

Dennis Flikweert / Department of Urbanism



# connecting

recreational networks and saline landscapes as opportunities for a climate proof delta

# landscape



## **COLOPHON**

### **CONNECTING LANDSCAPE**

Recreational networks and saline landscapes as opportunities for a climate proof delta

### **DELFT UNIVERSITY OF TECHNOLOGY**

Graduation lab Delta Interventions  
Department of Urbanism  
Faculty of Architecture  
Delft University of Technology

### **CONTACT DETAILS**

Dennis Flikweert  
student ID: 1302744  
Rembrandtlaan 179  
3241 AJ Middelharnis

06-46348947  
dennisflikweert@hotmail.com

### **MENTORS**

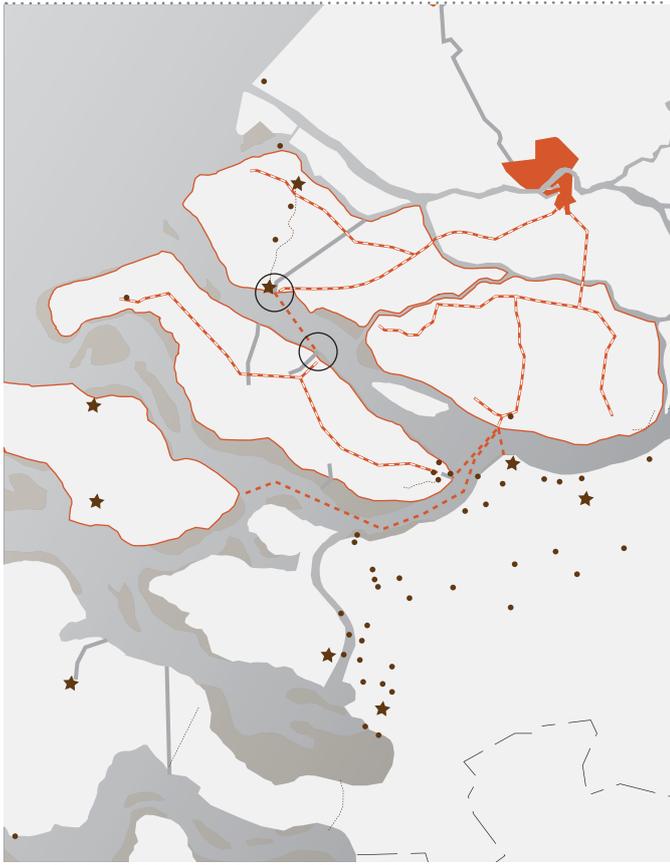
First mentor:  
Ir. I. Inge Bobbink  
department of Landscape Architecture

Second mentor:  
Prof. dr. ir. V.J. Han Meyer  
department of Urban Composition

External committee member:  
Ir. A.C. Alexander de Ridder



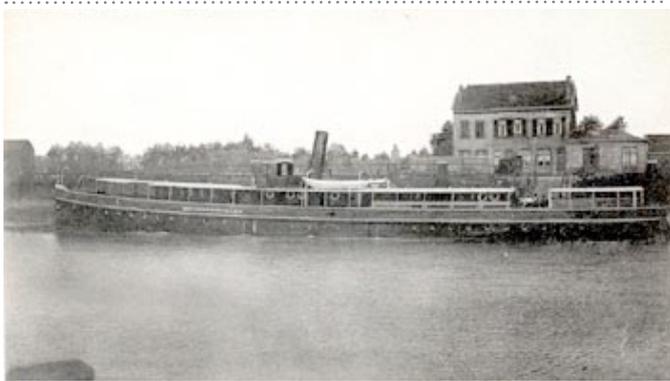
**FIGURE 0.1 / Map tramlines & ferries 1920**



Reason for my interest in the Southwest Delta as assignment for my graduation formed the stories about the long journey to Rotterdam with steamtram and ferry, but also the flood of 1953 and the Deltaworks. Because of the Deltaworks was also the accessibility of the islands increased, which has impact on the development of the settlements on the islands. Due to climate change are radical changes ahead for the Southwest Delta

My graduation project within the graduation lab of Delta Interventions is part of the master Architecture, urbanism and Building Sciences at Delft University. The subject for my graduation project is connecting landscape between urban regions and delta landscape and the transition between land and water.

**FIGURE 0.2 / Tramstation Hellevoetsluis**



Assignments in the Southwest Delta related to climate change are very complex. This made it difficult in the process to adhere to those aspects that form the basis of my design. I would like to thank my mentors ir. I. Inge Bobbink and prof. dr. ir. V.J. Han Meyer for guiding and help in structuring of my research and design. I also like to thank ir A.L. Anneloes Nilleson as supervising lecturer in the graduation lab of Delta Interventions. Finally thanks to my parents, loved ones and friends which have supported me through this period.

**FIGURE 0.3 / Tramstation Middelharnis**



Dennis Flikweert  
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## 1.1 - Introduction

Worldwide are urban deltas vulnerable because of water safety and ecology. Thereby are these areas very attractive to settle due to its economic, cultural, social and recreational opportunities. This combination of vulnerability and attractiveness makes urban deltas very complex, because they consists of a complex ecosystem, urban regions, agricultural and industrial land use, which are affected by economy, culture and society (Meyer et al. 2010). The development of the urban delta in the Netherlands is complicated due to a lack of an overall governance and because its part of a larger delta and a larger range of global seaports. To keep the seaports Antwerp and Rotterdam competitive with the other seaports

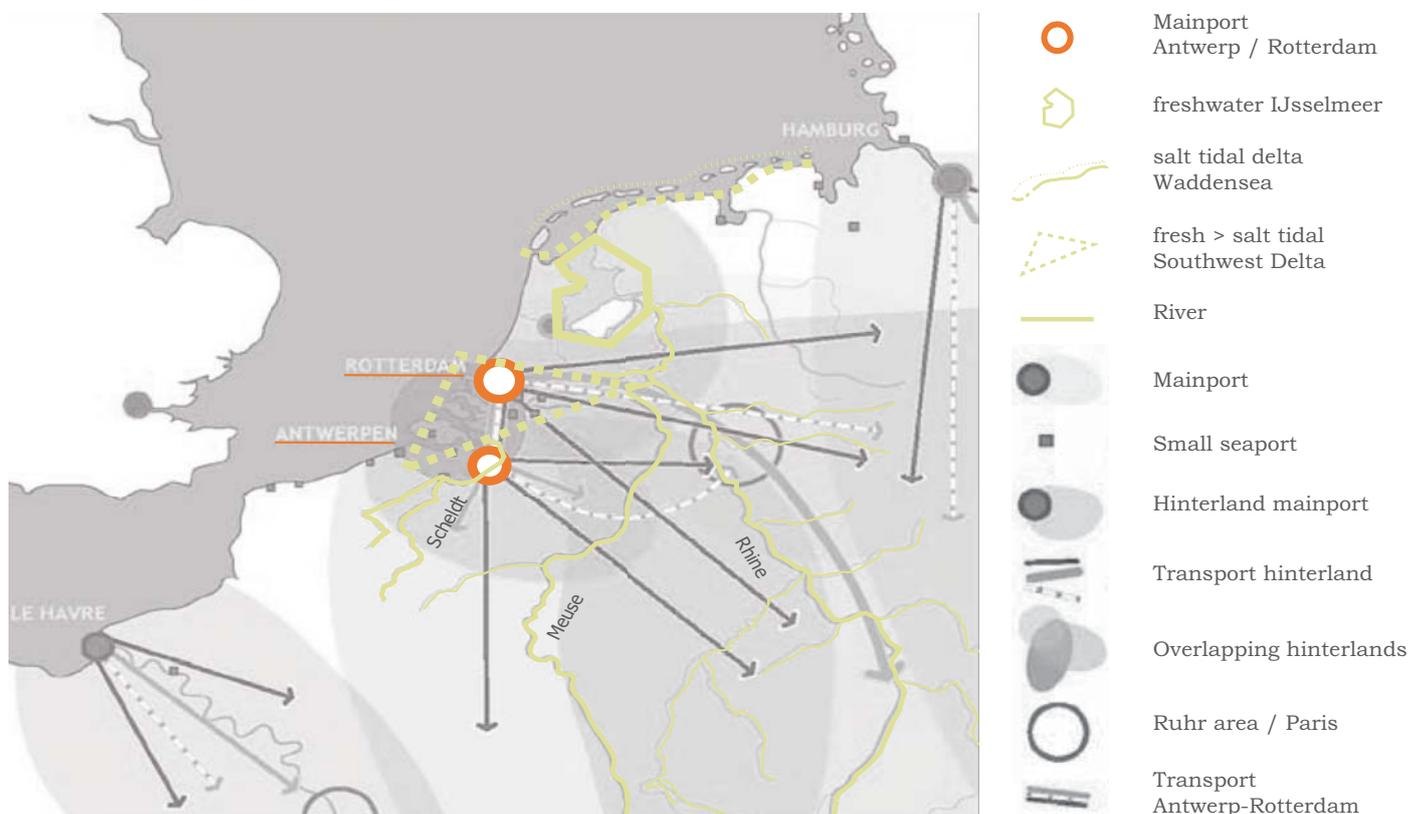
in the delta of Northwest-Europe, investment in capacity, efficiency and access to the hinterland. This became even more relevant because of the open borders as result of the European Union (Ministerie I&M and Ministerie EL&I, 2011b\*).

## 1.2 - Context

The estuary of the Rhine, Meuse and Scheldt is called the Southwest Delta. This delta accommodates the global seaports Antwerp and Rotterdam. The Southwest Delta is part of a larger Delta of Northwest-Europe and is located at the transition between salt water from the sea and freshwater from the rivers (figure 1.1). Other parts of the Dutch delta are the IJsselmeer and the Wadden Sea. Both, Deltaworks in the Southwest Delta and the Afsluitdijk between IJsselmeer and Waddensea

\* Ministerie van Infrastructuur & Milieu and Ministerie van Economische Zaken, Landbouw en Innovatie

FIGURE 1.1 / Southwest Delta and mainports Antwerp and Rotterdam in Northwest-Europe



edited source: (Ministerie I&M and Ministerie EL&I, 2011b: 16, 18)

were build for protection against flooding, shortening of the coastline and increasing of the freshwater supply. Because of the Afsluitdijk, the IJsselmeer became a freshwater lake and the Waddensea a saltwater tidal delta.

The port of Antwerp and Rotterdam are part of a range of seaports in Northwest-Europe. This range of harbours is regarded as one global port for Northwest-Europe and is called the 'Hamburg – Le Havre range'. The ports of Antwerp and Rotterdam form together with Gent, Zeebrugge, Zeeland Seaports, Dordrecht and Moerdijk the largest seaport complex of the world and accounts for over half of the trait of Northwest-Europe (figure 1.1).

The development of the urban delta is complex because the delta is ecological and economic part of a larger system. Thereby have these two aspects both there own spatial structure. The economic structure consists of urban regions, infrastructure and industrial areas. The ecological structure consists of the delta waters, nature and agricultural landscape. This separation results in two recognizable identities of the delta, which are the Urban Delta and the Delta Landscape.

### 1.3 - Logistic Delta

The Urban Delta and the Delta Landscape with their own structures are affected by the logistic delta with its ports and flows of goods over land and water. The port complexes are situated around two separate basins that are in open connection with the sea. Antwerp, Gent, and Zeeland Seaports are situated around the basin of the river Scheldt. Rotterdam, Dordrecht and Moerdijk are situated around the basin of the river

Rhine and Muese. Remarkable is the reverse position of the main port and the supporting ports in relation to the North Sea. This reverse position will affect future interventions to protect the delta against flooding related to the efficiency of ports.

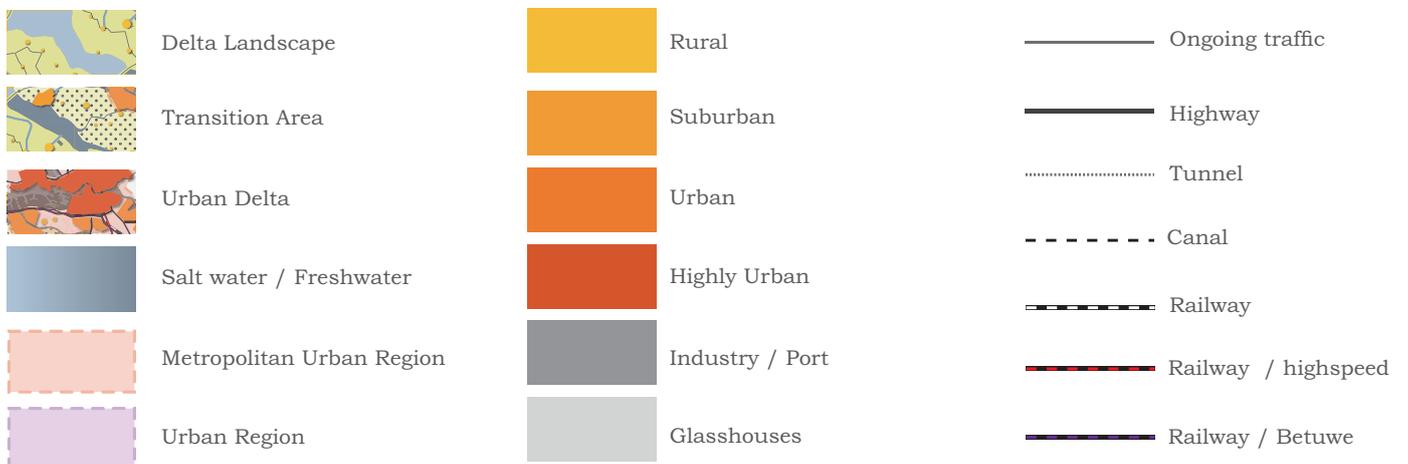
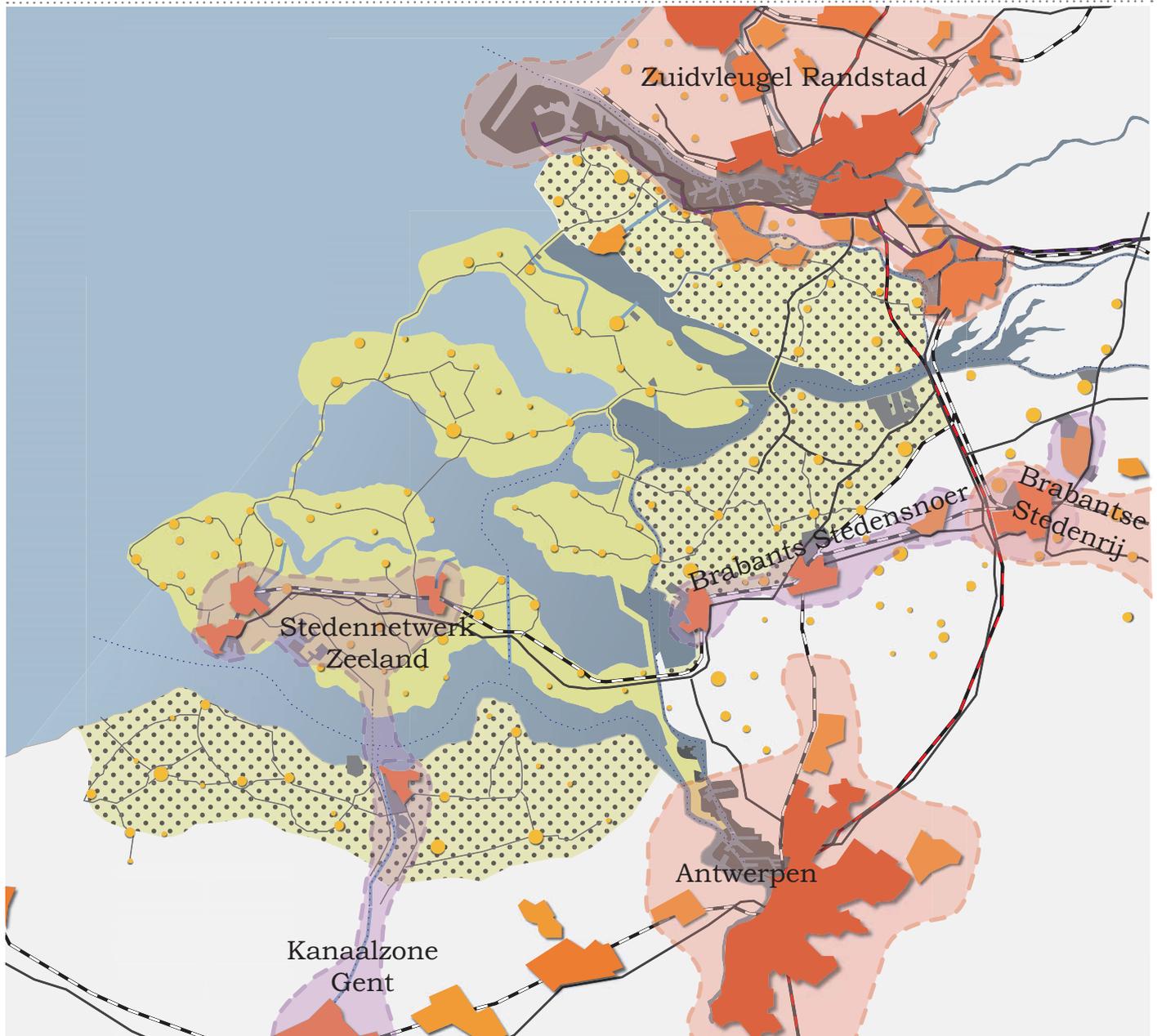
Other aspect of efficiency of transport between Antwerp and Rotterdam and between delta region and hinterland, are the bottlenecks in urban regions and shipping routes. The bottlenecks in the Urban Delta are situated around the station areas in the centre of the cities, because of safety risks for transport of hazardous substances. Bottlenecks on the shipping routes are the capacity of the locks between the port of Antwerp and Rotterdam.

### 1.4 - Spatial carriers

In the research report of MIRT (Meerjarenprogramma Infrastructuur, Ruimte en Transport) is the separation between Urban Delta and Delta Landscape explained by the logic of the emergence of cities on the edge of the Delta. Urbanization has to take place close enough to the water to benefit from it, but at the same time it has to take place on the higher grounds in order to reduce possible nuisance (Ministerie I&M and Ministerie EL&I, 2011b: 31). Result of the urban expansion on the edge of the delta is the contrast between rural landscape and urban fabric. Transition areas should function as connecting element between the urban region and the rural landscape. The way in which each transition area function as connecting element between the urban region and the rural landscape, depends on the structure and identity of the urban region it is connecting with. This structure and identity is defined by

# 1 - PROBLEM DEFINITION

FIGURE 1.2 / Urban regions on the edge of the estuarine landscape with in between the potential recreational landscape



edited source: (Ministerie I&M and Ministerie EL&I, 2011b: 28-30)

landscape, economy and society. The different urban regions with a distinctive structure and identity are: the south wing of the metropolitan region Randstad, Brabantse Stedenrij and Brabantse Stedensnoer (row of cities crossed by landscape corridors), Stedennetwerk Zeeland (row of cities on the lower sea clay) and the region of Antwerp (figure 1.2). The contrast between rural landscape and dense urban fabric is the largest for the Randstad. In the Brabantse Stedenrij, Brabantse Stedensnoer and Stedennetwerk Zeeland is the urban pattern more alternated with the landscape. The transition between Brabantse Stedenrij and Delta Landscape is enhanced by differences in landscape as height and soil, which have led to different spatial structures of the rural areas: Ribbon-shaped building structures on the high sandy grounds and compact settlements on the low sea clay grounds. The Antwerp-region is complete different. A swarm of ribbon-shaped building structures, villages and towns have developed around the centrally located city of Antwerp.

Besides the wide variety of the urban regions in the Urban Delta is the Delta Landscape divided in core region and transition areas between urban region and rural landscape (figure 1.2). These transition areas fulfil an important role in the experience of the urban delta as one unity and they have a recreational function for the urban regions. Due to its recreational function is the accessibility of the transition area from the urban region important.

### **1.5 - Safety and freshwater supply**

Climate change requires interventions for safety and freshwater supply.

These interventions are necessary in order to anticipate on the changing circumstances, which consist of a rising sea level, subsidence of the soil and more frequent larger peak discharges (figure 1.3). Also are there more often extreme situations of extreme local rainfall or periods of draught. These changing circumstances have a major impact on the water system and ecology which are the basis for the economic activities agriculture, fishery, tourism and recreation.

In the report Deltaprogramma 2012, werk aan de delta (Ministerie I&M and Ministerie EL&I, 2011a: 20-33), are several aspects described for a climate resilient approach. A climate resilient delta is based on the principle of multi layered safety. The first layer comprise of measures to prevent us against flooding. The second and third layer comprise of measures to minimize the impact of possible flooding by attention to spatial arrangement and disaster management. Another important aspect of a climate resilient delta is the way we deal with periods of draught. Nowadays we use the repression sequence in case of occasional draught (figure 1.4). Due to more frequent occurrence of extremes in the freshwater supply, this instrument is no longer appropriate. The water system needs to become more flexible, because otherwise problems will occur such as damage to the economy, damage to agricultural crops, restrictions on industry and restricted shipping on canals and rivers.

The freshwater supply in the Netherlands exist for 70% of water which is supplied by the rivers Rhine and Meuse and 30% exist of precipitation. Only 5% to 15% is used for prevention of salinisation

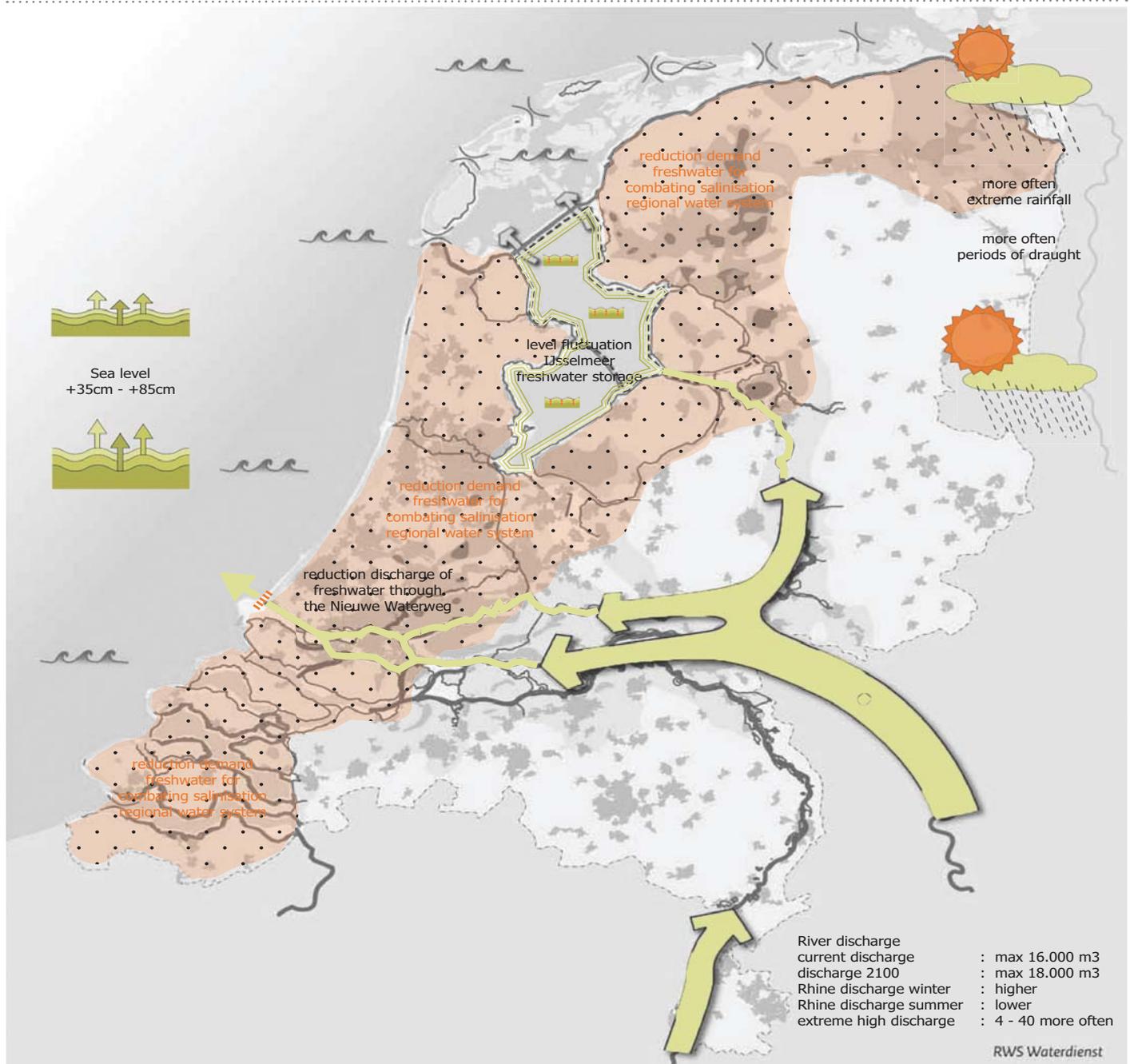
# 1 - PROBLEM DEFINITION

and water quality, by means of water drainage level and flushing. The two most important water supplies in the Netherlands are the IJsselmeer and the Southwest Delta. The IJsselmeer serves as large stock basin with a limited freshwater supply. But in the west of the Netherlands are just some small

stock basins and a large freshwater supply.

The availability of freshwater in the future can be influenced from the main water system or from the regional water system (figure 1.3). There are two possible options to enlarge the supply

**FIGURE 1.3 / Freshwater supply related to the consequences of climate change on the main water system and regional water systems**



edited sources: (Ministerie I&M and Ministerie EL&I, 2011a: 21, 23, 29, 31) / (PBL, 2011: 18)

# 1 - PROBLEM DEFINITION

of freshwater from the main water system. Most important is the reduction of the discharge of freshwater through the Nieuwe Waterweg, which is now necessary because of the reduction of salinisation. The second option is enlargement of level fluctuation of the IJsselmeer-region, in order that the IJsselmeer in periods of draught can be used as freshwater recourse for northern and western Holland. However research has shown that a larger level of fluctuation in the IJsselmeer is not profitable with the upcoming climate changes. An alternative measure is increasing the freshwater discharge through the IJssel. The possibilities of this measure are strong related to the possibilities of the reduction of salinisation in the Nieuwe Waterweg, for which a large part of the river discharge is used (PBL, 2011: 59-63\*).

The availability of the freshwater can also be influenced by the demand of freshwater from the regional water systems. It is possible to reduce the demand by flexible handling of the

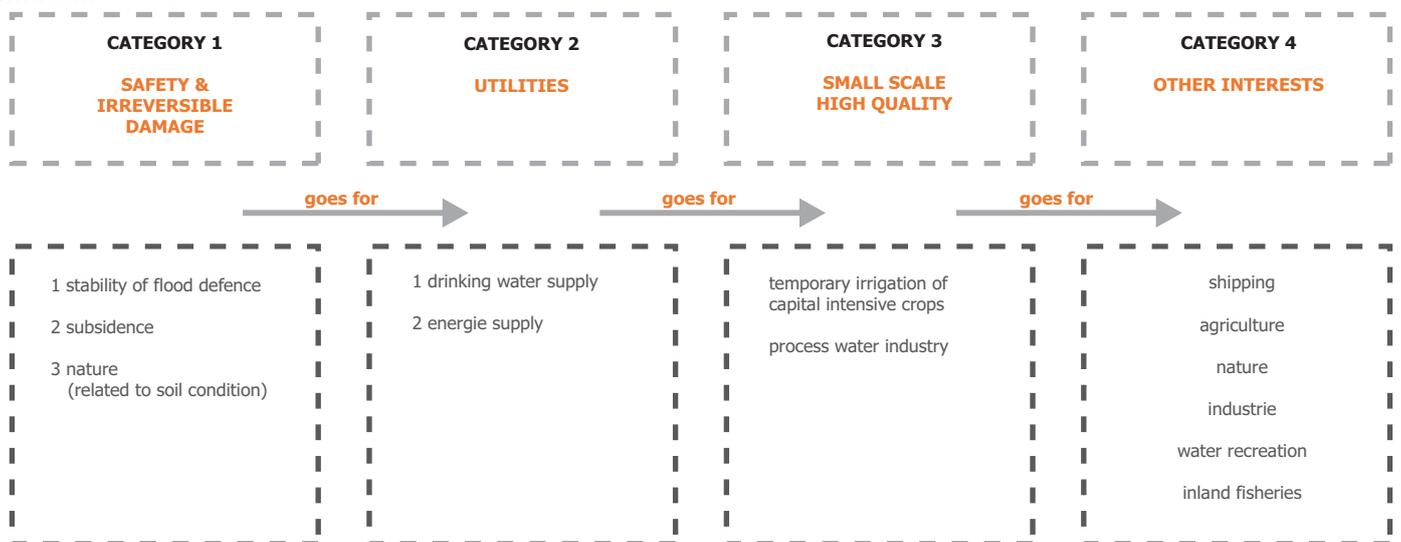
salinity of the groundwater, which will not affect on agricultural crops if you select them more carefully on the degree of salt resistance (PBL, 2011: 55). This will decrease the demand of freshwater of the main water system, which is often used for flushing and shortages because of artificial maintained low groundwater level. The ability to retain more freshwater of rainfall and higher groundwater levels is only profitable in case of limited climate changes (figure 1.3).

