, scheepvaart omleiden
- Brede zomerbedding in dynamisch rivierensysteem
- Meer dynamiek en hoger overstromingsrisico landelijk gebied laag Nederland



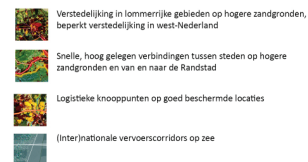
#### Landbouw en natuur



#### Energie



#### Verstedelijking



# THE NEW DUTCH LANDSCAPE

## Herinnering aan Holland

Denkend aan Holland  
zie ik breede rivieren  
traag door oneindig  
laagland gaan,  
rijen ondenkbaar  
ijle populieren  
als hoge pluimen  
aan den einder staan;  
en in de geweldige  
ruimte verzonken  
de boerderijen  
verspreid door het land,  
boomgroepen, dorpen,  
geknotte torens,  
kerken en olmen  
in een grootsch verband.  
de lucht hangt er laag  
en de zon wordt er langzaam  
in grijze veelkleurige  
dampen gesmoord,  
en in alle gewesten  
wordt de stem van het water  
met zijn eeuwige rampen  
gevreesd en gehoord.

Hendrik Marsman

## Herinneringen aan Holland 2100

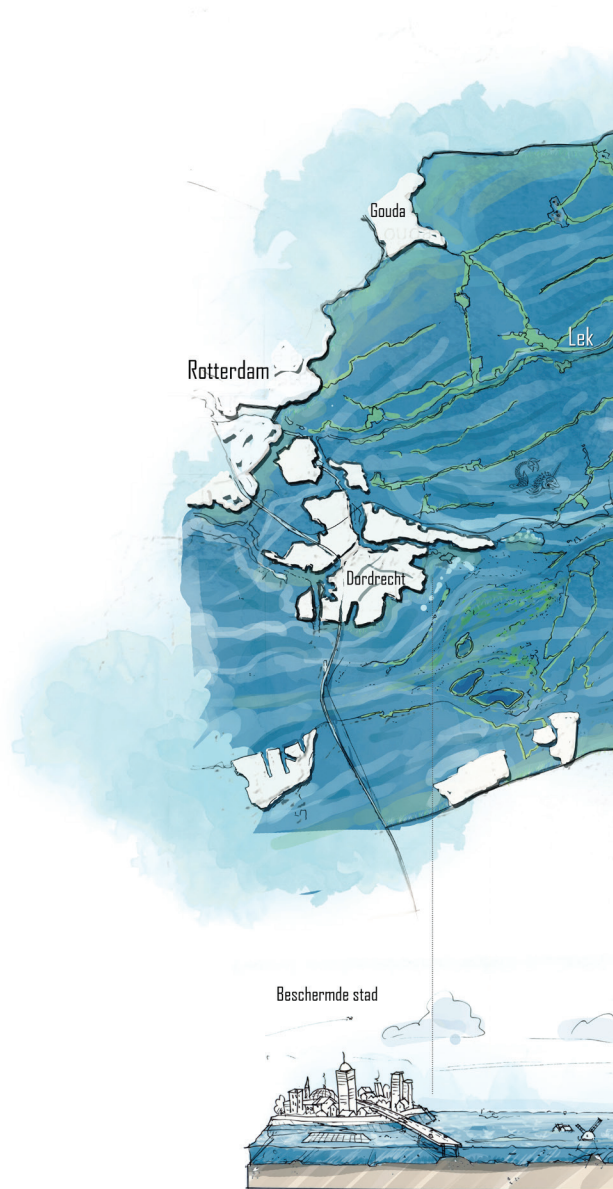
Denkend aan Holland  
zie ik overstromingen  
traag zie ik laagland  
zeewaarts gaan,  
rijen vluchtenden  
over moete dijken  
als laatste strijders  
in het water staan;  
en in de geweldige  
ruimte verzonken  
de halve wieden  
in verdrinken land,  
boomkronen, daken,  
geknotte torens,  
kerken en graven  
in een vreemd verband.  
de lucht hangt er laag  
en de zon wordt er langzaam  
in grijze veelkleurige  
dampen gesmoord,  
en in oude gewesten  
wordt de stem van het water  
met zijn eeuwige rampen  
niet meer gehoord.