## 1.6 - Agriculture, Landscape & Nature

What is the impact of climate change and interventions in the delta on nature and the ecologic network? Implementation of the ecological network has all ready result in expansion of nature reserves and connecting them. However, is nature able to adapt quick enough to the changing climatic conditions, with the risk of loss of biodiversity? The Netherlands have a major responsibility according to the typical ecosystems of a lowland delta. Interventions of the water

\*Planbureau voor de Leefomgeving

FIGURE 1.4 / Repression sequence for freshwater during temporary periods of draught



edited source: (Ministerie I&M and Ministerie EL&I, 2011a: 28)

system are subject to Natura-2000 and are in accordance with decisions of water safety and freshwater supply.

In the report 'Een delta in Beweging (PBL, 2011: 69) is stated that the quality of the rural area to a large extent is shaped by agriculture, because 55 percent of the Netherlands exist of agricultural land. Agriculture is under major influence of the economy because of its production for a certain market: regional, national, European or global. Current problems between land-based agriculture and nature are often the consequence of choices made in the past according to landscaping, designed for optimal use of the agricultural. However, between land-based agriculture and nature are many conflicting demands on groundwater level and the regional water system. Nowadays it is adjusted to prevention of damage to agricultural crops by water. Disadvantages of these choices are expedited discharge of rain fall, slight build-up of water recourses during winter, shortage of freshwater during summer, subsidence, salinisation of groundwater and dehydration of nature. Because of this conflicting demands, from agriculture and nature, the Planbureau voor de Leefomgeving (PBL, 2011: 72) seeks to a recalibrated balance between agriculture, landscape and nature. Besides this more heterogeneous balance between agriculture, nature and landscape it is still not climate resilient. In the Southwest Delta it is important to restore the dynamics of freshwater and salt water as well as tides, whereby recovery of fish migration between sea and river can be taken into account.

### 1.7 - Conclusion

**In the Southwest Delta are the main issues safety, freshwater and fragmentation of the urban delta. Interventions related to flood defence will also influence the freshwater supply. Due to climate change, there is not enough freshwater available because of more frequent periods of draught and too much consumption of freshwater for prevention of salinisation in the river and the water systems of the polders. The impact of climate change on the freshwater supply is of major importance for urban regions, ports, industry, agriculture and recreation. The availability of freshwater can be influenced from the main water system or from the regional water systems. Most important is to reduce the discharge of freshwater through the Nieuwe Waterweg, which is now necessary for combating the salinisation. The availability of freshwater can also be influenced from the regional water systems by reducing the demand on freshwater from the main water system. Thereby a different arranged regional water system can contribute to an improved balance between agriculture and nature with their conflicting demands on the regional water system. The fragmentation of the urban delta is the result of development of cities on the edge of the estuarine landscape, which are in strong contrast with the rural landscape in the center of the delta. The transition areas between them connects city and estuarine landscape insufficient, which can be strengthened by transforming the transitional area into a recreational landscape.**

### 2.1 - Problem Statement

In the problem definition has emerged that the main issues in the Southwest Delta of Rhine, Meuse and Scheldt are: safety, ecology, freshwater supply and fragmentation of the Southwest Delta. Due to climate change are interventions required in order to guarantee safety and freshwater supply in the future. Thereby have interventions related to flood defence large impact on the freshwater supply. Besides the interventions required by climate change is the Southwest Delta fragmented as result of the urban regions, which have developed on the edge of the delta and which are in strong contrast with the rural landscape in the centre of the delta. However, the transition areas connects the urban regions and rural landscape insufficient.

### 2.2 - Project aim

In addition to solving fragmentation and the impact of climate change on flood defence and freshwater supply independently, the question is how these two developments can reinforce each other, contribute to ecological restoration of the delta and reflect the historical development of the spatial structures in the Southwest Delta. A development which has defined settlements and how they are related to the water. Instead of looking for a solution on the larger scale, is this graduation project focussed on the consequences and opportunities for small settlements in the delta, which are the result of interventions on flood defence and freshwater supply. In order to investigate at the same time the insufficient connection between urban regions and rural landscape, the graduation project will focus on settlements located in the transition area.

**THE SOUTHWEST DELTA OF RHINE, MEUSE AND SCHELDT IS FRAGMENTED BECAUSE URBAN REGIONS AND DELTA LANDSCAPE ARE NOT INTEGRATED DUE TO CHARACTARELESS TRANSITION LANDSCAPES**

**DEVELOPMENT OF A CHARACTERISTIC TRANSITION LANDSCAPE IN BETWEEN URBAN REGIONS AND DELTA LANDSCAPE BY TAKING ADVANTAGE OF INTERVENTIONS FOR A ECOLOGIC RESTORED AND CLIMATE PROOF DELTA**

How can interventions for an ecologic restored and climate proof delta contribute to a dynamic connecting landscape between urban region's and the delta landscape but also to an enhanced spatial quality of the transition between settlement and water?

#### Subquestions spatial structure:

- How can loss of identity on site be avoided in regeneration of the connection between urban region and delta landscape?
- How did flood defence and infrastructure develop through time and how does this affects economic and urban development in the delta?
- What are the typologies of the settlements and how are they related to the spatial structure of the landscape and the water?

#### Subquestions climate change:

- How can interventions on flood defence and an ecologic restored delta enhance the spatial quality of the transition between settlement and water, but also the connecting landscape between urban region's and delta landscape?
- How can the demand on freshwater from the main water system be reduced by solutions within the regional water system and what is their impact on the landscape?

#### Subquestions connecting landscape:

- What are the similarities and differences between the islands and what are their opportunities for future development?
- How can saline landscapes enhance the spatial quality of the transition between settlement and water in which agriculture, nature and recreation are integrated?
- How can Hellevoetsluis become the gateway between urban region and delta landscape in relation to its position in the connecting landscape?

**4.1 - Literature study**

The literature study for this graduation project consists of two aspects. The first aspect is more a scientific one, which is based on scientific books and articles. This literature study places the graduation project in the theoretical context of that specific subject. The subject for the theory paper is the transition between urban region and rural landscape and will describe how design and planning on this relation has developed through time and which tools can be used to design a dynamic and characteristic transition.

**The product of this literature study is a theory paper.**

The second aspect of the literature study consists of books, government reports, articles and online documentation about delta interventions, water management, restored ecology, salinisation, aquaculture and port development.

**The product of this literature study is the research which form the answer to the subquestions concerning climate change.**

**4.2 - Historical analyses**

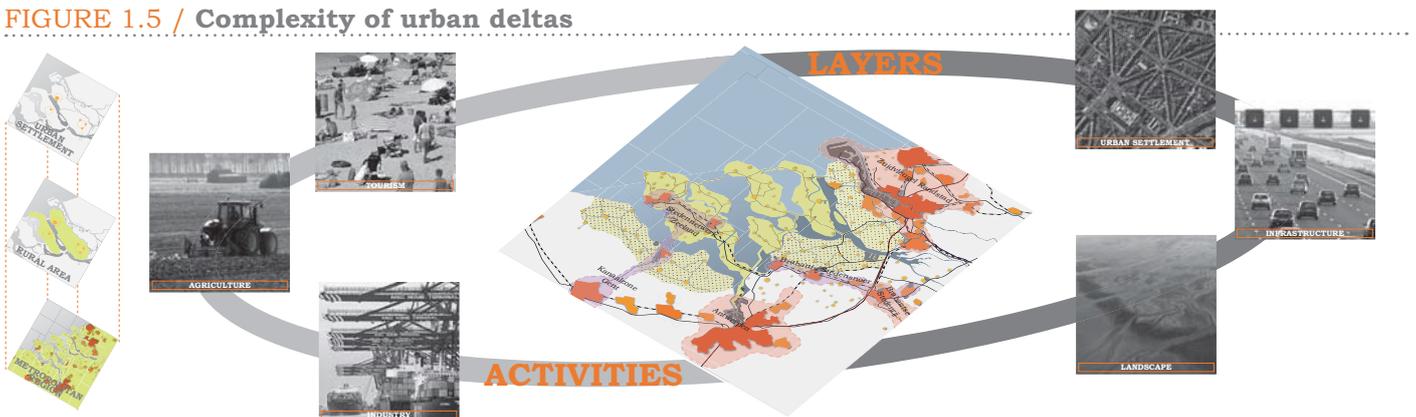
The historical analyses is a comparison analysis on different periods, scales and layers. This analysis is an elaboration of the layers-approach and is developed

to get a better understanding of the complex delta landscape. This approach makes a distinction between the layers landscape, infrastructure and agglomeration. Interrelations between layers become visible if they are analysed on different scales and in different periods. This approach helps to understand what the impact will be of an intervention on the complex delta landscape.

In the article ‘Towards a typology of urbanized deltas’ describes Meyer and Nijhuis(2011: 1) this complexity as follows: *“Urban deltas represent an extreme variation of a general phenomena in the urbanized world: the combination of an urban system with a natural system. Both systems influence each other but have also their own dynamics. Urban deltas are an extreme variation of this combination because of the complexity of the urban system as well as of the natural system”.*

To combine this approach with the plan analysis on scale of the urban settlement, you even get a better understanding of the relation between settlement and landscape. This analysis makes a distinction between the different changes of the natural landscape. The method determine the following layers (steenbergen, 2008):

FIGURE 1.5 / Complexity of urban deltas



- **Basic form**  
The basic form is representation of the way in which the topography of the landscape is reduced, rationalised or activated in the ground plan (Steenbergen, 2008: 39)
- **Spatial form**  
The spatial form is the composition of the three-dimensional spaces of the landscape, resulting in spatial dynamic of the landscape (Steenbergen, 2008: 127)
- **Metaphorical form**  
The metaphorical form is the representation of how iconic images and architectural forms mutual with elements from nature as water, relief and movement (Steenbergen, 2008: 235)
- **Programmatic form**  
This form emphasizes the functional zoning and organisation of the program in relation to movement patterns (Steenbergen, 2008: 243)

**The product of this historical analysis are analysis drawing and conclusions which are the answer on the subquestions concerning the spatial structure.**

### 4.3 - Case study

The case study is an in depth study of specific cases or projects. To make the case study more concrete, the cases are selected on one or two issues which are fundamental for understanding. For the graduation project is the focus on the transition between train and ferry and how that is related to the waterfront, fortification and centre of the town. The study is done for the future transition between train and ferry in Hellevoetsluis on the cases of Den Helder, Enkhuizen, Harlingen and Vlissingen In depth study can be done by spatial analysis in order to compare, describe or learn of a place.

When multiple case studies are used it is important to highlight the similarities and differences between them (Rocco, 2011).

**The product of this case study is an comparison and analysis of the relation between town centre, railway station, ferry, tourist attraction and the waterfront for the different cases. In addition is a toolbox created which consists of street elements that strengthen the spatial experiences of routes between the different areas.**

### 4.4 - Design experiment

In the design experiment are interventions evaluated on there effects on the spatial quality of the environment or composition element. There are three design experiments possible, which are Experimental transformation of the topography, experimental transformation of the type and experimental composition (Steenbergen, 2008). For the graduation project only experimental composition will be used. In this experiment a experimental composition is designed, which consists of an clear ordering of the present elements and structures.

**The product of the design experiment consists of a experimental composition which integrate existing spatial structures of the landscape with elements of the new recreational landscape which contains integrated water elements for freshwater supply and aquaculture.**

## 4 - METHODOLOGY & PROJECT STRUCTURE

### PROJECT DEFINITION

**PROBLEM  
DEFINITION**

**PROBLEM  
STATEMENT**

**PROJECT  
AIM**

**RESEARCH  
QUESTION**

#### SPATIAL STRUCTURE

#### CLIMATE CHANGE

How can loss of identity on site be avoided in regeneration of the connection between urban region and delta landscape?

How did flood defence and infrastructure develop through time and how does this affects economic and urban development in the delta?

What are the typologies of the settlements and how are they related to the spatial structure of the landscape and the water?

theory  
paper

historical  
analysis

spacial  
analysis

How can interventions on flood defence and an ecologic restored delta enhance the spatial quality of the transition between settlement and water, but also the connecting landscape between urban region's and delta landscape?

How can the demand on freshwater from the main water system be reduced by solutions within the regional water system and what is their impact on the landscape?

literature  
study

literature  
study

#### RECREATIONAL LANDSCAPE

What are the similarities and differences between the islands and what are their opportunities for future development?

How can saline landscapes enhance the spatial quality of the transition between settlement and water in which agriculture, nature and recreation are integrated?

How can Hellevoetsluis become the gateway between urban region and delta landscape in relation to its position in the connecting landscape?

comparison

design  
experiment

case study

#### DESIGN

**CONCLUSIONS**

**RECOMMENDATIONS**

**REFLECTION**

### 5.1 - Involved disciplines

The focus of the graduation project is the urban delta concerning the transition between urban regions and rural landscape, with the water-landscape as structuring element. Because a combination of urban, architectonic and landscape elements are involved is a interdisciplinary approach required. This interdisciplinary approach forms the basis for the master studio 'Delta Interventions' which is part of the master Architecture, Urbanism and Building Sciences at Delft University of Technology. In order to continue this interdisciplinary approach through the graduation project have I choose my mentors in the department of Urban Composition (Prof. dr. ir. V.J. Han Meyer) and of Landscape Architecture (ir. I. Inge Bobbink).

The department of Urban Composition is focused on theory and methodology of the urban design, involving assignments related to a strong and flexible urban groundplan, systems of water management as core element of the groundplan and interconnecting of various types of networks at different scale levels. In the urban delta is interconnecting of different networks at different scales important for the reachability of the recreational landscape in the transition between urban region and rural landscape. Thereby implies water as core element of the urban groundplan that there is a shift to landscape network as structuring element in the groundplan of the urban delta.

The department of Landscape Architecture is focussed on theory and methodology of landscape architecture, but is expanding its expertise into the

urban landscape in which landscape structures cities and the urbanisation of the man-made landscape. The importance of landscape as structuring element requires an understanding of space-time condition of the landscape with regard of spatial quality and cultural identity and its potential for change. The result is the design of a new typography which integrate new programme into a landscape, with retention of its spatial quality and cultural identity.

### 5.2 - Scientific relevance

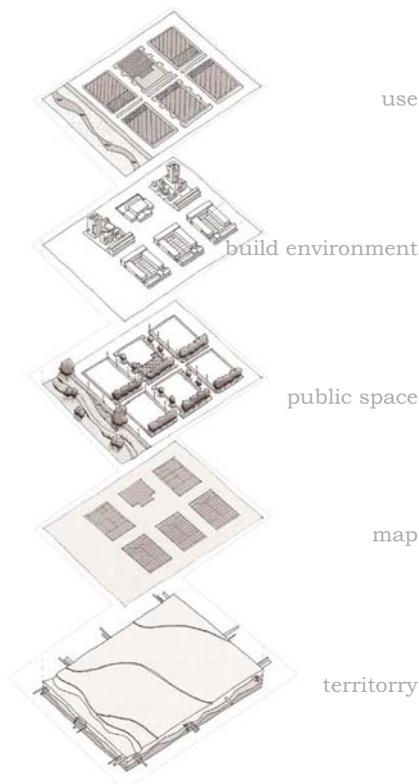
The scientific relevance of the graduation project derives from the interdisciplinary approach of urbanism, landscape architecture and water management. An interdisciplinary approach means use of analysis and design tools from both disciplines. Interventions arising from water management needs to be integrated in the urban or rural landscape.

Combined tools from both disciplines are applied in the analysis of the Southwest Delta. As described in methodology compares the historical analysis the area of study on different scales, different layers and different time periods in order to get a better understanding of intended effects of interventions on the environment. This historical analysis is combined with spatial analyses, approached from the discipline of landscape architecture. This spatial analyses focuses on the spatial transformation and composition of the landscape. Because of this interdisciplinary approach is considered for each scale which layers should be analysed. From the discipline of urbanism is emphasised on program, public space and use. From the discipline of landscape architecture is

emphasised on landscape, network and spatial composition. In the historical analysis of the Southwest Delta shifts the emphasis from program and network on the largest scale to program, landscape and spatial composition on the smallest scale. The value of these combined analysis methods is a better understanding of what impact strategic interventions on the larger scale have on the spatial composition on the smallest scale. These strategic interventions on the larger scale consists of the connection between urban region and delta landscape and the interventions for a ecologic restored and climate proof delta. Thereby have these interventions a major impact on the composition of the transition between land and water in the delta and the spatial relation of settlements to the water.

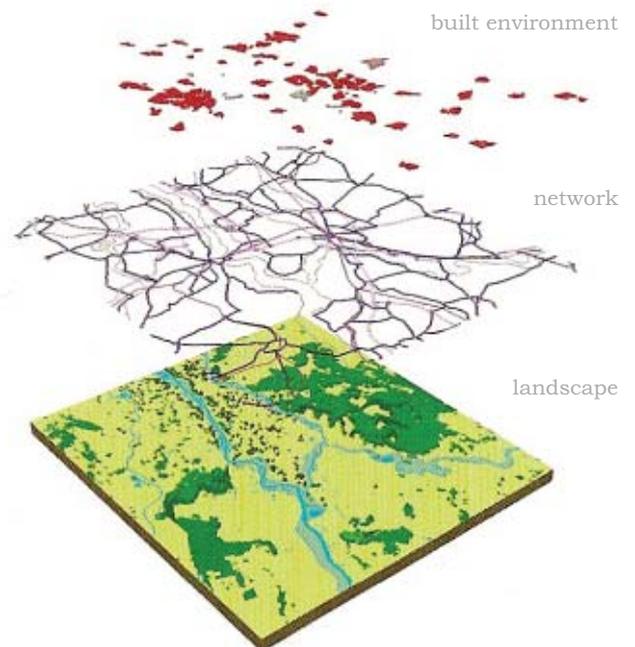
This interdisciplinary approach is also reflected in the output of the theoretical framework. Within this theoretical framework is research done into tools which can be used to design dynamic and characteristic artificial landscapes. Due to changed paradigms can water and landscape become structuring elements in these artificial landscapes. In order to use landscape and water as those structuring elements in adaptation to new economies and ecologies without loss of identity, the following tools are defined: processes over time, horizontality, imaginary, networks and collective memory. The two most practically applicable tools are networks and collective memory, which can reinforce each other when they are combined. A network is a structure which can absorb, transform and exchange with its environment.

FIGURE 1.6 / layers discipline of urbanism



source: (Heeling et al, 2002: 19)

FIGURE 1.7 / layers discipline of landscape architecture



source: (Meyer et al, 2010: xiv)

Water and landscape are good examples of this kind of structures, because they are formed by processes over time. This flexibility in combination with identity is also needed to create meaningful and vibrant public space. This kind of public space can be created by collective memory on site. If they are included in the networks can they improve its stability and robustness. Application of these tools is possible in two cases of the graduation project.

One of the cases is the position of Hellevoetsluis in the transition area between urban region and delta landscape. Hellevoetsluis can function as gate between urban region and delta landscape if it is connected to robust networks. In Hellevoetsluis are the fortification and 'veerhaven' sites with historic value. Strengthened by collective memory on site and connected to robust networks can the improve the transition between urban region and delta landscape.

The other case is the transition between land and water and the relation of settlements to the water which is disturbed by the structure of polders. Settlements originally arose at the water are only connected to the water by canal. Due to climate change needs the delta to adapt to changing circumstances. This will also cause changes in the regional water system on the island. Adaptation to these changes could be utilized for improving the connection between settlement and the water. Actually is this strengthen memory on site with the regional water system as adaptive network.

### 5.3 - Social relevance

The social relevance is beside an ecologic restored and climate proof delta

based on impact and opportunities on the smaller scale. This impact and opportunities relate mainly to the local economies in the Southwest Delta and the attractiveness to live there. These local economies consists largely of the sectors fishing, agriculture and recreation. Due to climate change is the continued existence of agriculture in its current form threatened. On the other hand can changing circumstances for an ecologic restored and climate proof delta be an opportunity for fishing and recreation. Regarding an attractive living environment is relation to the water and accessibility of the urban regions of interest.

The continued existence of agriculture in the Southwest Delta depends on the availability of freshwater. As described in the problem definition depends the availability of freshwater on the main water system and the regional water system. According to the main water system is an integral vision important because of the distribution of river discharge between Southwest Delta and IJsselmeer. With regard to increasing inland salinisation in the main water system plays the distribution of river discharge an important role in the availability of freshwater. Increased inland salinisation of the main water system is the result of low river discharge, rising sea levels and maybe restored open connections to sea in the Southwest Delta. Salinisation also effects the regional water system, which use water from the main water system for prevention of internal salinisation. Also the regional water system have to adapt to the changing circumstances. Interdependence of the different water systems needs an integral approach for an ecologic restored and climate proof delta.

### 6.1 - Introduction

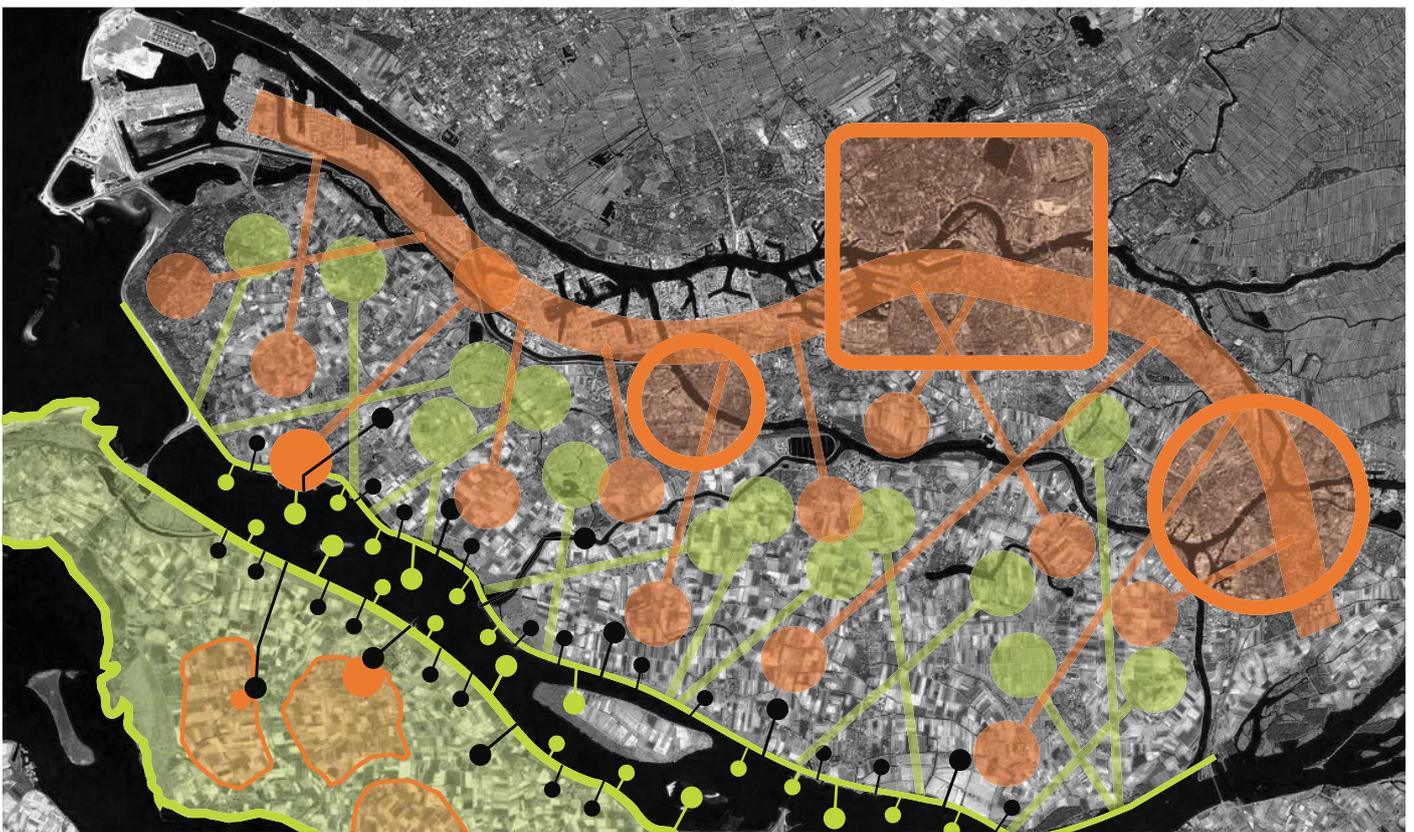
The subject for the theory paper is the transition between urban region and delta landscape and will describe how design and planning on this relation has developed through time and which tools can be used to design a dynamic and characteristic transition. In the southwest delta are two different transitions. One of them is the transition between urban regions and delta landscape. The other one is the transition between settlement in the delta landscape and the water.

**Sub question:** *The research question answered in this theory paper is how loss of identity on site can be avoided in regeneration of the connection between urban region and delta landscape.*

### 6.2 - Transition urban region / delta landscape

The transition between urban regions and delta landscape refers to the scale of the urban delta. Urban deltas are a combination of an urban system and a natural system, with both their own dynamics. The disturbed balance between urban pattern and rural landscape can be found in distance, contrast and identity. The disturbed balance could be restored by a decreased distance and increased contrast between urban pattern and rural landscape. There can be made a distinction between internal landscape in the urban pattern and of compact cities in the rural landscape, between peripheral disposition and central disposition. The concept of the peripheral disposition on the regional

FIGURE 2.1 / Transition between urban/landscape & water/land



edited source: [www.bing.com/maps](http://www.bing.com/maps)

scale result in a regional life pattern of its inhabitants. This regional life pattern is defined by consciously chosen places for living, work, use of facilities and recreation.

### 6.3 - Transition between land / water

The transition between settlement in the delta landscape and the water refers to the scale of the delta settlement. This transition is influenced by the changing natural system due to climate change and restoring ecology. There has been changes in paradigms according to water and landscape. The paradigm according to water has changed from fighting against water into working with water. The paradigm according to landscape has changed from landscape as compensation for negative effects of urban development into landscape as structuring instrument in adaptation to new economies and ecologies without loss of identity. Within this new paradigm is focused on the recovery of artificial landscapes as post-industrial, post-agricultural and transition areas. How can lack of identity be restored, based on cultural history of the site in the context of climate change and restored ecology.

### 6.4 - Conclusion

In order to use landscape as structuring instrument in adaptation to new economies and ecologies without loss of identity, the following attitudes are defined: processes over time, horizontality, imaginary, networks and collective memory. The two most practically applicable attitudes are networks and collective memory, whereby the network is of importance for the regional scale of the urban delta and the collective memory is of importance for the local scale of the settlement and the public space.

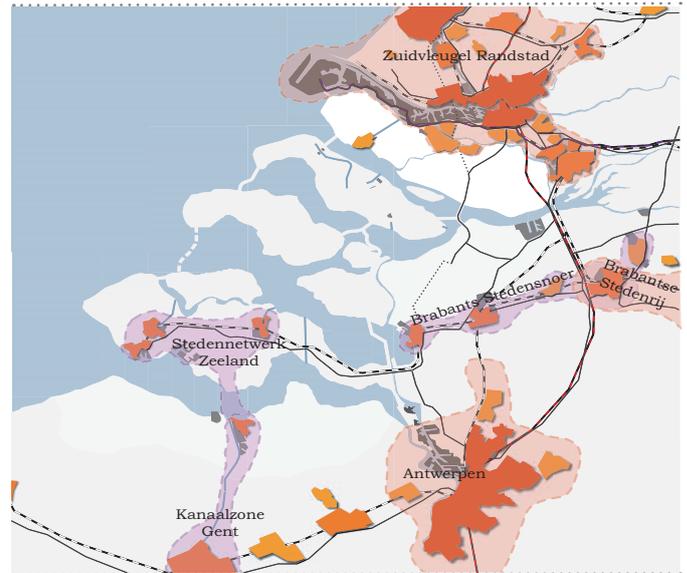
Networks of the Southwest Delta can be divided in two kinds, ecologic networks and economic networks. The ecologic networks consists of the delta waters and the economic networks consists of three corridors. These corridors consists of infrastructure which connects urban regions, shipping routes which connects ports and Deltaworks connects recreation on the islands with the urban regions. Interaction between these different systems is important and is possible if the different networks all have the capacity to absorb, transform and exchange with its environment. This flexibility in combination with identity is also needed to create meaningful and vibrant public space. If they are included in the networks can they improve its stability and robustness. In order to create characteristic public space, the tool/art of collective memory is the most important one. Within this tool, site function as framework for the memory on site. Because this framework is based on one or several fixed itineraries, its more applicable to artificial landscapes. Memory on site is comparable to the art of gardens, which is an in situ representation of the surrounding landscapes. The art of memory is an in situ representation of history on site.