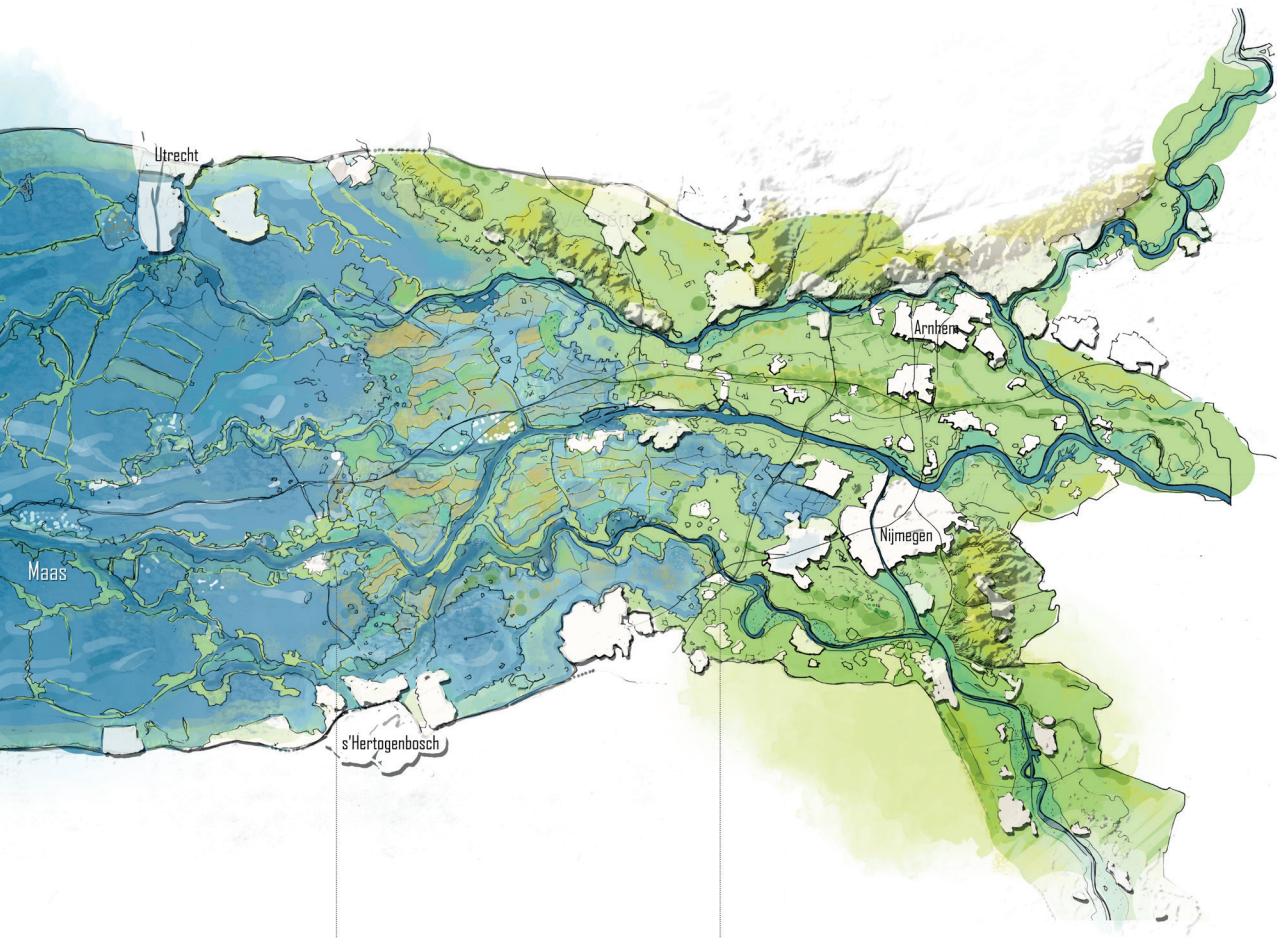
Cor mineur

## Herinneringen aan Holland 2100

Denkend aan Holland  
zie ik breede rivieren  
traag in getijden  
zeewaarts gaan,  
rijen recreanten  
over ijle dijken  
als laatste dragers  
in het water staan;  
en in de geweldige  
ruimte verzonken  
de oude cultuur  
in verdrinken land,  
boomstronken, dorpen,  
geknotte torens,  
doorweekte kerken  
in vloeibaar verband.  
de lucht hangt er laag  
en de zon wordt er langzaam  
in gebroken kleurige  
golven gesmoord,  
en in alle gewesten  
wordt de stem van het water  
met zijn eeuwige rampen  
beleefd en gehoord.

Cor majeure





Utrecht

Maas

Arnhem

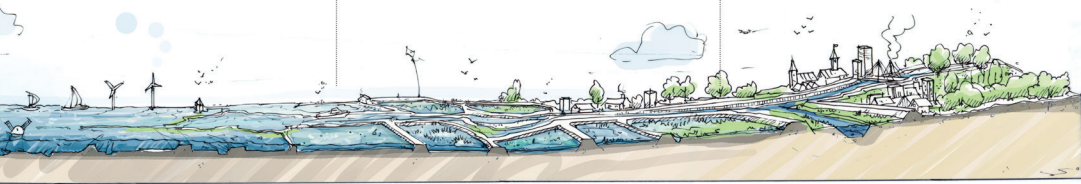
Nijmegen

s'Hertogenbosch

Verdronken landschap

Getijdenlandschap

Rivierenlandschap







## IN THE CAPILLARIES OF THE DELTA

Arcadis  
Defacto  
Vista

# INTRODUCTION TO THE CHALLENGE

## TEAM PRESENTATION

### Defacto

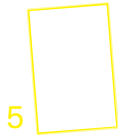
Defacto urban and landscape design is an innovative office for research and design in the domain of urbanism. Defacto was founded in 2006 and works on projects worldwide. The unique selling point of the office is to connect urban and landscape design with contemporary challenges such as climate change, circularity, green cities and water management.