## 7.1 - Introduction Southwest Delta

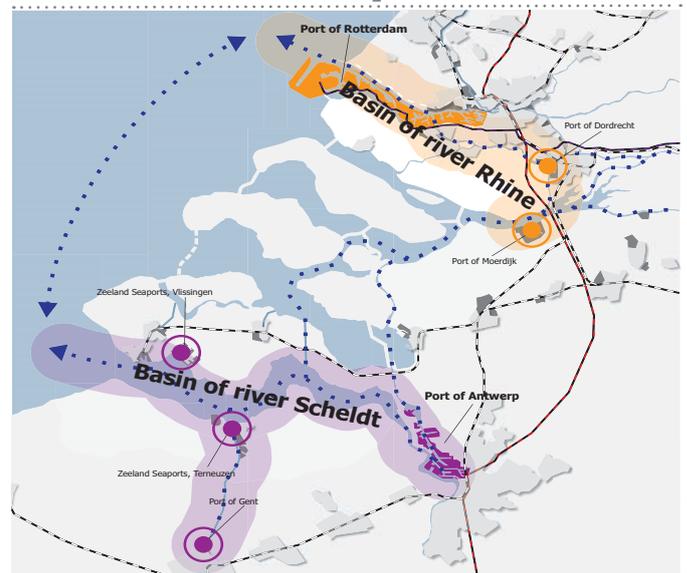
The Southwest Delta consists of the islands in the province of Zeeland and Zuid-Holland, which are located in the Rhine-Meuse-Scheldt estuary. The Southwest Delta developed from almost a closed coastline, influenced by tides, towards a landscape of islands and tidal channels. The Southwest Delta developed from almost a closed coastline, influenced by tides, towards a landscape of islands and tidal channels. The separation between land and water becomes sharper because dry land is diked. However due to several large floodings, the pattern of the delta changed dramatically. In order to get more control of the delta the small islands are forged into larger entities. After the flood in 1953, it became clear that large areas of the delta landscape were vulnerable (Hocks, Hoekstra and Stedenbouwkundig Ontwerpbureau POSAD, 2009).

As response to the flood of 1953 were the Deltaworks constructed. They shortened the coastline and divided the delta in compartments. Because of the increased safety against flooding the delta became an attractive environment for urban development (Meyer, Versluis and Nillesen, 2011). This urban development still takes place on the edge of the estuarine landscape and the port activities are located around the two inlets which are in open connection with the North sea. Due to the Deltaworks are the islands more accessible for recreation. However is the recreation more located near the North sea. This has partly to do with the landscape and the beaches, but also with the accessibility of the water basins which are divided by dams. This decrease the possibilities for water recreation.

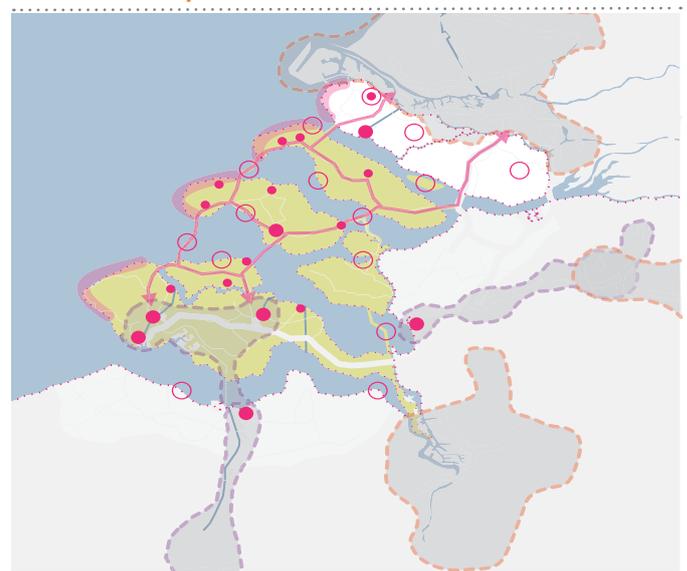
**FIGURE 2.2 / Corridor of urban regions**



**FIGURE 2.3 / Corridor of ports**



**FIGURE 2.4 / Corridor of recreation**



## 7.2 - Historical analysis Southwest Delta

**Sub question:** *How did flood defence and infrastructure develop through time and how does this affects economic and urban development in the delta?*

### 1920

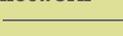
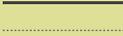
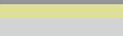
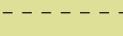
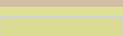
- Fortifications on edge of higher sandy soils
- Steam tram + Ferries connect islands to Rotterdam
- Cities in the landscape

### 1980

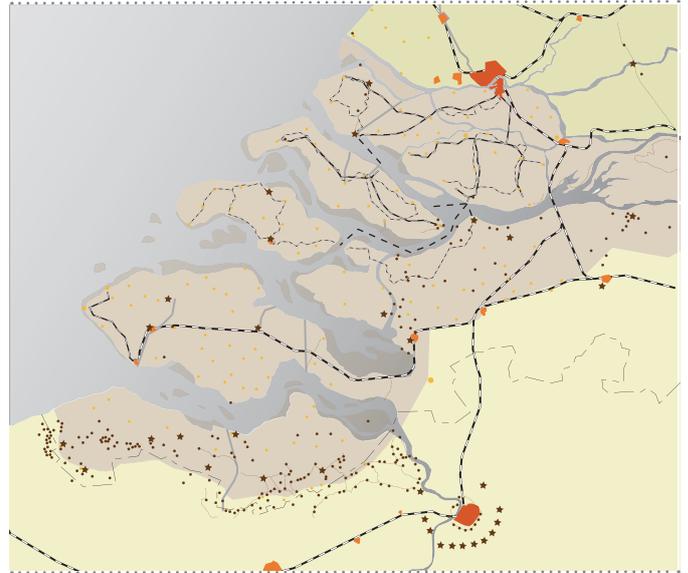
- Development of large ports (Antwerp/Rotterdam) and glasshouses
- Deltaworks and highways improve accessibility of the islands
- Urban expansion of the cities in Brabant and Zeeland

### 2010

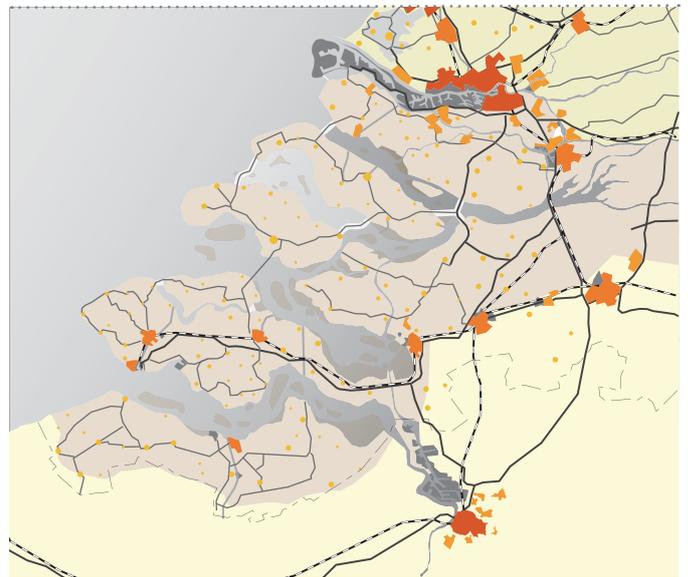
- International train-connections improve accessibility of the metropolitan region
- Emergence of the urban ring around the green/blue delta landscape
- Because of the European Union there is free transport of passengers and goods between EU member states

general		built environment	
	water		rural
	ground		suburban
	sandbank		urban
network			highly urban
	ongoing traffic		industry
	highway		greenhouses
	tunnel		clay
	ferry		peat
	canal		sand
	railway		
	railway/ highspeed		
	railway/ betuwe		
	tram		

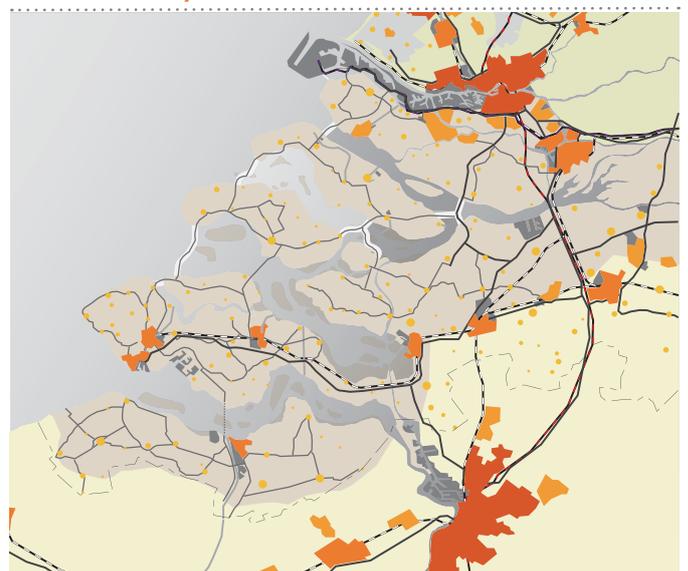
**FIGURE 2.5 / Southwest Delta 1920**



**FIGURE 2.6 / Southwest Delta 1980**



**FIGURE 2.7 / Southwest Delta 2010**



### 8.1 - Introduction Goeree Overflakkee

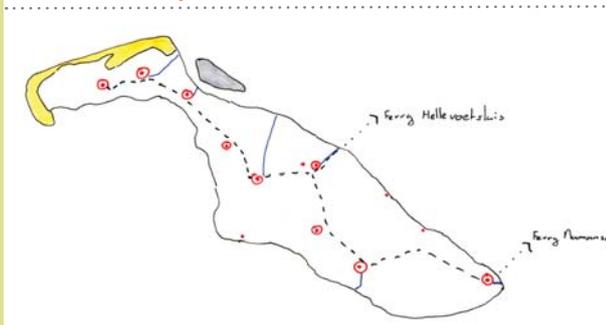
The peninsula consists of the islands Goeree and Overflakkee. By the Deltaworks the accessibility increased. Goeree has a large diversity of landscapes which are formed by the strong influence of the sea. The landscape of Overflakkee is caused by diking of sand planes and accretions. The landscape is characterized by the contrast between winding dykes and creeks with straight roads and ditches. A common type of village is the circular village with church ring, main street and harbour. Goeree Overflakkee is located in between the Grevelingen and the Haringvliet. After the inlets were closed off the Grevelingen became a salt lake and the Haringvliet became a freshwater lake. The Haringvliet has the function water storage basin and discharge to sea (Oerlemans, 1992).

### 8.2 - Historical Analysis Goeree Overflakkee

1920

- Villages develop along steamtramline

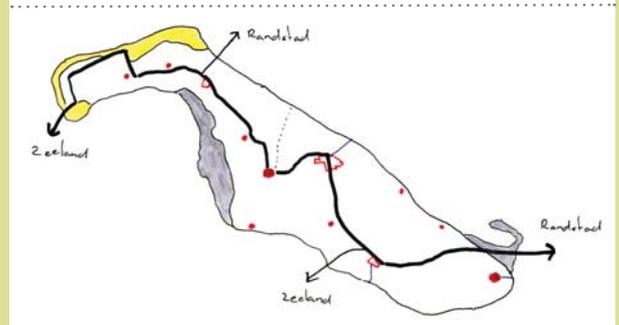
**FIGURE 2.8 / Goeree Overflakkee 1920**



1980

- Because of deltaworks islands are accessible by car
- Villages which are connected to the main road and with a canal to the haringvliet become more important

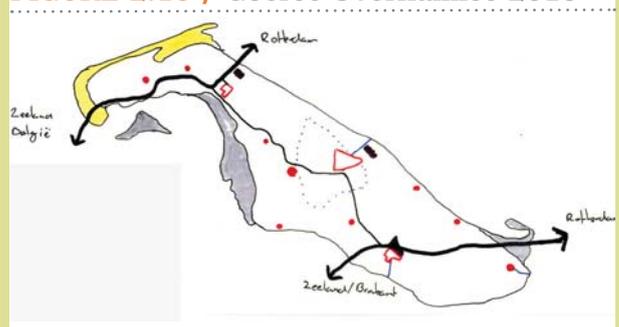
**FIGURE 2.9 / Goeree Overflakkee 1980**



2010

- Because of being a central area in the metropolitan region of the south-west delta and improved accessibility of Zeeland, the north-south connections are the main structures
- Economic development on crosspoints between local and regional main structures

**FIGURE 2.10 / Goeree Overflakkee 2010**



**FIGURE 2.11 / Goeree Overflakkee 1920**



**FIGURE 2.12 / Goeree Overflakkee 1980**



**FIGURE 2.13 / Goeree Overflakkee 2010**



### 8.3 - Introduction Voorne-Putten

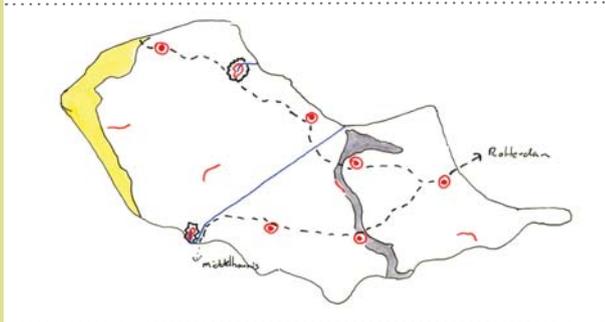
These double island forms a hushed landscape from which the dynamic is almost gone because of the closed inlets. The emergence of the two islands is the result of the alternating periods of turbulent or tranquil behaviour of the water. The first embanked polders were islands of peat on the north side of Voorne-Putten and had a round shape. The contrast between the first polders and the accretions is less clear because of dams in the tidal creeks to accelerate the sedimentation. The separation between the two islands is formed by the Bernisse, which function as freshwater inlet. On Voorne were two fortresses located which were connected in 1800 with a defence of fortifications. The expansion of the Port of Rotterdam and the Spijkenisse had large impact on the landscape (Oerlemans, 1992).

### 8.4 - Introduction Voorne-Putten

#### 1920

- Villages develop along tramline
- Fortress towns

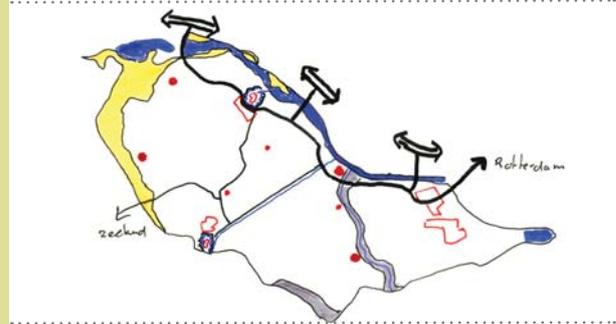
FIGURE 2.14 / Voorne-Putten 1920



#### 1980

- Because of highways island is more accessible by car
- Villages which are located along the Oude Maas benefit from the harbour activities

FIGURE 2.15 / Voorne-Putten 1980



#### 2010

- Transformation of north-edge because of harbour and Brielse-Meer Because of metroline in Spijkenisse and urban expansion Voorne-Putten is living and recreational environment for the Randstad
- New activity on the island are the glasshouses near Den Briel

FIGURE 2.16 / Voorne-Putten 2010

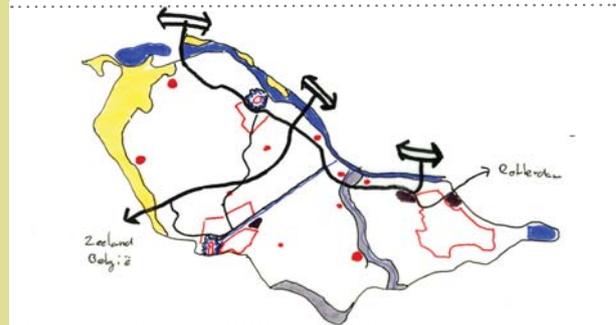


FIGURE 2.17 / Voorne-Putten 1920



FIGURE 2.18 / Voorne-Putten 1980



FIGURE 2.19 / Voorne-Putten 2010



## 9.1 - Typology of the settlement Middelharnis

**Sub question:** *What are the typologies of the settlements and how are they related to the spatial structure of the landscape and the water?*

The settlement actually exist of two villages, Sommelsdijk and Middelharnis, which were founded on different sandbars, with their own church, own ring road, main street and harbor.

Because of land reclamation became the harbor inaccessible and were the harbors connected by a canal with the Haringvliet.

After the Deltaworks were build it became possible to expand the village outside the ring dike towards the Haringvliet. Therefore the ring dike no longer form the edge of the village. As result is the centre shifting to point where the passage through the dike connects the new extension

**FIGURE 2.20 / Typology of the settlement Middelharnis**

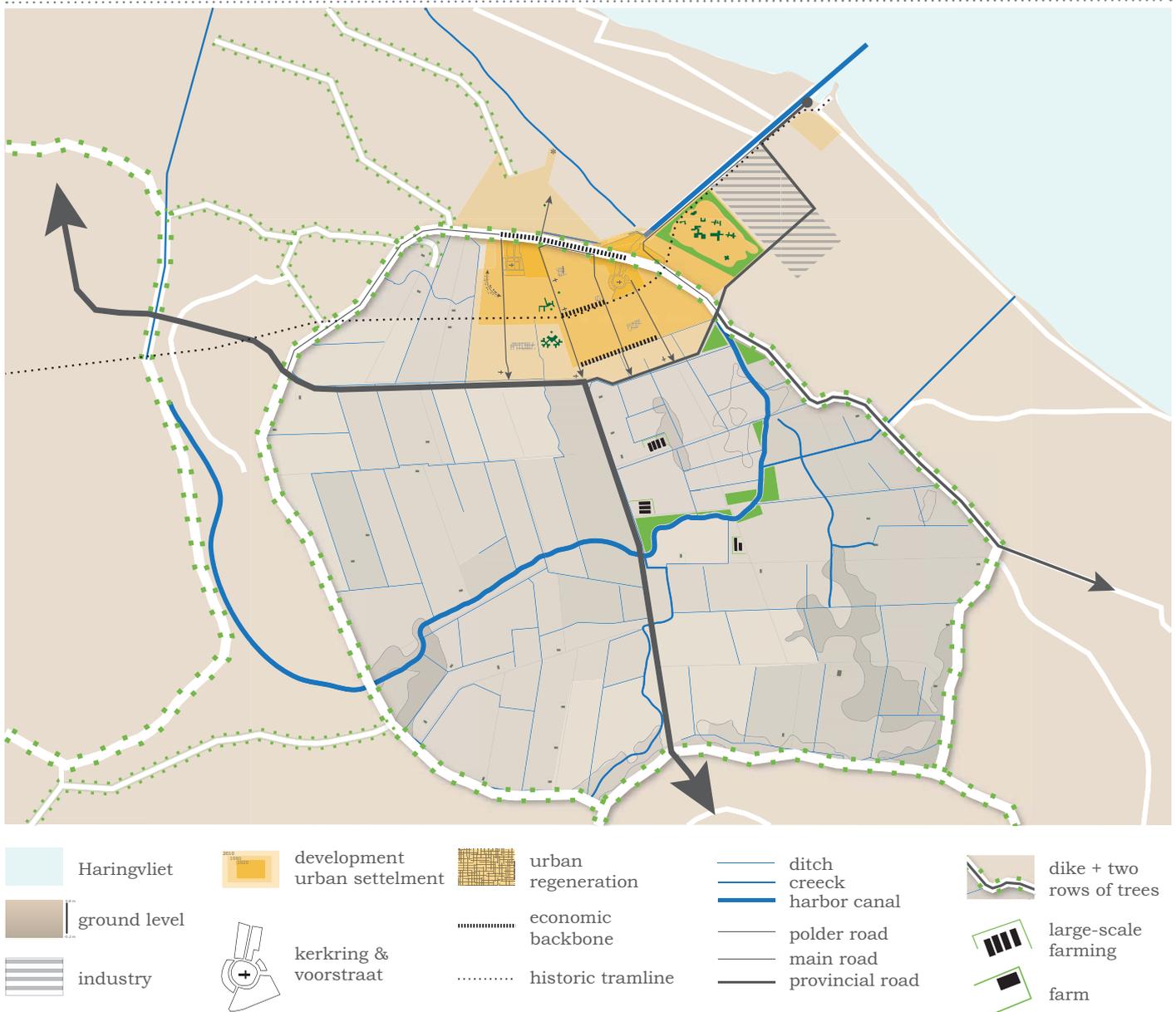


FIGURE 2.21 / Sandbars Flakkee 1400

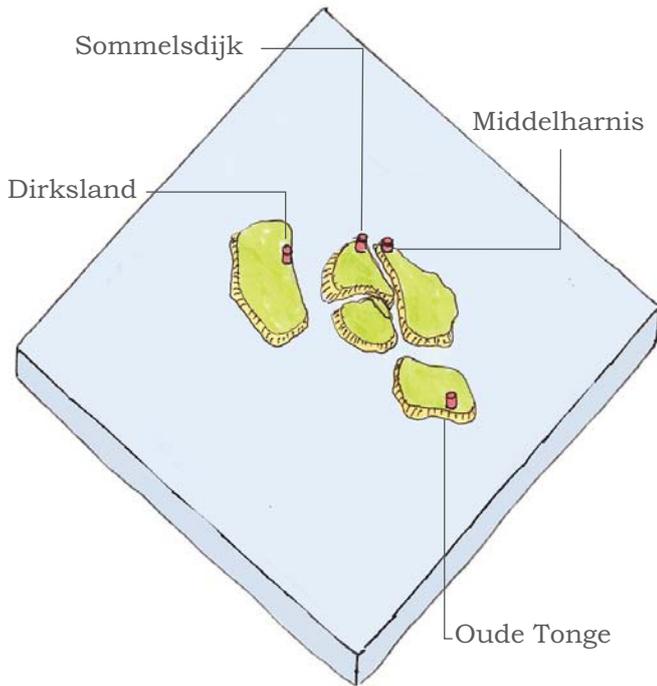


FIGURE 2.22 / Ringdike Flakkee 1600

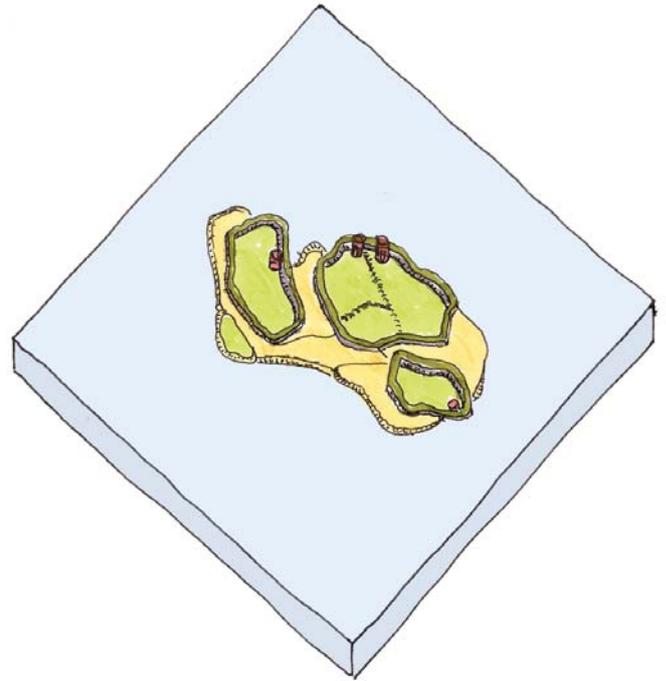


FIGURE 2.23 / Sand planes in front of harbor Flakkee 1700

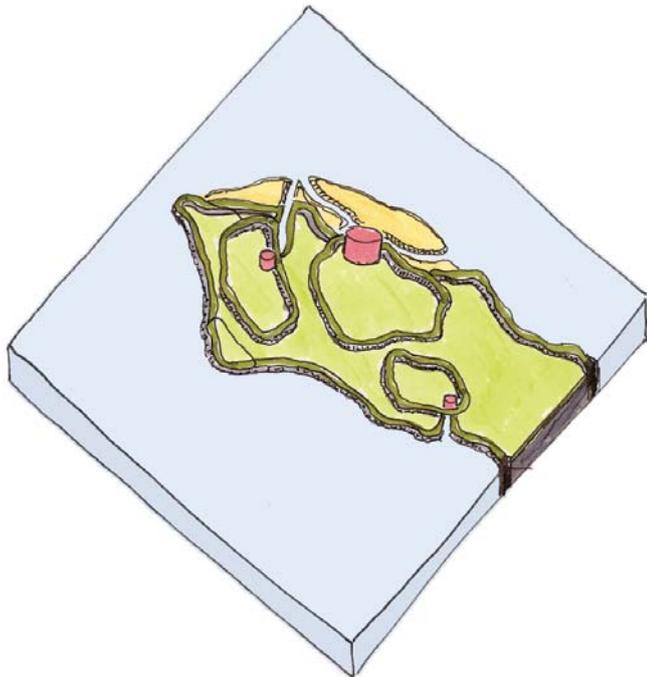
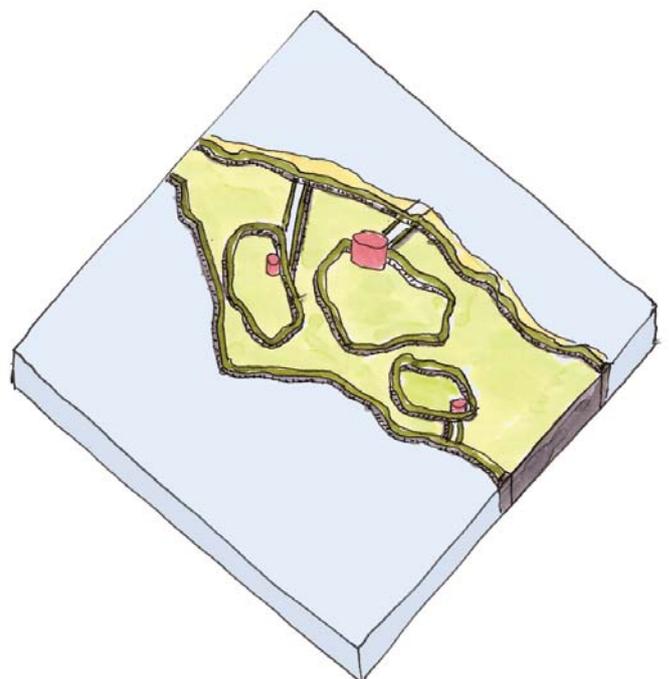


FIGURE 2.24 / Harbor canals Flakkee 1900



### 9.2 - Characteristic elements of Middelharnis

To the existing characteristic elements of Middelharnis are new elements added after the position of the ring dike in the structure of the settlement has changed. The original elements are the church, ring road, harbor and harbor canal. New elements are the viewpoint on the artificial mound and the waterfront as sharp edge highlighted by wind turbines. The viewpoint with the artificial mound is located on the crossing of two resolved creeks. The

axis which form the passage through the ring dike is positioned on the resolved creeck, which separated the sandbars on which Sommelsdijk and Middelharnis were founded. The other creeck used to be the entrance to the harbor of Sommelsdijk and Middelharnis when there was a sandbar in front of the ring dike. Unfortunately has the harbor canal lost its spatial quality, caused by the buisness park and the lack of spatial integration in the landscape.

**FIGURE 2.25 / Characteristic element: Church in ring road, connected to ring dike and harbor**



**FIGURE 2.26 / Viewpoint on top of artificial mound**



**FIGURE 2.27 / Waterfront Haringvliet, sharp edge highlighted by wind turbines**



## 9.3 - Typology of the settlement Hellevoetsluis

**Subquestion:** *What are the typologies of the settlements and how are they related to the spatial structure of the landscape and the water?*

The development of Voorne-Putten started on small islands with tidal channels in between. The reclamation goes much faster due to small dams in the tidal channels. After the island

was flooded in 1530, new dikes were constructed around the swirl, which makes them very winding. Brielle was founded in the 13th century. Hellevoetsluis is founded in the 15th century and transformed into a naval port in the 16th century. Around 1800 a line of defence with fortifications was constructed between Brielle and Hellevoetsluis. The growth and importance of both cities depended on the accessibility by water from Rotterdam and the Noordzee.