### Vista

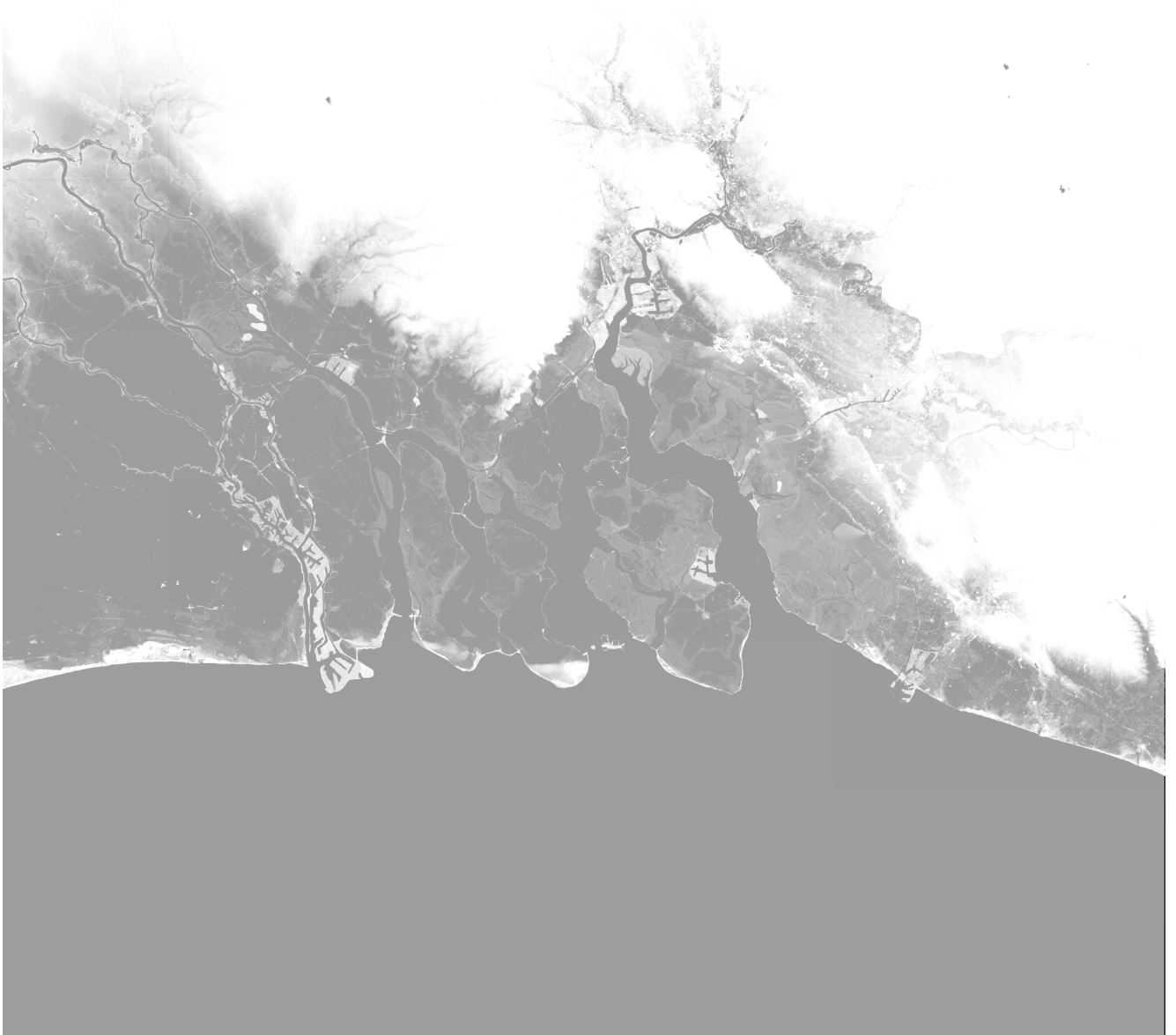
Vista is a landscape architecture office in which thinking in processes and results is key, with a sharp eye for detail and an overview of the whole. Vista started 25 years ago with the design of clear solutions for complex issues on every scale and for every terrain. Landscape architecture projects like parks, estates and agriculture landscape are core. The specific concepts Vista is specialized in are Building with Nature, Green Cities, Energy Transition and Environment and Climate.

### Arcadis

Sustainability at the heart of the work of Arcadis, the focus is on improving quality of life. The solutions that Arcadis develops address important societal challenges around resilience, places, and mobility. Leveraging data and technology, Arcadis has the capabilities and services to meet client demands driven by global trends such as urbanization, climate change, digitalization, evolving stakeholder expectations and potential unforeseeable events.



# LIMBURG



# DISCOVERY / ANALYSIS

DEFINITION OF THE  
CHALLENGE  
PROBLEM STATEMENT

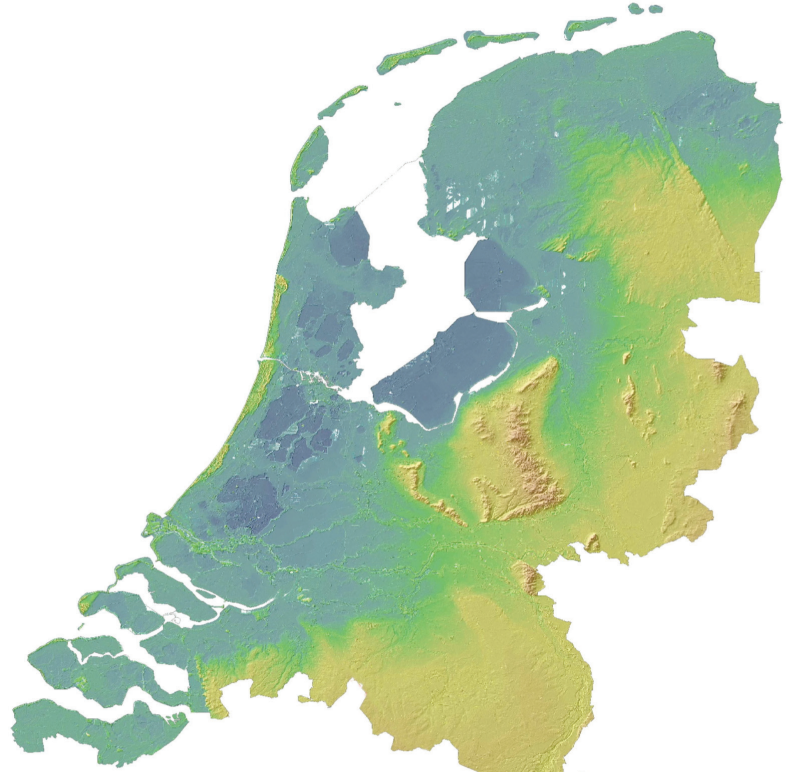


Figure 2: Case study limburg location. source ahn.nl

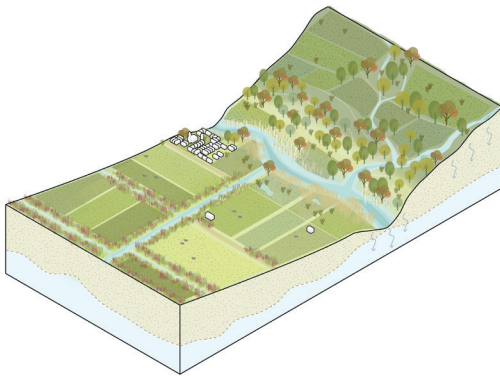
Figure 3: Hill landscape of Zuid-Limburg

Figure 4: River the Geul

Figure 5: Geul in Valkenburg



SOUTH LIMBURG



## ANALYSIS

(1) Memo afvoer- en overstromingskarakteristieken, effecten en maatregelen voor RDD ontwerp. Arcadis 2022  
(2) Overstroming juli 2021. Flycatcher 2021

## FLOODING IN THE GEUL

Due to unexpected large amounts of rainfall without precedent of average amounts in the Geul catchment: 128 mm in 48 hours. The river Meuse proved to be resilient, but the tributary Geul was not. The water level increased circa 40 cm / hour and caused € 400 million damage. It could have been significantly worse, due to the floodings in neighboring countries Germany and Belgium leading to casualties and billions of euros in damage.