**FIGURE 2.28 / Typology of the settlement Hellevoetsluis**

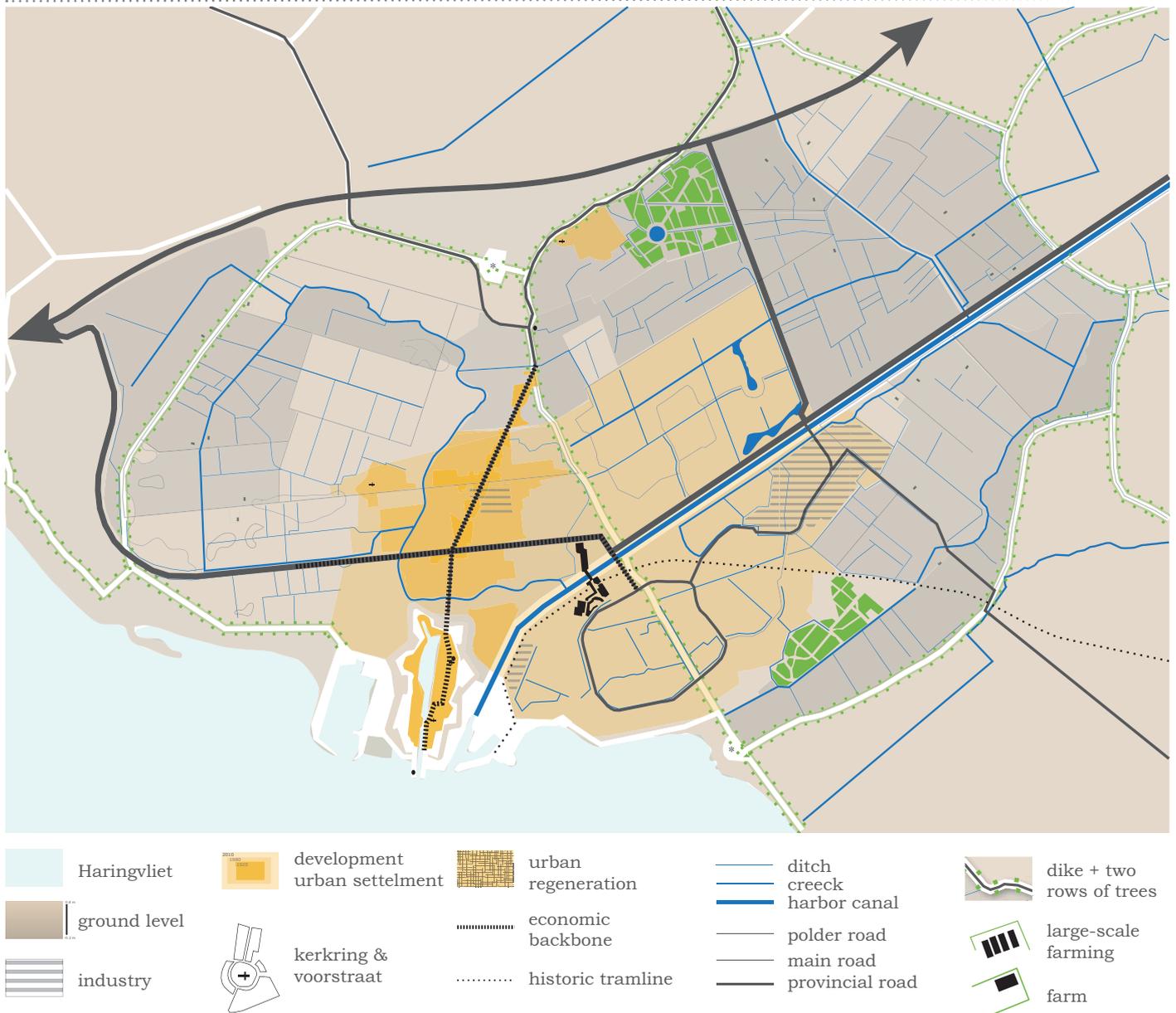


FIGURE 2.29 / Sandplanes Voorne-Putten 1300

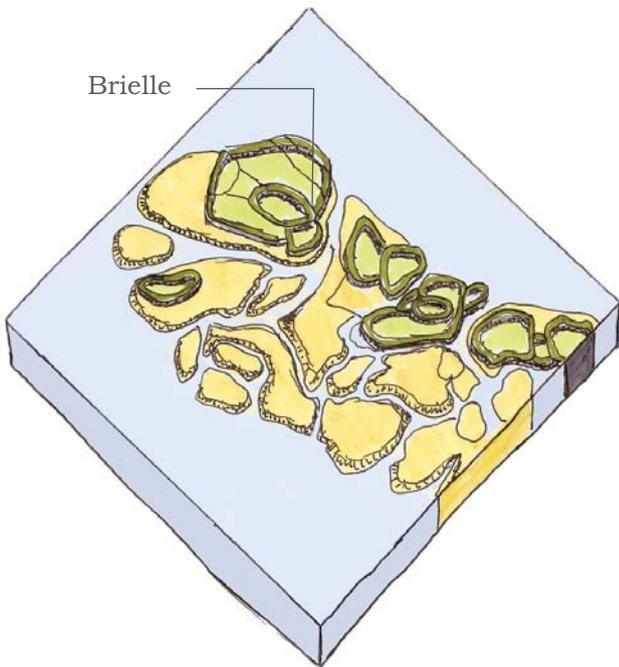


FIGURE 2.30 / Tidal Creeks Voorne-Putten 1400

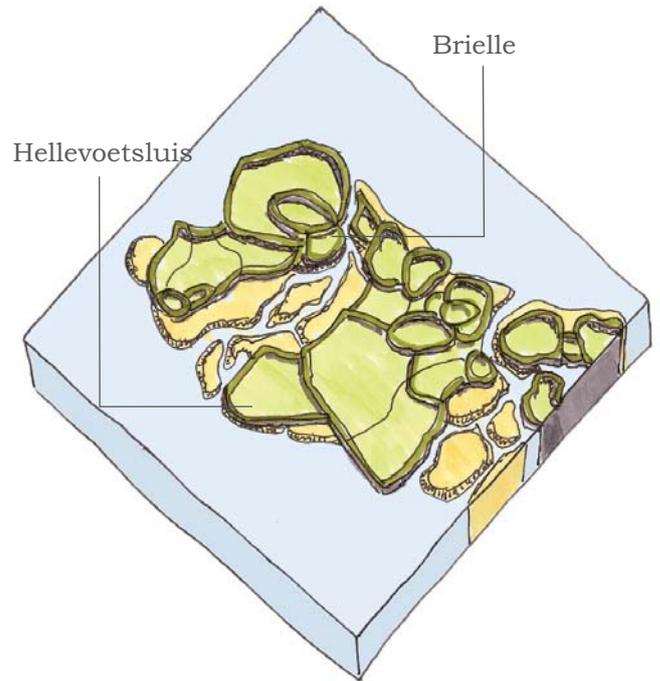


FIGURE 2.31 / Line of defence and canal of Voorne 1700

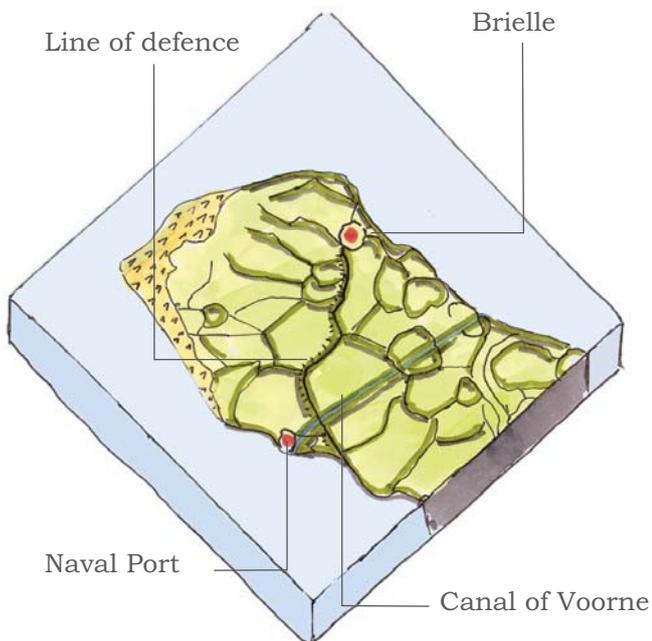
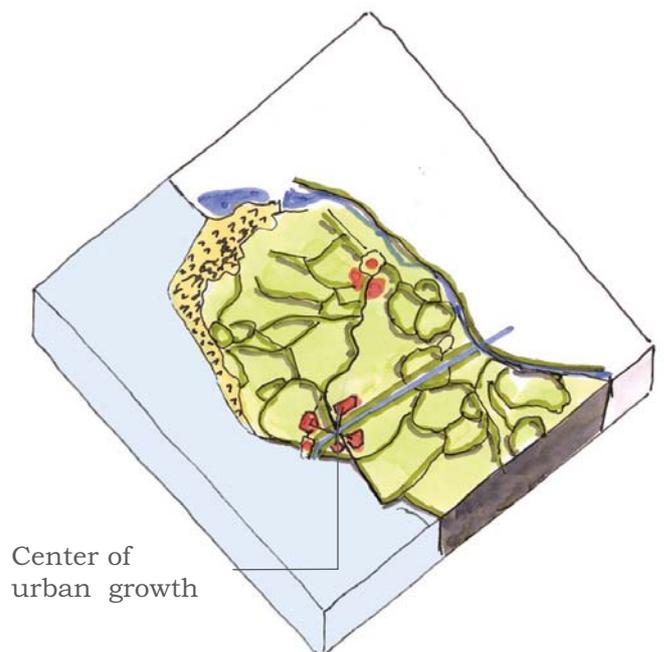


FIGURE 2.32 / Urban growth Hellevoetsluis and Brielse Meer 1900



### 9.4 - Characteristic components of Hellevoetsluis

Linear structures define the spatial structure of Hellevoetsluis. Most important linear structure is the canal of Voorne, which divide Hellevoetsluis in two separated parts. Unfortunately are the crossing bridges fixed and is the canal no longer accessible for water recreation. Due to parking lots and business parks along the canal is the canal spatial insufficient integrated in its environment and forms a barrier. However the canal can become the

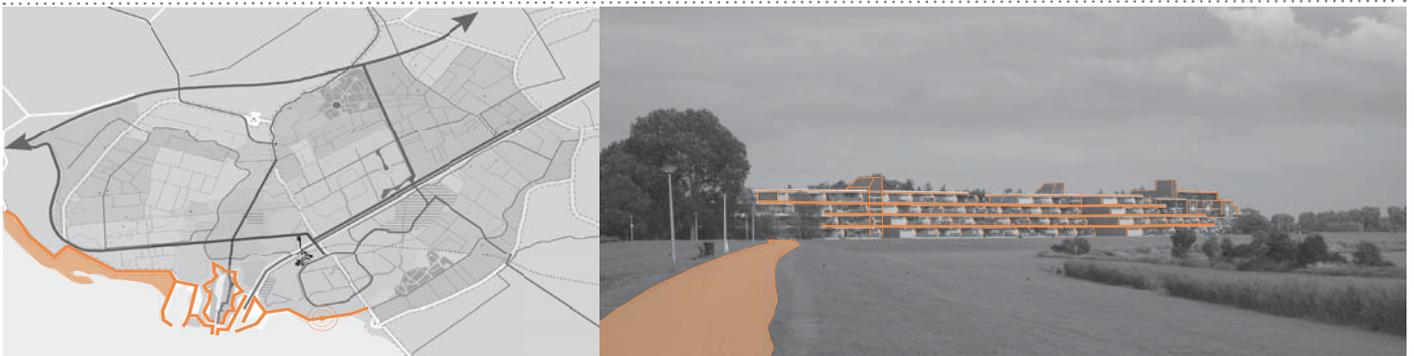
centre of the settlement and form a strong connection between fortification, waterfront and shopping mall. The waterfront consists of the old naval which is a historic protected cityscape. But this beautiful front is enclosed by two different edges of the Haringvliet which function as barrier between the water and the settlement.

Two other linear structures are the city boulevard with its highrise and the old defence line, still recognizable as winding dike through the settlement.

**FIGURE 2.33 / Shopping Mall is fixed construction over the canal**



**FIGURE 2.34 / Waterfront as barrier between Haringvliet and settlement**



**FIGURE 2.35 / Entrance boulevard spatially accentuated with highrise buildings**



## 10.1 - Introduction ecologic restored delta

**Sub question:** *How can interventions on flood defence and an ecologic restored delta enhance the spatial quality of the transition between settlement and water, but also the connecting landscape between urban region's and delta landscape.*

In the Southwest Delta are different aspects of importance because of its vulnerability and attractiveness at the same time. One of the aspects is a climate proof and ecologic restored delta. On the other hand is the transition between urban region's and delta landscape together with the transition between settlement and delta water an important aspect. According to all aspects is water the spatial carrier which has formed the delta landscape and will define it in the future. Interventions in the Southwest Delta should contribute to reducing the vulnerability, but at the same time enhance the attractiveness. Interventions from the past were primarily designed for safety and freshwater supply in order to create optimal conditions for economic activities. Most important interventions of the past are the Afsluitdijk and the Deltaworks, which were realized in order to protect against flooding and ensuring economic development (Meyer et al, 2010: 21-43). The reason for building the Afsluitdijk was the flood of the Zuiderzee in 1916 and the vulnerability of the food supply during the First World War. The construction of the Afsluitdijk created a large freshwater supply that made land reclamation possible and new agriculture. The reason

**FIGURE 3.1 / Afsluitdijk & IJsselmeer**



source: [www.deltawerken.com](http://www.deltawerken.com)

**FIGURE 3.2 / Deltawerken**



source: [www.deltawerken.com](http://www.deltawerken.com)

**FIGURE 3.3 / Climate proof delta**



source: [www.deltacommissie.com](http://www.deltacommissie.com)

for building the Deltaworks was the flood of the Southwest Delta in 1953 and the postwar economy after the Second World War. A strong Dutch economy made it possible to think beyond protection of economic development, creating more attention for environmental impact. The changed paradigm, working with water, resulted in an integrated approach of adaptive and defensive strategies. At this moment we are facing a major assignment due to climate change, with regard to a climate proof and ecologic restored delta.

The Southwest Delta is part of the main water system of the Netherlands, which further consists of the rivers and the IJsselmeer. The interventions on flood defence and freshwater supply are an opportunity to restore the ecology and dynamics of the Southwest Delta. Ecological problems have emerged because of partitioning of the Rhine Scheldt delta by the Deltaworks. Because each basin has its own water system, the ecological problems also vary per basin (Hofland et al, 2009: 9).

- blue-green algae in Volkerak-Zoommeer
- Oxygen deficiency in Grevelingen
- Structural erosion (zandhonger) in the Oosterschelde
- Sedimentation of polluted sludge in the Haringvliet

Besides adverse ecological effects of the Deltaworks, the Southwest Delta became less vulnerable, better accessible and the availability of freshwater increased. In order to restore the ecology and dynamics of the delta, the partitioning of the delta and the enclosure of the delta from sea have to be reversed (Schrijnen and Hoekstra, 2010: 145). However a restored

ecology and dynamics of the delta can effect the availability of freshwater. Consequence may be that the availability of freshwater for the regional water systems will decrease and result in adjustment of the regional water systems to control internal salinisation.

Due to the disturbed ecology and dynamics of the delta is the spatial quality decreased by the loss of a dynamic transition between water and land (Hofland et al, 2009: 13). This dynamic transition was shaped by intertidal areas, which has strongly decreased due to land reclamation and the disappearance of tidal movement. The constructed delta seemed to consist of two different worlds land and water, lying with their backs once against each other, with the dike as hard boundary in between. Together with the regional development through construction of infrastructure has led to loss of the spatial interaction between settlement and water.

Interventions for a restored ecology and dynamics in the delta should also taken into account the value of water safety as result of the Deltaworks and the fact that they are far from being economically depreciated (Hofland et al, 2009: 15). An integrated approach is needed to construct a climate proof delta with a restored ecology and preservation of the Deltaworks which maintain their function in a revised main water system. In this revised main water system is a restored ecology and dynamics in the delta formed by the following interventions (kennis voor klimaat, 2009: 15):

- Interconnecting delta waters
- Recovery exchange of water with water of the North Sea
- Recovery of flow river water through Southwest Delta

According to Schrijnen and Hoekstra (2010: 145) is public support for large scale interventions to restore the ecology and dynamics of the delta is more complicated than at the time of the Deltaworks. To create enough public support, an integrated approach is necessary in which restored ecology is combined with flood defence and freshwater supply. Public support can even be enhanced by attention for economic developments and environmental impact. The environmental impact can be given significance on the scale of the settlement and its spatial relation to the water through shaping the transition between water and landscape (Schrijnen and Hoekstra, 2010: 152). This will cause a transformation of the dike into a transition area in which nature, tourism, flood defence and culture is combined. Due to development of this transition, both in outer dike areas and inner dike areas, will result in economic and ecologic effects on the scale of the delta and the scale of the settlement.

### 10.2 - Delta variants for an ecologic restored Southwest Delta

As described are we facing a major assignment to create a climate proof and ecologic restored delta. Within this assignment is also attention given to the design of the transition between water and land. The strategy for an ecologic restored delta consists of the three principles interconnecting delta waters, exchange of freshwater with salt water from the North Sea and water from the river flows through the delta. To realize these three principles are several delta variants possible in order to construct a ecologic restored and climate proof delta. These variants will be compared in order to get a better understanding of the environmental impact of each

variant for the settlements Middelharnis and Hellevoetsluis. All variants will be described briefly and compared on the following aspects:

- Principles for an ecologic restored delta
- Coherence between delta variant and main water system
- Position of Hellevoetsluis in transition between urban region and delta landscape, defined by a variant of 'closable open Rijnmond'
- Created opportunities for shaping the spatial connection between settlement and delta water, but also for shaping of the transition between water and land.

### 10.3 – Closable open Rijnmond

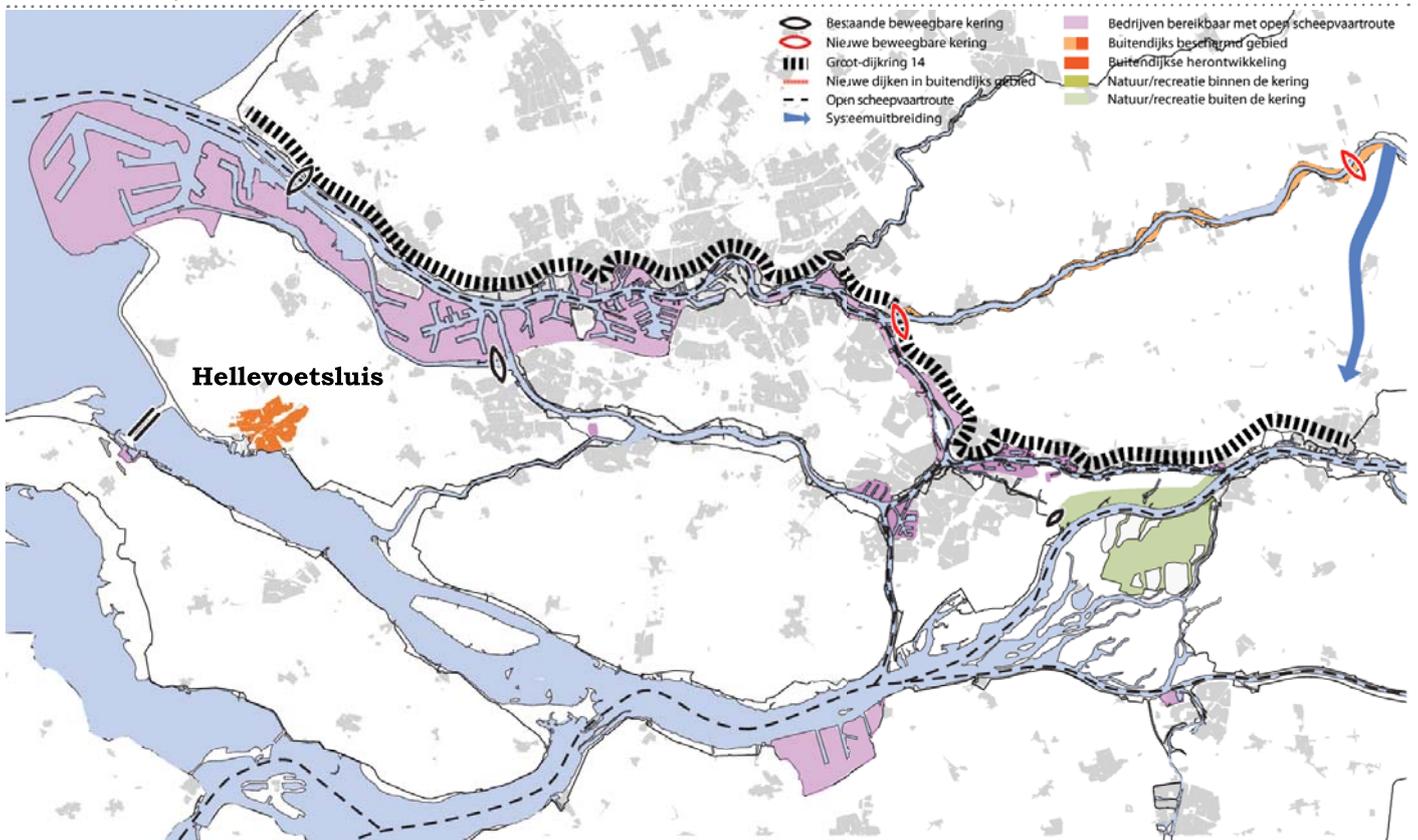
The idea of a closable open Rijnmond at both sides, river and North Sea, is a possible solution for a long-term water safety of Rotterdam and Drechtsteden (Rijcken, 2010). However there are several variants possible of a closable open Rijnmond, which have different consequences for shipping and the transition area between urban region and delta landscape. There will be more often peak discharges and periods of draught due to climate change. Periods of draughts mainly provides problems with controlling the salt intrusion of the Nieuwe Waterweg and making inlets for freshwater useless. The problem with peak discharges is the safety of outer dike areas (floodplains) in Rijnmond and the safety level of the dikes. The safety level of the dikes have become even more important because of the increased economic value of the area which is protected by it.

The way in which the Rijnmond area is closable has consequences for the shipping to the hinterland and between Antwerp and Rotterdam. Closure of

the Nieuwe Waterweg, temporary or permanent, mainly effects the shipping route of sea vessels to the old seaports in Rotterdam. The shipping route for inland vessels to Europort and Maasvlakte I and II is mainly through the Oude Maas, Hartelkanaal and Calandkanaal. The question is how long economic interests are chosen over the importance of safety and freshwater supply in a climate proof delta. This consideration have become more relevant because of shifting ports towards sea for both Rotterdam (Europort, Maasvlakte I and II) and Antwerp (Zeebrugge). At the same time are old city ports transformed into outer dike living and recreation areas, which means extra safety problems when Rijnmond is not closable for peak discharges.

Besides negative effects for shipping, a closable open Rijnmond has also benefits because of a controllable water level. In case of a closed Rijnmond area at peak discharges, the water is discharged to the Southwest Delta. The advantage of this is lower costs for raising dikes and a reduced rising of the water level due to a available larger water surface in the basins of the Southwest Delta. In the different variants of a closable open Rijnmond developed by A.L. Nillesen and C.M. de Hoog is looked at possibilities for development for inner dike areas and outer dike areas and the consequences for shipping. After a short description of these variants is for each delta variant determined which variant of a closable open Rijnmond fits best. The way in which the Rijnmond area can be closed is always a combination of displacing

FIGURE 3.4 / Current situation Rijnmond area



edited source: [www.aor.tudelft.nl](http://www.aor.tudelft.nl)

dike-ring 14 and placing of movable dams. The displacing of dike-ring 14 will define the urban development of the transition area between urban region and delta landscape.

• **Closable open Rijnmond, variant 1**

In this variant dike-ring 14 is displaced to the upper side of the Oude Maas and Beneden-Merwede. This makes the Rijnmond area protected and development of living, work and recreation on the floodplains possible. At the same time are open shipping routes and port activities in Dordrecht maintained.

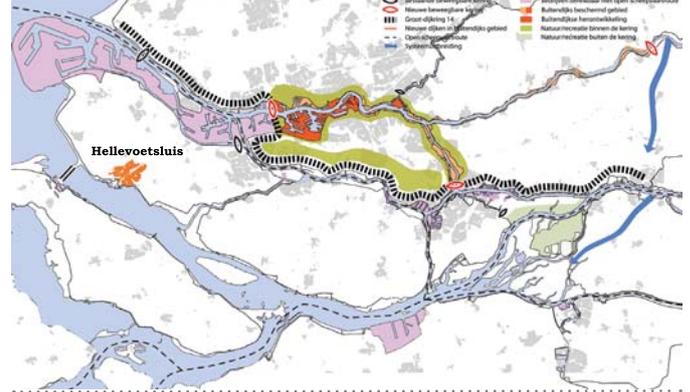
• **Closable open Rijnmond, variant 2**

In this variant dike-ring 14 is displaced to the upper side of the Oude Maas, but below Dordrecht. Therefore are extra movable dams needed in the Dordtse Kil and Beneden-Merwede. Again is development of the outer dike areas in Rijnmond possible. However, shipping to the hinterland will be redirected through the Nieuwe-Merwede in case of a closed Rijnmond area.

• **Closable open Rijnmond, variant 3**

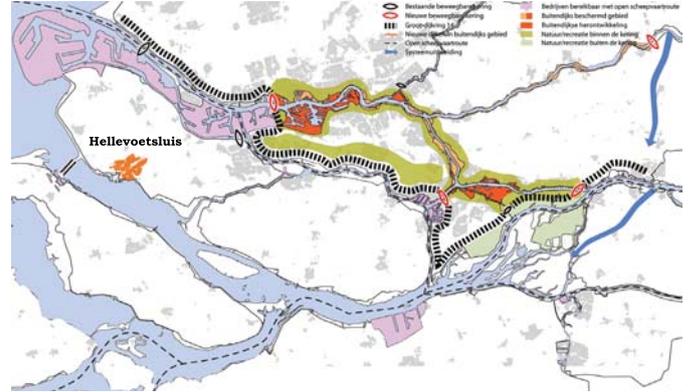
In this variant dike-ring 14 is displaced to the bottom of the islands Voorne-Putten, Hoeksche Waard and Dordrecht. Therefore are extra movable dams needed in the Spui, Dordtse Kil and Beneden-Merwede. The movable dam in the Spui is also useful in periods of draught, because it can be used to stop the internal, backwards salinisation through the Nieuwe Waterweg. However, this variant has a major impact on shipping between Antwerp and Rotterdam, but also to the hinterland. On the other hand arise opportunities for urban development of Voorne-

**FIGURE 3.5 / Closable open Rijnmond, variant 1**



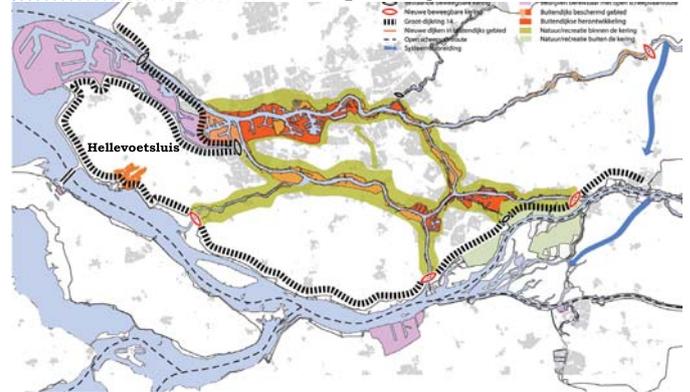
edited source: [www.aor.tudelft.nl](http://www.aor.tudelft.nl)

**FIGURE 3.6 / Closable open Rijnmond, variant 2**



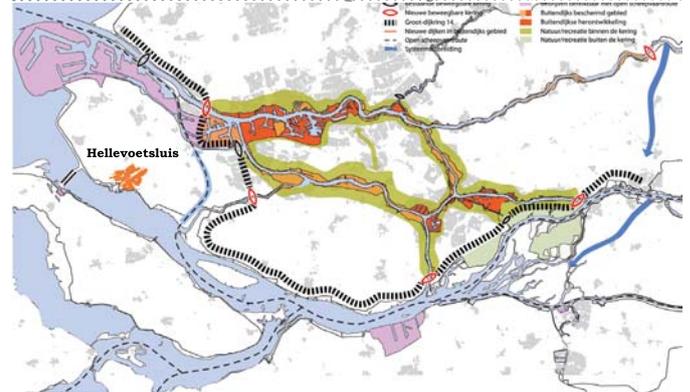
edited source: [www.aor.tudelft.nl](http://www.aor.tudelft.nl)

**FIGURE 3.7 / Closable open Rijnmond, variant 34**



edited source: [www.aor.tudelft.nl](http://www.aor.tudelft.nl)

**FIGURE 3.8 / Closable open Rijnmond, variant 4**



edited source: [www.aor.tudelft.nl](http://www.aor.tudelft.nl)

Putten and Hoeksche Waard due to the increased safety level. Also forms the displacement of dike-ring 14 a clear border between urban region and delta landscape.

- **Closable open Rijnmond, variant 4**  
In this variant is dike-ring 14 displaced along the Bernisse and to the bottom of islands Hoeksche Waard and Dordrecht. Extra movable dams are placed in the Nieuwe Waterweg, Spui, Dordtse Kil and Beneden-Merwede. Due to a new canal along the Bernisse is shipping possible by means of this extended shipping route. Also is in this variant dike-ring 14 a clear border between urban region and delta landscape. Because of the unique position of Voorne-Putten in this variant, becomes this island a strong

connection between urban region and delta landscape.

### 10.4 - Conclusion Closable open Rijnmond

Described variants for a closable open Rijnmond can be divided in two categories. One category contains variant one and two which are about maintaining open shipping routes and a smaller area, which is protected by dike-ring 14. In this category belong the islands Voorne-Putten and Hoeksche Waard, which form the transition area between urban region and delta landscape, more to the delta landscape. The other category contains variant three and four, which choose safety and freshwater supply above shipping and dike-ring 14 protects a larger area which become available for urban development.

### 11.1 - Delta variant 'discharge corridor'

The variant 'discharge corridor' focuses on safety and dike shortening. This shortening of dikes is achieved by construction of a dike-ring north of the river Waal and south of the river Maas. This results in a direct discharge through the Haringvliet with permanent open floodgates in the Haringvlietdam to the North Sea. Because there is only one way of discharge to the North Sea, the two dike-rings have to be strong enough and maintain their function of flood defence, even with very high water levels. In order to control the water level in the Rijnmond area is the Nieuwe Waterweg permanent closed by a sea lock. As a result, there is more freshwater available for agriculture in the Southwest Delta.

- **Matching variant for a closable open Rijnmond**

Variant which fits best in Plan Beaufort is variant 3, with a displacement of dike-ring 14 to the bottom of Voorne-Putten and Hoeksche Waard. This means that these islands are suitable for urban development due to the improved safety level. However, the transition area between urban region and delta landscape is narrowed to the width of the new dike-ring.

- **Coherence with main water system**

This delta variant creates one discharge through the Southwest Delta between two dike-rings. Because of this the water level behind the dike-rings is controllable. Coherence with the main water system is achieved by the high safety level of both dike-rings, widened discharge basin and always direct discharge on the North Sea.

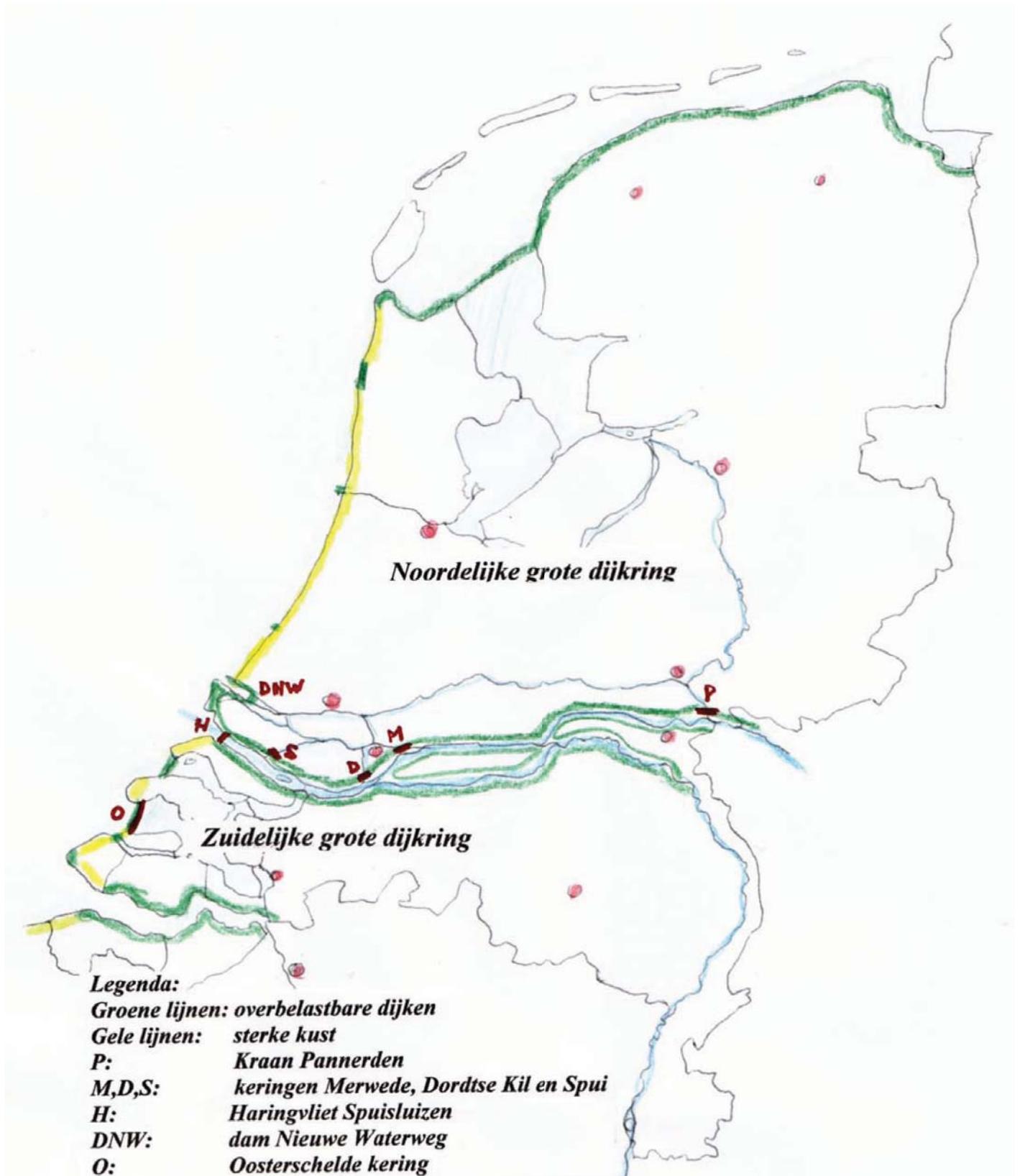
- **Principles for a restored ecology**

Within these delta variant are most of the ecological problems not solved, because two of the three principles are not achieved. There is exchange of freshwater with salt water of the North Sea in the Haringvliet. This solves only the problem of sedimentation of polluted sludge. Because the delta basins are not interconnected and there is no discharge of river water through those interconnected basins are other ecological problems not solved.

- **Opportunities for an improved environmental quality**

As result of the main discharge between two dike-rings is it possible to create controllable water structures behind them. Around these water structures it is easy to strengthen the relation between settlement and water. However the dynamics of the delta are omitted, because they are only present at the dike-rings. The transition between land and water is narrowed to the width of the dike-ring. Improvement of this transition can be achieved by adding program to this dike-ring and increase of the contrast between dynamic water landscape and controlled water landscape.

**FIGURE 3.9 /** Delta variant discharge corridor



source: Atlas van Initiatieven, TU-Delft

### 11.2 - Delta variant 'extended discharge'

This variant 'extended discharge' focuses on prevention of inland salinisation and retaining freshwater in the Southwest Delta as long as possible. This requires a permanent closure with a sea lock of the Nieuwe Waterweg. In order to retain the freshwater longer in the delta, a connection between Haringvliet and Grevelingen is needed through Goeree-Overflakkee. This makes it possible to discharge the river water through the Haringvliet, Grevelingen and Oosterschelde to the North Sea. In addition is the Volkerak-Zoommeer flushed with freshwater as well. In case of peak discharges is it possible to discharge water at sea at the Haringvlietdam and Brouwersdam. When discharge at sea is not possible because of high water levels at sea, is temporary storage on Haringvliet, Grevelingen and Oosterschelde possible. Purpose of this variant is restored delta dynamics and maintenance of freshwater in Haringvliet and Volkerak-Zoommeer.

- **Matching variant for a closable open Rijnmond**

With this delta variant are several variants of a closable open Rijnmond possible because the focus is on retaining the freshwater in the Southwest Delta as long as possible. On the other hand is a restored delta dynamics also an interest, from which Voorne-Putten and eventually Hoeksche Waard can benefit. This depends on the position of dike-ring 14. Therefore the choice is probably on variant 1 or 2 because they have the least impact on shipping.

- **Coherence with main water system**

Because of the extra space for temporary storage of the river discharge in the Southwest Delta is a redistribution of the freshwater between Southwest Delta and IJsselmeer less necessary. In this delta variant is enough space to absorb the accelerated river discharge due to the project room for the river. In case of a surplus of freshwater is discharge at sea possible at the Haringvlietdam and Brouwersdam. This is important because of sweetening in the Grevelingen.

- **Principles for a restored ecology**

With this delta variant are all three principles for a restored ecology achieved. Because the interconnection between Haringvliet, Grevelingen and Oosterschelde are both delta dynamics and exchange of freshwater and salt water restored. As result of the extended discharge to the North Sea are there no problems with inland salinisation. The sedimentation of polluted sludge in the Haringvliet will be reduced. The shortage of oxygen in the Grevelingen is history because of oxygenated freshwater from Haringvliet and salt water from the Oosterschelde. Finally is structural erosion (zandhonger) in the Oosterschelde reduced by sedimentation carried by water from Haringvliet and Grevelingen.

- **Opportunities for an improved environmental quality**

The opportunities for an connection between settlement and delta and an more dynamic transition between land and water are improved. This is because there is enough space for the water, delta dynamics are restored and in case of a storm surge, the delta can be closed of by the storm

surge barrier in the Oosterschelde. In addition is storage of peak discharges in the IJsselmeer also an solution. This means no major heightening of the dikes. Due to restored dynamics intertidal areas may occur on the transition between land and water. This will improve also the spatial relation between settlement and water.

**FIGURE 3.10 / Delta variant extended discharge**



source: [www.adviesgroepbormenhuijgens.nl](http://www.adviesgroepbormenhuijgens.nl)

### 11.3 - Delta variant 'branched discharge'

This delta variant is based on the idea which is applied in the delta variant 'discharge corridor', which consists of one discharge corridor. In contrast to this variant is this one corridor divided in two corridors in the Southwest Delta. One of this corridors still goes through the Haringvliet. The other corridor goes through Volkerak-Zoommeer and Oosterschelde to the North Sea. Also are both these corridors surrounded by dike-rings. Because of their high safety is there no risk for flooding in case of peak discharges. In this variant is connection between Grevelingen and North Sea restored.

- **Matching variant for a closable open Rijnmond**

The variant which fits best in the delta variant 'branched discharge' is variant 3, with a displacement of dike-ring 14 to the bottom of Voorne-Putten and Hoeksche Waard. This means that these islands are suitable for urban development due to the improved safety level. However, the transition area between urban region and delta landscape is narrowed to the width of the new dike-ring. An additional advantage of this delta variant is the restored delta dynamics in the Grevelingen, allowing a dynamic transition between land and water at least from one side at the island Goeree Overflakkee.

- **Coherence with main water system**

This delta variant is based on redistribution of the freshwater between Southwest Delta and IJsselmeer. The redistribution is adaptable to both peak discharges and periods of draught. In case of low river discharge more freshwater

is distributed to the IJsselmeer and Markermeer to create a freshwater supply for the west of the Netherlands. In case of peak discharges there are no safety problems due to the dike-rings.

- **Principles for a restored ecology**

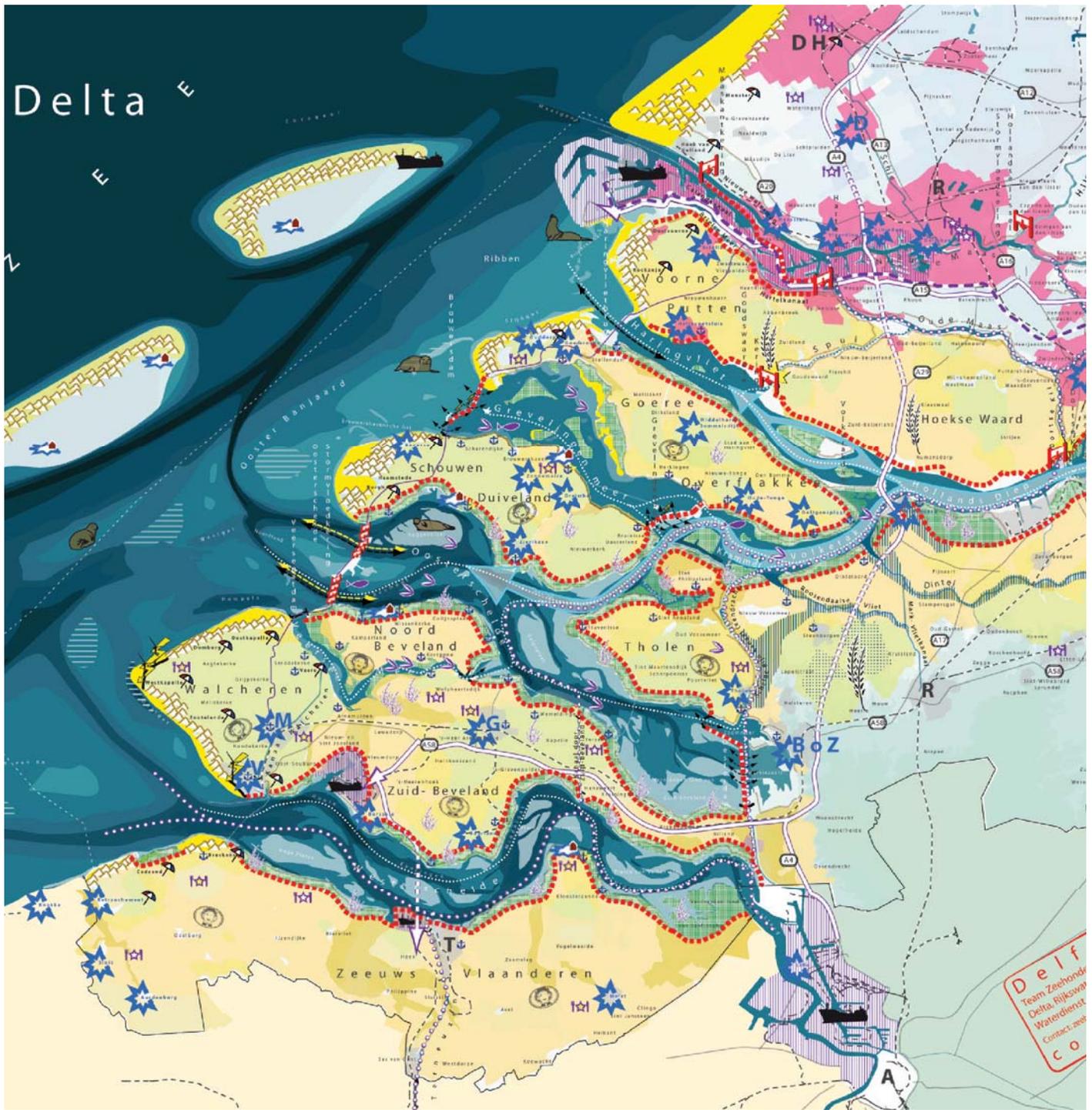
In this delta variant are all three principles for a restored ecology achieved in contrast to the variant 'discharge corridor'. As result of the two branches of river discharge the dynamics restored as well as the exchange of freshwater and salt water. In the Haringvliet is the sedimentation of polluted sludge reduced due to discharge through the Haringvliet. The blue-green algae in the Volkerak-Zoommeer is resolved due to throughput of discharge through Oosterschelde at the North Sea, which also reduce the structural erosion (zandhonger) in the Oosterschelde. Finally is the shortage of oxygen restored by exchange of water in the Grevelingen with water from the North Sea.

- **Opportunities for an improved environmental quality**

On the one hand, climate dikes increase the barrier between land and water despite added program on the climate dikes. On the other hand is an interesting tidal area created in the Grevelingen. A dynamic transition between land and water can be created in relation to the Grevelingen, with its closable connection to the North Sea. There will be differences in transition between land and Haringvliet and between land and Grevelingen on the island Goeree Overflakkee. The structure of polders on Goeree Overflakkee can be used to strengthen the connection between settlements and tidal waters.

# 11 - DELTA VARIANTS

FIGURE 3.11 / Delta variant branched discharge



<p><b>De veiligste delta - 100% overlevingskans</b></p> <ul style="list-style-type: none"> <li>sterkteverhoging/versterking</li> <li>sterkteverhoging op één door geheel open</li> <li>versterking/versterkte dij</li> <li>versterking dijken en stranden/zandwalen</li> <li>strand voor de kust met goud</li> <li>maxi profiel A</li> <li>maxi profiel B</li> </ul>	<p><b>De veiligste delta - een dynamisch evenwicht</b></p> <ul style="list-style-type: none"> <li>stelt voor uitbreiding herstel gebied/dynamiek</li> <li>meer doorlatende dammen, natuurlijk gebied</li> <li>brede waterkeringzones</li> <li>versterking kustfundament</li> <li>aanpakken O&amp;M L&amp;V natuurlijk zandtransport</li> <li>natuurlijke afvoer rivierwater over Hartingplaat en Oosterschelde</li> </ul>	<ul style="list-style-type: none"> <li>Balanceren van de delta</li> <li>beheersing</li> <li>versterking</li> <li>heraanpak van de Gouwe</li> </ul>	<p><b>De leefdigste en meest leefbare delta - overgevoelig economie</b></p> <ul style="list-style-type: none"> <li>recreatie</li> <li>meer open waterverbindingen</li> <li>recreëren &amp; versterken historische steden en dorpen</li> <li>nieuwe waterfuncties/wateruitgaves</li> <li>bestaand/nieuw recreatiepark</li> <li>bestaand/badplaats/jachthaven/visserij</li> <li>wereld erfgoed</li> </ul>	<ul style="list-style-type: none"> <li>landbouw</li> <li>duurzame energieproductie</li> <li>groenvalige duurzame landbouw</li> <li>zonne en windenergie</li> <li>nieuwe geavanceerde zonnepanelen</li> <li>groene energie uit golf</li> <li>groene energie uit wind</li> </ul>	<ul style="list-style-type: none"> <li>rijn-ontdijken</li> <li>landbouw</li> <li>beheersing</li> <li>recreatieve route</li> <li>opbouwde schuifwaterverbindingen</li> <li>potentiële haven</li> <li>haven gebied</li> </ul>
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source: Atlas van Initiatieven, TU-Delft

### 11.4 - Delta variant 'open sea inlets'

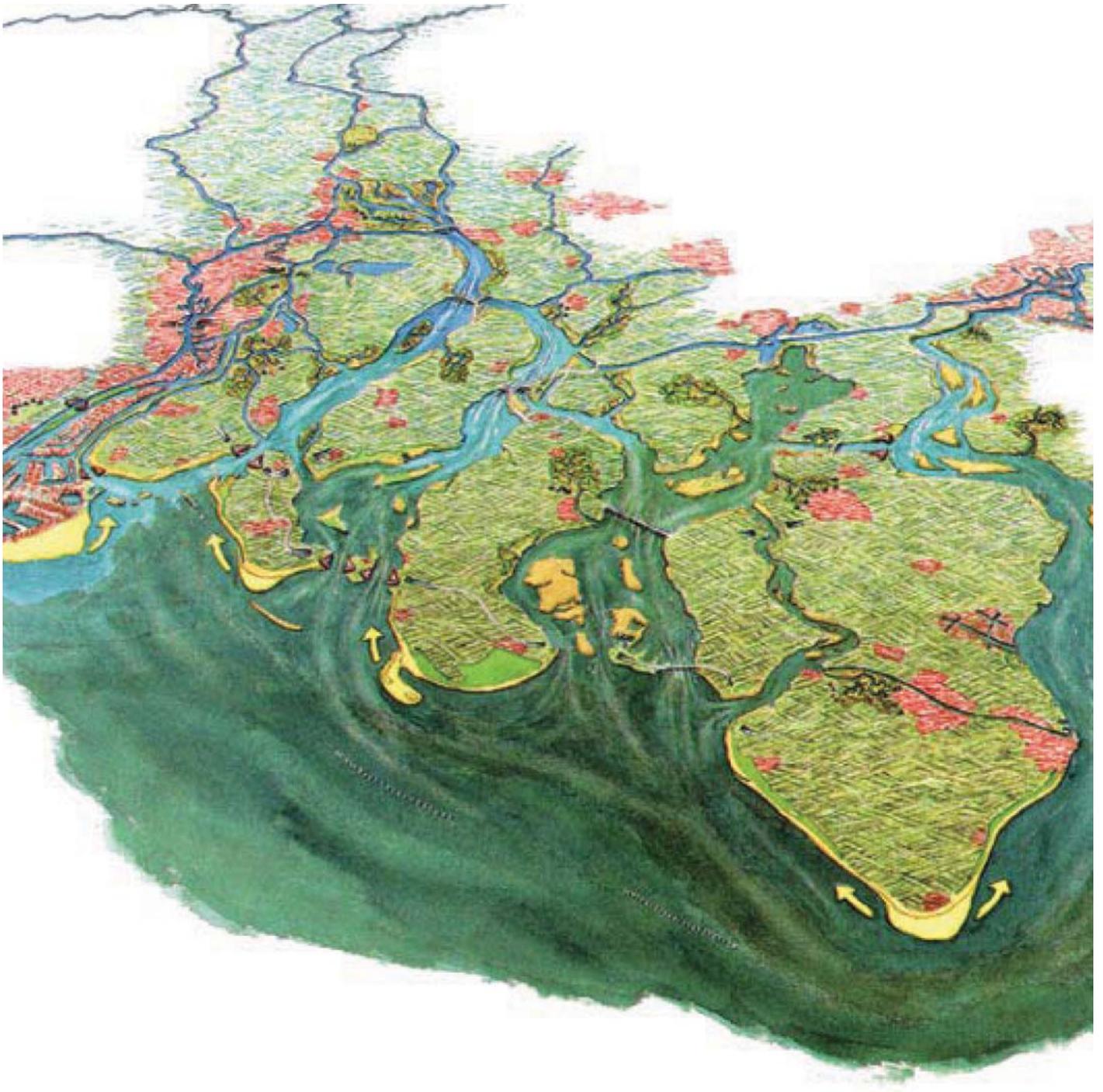
This delta variant is developed by World Wildlife Fund and consists of open sea inlets in which safety is partly the result of natural processes. In order to create an attractive region for tourism and recreation between Rotterdam and Antwerp is the delta transformed into an archipelago. The relation between land and water is restored by processes of accretion at the edges of the islands. Transport through the delta also gets an impulse by new tunnels, bridges and fast ferries. Agriculture in the delta has adapted to the new situation or is relocated elsewhere to reduce the need for freshwater. In this created dynamic landscape are low lying settlements lifted or enclosed by ring dikes. As a result is the land in between available for transformation into an intertidal area. Exchange of elevated nature and low lying agricultural land become possible.

- **Matching variant for a closable open Rijnmond**

The variant for a closable open Rijnmond which fits best in this delta variant is 1 or 2. The reason for this is the shortage of space in Rijnmond for natural processes. The aim of this delta variant is an area as large as possible in which natural processes can be restored. Consequence is that as little land as possible is enclosed by dike-ring 14. Thereby are Voorne-Putten and Hoeksche Waard also part of the dynamic open delta. A combination of urban and recreational development with intertidal areas result in dynamic transition between urban region and delta landscape.

- **Coherence with main water system**  
Due to the natural processes in the open sea inlets, the delta will grow together with the rising sea level. This means that river discharge during storm surges remains possible. In order to limit interventions for a safe delta is transformation of the voordelta possible to reduce the height of the waves from sea.
- **Principles for a restored ecology**  
The aim of this delta variant is complete recovery of the ecologic delta despite of high costs with regard to agriculture, freshwater supply and safety. Exceptional in this variant is the large scale of restoring intertidal areas and the eventually exchange between agricultural land and nature.
- **Opportunities for an improved environmental quality**  
This variant will result in a dynamic delta landscape in which settlements are as small islands in a landscape of intertidal areas. Settlements which originally arose on the edge of the water, then lost their relation to the water, become again settlements at the water. What will be their new waterfront ?

FIGURE 3.12 / Delta variant 'open sea inlets'



source: Atlas van Initiatieven, TU-Delft

### 11.5 - Conclusion delta variants

Within this study of delta variants has become clear that there are actually two feasible variants which also match the principles for a ecologic restored delta. These two variants are 'extended discharge' and 'branched discharge'. The other variants are more extreme ideas of an delta which is completely open or as closed as possible. These variants are 'open sea inlets' and 'discharge corridor'. Differences between the variants 'extended discharge' and 'branched discharge' are whether or not maintaining a freshwater Haringvliet, whether or not temporary storage of peak discharges in the delta and whether or not redistribution of freshwater between Southwest Delta and IJsselmeer.

In the Southwest Delta are ecological problems caused by the construction of the Deltaworks. Restoring the ecological problems of the delta is possible by reversing the partitioning of the delta and river discharge through the delta with open connection to sea. A restored ecology is feasible if it is done together with interventions for a climate proof delta. Attention to local opportunities and consequences is needed to create public support for these interventions on the larger scale. Possible opportunities on the local scale can be found in the transition between land and water, but also in the lost connection between settlements and the water. This connection between settlement and the water is one of the unique qualities of the Southwest Delta.

The study of 'closable open Rijnmond' variants in combination with the study of delta variants gives understanding of the impact on the spatial relation with the water of the settlements

Middelharnis and Hellevoetsluis, which are characteristic for other settlements in the delta. The development of the transition area between urban region and delta landscape is determined by the variant of a closable open Rijnmond. It also determines the position of Hellevoetsluis in this transition area. The way in which the connection between settlements as Middelharnis and the water is improved depends on the chosen delta variant. Regional water system and main water system determine the possibilities for organisation of the transition between land and water.

### 12.1 - Introduction

**Sub question:** *How can the demand on freshwater from the main water system be reduced by solutions within the regional water system and what is their impact on the landscape?*

The main water system focuses on restoring the ecology and flood defence. The regional water systems focuses on freshwater supply. The study of delta variants shows that there can be a difference in the availability of freshwater from the main water system. Most of the freshwater from the main water system is used for flushing and groundwater management, for the prevention of internal salinisation. However the demand for freshwater from the main water system can be reduced by adjustments within the regional water system. There are two strategies developed to align the demand and supply of freshwater in the future. These two strategies comprises resisting salinisation or allowing salinisation (de Vries, et al., 2009). The strategy of resisting consists of measures to reduce the amount of freshwater which is required for flushing and groundwater management. This means structural changes of the current inefficient water system with separated supply of freshwater and drainage of brackish seepage water. Consequence is a reduced demand of freshwater from the main water system. The other strategy is about allowing internal salinisation of the regional water system, which retains its original function of drainage. Consequence is the disconnection of the freshwater supply for agriculture, which is then delivered by the private sector.

### 12.2 - Zoning

Besides more efficient use of the available freshwater are there also opportunities when salinisation is allowed (Guldmond, et al., 2007: 9). Climate change will increase internal salinisation because of increased seepage pressure due to rising sea level, disappearance of infiltrated freshwater in the ground during dry periods and subsidence as result of water drainage (Bergen, et al., 2008: 11-16). The more efficient use of the available freshwater is hampered by crop rotation (de Vries, et al., 2009: 34). When both, efficient use of freshwater and take advantage of saline opportunities, are combined in one regional water system should be selected the strategy of resistance. More efficient use of available freshwater can be achieved by separated supply of freshwater and drainage of brackish water. In addition, combating of internal salinisation can be reduced through zoning of the regional water system. Result is a water system in which some areas make more efficient use of the available freshwater and in other areas is salinisation allowed.