## FLOODING IN VALKENBURG

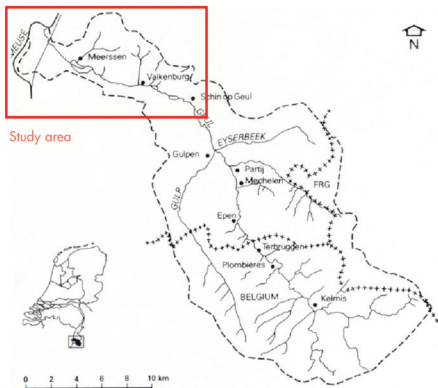
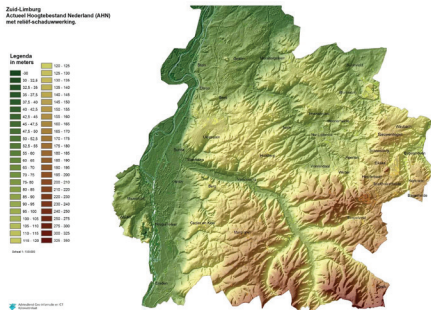
The total peak discharge of 130 m<sup>3</sup>/s at Valkenburg was 70% (90 m<sup>3</sup>/s) from the Belgium side of the catchment. The problems occurred due to backwater at bottlenecks such as Valkenburg and bridges. People were surprised by the rising water level and 89% of the people were not prepared for evacuation.



Figuur 19 Berekende overstromingen vanuit de Geul voor gehele stroomgebied

## THE CHARACTERISTICS OF THE GEUL CATCHMENT AREA ARE:

- Length Geul 58 km
- 250 m. height difference from source to mouth
- 340 km<sup>2</sup> hill landscape (35 km long, average 10 km wide)
- over 1/3 is located in Belgium



(1) Analyse overstrooming  
Valkenburg  
Watersysteemevaluatie  
Waterschap Limburg, Deltares  
2021

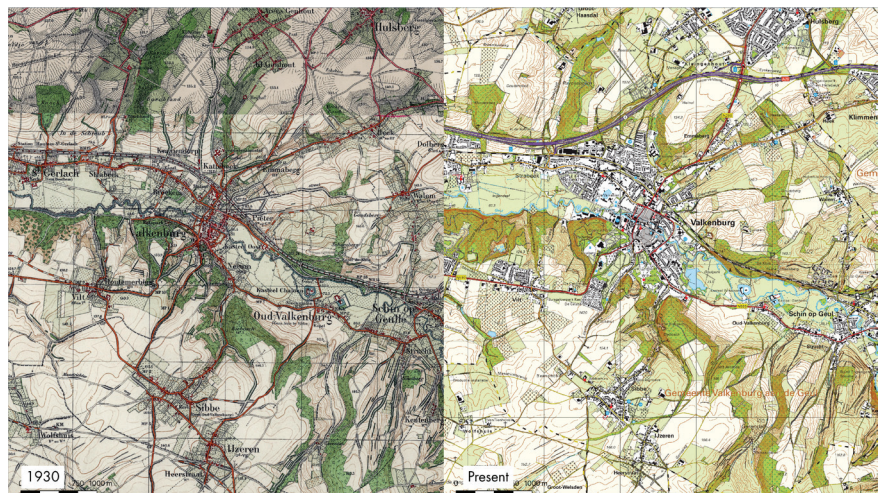
## PRINCIPLES OF THE PROJECT

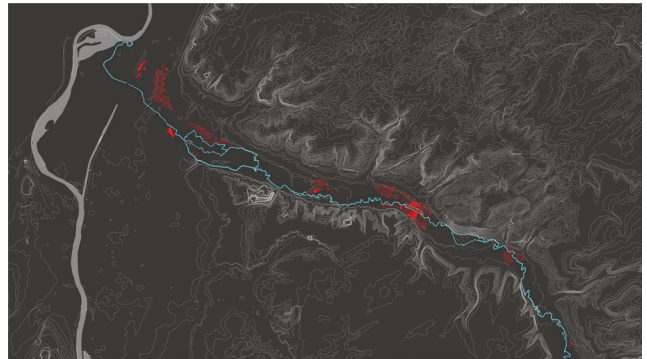
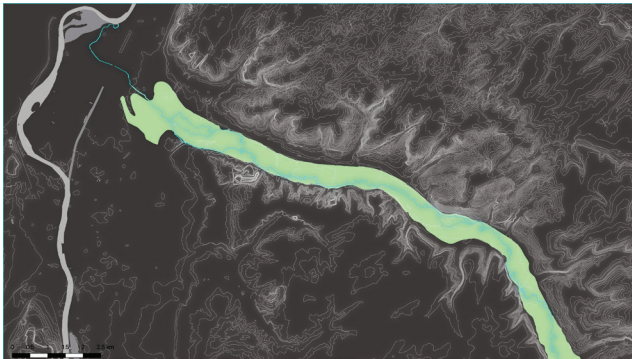
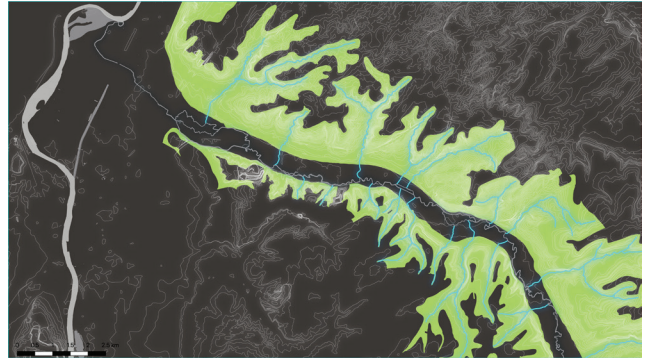
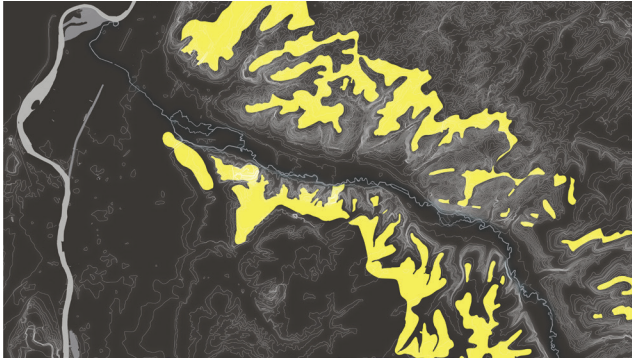
Challenges: landscape's insufficient water retention due to changing land use