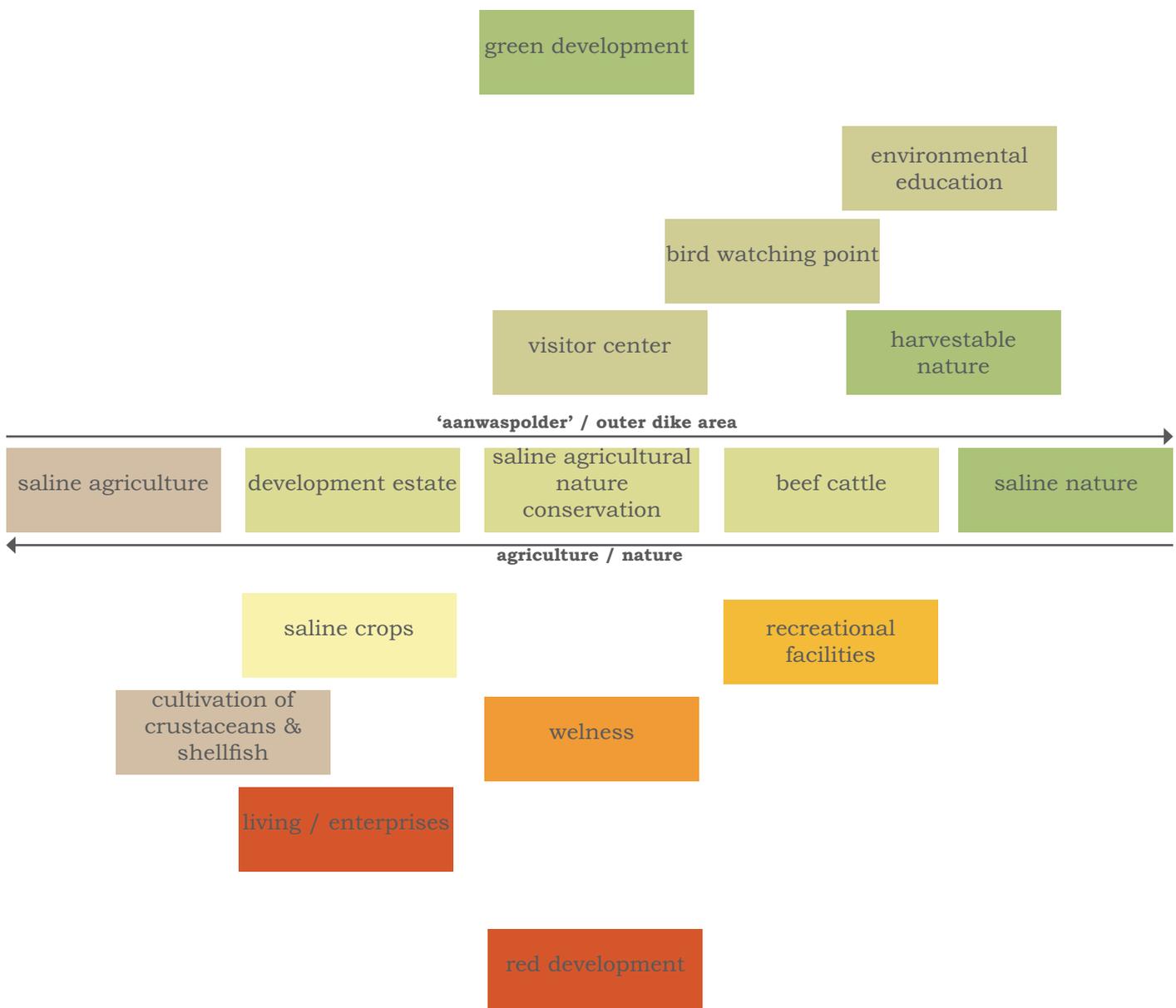
### 12.3 - Opwaspolder & Aanwaspolder

The spatial structure of polders on Goeree Overflakkee, is ideal for zoning. Applying zoning in this way makes it possible to improve the cultural-historical position of the settlements in relation to the water. There is a distinction between two types of polders on Goeree Overflakkee. The first type of polders (opwaspolder) was created by diking of sand planes, which were caused by sand deposition. This kind of polders are wide open spaces. The second type of polders, aanwaspolder, was created by diking of sand deposition at the dikes surrounding the first type of polders. This kind of polders is

rectangular shaped. The 'opwaspolder' is structural adjusted for cultivation of flower bulbs and chicory, which needs efficient use of the available freshwater. In the 'aanwaspolder' is salinisation allowed and can arise a new landscape with saline agriculture and nature. Besides the problem of internal salinisation are there other assignments in order to create a dynamic recreational landscape.

These assignments are restoring the balance between agriculture and nature and improving the historic relation between settlement and water. Since there are two types of zones defined, 'opwaspolder' and 'aanwaspolder', for each type will be explained which solutions and opportunities contribute to the implementation of the described assignments.

**FIGURE 3.13 / Integral development of saline agriculture and nature**



edited source: Zilt verweven (Guldmond, et al., 2007: 36)

### 13.1 - Saline Landscape

The saline landscape will be constructed along the transition between land and water and strengthen the spatial relation of settlements to the water. Transformation into a saline landscape should be taken advantage of to improve the balance between nature and saline agriculture. Because an improved balance between landscape and nature its easier to connect with the outer dike areas in which is the emphasis is on nature. In this interconnected inner dike and outer dike transition area is an opportunity to create a recreational landscape. There are several possibilities to develop nature and agriculture jointly in a saline landscape, though it will always be next to each other. Therefore is an regional strategy needed with inner dike the emphasis will be on agriculture and outer dike the emphasis will be on nature. Regional development is needed for the following reasons (Guldemon, et al., 2007: 35):

- Saline products have a small sales market.
- Development of nature only have indirect benefits and needs to be combined with economic profitable developments as living and recreation
- Integral development from the beginning results in optimal benefit for nature, agriculture and recreation

Adapting to a saline landscape can be achieved by choice of saline crops as sea vegetables, salt tolerant crops and aquatic cultivations, but also cultivations as shellfish, fish, molluscs and worms. In the rapport of InnovatieNetwerk 'zilte verweven' (Guldemon, et al., 2007: 36-38) are described several concepts of integral development of agriculture and nature, which are the concepts

tidal nature polder, saline chain and saline estate. The tidal nature polder is under influence of salt/brackish water from the estuary. A combination of aquaculture and tidal nature will create a landscape which corresponds to a natural salt marches. Addition of recreation and harvestable nature this tidal nature polder become a saline chain. Attached to this tidal nature polder can saline estates be developed. Therefore are living and recreational facilities embedded in this saline landscape.

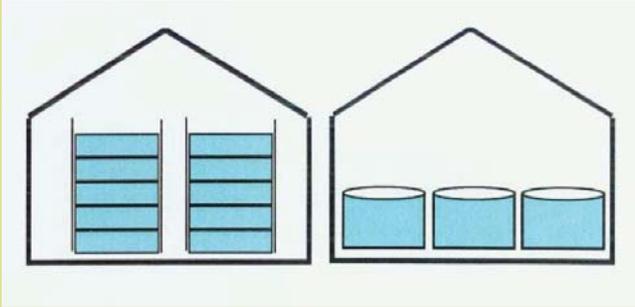
### 13.2 - Spatial strategy for saline landscape

Aquaculture is developed to compensate the decreasing fish stocks. Besides could aquaculture be a catalyst for alternative cultivations than traditional agriculture in areas in which salinisation admitted. However there are different types of aquaculture, which can be combined in different production processes with a closed circuit. Because the various cultivations and various combinations of them are there differences in spatial appearance. The various types of cultivations are fish, shellfish, clam worms, saline crops and algae. Therefore are various spatial typologies developed which can be divided in three categories (Kubber and Goosen, 2009: 1). The second category is the most appropriate to embed in the 'aanwaspolder'. Current agricultural landscape can be transformed into a new pond landscape. Due to nets stretched above the ponds, the landscape looks like a landscape with glasshouses

- **Category 1 / industrial aquaculture in sheds**

In this category is the focus on cultivation of fish in sheds. This kind of production processes are highly specialized and optimised with closed circuits.

FIGURE 3.14 / Category 1

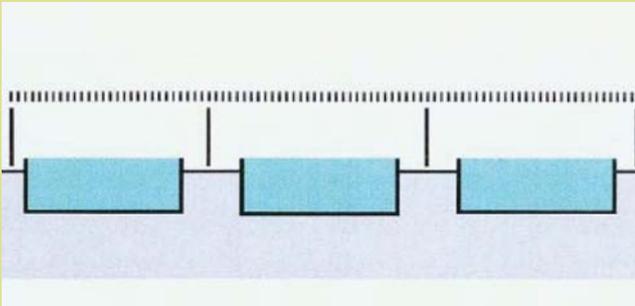


edited source: (Kubber and Goosen, 2009: 16)

- **Category 2 / agricultural pond landscape**

This category is the easiest to embed in the transformed traditional landscape into a saline landscape. The agricultural pond landscape consists of a dense path structure and ponds overwrought with nets. This landscape has similarities with glasshouses. At the same time is it possible to combine various cultivations based on both land and water. Within this pond landscape can nature, recreation and living be embedded.

FIGURE 3.15 / Category 2

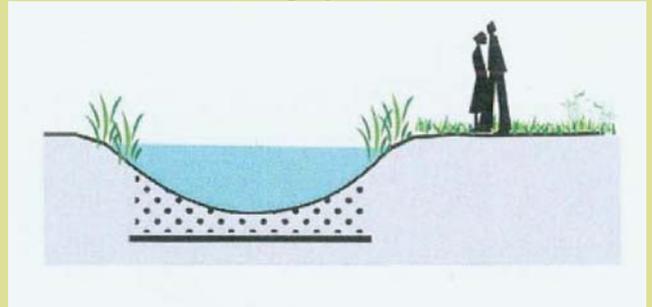


edited source: (Kubber and Goosen, 2009: 16)

- **Category 3 / aquaculture in natural environment**

This third category is about extensive cultivation and form only a small part of the production of the total aquaculture. Cultivation in the natural environment can be developed in affiliation with nature, whereby it could connect nature and agricultural landscape.

FIGURE 3.16 / Category 3



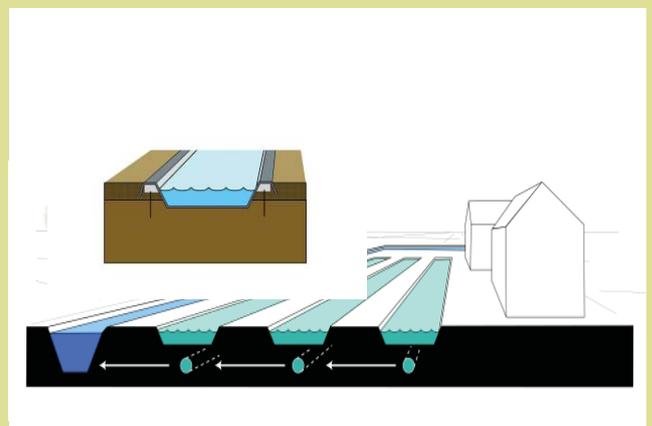
edited source: (Kubber and Goosen, 2009: 16)

## 13.3 - Spatial integration agrarian pond landscape

- **Salt water leaks & foil edges**

Leakage of salt water should be prevented. Prevention of leakage by discharge drains or foil. If foil is used it needs to be with good finishing of the edges.

FIGURE 3.17 / Drains & Foil

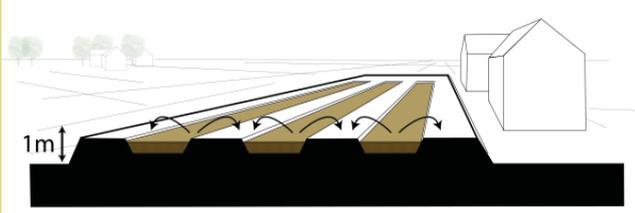


edited source: (Kubber and Goosen, 2009: 40)

- **Closed ground balance.**

Closed ground balance is needed. Therefore are ponds half buried and the paths in between are heightened with the soil from the digged ponds.

**FIGURE 3.18** / Ground balance

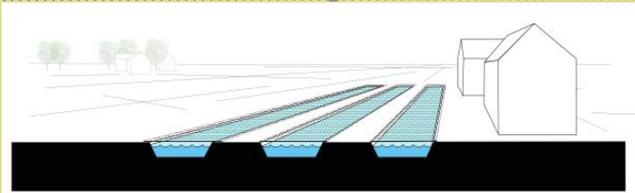


edited source: (Kubber and Goosen, 2009: 40)

- **Shielding nets**

Nets need to be stretched just above the water of the ponds in order to avoid a landscape with the appearance of glasshouses.

**FIGURE 3.19** / Shielding nets

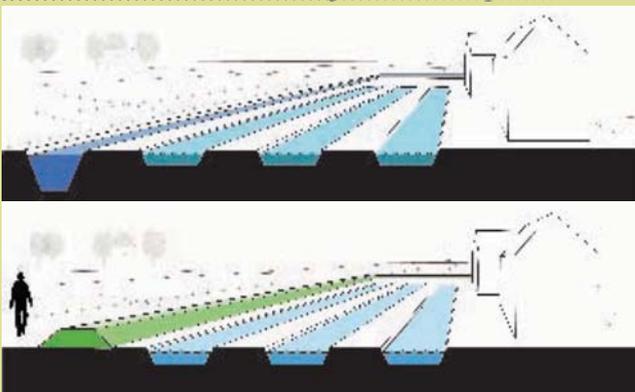


edited source: (Kubber and Goosen, 2009: 41)

- **Property boundary & landscape integration**

Fences should not be placed around the property as boundary, but ditches could function as boundary around the property. Landscape integration is not accomplished by plants. Landscape integration can be accomplished by small dikes.

**FIGURE 3.20** / boundary & landscape



edited source: (Kubber and Goosen, 2009: 41)

### 14.1 - Ring dike polder

As result of the spatial zoning of Goeree Overflakkee in 'aanwaspolders' and 'opwaspolders' is the regional water system automatically divided in various subsystems. This makes it more easy for structural adjustments in 'opwaspolders' to continue intensive cultivation of traditional agricultural crops. Among these structural adjustments is the separation between freshwater supply and drainage of brackish water. If there is not enough freshwater available from the main water system, additional resources can provide for the demand for freshwater. Two possible local sources of freshwater could be effluent of sewage treatment plants or seasonal storage of rainfall on the plot. Both resources can be embedded in a water system with separated supply of freshwater and drainage of brackish water. Besides can these recourses also contribute to an improved balance between nature and agriculture in the opwaspolder.

### 14.2 - Effluent of sewage treatment plants

Goeree Overflakkee has five sewage treatment plants which produce each year six million cubic meters of effluent (de Vries, et al., 2009: 69-72), which is freshwater. A disadvantage of utilizing effluent is that its produced continuously during the year, but demand on effluent is only required during irrigation period in spring and summer. In order to utilize dispersed production of effluent is temporary storage of effluent needed. An other disadvantage of effluent from sewage treatment plants is the concentration of chloride in effluent, which makes it useless for irrigation of intensive cultivations as flower bulbs and chicory. Cause of the high concentration of

chloride in effluent is probably leakage of brackish groundwater in sewage system. To be able to utilize effluent for irrigation it needs to be guided through a constructed wetland (helophyte filter). Constructed wetlands are not as controllable as treatment plants, but have the advantage that they can easy be embedded in the landscape. Because of this advantage, constructed wetlands could be combined with additional functions as recreation, nature, retention area and cultivation of rushes and reeds.

### 14.3 - Seasonal storage rainfall on plot

Accommodation of demand on freshwater from local recourses can also be found in seasonal storage of the precipitation surplus in freshwater lenses. The current regional water system is based on combating internal salinisation by flushing and drainage of saline seepage. As a result of relatively dense network of drains is it in the current situation not possible to form freshwater lenses. By maintaining the groundwater level artificially low in some plots, the saline seepage will increase compared to other plots which are not drained. This difference in groundwater levels occurs also between agriculture and nature. Storage of freshwater on plots can combat the saline seepage and neutralize the differences between groundwater levels for agriculture and nature.

Storage of precipitation in freshwater lenses on plots is possible at a small scale by lowering the water level in the ditches, which will increase the saline seepage in the ditches. This will result in larger freshwater lenses in the plots which salinisation of the root zone prevents. This intervention is

probably only profitable in areas where the saline groundwater level is close to the surface. In order to increase the storage capacity of the plots is a system developed in which deep drainage and level management of the ditches is combined. These systems are developed in order to cultivate flower bulbs independently of the substratum of clay, by placing a layer of sand on top of it. Of this developed system is pilot project, project Bollenmeer in Noord-Holland. For this system are three variants developed, of which two are based on extern supply of freshwater and the other one is only based on seasonal storage of precipitation. All variants can be combined with separated supply of freshwater and discharge of salt water (Dik and Vliegthart, 2009: 9-10).

**14.4 - Conclusion Regional Water System**

The demand on freshwater in the regional water system can be adjusted to the availability of freshwater from the main water system. Therefore are solutions possible for decreasing of the demand and increasing of the availability through zoning of the regional water system. The ‘aanwaspolders’ are the zones in which internal salinisation is utilized. In the ‘opwaspolders’ is efficient use of the available freshwater enhanced. Due to the contrast between the different water systems and contrast between landscapes result in a dynamic landscape.

• **System 1, cultivation with weak infiltration**

Degree of infiltration or seepage depends on balance between water levels with neighbouring plots. In case of

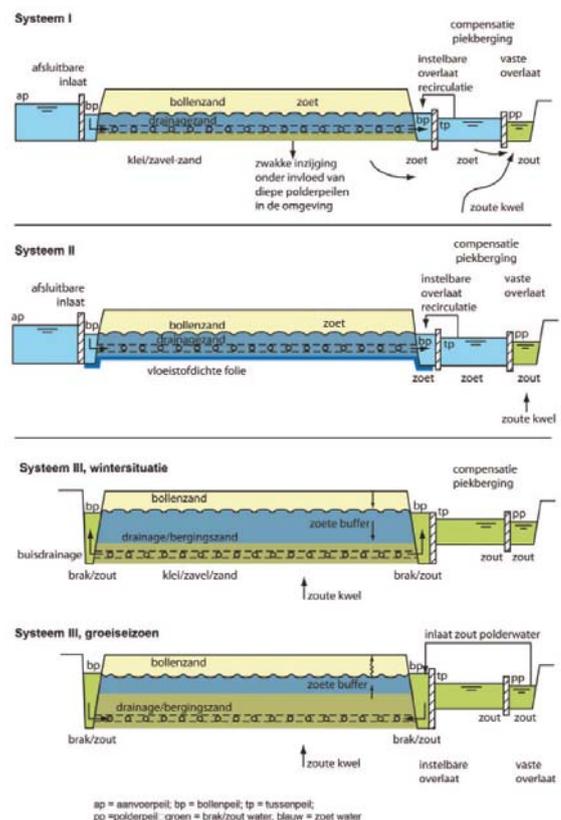
• **System 2, cultivation on impermeable layer**

The impermeable layer is added underneath the level of drainage to prevent seepage of saline water and to deep infiltration of freshwater.

• **System 3, cultivation with seasonal storage of precipitation in shallow subsurface**

Infiltration takes place from stored underground precipitation surplus, which will suppress saline seepage and drift of through deep drains.

FIGURE 3.21 / Cultivation systems



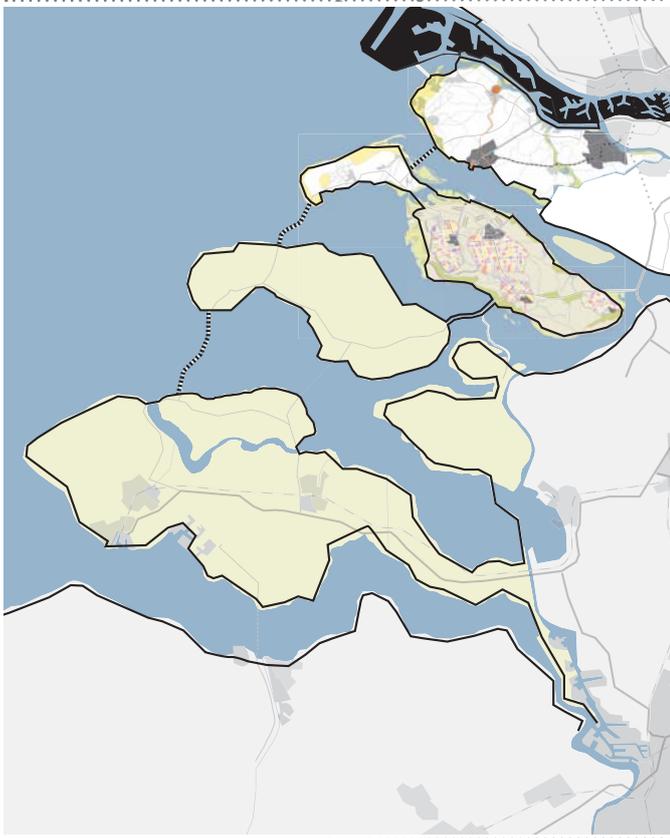
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### 15.1 - Climate change

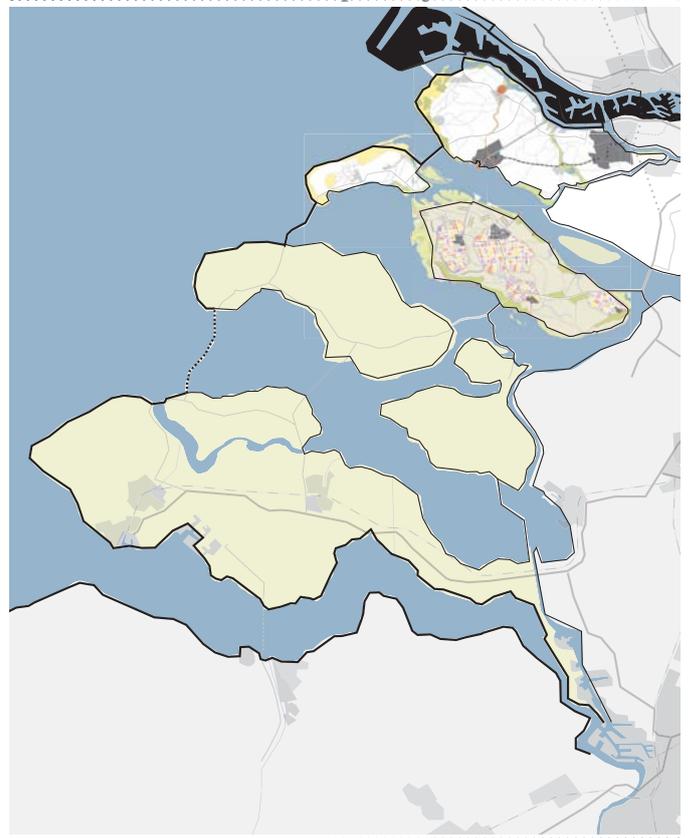
According to an ecologic restored and climate proof delta is it important to interconnect the various water basins of the delta and restoring the discharge of river water through the delta to sea. From the literature study on the water system has emerged that there are various delta variants to achieve this principles, which are also determinative for the chosen variant of a closable open Rijnmond. The two delta variants which realise best the principle for the Southwest Delta, are the variants 'branched discharge' and 'extended discharge'. Both variants have different consequences for the dynamics of the delta, freshwater supply, transition between land and water and the transition between urban region and delta landscape.

The delta variant of 'branched discharge' is combined with variant 3 of a closable open Rijnmond. This combination mainly effects the freshwater supply and the transition between land and water. Climate dikes will decrease the relation between land and water. The delta variant of 'extended discharge' is combined with variant 1 of a closable open Rijnmond. This combination mainly effects the transition between land and water as well as the transition between urban region and delta landscape. The direction of development will determine the orientation of Goeree Overflakkee towards Haringvliet or Grevelingen and will determine the orientation of Voorne-Putten towards delta landscape or urban region.

**FIGURE 4.1** / 'branched discharge' & variant 3 closable open Rijnmond



**FIGURE 4.2** / 'extended discharge' & variant 1 closable open Rijnmond



### 15.2 - Principles derived from theoretical framework

From the theoretical framework has emerged the importance of transition areas, networks and meaningful places by collective memory. The transitions on which is focussed in the design are the transition between urban region and delta landscape and the transition between land and water. The transition between urban region and delta landscape is of importance on the regional scale of the Southwest Delta. In this transition are connective networks important. The transition between land and water is of importance on the local scale. In this transition is meaningful space by collective memory on site a tool to improve the relation between settlement and water.

### 15.3 - Principles derived from historical analyses

From the historical analyses has emerged various structuring networks in the Southwest Delta. These networks consists successively of fortifications, steam tram lines and Deltaworks. In order to create an ecologic restored and climate proof delta are the water basins interconnected, which become thereby also a network. Other networks which can occur on the islands in the delta are saline chains on the transition of land and water, which combine nature, agriculture and recreation in one structure. This transition is also spatial improved by creating a zoned landscape with freshwater cultivation in 'opwaspolders' and saline cultivations in 'aanwaspolders'.

**FIGURE 4.3 / Concept: urban gateway & zoned landscape**



## 15.4 – Urban Gateway

Hellevoetsluis is positioned on the end of various existing and future networks, and could form the gateway between urban region and delta landscape.

- **Water defence line between Brielle and Hellevoetsluis**

The water defence line connects the fortifications of Brielle and Hellevoetsluis, located between Maas and Haringvliet. The dike which connects the fortifications is nowadays a slow traffic route and part of the cycling network of ANWB/VVV.

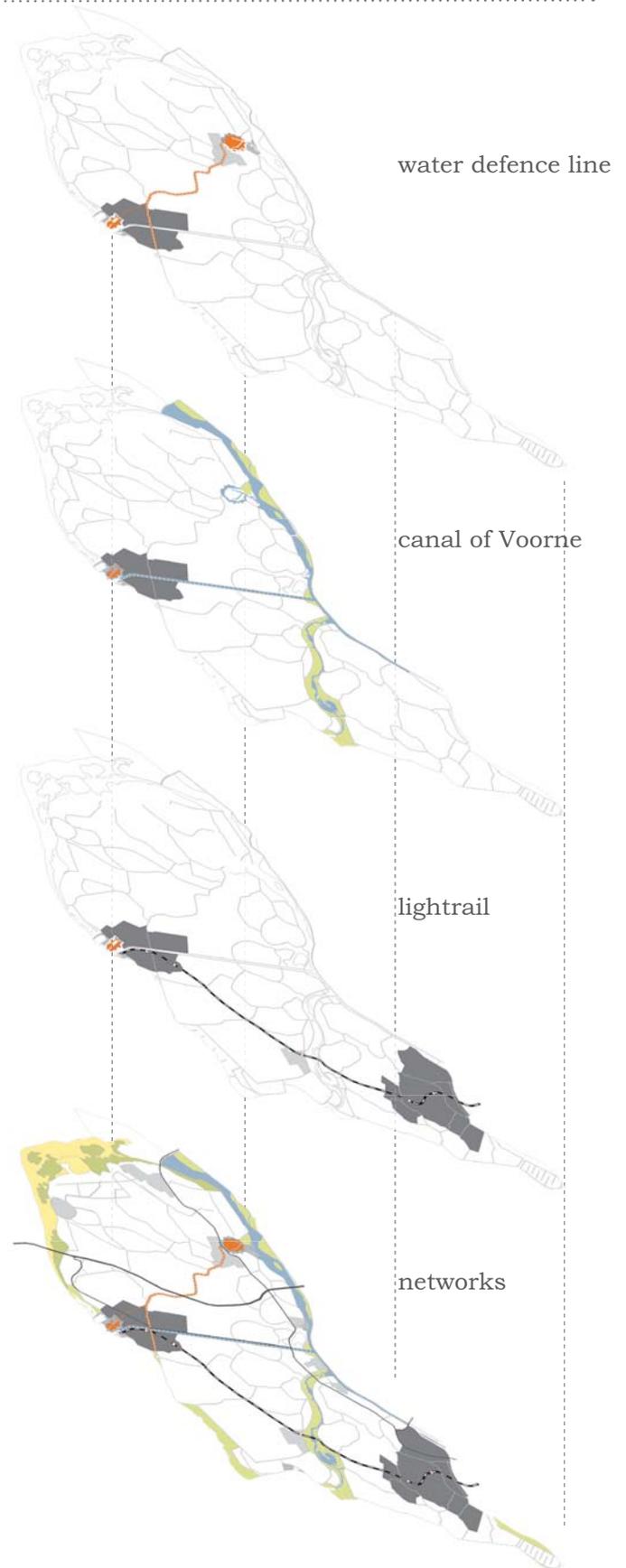
- **Canal of Voorne**

The canal of Voorne formed the entrance to Rotterdam by water. Nowadays is the canal of Voorne not navigable for recreational vessels due to the shopping mall and fixed bridges constructed over the canal. In the future it should become navigable for recreational vessels and become part of the ‘Staande Mastroute’, which is a route for sailing vessels from the Southwest Delta to the Eems near Groningen

- **Lightrail Den Haag – Hellevoetsluis**

The islands of Zuid-Holland were reachable from Rotterdam by steamtrams and steam ferries. The realisation of the Deltaworks meant the end of the steam trams and steam ferries. Nowadays are in the summer a lot of bicycle ferries between the islands. To increase the function as gateway of Hellevoetsluis, the old tramline could be redeveloped into light rail between Rotterdam and Hellevoetsluis.