Lessons learned from the 2021 flooding:

- Due to changing land-use and urban development the ability to discharge and store water has decreased
- Flooding in the Geul (2021) happened quickly with limited time to evacuate. Robust infrastructure / buildings offer a solution to limit damage
- There are four landscape components
- Each landscape offers different opportunities to flood prevention

(1) Analyse overstrooming Valkenburg Watersysteemevaluatie Waterschap Limburg, Deltares 2021





Plateaus  
 Agriculture  
 Loess soil  
 Limited infiltration capacity  
 Vulnerable to erosion from surface runoff

Geul valley  
 Agriculture  
 Water retention areas  
 Backwater during heavy rainfall > risk of flooding

Slopes and streams  
 Agriculture  
 Graften and forests  
 Streams  
 Loess soil  
 Limited infiltration capacity  
 Very vulnerable to erosion from surface runoff

Urban areas  
 Towns (Valkenburg, Schin op Geul, etc)  
 Limited space for water retention  
 Backwater during heavy rainfall > risk of flooding

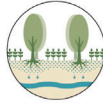
# DESIGN AND DEVELOPMENT

## CREATING THE PROPOSITION SKETCHING

### Store



Forestation



Agroforestry

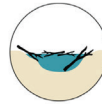


Underground water storage

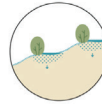


New housing typology

### Delay



Reduce management of  
fallen branches



Hedges & grafts on slopes



Ecological bank

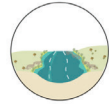


Create water reservoir

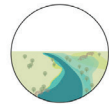


Naturalizing the stream

### Discharge



Widen the river



Natural flood area



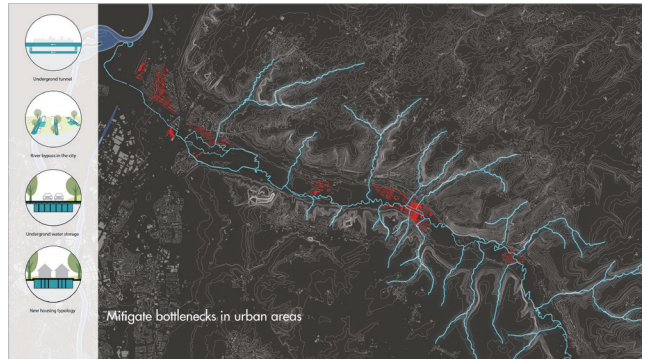
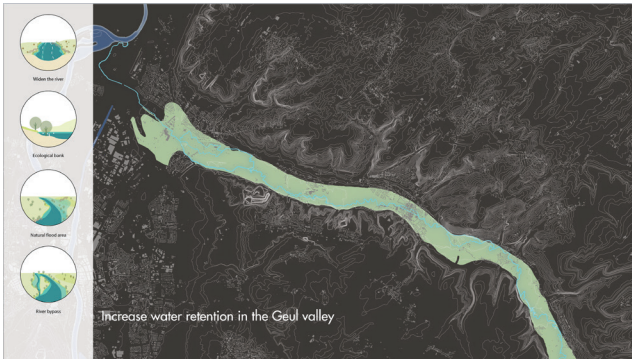
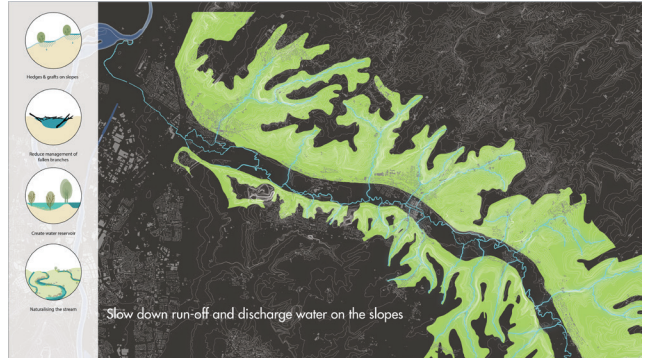
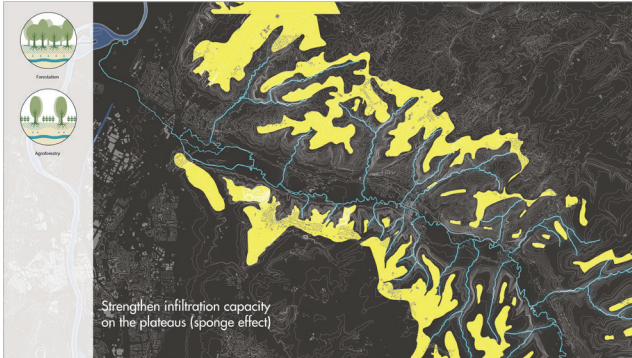
River bypass



River bypass in the city



Underground tunnel



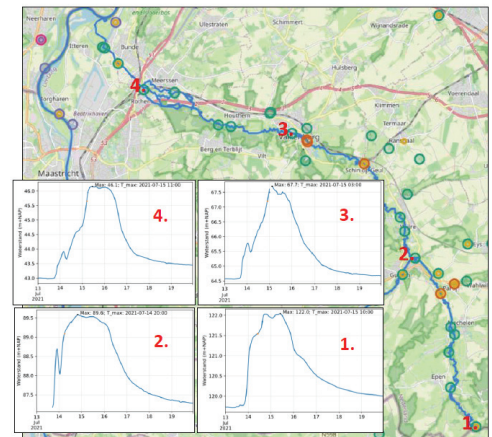
## CRITICAL ASPECTS

Lessons for RDD study:  
Flooding along the Geul as in 2021 happened quickly with limited time to prepare and evacuate. Robust infrastructure/buildings can offer a solution to limit the damage.

## RUNOFF AND FLOOD CHARACTERISTICS

The characteristics and behavior of the flood can be understood based on the analysis of the flood in 2021 of Deltares Analysis flood Valkenburg; Water system evaluation Water board Limburg. As shown in Figure 1, the elevated water level continued for about one day before falling again. The floods around the Geul in 2021 were estimated as an event with a return time of approximately 1,000 years. Currently, the standard for the Geul in Valkenburg is once every 25 years. The water system around the Geul was therefore not prepared for this event. The danger of the amount of 128 mm precipitation and Peak discharge of about 130 m<sup>3</sup>/s near Valkenburg only came into focus on the 14th of July 2021. There appeared to be too little time to safely leave the area. In the Geuldal, campsites in particular were evacuated right next to the Geul. On the night of the 14th of July, many people were overwhelmed by the high water; 89% were not or hardly prepared for evacuation, and 82% had not considered this themselves.

Figure 6: Water level developments at various locations along the Geul.  
Source [4]



## MEASURES FOR WATER RETENTION

Lessons for RDD study:  
Retention alone seems insufficient to prevent future events and therefore a combination of measures is needed. Nevertheless, it is an important part of the solution, especially when combined with sustainability and nature restoration.

Implementation of retention within the entire Geuldal to prevent flooding in Valkenburg requires major interventions. An indicative calculation from an MSc thesis Hydrological Response of the Geul Catchment to the Rainfall in July 2021 concludes that 2.7 km<sup>2</sup> of retention area should be realized. The study of Deltares suggests lowering retention area from 1.1 to 1.4 km<sup>2</sup>. Increasing the current storage by a factor of 5 will reduce the water level by 0.1 to 1m over 7 km.

Redevelopment of agricultural plots is expected to result in 10 mm additional infiltration capacity (on an area average precipitation of 128 mm). This alleviates some weight from the challenge but is insufficient to prevent similar flooding as in 2021. Additionally, the planting and restoration of forests along the slopes can contribute and is desirable in the context of natural restoration. Further study would also be required to estimate the impact based on where and how these forests are created. Previously proposed measures such as in a by-pass along Valkenburg remain necessary to limit risks in the event of extreme high water.

## EFFECTS FOR THE MEUSE

Conclusion for RDD design:  
An extreme discharge of the Geul as in 2021 does not now lead to an unforeseen large risk downstream due to flattening of the high water peak. Considering sea level rise, for the same reason, extreme discharge from the Geul will not lead to unforeseen high water levels along the Meuse. Therefore, focus more on slowing down water to the stream valley than on slowing down water to the Meuse.

Whether delayed by measures, the water in the Geul is discharged into the Meuse. Further down the Meuse, the effects of the amount of water from the Geul is limited. As shown in Figure 2, flattening of the water level and thus the amount of discharge occurs downstream. This is a physical phenomenon, with increasing water depth, a relatively smaller part of the run-off water is in contact with the soil leading to the average friction decreasing, and faster water flows. The result is that the peak of water moves downstream a slightly faster than the rest of the discharge. However, other aspects also play a role in understanding this phenomenon, such as the river slope and local width of the river which require model calculations.

Another reason for the lowering of the high-water discharge over the Meuse is the influence of retention areas where water is temporarily retained. It is estimated that by draining retention areas, the water levels at Roermond have been reduced by 5 to 10 centimeters, and further downstream by 10 to 20 centimeters.

The result of the 'flattening' discharge after a 'wave' is an extreme water level in the order of 1/1000 years in the Geul, but at the same time the extreme water level in the Meuse was in the order of 1/10 years.

## TRANSBOUNDARY EFFECTS

Seventy percent of water that flooded Valkenburg during the high tide of 2021 came from Belgium. Given that the infiltration capacity in northern Belgium is limited by rock in the subsurface on/around the river bottom, it is difficult to raise the current capacity of 50%. Other measures to increase the discharge in Belgium would be negatively impact the water safety in the Netherlands.

Conclusion for RDD design:  
Broaden scope to seek cooperation and measures across the border to arrive to (cost) more effective solutions.