FIGURE 4.4 / Concept: urban gateway



## 15.5 – Zoned Landscape

Middelharnis is a characteristic ring dike village, which loss its relation to the water by reclamation. To reconnect ring dike village with the water is the island transformed into a zoned landscape with freshwater and salt water cultivation. This zoned landscape is possible by interventions in the regional water system which are described in chapter 3 about climate change.

- **Transition of land and water**

The saline chain consists of the dike and wetlands in outer dike areas as well as inner dike areas. The saline chain combines nature, agriculture and recreation into one spatial structure which surrounds the island.

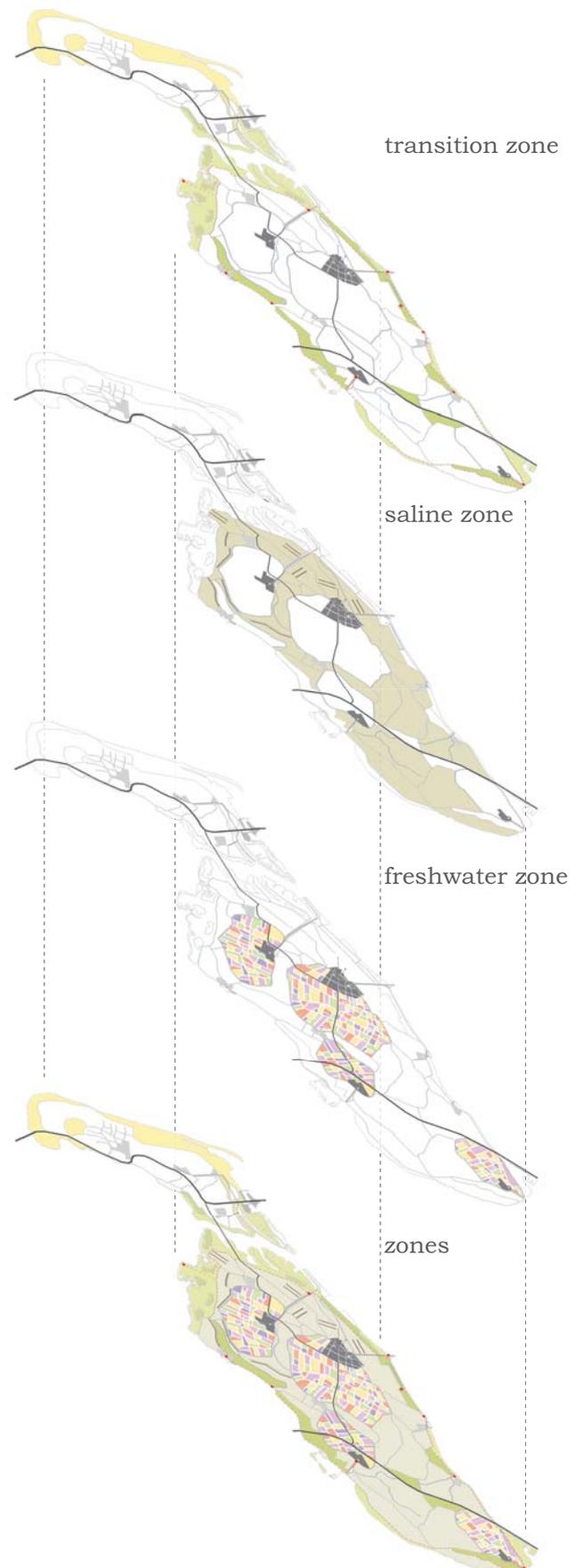
- **Saline production landscape**

The saline production landscape consists of ‘aanwasppolders’ which are located between the dike ring villages in the ‘opwasppolders’ and the water. The relation between dike ring villages and the water should be increased by means of landscape architectonic elements. These elements consists of structures and elements of saline aquaculture on land.

- **Freshwater production landscape**

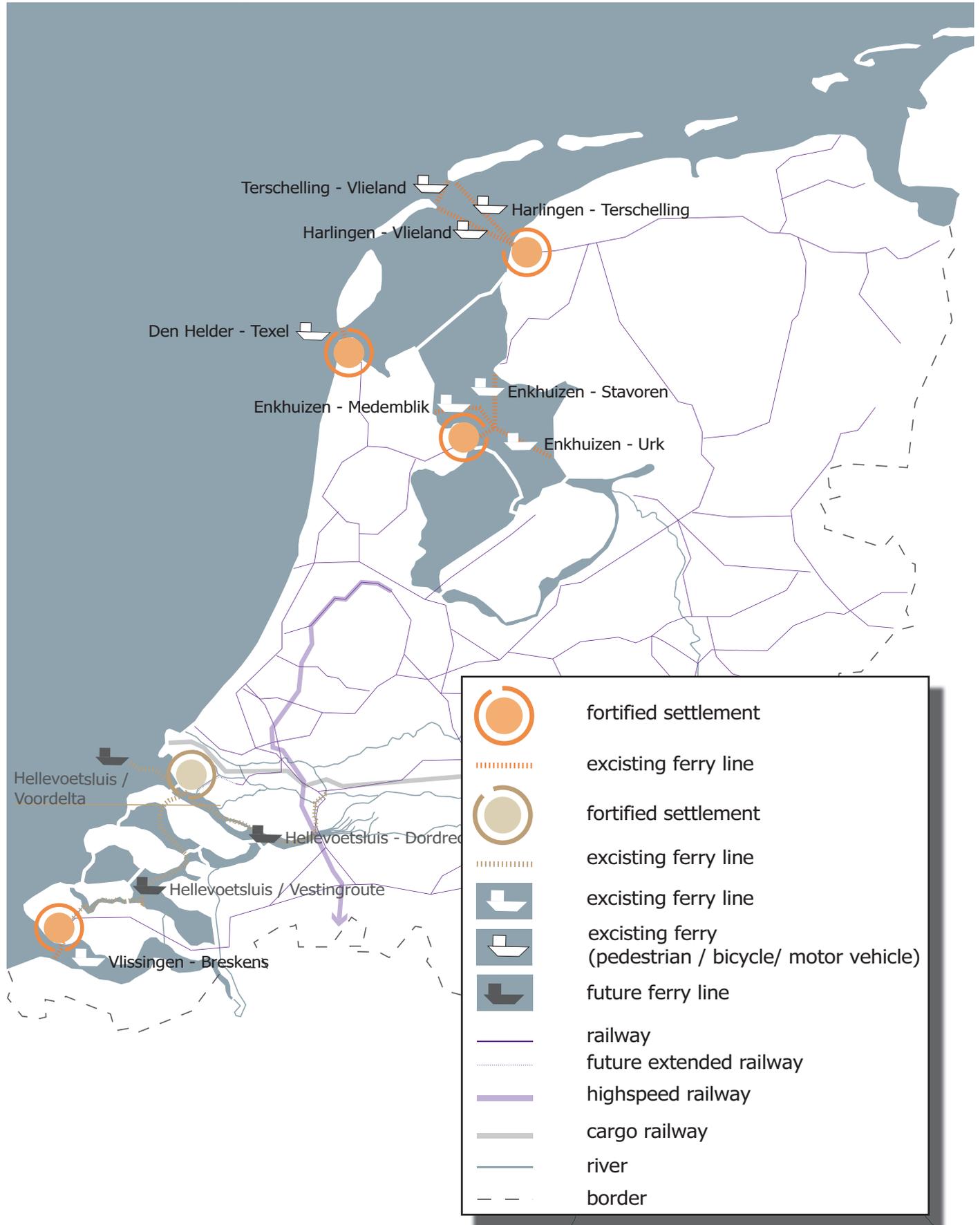
The freshwater landscape is located in the ‘opwasppolders’ the polders in which the dike ring villages are founded. Due to the contrast between freshwater production landscape and saline production landscape is a new spatial relation constructed between dike ring village and water edge.

FIGURE 4.5 / Concept: zoned landscape





**FIGURE 4.6 / Overview case studies transfer train/ferry**



16.2 - Den Helder

- Town centre on route between station and ferry terminal
- Ar & culture district developing as connecting area between town centre and ferry terminal
- No program on waterfront

FIGURE 4.7 / Den Helder transer train/ferry

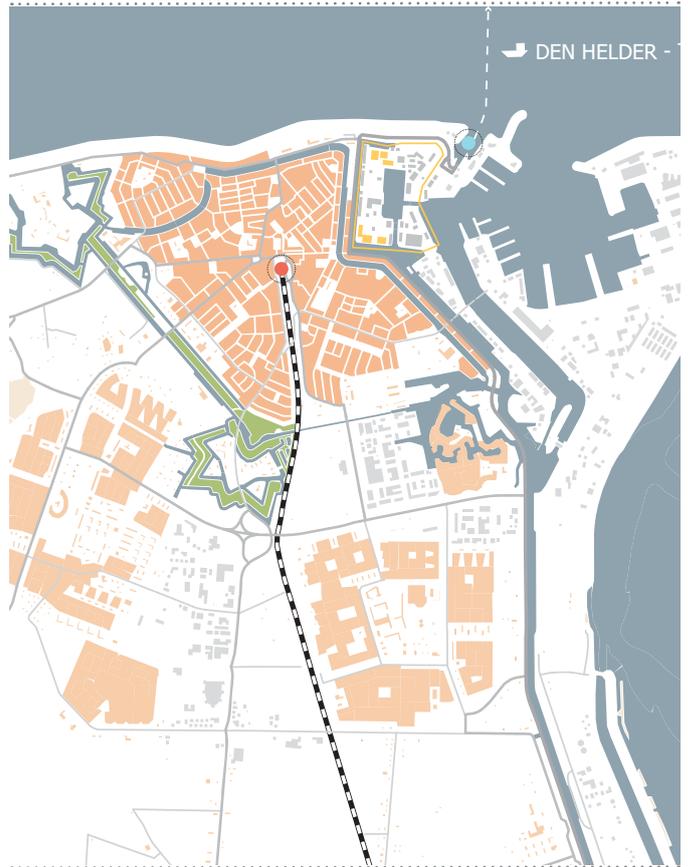
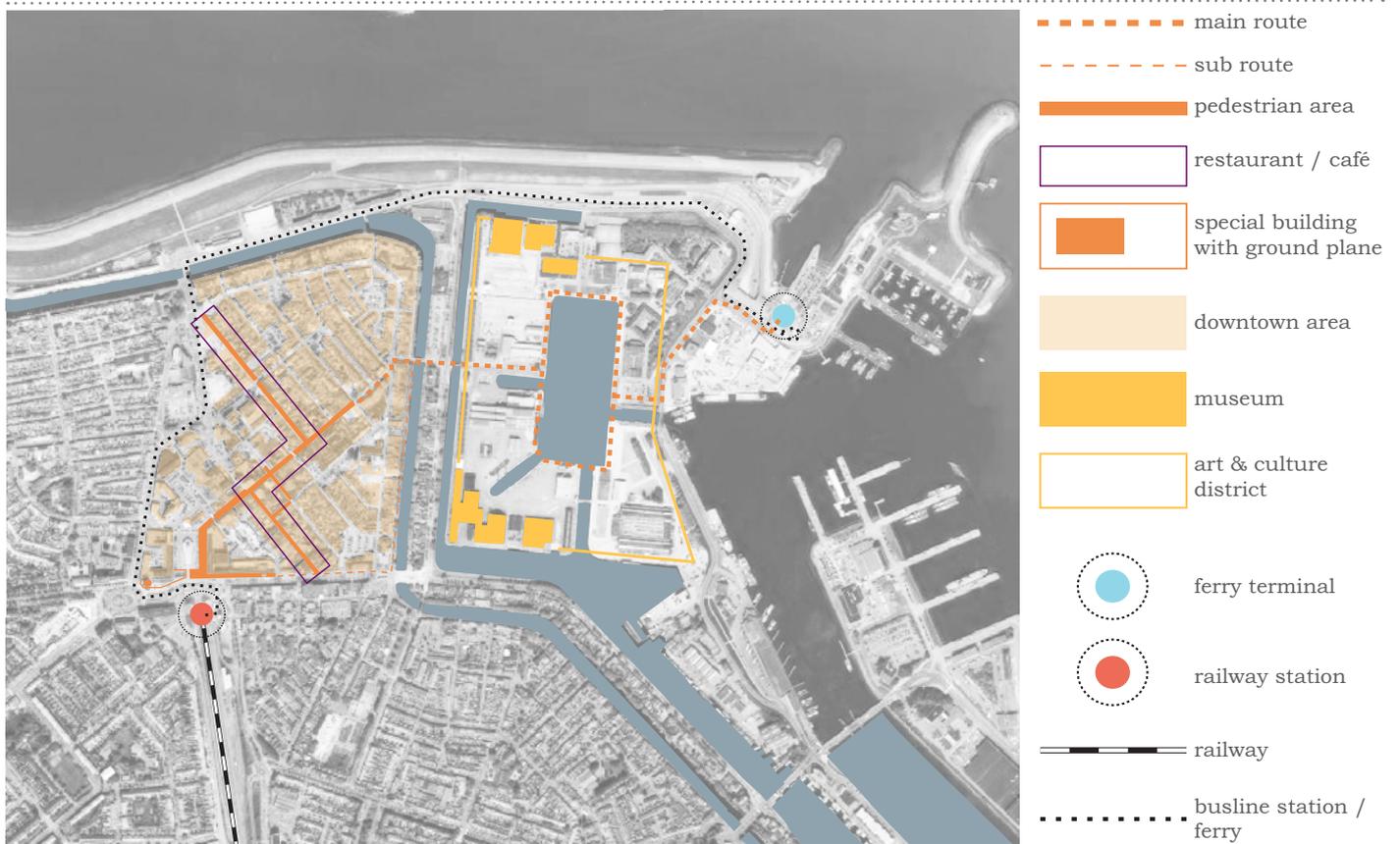


FIGURE 4.8 / Relation between town centre, railway station, ferry, art&culture and waterfront



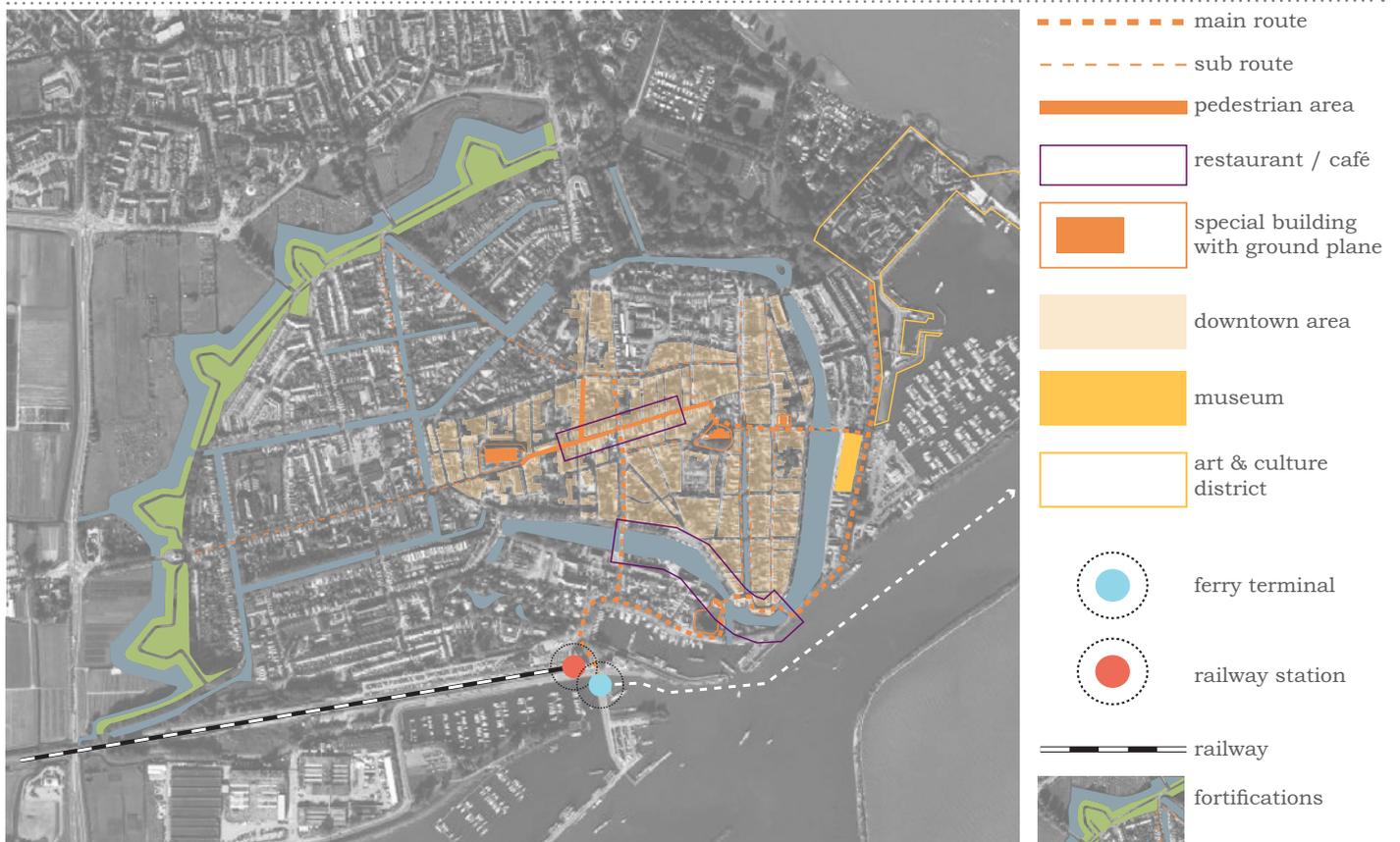
16.3 - Enkhuizen

- Direct transfer between train and ferry
- Relation between town centre and ferry/train is realized by parallel route to museum

FIGURE 4.9 / Enkhuizen transer train/ferry



FIGURE 4.10 / Relation between town centre, railway station, ferry, art&culture and waterfront



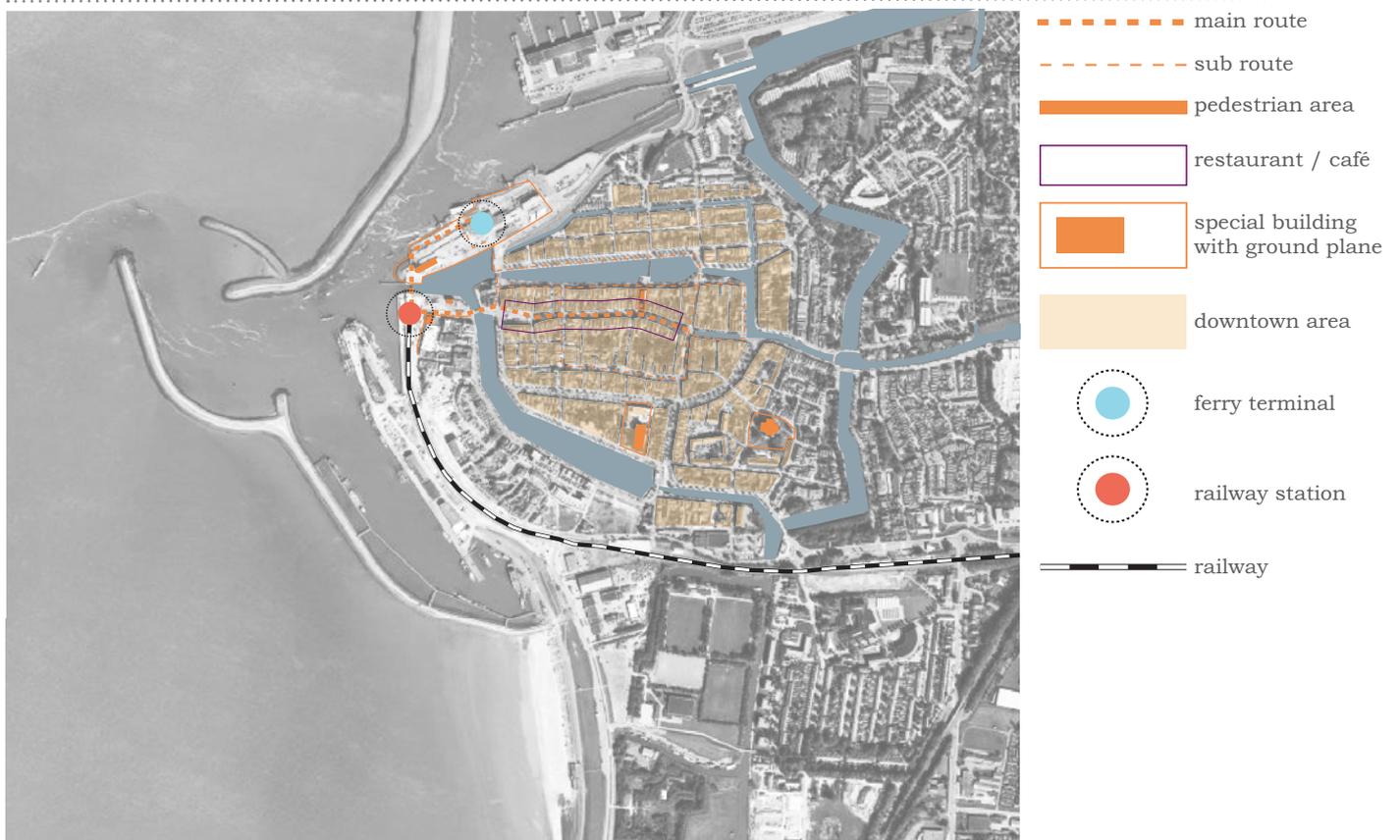
16.4 - Harlingen

- Train station, ferry terminal and town centre are close related to each other, missing programme along connection
- Train station and ferry terminal form a barrier in between the town centre and the Waddenzee
- Waterway through town centre connects centre with ferry and train

FIGURE 4.11 / Harlingen transer train/ferry



FIGURE 4.12 / Relation between town centre, railway station, ferry, art&culture and waterfront



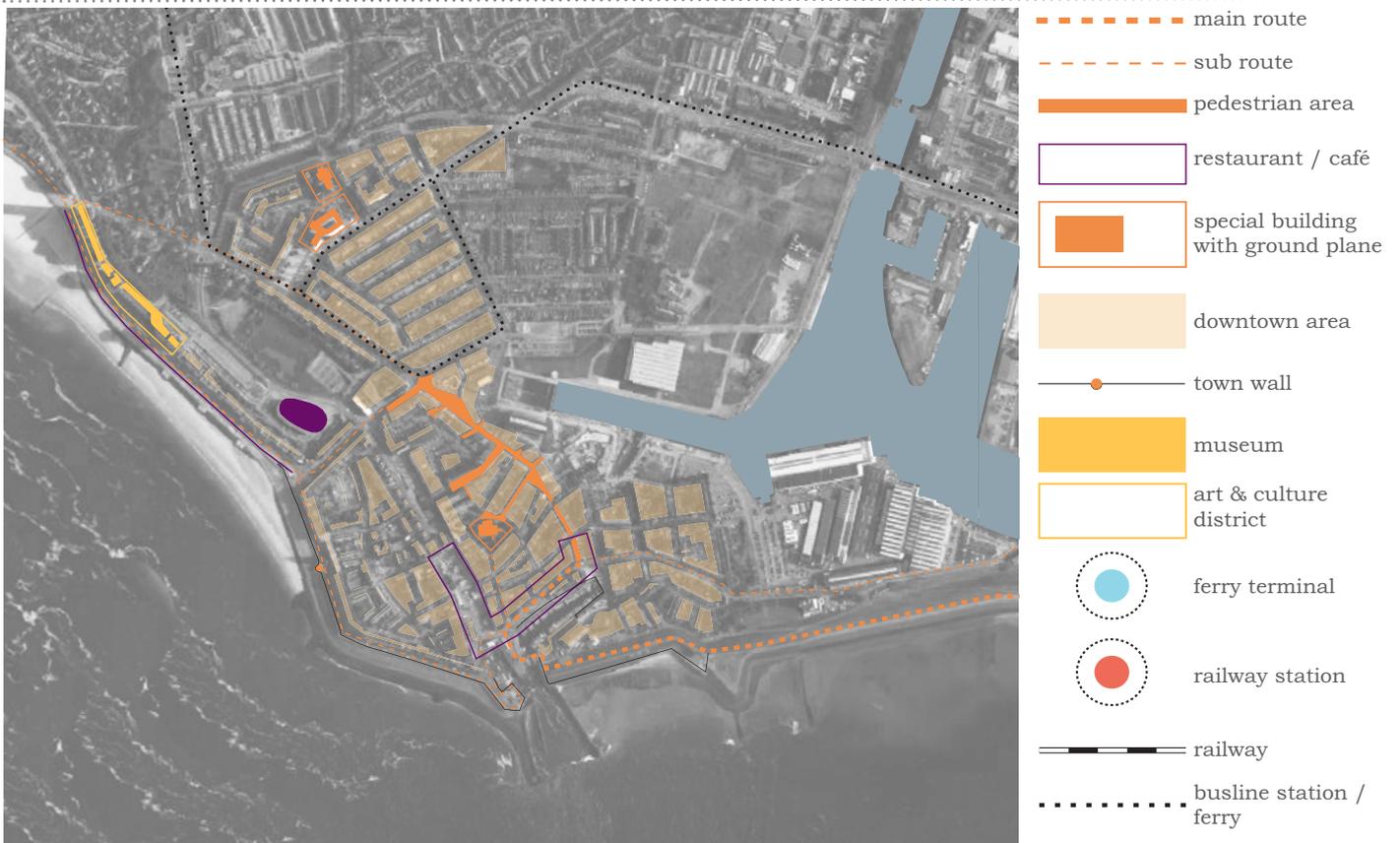
16.5 - Vlissingen

- Direct transfer between train and ferry
- No relation between town centre and railway station / ferry terminal
- Town centre is fragmented in shopping street, boulevard and townwall

FIGURE 4.13 / Vlissingen transer train/ferry



FIGURE 4.14 / Relation between town centre, railway station, ferry, art&culture and waterfront



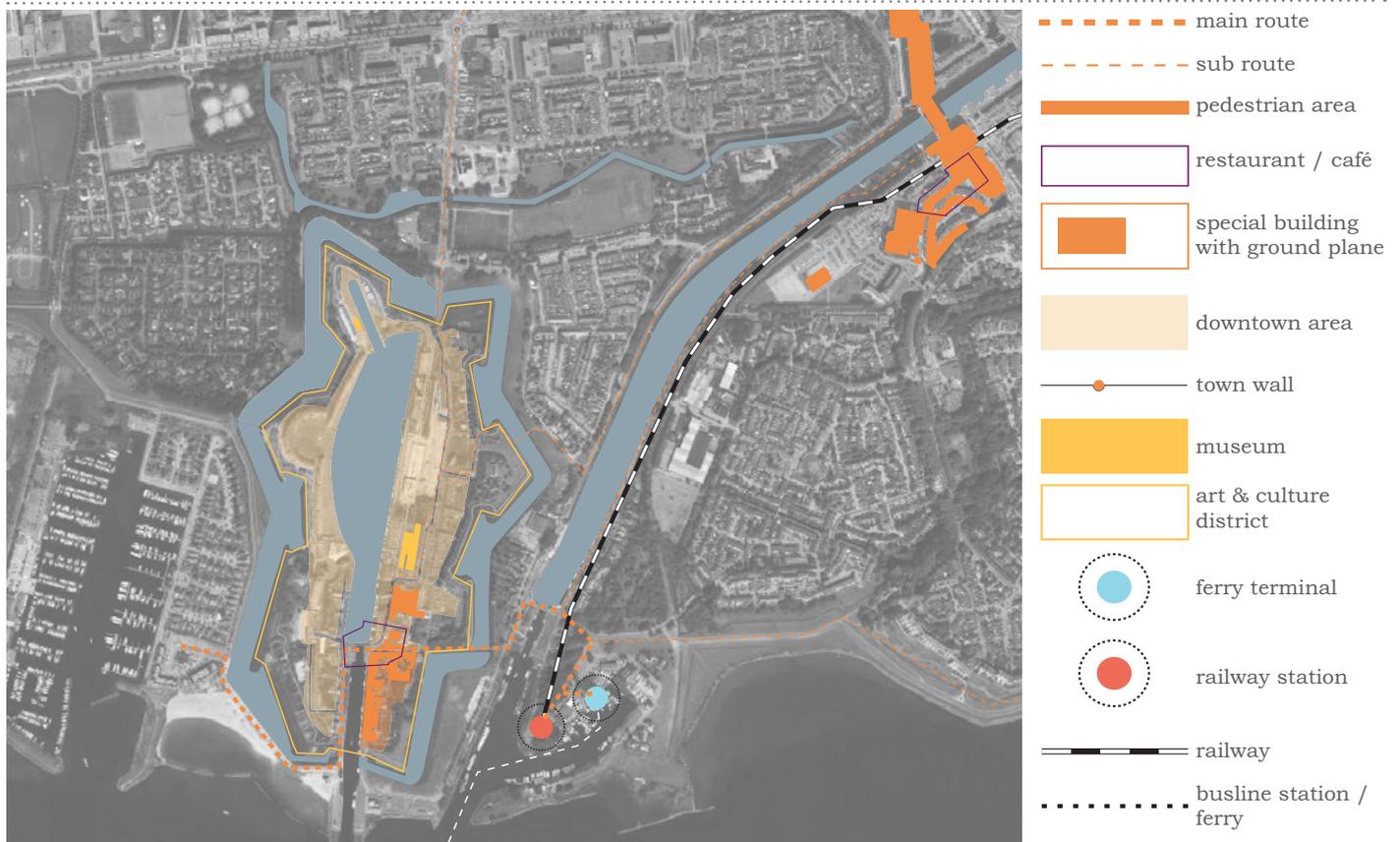
## 16.6 - Hellevoetsluis

- Direct transition between train and ferry
- Close relation between ferry/train and fortifications, but not very strong
- No relation between town centre and waterfront existing of fortifications, train and ferry
- Canal will be transformed into waterway, and will connect town centre and waterfront

## 16.7 - Conclusion

Hellevoetsluis could be an example of a direct transfer between lightrail and ferry. To benefit from this amount of travellers from urban region to delta landscape is the relation between historic center and shopping mall to this transfer terminal of importance. Enkhuizen and Harlingen are the most comparable cases. Instead of Enkhuizen is in Hellevoetsluis the shopping center not located in between transfer terminal and historic attraction. In Hellevoetsluis are these actually disconnected of each other with the canal as barrier in between. Looking at Harlingen becomes clear that a transfer terminal at the waterfront can work as a barrier between town centre and coast. Routing and programme between the different elements is important to connect them with each other.