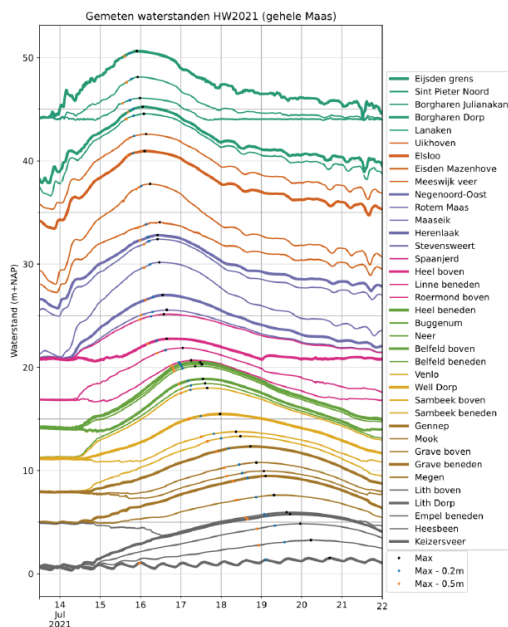
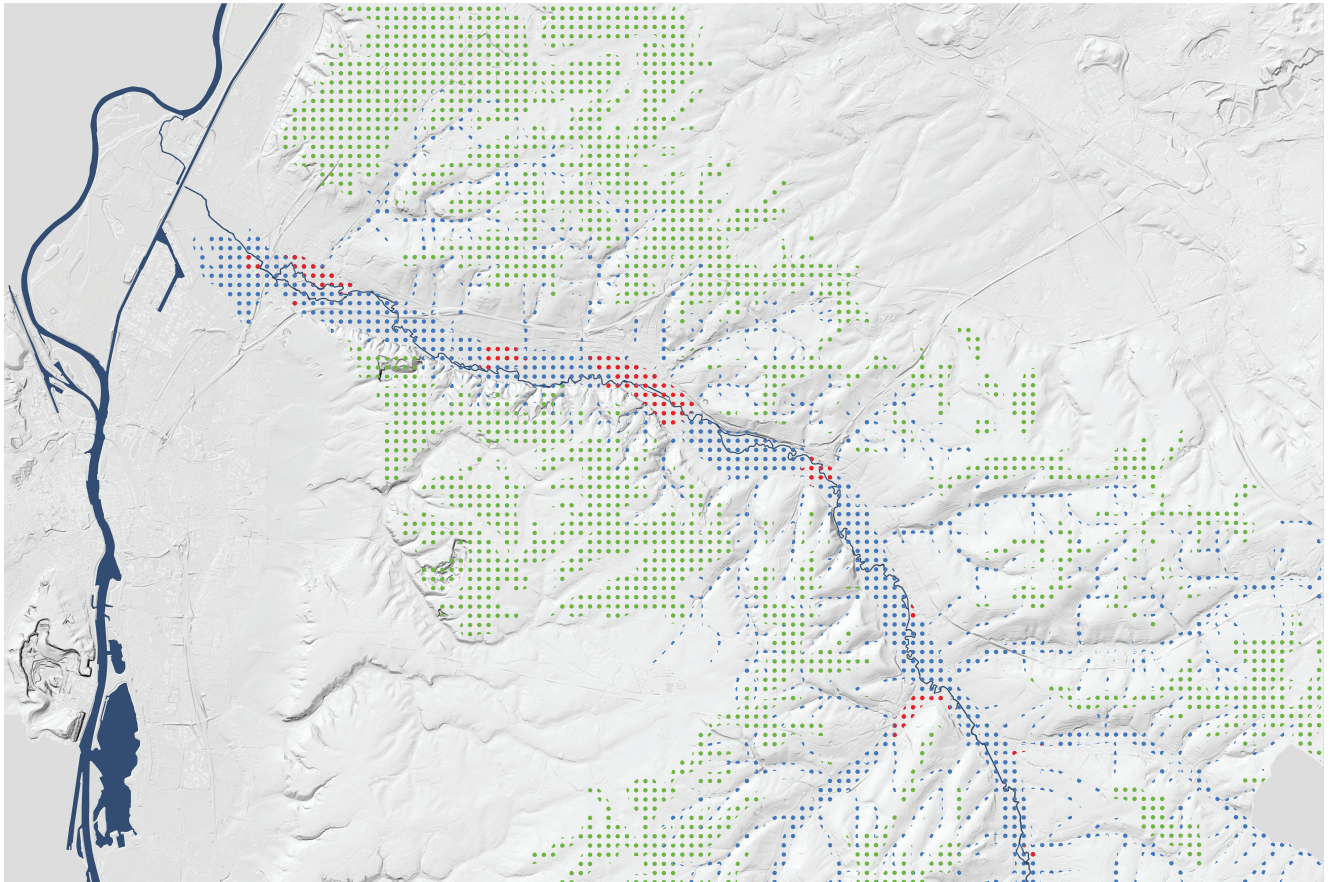


Figure 7: Measured water levels of the LMW monitoring network of Rijkswaterstand for the entire Meuse. Source [3]


# FINAL PROJECTION


## PROJECT MANIFESTO


Different measures will together contribute to prevent or decrease the risk of flooding. However, climate change makes it difficult to forecast heavy rains (rain bombs) that happened in 2021, making multi-layered security plans important. Therefore, evacuation strategies should be developed. Transboundary collaboration between Belgium and the Netherlands is necessary to cover the entire water catchment area of the Geul because the water storage potential on the Dutch side is insufficient for preventing a flooding such as in 2021. The combination of measures should respond to the fact that 70% of the flooding water arrived from Belgium. Further integral solutions should be found that are linked with other challenges and opportunities such as nature development, urbanization or the transformation of agriculture. Examples of this are integral hill-landscape development that work with increase natural buffering and involve local inhabitants in the plans.




## Landscape adaptation 2100

 Plateaus: agricultural transition forests (diversify landscape, e.g. agroforestry)

 Slopes: tree planting and restoration of hedge landscapes, other innovations

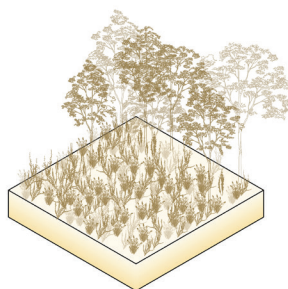
 Stream valleys: increase discharge potential, room for water, restrictions for urbanisation, awareness of potential risks

 Cities and villages: bypass, water storage

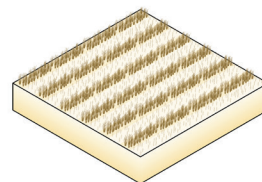
## FINAL VISION

## PLATEAUS: AGROFORESTRY AND REFORESTATION

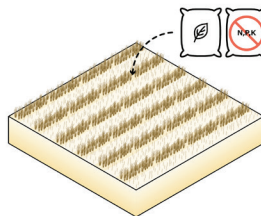
Long term measures are involving the longue durée of the landscape morphology. The landscape is made productive with food, clean water, biodiversity and CO<sub>2</sub> storage. These aspects coincide with the measures needed to increase the infiltration capacity with 10 mm. However, the precipitation in July 2021 was 128 mm so the effect on preventing a flooding like 2021 is limited.



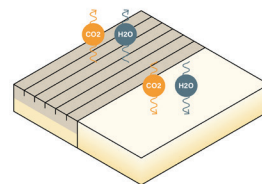
minder vruchtel  
omvormen naar natuur, water-berging, bos  
"woeste gronden"



strooksteelt  
lichte machines



groenbemesters in plaats van kunstmest

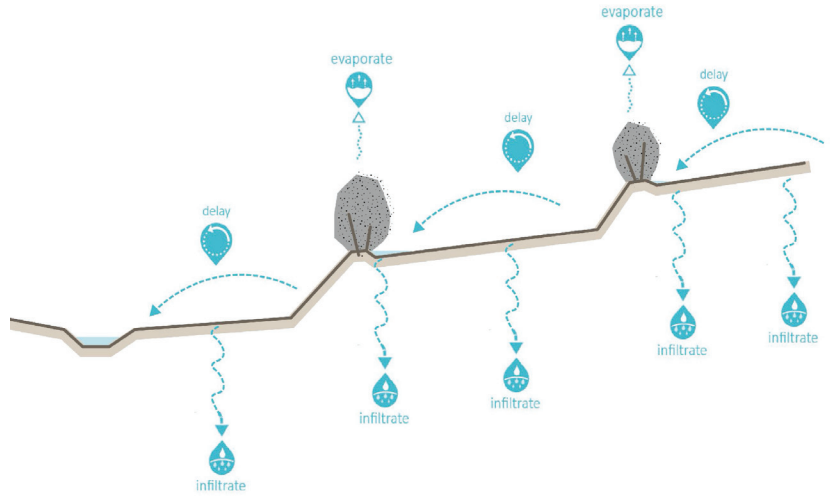


niet-kerende grondbewerking

(1) Memo afvoer- en overstromingskarakteristieken, effecten en maatregelen voor RDD ontwerp. Arcadis 2022

## SLOPES: BUILD GRAFTS AND HEDGES

The slopes of the landscape will be attributed with grafts and hedges. This is close to the historical landscape, the original ecosystem and as such more attractive for recreation.

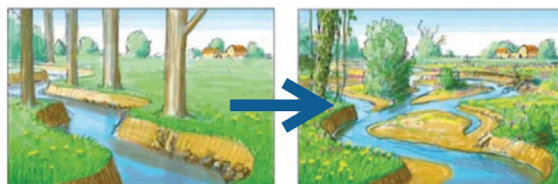


## GEUL VALLEY: ROOM FOR THE WATER

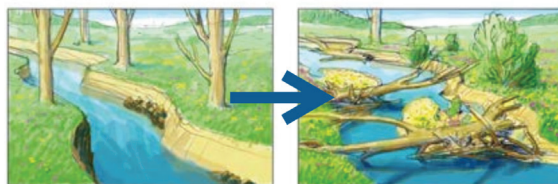
On the short term the discharge potential of the Geul will be increased by creating room for the water in dialogue with restrictions for urbanization. On the long-term water buffers 1,1 - 1,4 km<sup>2</sup> are proposed to multiplying current buffer capacity by 5 that will lower the water level 0,1 to 1 m. over 7 km.



Develop waterretention areas (2)



Create more space for creeks (2)



Wood to slow down currents (2)

(1) Memo afvoer- en overstromingskarakteristieken, effecten en maatregelen voor RDD ontwerp. Arcadis 2022

(2) Onderzoek effecten natuurlijke oplossingen Geuldal op hoogwater 2021. Stroming 2022

## CITIES AND VILLAGES: BYPASS

Storing water alone will not prevent floods to happen as in 2021. Measures like a bypass are needed on the short term. For the long term the city should be redeveloped, oriented on the slopes of the Geul valley.







## COLOPHON

Redesigning Deltas, the Netherlands, 2022-ongoing

Redesigning Deltas Program Partners: TU Delft, Deltares, Convergence Alliance-Resilient Delta, The Delta Commissioner, PBL Netherlands Environmental Assessment Agency, Wageningen University & Research, EUR, IHE Delft

Redesigning Deltas Program Coordination: TU Delft, Faculty of Architecture and the Built Environment, Delta Urbanism Interdisciplinary Research Group. Chris Zevenbergen, Fransje Hooimeijer, Taneha Kuzniecowa Bacchin. TU Delft, Policy & Strategy Department, Nikki Brand, Geneviève Girard. Deltares, Ellen Tromp,

Redesigning Deltas – Design Study Line Project Leaders: Fransje Hooimeijer, Taneha Kuzniecowa Bacchin

Redesigning Deltas – Design Study Line Advisory Board: Chris Zevenbergen, Erik Luiten, Like Bijlsma, Hans de Boer, Remon Pot, Ellen Tromp, Nikki Brand

Redesigning Deltas – Design Study Line Design Exhibition Production: Fransje Hooimeijer, Taneha Kuzniecowa Bacchin, Julia Ferreira de Sousa Daher, Francesca Rizzetto, Luca Iuorio



<https://www.redesigningdeltas.org>



Give your response to the design study

Redesigning Deltas – Design Study Teams:

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Arcadis: Marco Veendorp, Richard Marijnissen

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Bosch Slabbers: Stijn Koole, Ian Officer, Ian Officerin, Niels van Hasselt,  
Wendy van der Horst  
Tauw: Coen Riemslog

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Royal Haskoning DHV: Nanco Dolman

Team Rotterdam Delfland

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Marina Dondras, Lea Hartmeyer  
Flux landscape architecture: Gerwin de Vries, Kris Kersten, Britt Piek  
Sweco: Jan Kollen, Nikéh Booister, Renée Swinkels

Team Zeeland

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Aikaterina Myserli  
Feddes-Olthof: Yoran van Boheemen, Daniel Barrero  
Witteveen & Bos: Herman Mondeel

R D

REDESIGNING DELTAS U

TU Delft

Deltares

WAGENINGEN UNIVERSITY & RESEARCH



Erasmus ERASMUS UNIVERSITY ROTTERDAM

Erasmus MC University Medical Center Rotterdam

PBL Netherlands Environmental Assessment Agency

NATIONAAL DELTAPROGRAMMA

IHE DELFT

DE URBANISTEN

Witteveen+Bos

ZUS ZONES URBAINES SENSIBLES

FABRICations.

ARCADIS

LOLA

STUDIO. HART ZEMA.

SWECO

TAUW

Defacto urbanism

Royal HaskoningDHV Enhancing Society Together

FEDDES/OLTHOF

flux LANDSCAPE ARCHITECTURE

Bosch Slabbers

VISTA

TEAM ROTTERDAM PORT/CITY

TEAM ZEELAND

TEAM DELFLAND

TEAM RIVEREN

TEAM LIMBURG