**FIGURE 4.15 / Relation between town centre, railway station, ferry, art&culture and waterfront**



## 17.1 - Urban gateway

Hellevoetsluis is located in the transition between urban region and delta landscape and at the same time at the edge of the delta. Due to its position in the delta is Hellevoetsluis under the influence of the transformations in the delta in order to develop a ecologic restored and climate proof delta. As described in the chapter three about the main water system is Hellevoetsluis influenced by a possible development according the delta variant 'branched discharge' and extended discharge. The position of Hellevoetsluis in the transition between urban region and delta landscape will be influenced by development of the region Rijnmond according to the variants for a closable open Rijnmond.

The design of Hellevoetsluis will focus on development of networks and programme in order to improve the gateway function of the city. To get a better understanding of this gateway

function of Hellevoetsluis are similar cities investigated which are all ready a gateway between urban region and delta landscape. In these cases is looked at position, programme and routing, which are of interest for the integration of a transfer terminal between light rail and ferry. The networks which are developed in Hellevoetsluis are the canal and the light rail. In the direct environment of the transfer terminal will also be developed programme which is of interest on a regional scale.

Seen from all these aspects is the Veerhaven of Hellevoetsluis the most interesting location to design, because all these aspects come together in this place. In the current situation is the Veerhaven a backward area with some small shipyards. In the design benefits the Veerhaven from the development of the networks canal and light rail and can be developed as link in the connection between shopping mall and fortification.

**FIGURE 4.16 / Design of Veerhaven in relation to shopping mall and historical center**

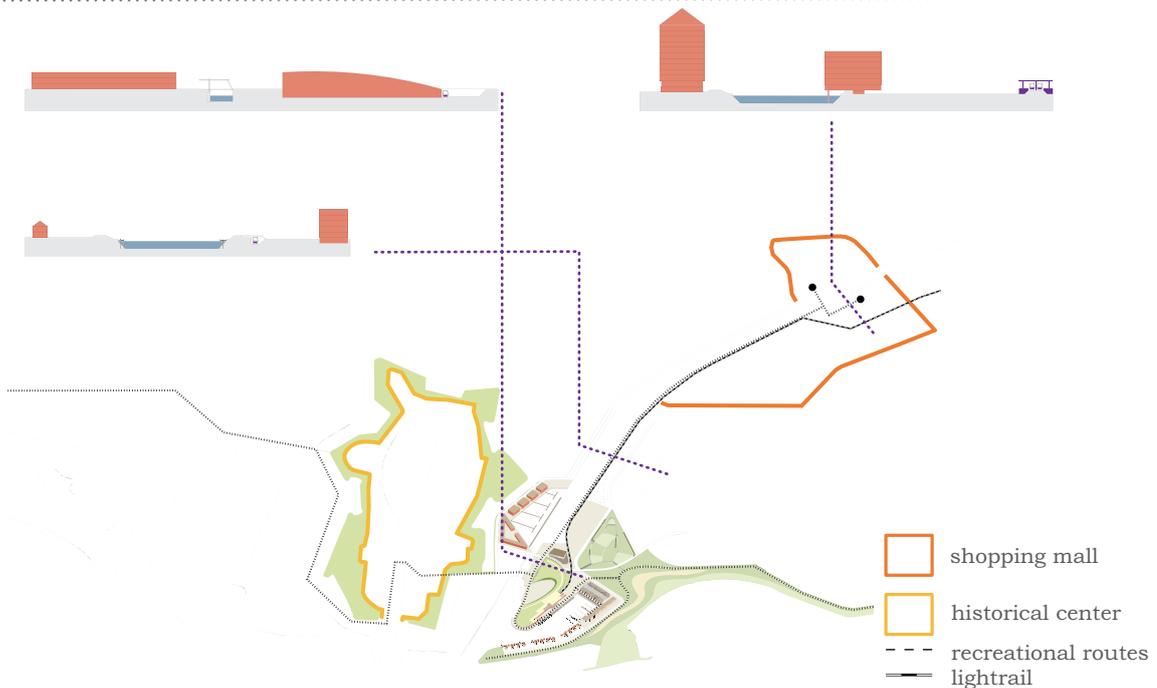
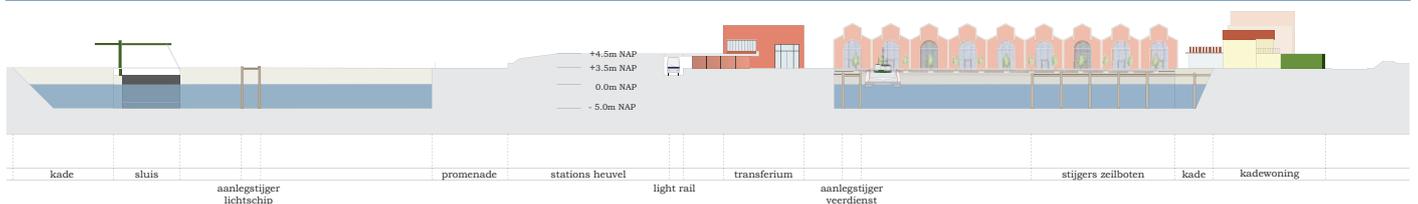
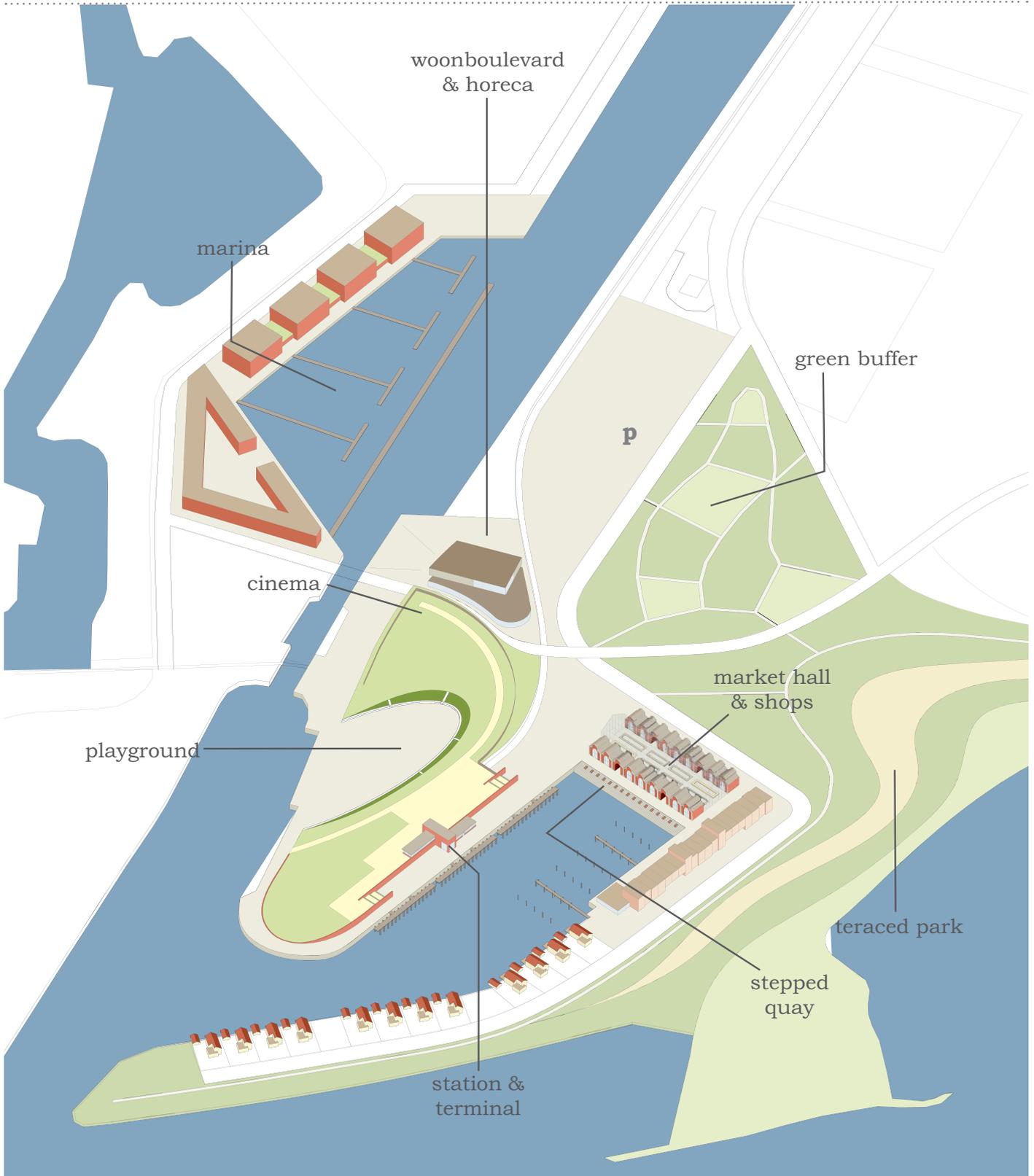


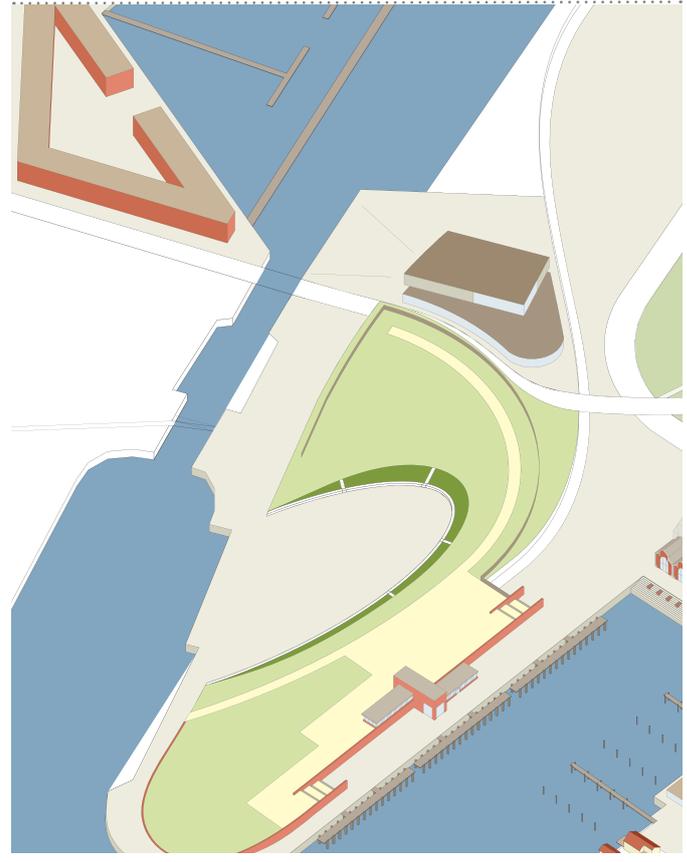
FIGURE 4.17 / Design of transfer terminal Veerhaven Hellevoetsluis



**17.2 - Transfer terminal**

A condition for the transfer terminal was a direct transfer possible between light rail and ferry. An other aspect was an logical and clear routing to the fortification and the shopping mall. Therefore is chosen to position the station with underneath a green hill, with the façade and entrance towards the unloading quays serving the ferries. Because of this the quay become a clear and logical routing. In order to strengthen the relation between shopping mall and fortification is along the route, at the sluices, also a furniture strip and nightlife facilities. The quay can further develop as boulevard between the canal and the light rail towards the shopping mall. This shopping mall will be deconstructed to enable recreational boating to use the canal.

**FIGURE 4.18 / Transfer terminal & playground**



**FIGURE 4.19 / Reference: Entdeckerpark Bremen**



**17.3 - Market hall**

The market hall together with the apartments and the transfer terminal form together the enclosure of the Veerhaven and creates a water square. The market hall is also programme which attracts people from the region. In the facades of the long sides of the market hall are also small shops, restaurants and art galleries established. By constructing the quay in front of the market hall as a stairs is it possible in ombination with a floating stage to organize festivals and concerts in the Veerhaven. A part of the Veerhaven can be developed as marina with moorings for the residents of the apartments. The waterfront enclose the urban water square with a green border.

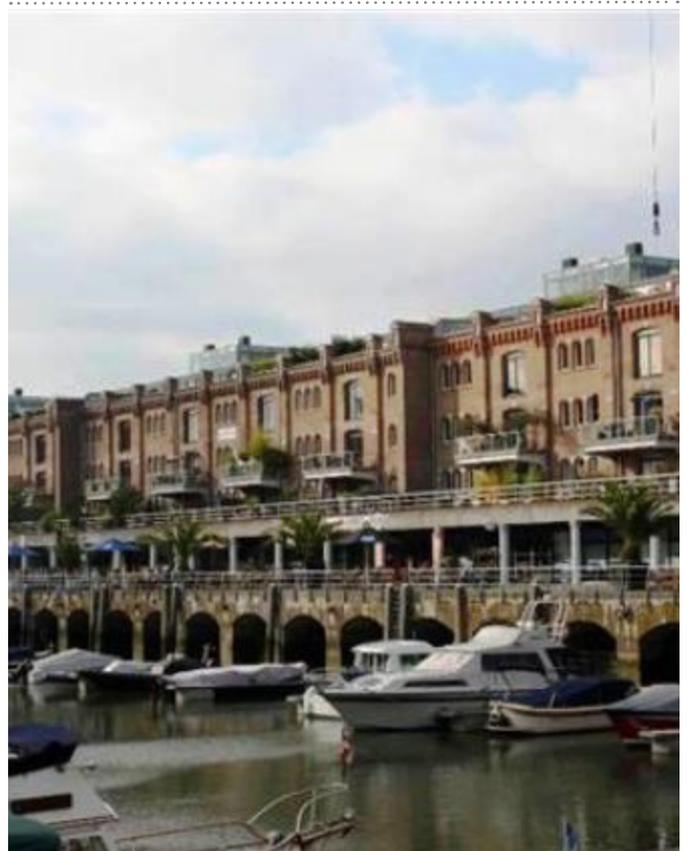
**FIGURE 4.20 / Water square & market hall**



**FIGURE 4.21 / Market hall Valencia**



**FIGURE 4.22 / Quea Entrepot Rotterdam**

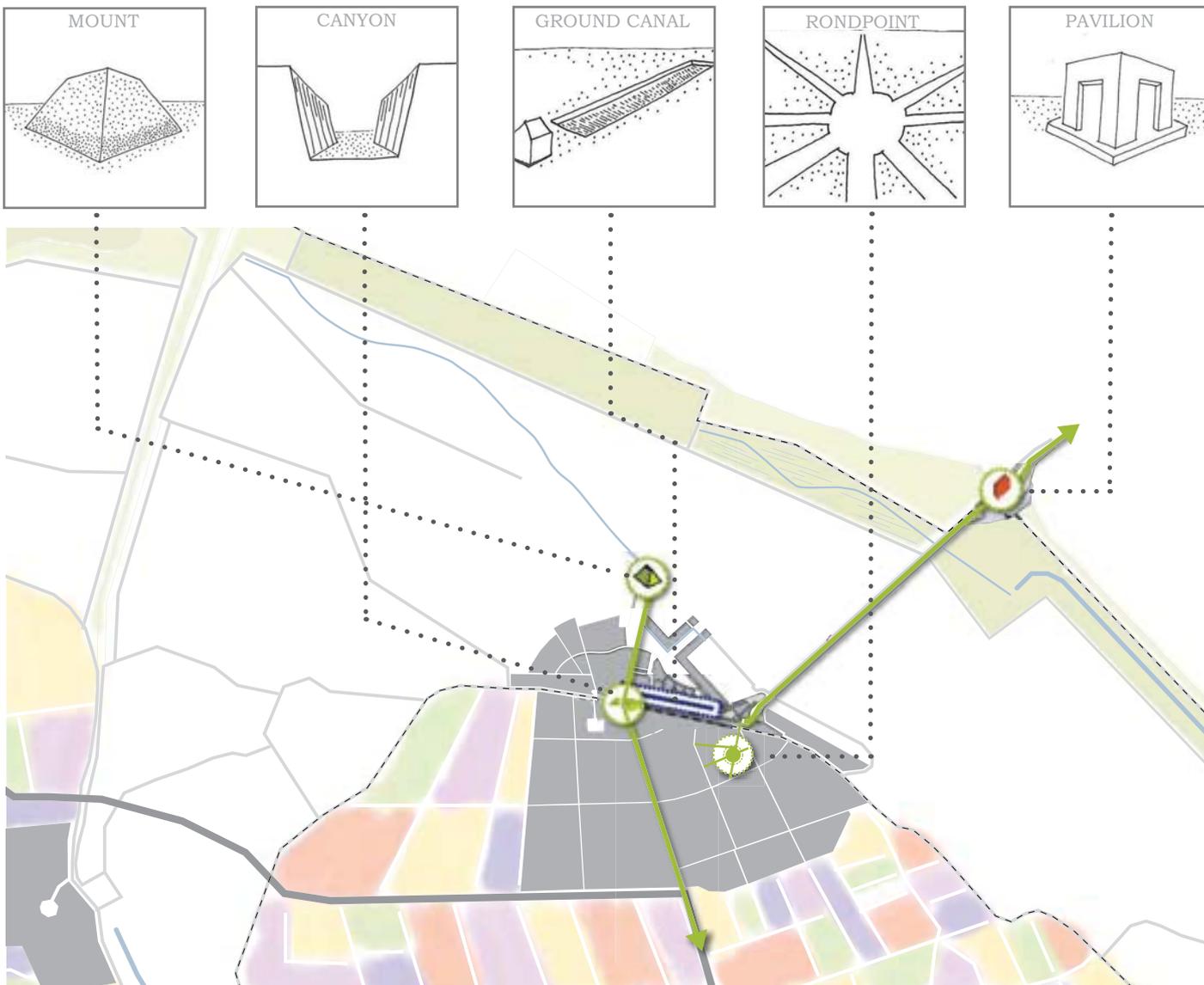


**18.1 - Introduction**

For the design of the recreational landscape of Middelharnis is the experimental composition used. In this composition is looked at landscape architectonic elements which are all ready on the side and how they organize the landscape. A landscape which will be transformed to a more dynamic and recreational landscape. The concept for the design of Goeree Overflakkee consists of a zoned landscape which is defined by the distinction in saline 'aanwaspolders'

and freshwater 'opwaspolders'. Due to the contrast between 'opwaspolder' and 'aanwaspolder' will the relation of Middelharnis to the water change. The transition area between settlement and Haringvliet will be developed to a saline landscape with aquacultures. In this transition can composition of landscape architectonic elements be utilized to strengthen the relation between Middelharnis and Haringvliet and to integrate landscape elements of aquaculture in a saline agricultural landscape.

**FIGURE 4.23 / Basic landscape architectonic elements placed in concept of zoning and connecting**



### 18.2 - Axes & elements

The landscape architectonic elements can be subdivided in the categories: building, ground plan, constructions, plantation and water. There are all ready some axes and transformations of landscape architectonic elements in Middelharnis (van der Zwart, 2004: 42-43). There are two axes which structure the spatial relation between opwaspolder and aanwaspolder. Both axes have in common that they cross the ring dike around the opwaspolder. One axis connects the Haringvliet through a canal with the historic center of the village, with the church as orientation point in the middle of the rondpoint. The other axis connects the aanwaspolder with the opwaspolder with the mount as orientation point in the saline landscape.

- **Mount / figuur 4.24**

The mount is an artificial hill. Due to the height difference, the mount often function as viewpoint (van der Zwart, 2004: 77). In Middelharnis is the mount constructed of residual soil which remained from the new building side. The mount function as viewpoint and orientation point.

- **Canyon / figuur 4.25**

Deep and steep incision in terrain as dramatisation of the difference in height. The canyon often is part of a route and forms both a barrier as a passage (van der Zwart, 2004: 81). In Middelharnis is the breakthrough of the dike dramatized. This breakthrough was needed to connect the new residential area with the rest of the village.

**FIGURE 4.24 / Mount, ground plane**



**FIGURE 4.25 / Canyon, ground plane**



- **Grand canal / figuur 4.26**

The grand canal is a rectangular canal with landscape size, without transport function. The grand canal is a quite large element which can function as structuring element sightline (van der Zwart, 2004:154). In Middelharnis is the grand canal a structuring element of the new residential area. It also function as connection between the two crossing axis over the dike.

- **Rondpoint / figuur 4.27**

Rondpoint forms the center of several crossing lanes (van der Zwart, 2004:82). In Middelharnis is the historical center of the village, the church, point of orientation, located at the crossing of several lanes. One of the lanes crosses the dike and connects to the harbor canal, which connect the center with the water.

- **Pavilion / figuur 4.28**

Pavilion is a small building which is part of a larger entity. The pavilion marks a place in the landscape and offers the opportunity experience the landscape from within (van der Zwart, 2004: 100). The pavilion is located at the end of the canal, near a small beach at the edge of the Haringvliet. The pavilion forms a destination for cyclists and pedestrians during summer for inhabitants of surrounding villages.

**FIGURE 4.26 / Grand canal, water**



**FIGURE 4.27 / Rondpoint, ground plane**



**FIGURE 4.28 / Pavilion, construction**

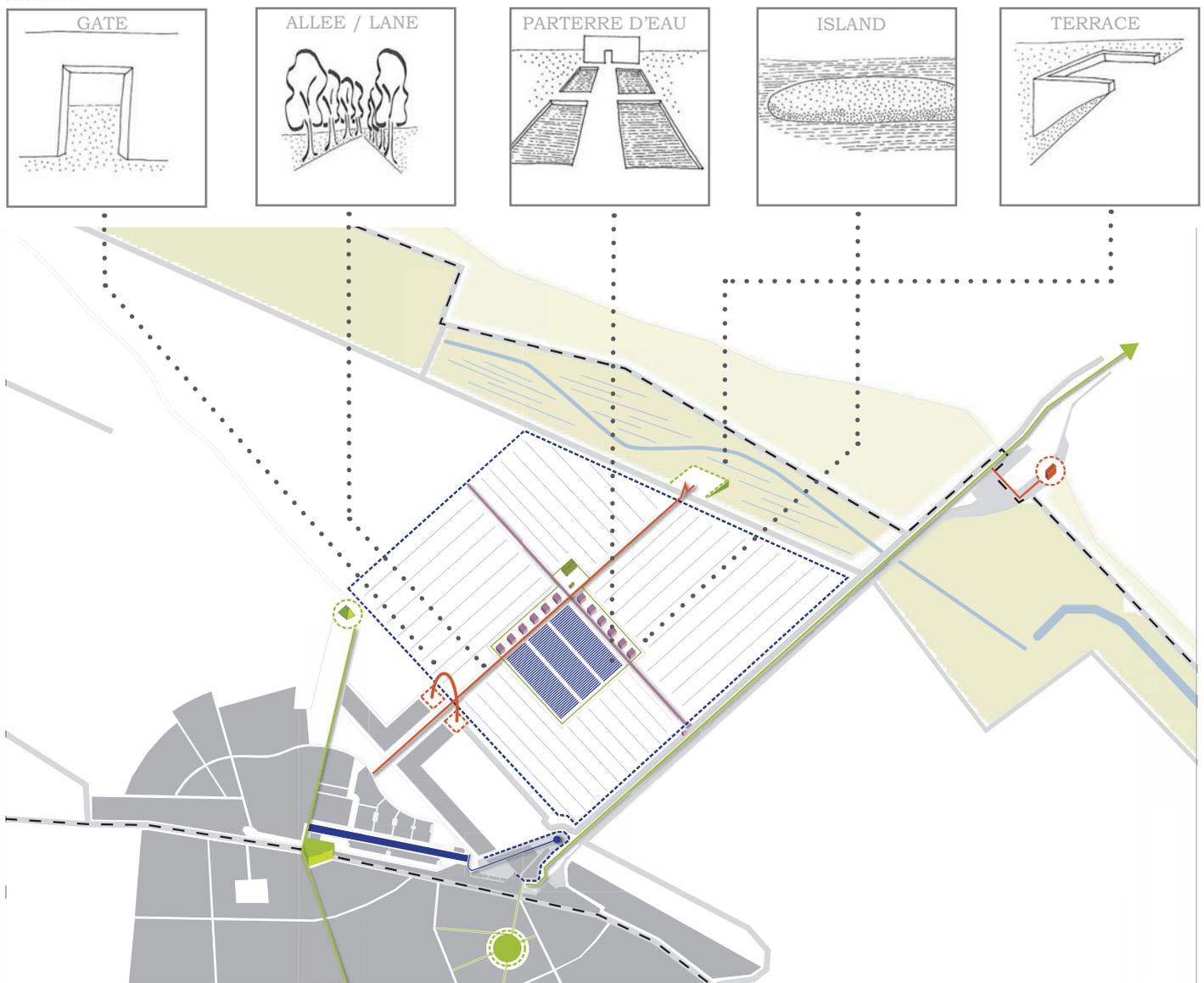


**18.3 - Experimental Composition 'island'**

In the experimental composition in figure 4.22 are the elements for aquaculture clustered within the center the sheds, farmhouse and cultivation ponds. These are surrounded by the wetlands for saline crops. In this composition is one axis which connects village, agricultural cluster and wetlands along the Haringvliet. In this composition are added the following landscape architectonic elements: Gate, allee, parterre d'eau, island and terrace.

- **Gate**  
 This element forms a passage through the enclosure of an area. The gate marks the boundary between inside and outside. A gate can be closable or not, depending on what kind of boundary it marks. (van der Zwart, 2004: 101). In this composition is the gate positioned on the transition between village and polder landscape.
- **Allee**  
 This element is a guided road or path by trees or hedges. The allee is a

**FIGURE 4.29 / Experimental composition 'island'**



connecting element, which define a sort of inside/outside effect (van der Zwart, 2004: 116). In this composition it connects village, through the saline agricultural landscape to the wetlands. The saline landscape can be a obstacle with regard of possible vegetation

- **Parterre D'eau**

This element is a formal ground pattern of several mirror ponds. Thy emphasize the horizontality of the ground. Most of the time is looked on them from a higher point (van der Zwart, 2004: 157). In this composition are they transformed into cultivation ponds. Due to the soil balance becomes the surface of the ponds lifted above ground level and forms a artificial dwelling hill in the surrounding wetlands for saline

crops. On the other hand is looked down on them from buildings, the mound and the surrounding dikes.

- **Island**

The island is land which is enclosed by water (van der Zwart, 2004: 151). The island in the composition is formed by the cluster of sheds, farmhouse and cultivation ponds.

- **Terrace**

This element is an horizontal plateau on the slope, constructed for a seat and viewpoint. Connects the building or route with the view. Due to its horizontality does it emphasize the morphology of the terrain. (van der Zwart, 2004: 83). In this composition forms the terrace the endpoint of the axis which connects the village with the wetlands (figure 4.30).

**FIGURE 4.30 / Outerdike Wetlands on transition land water**

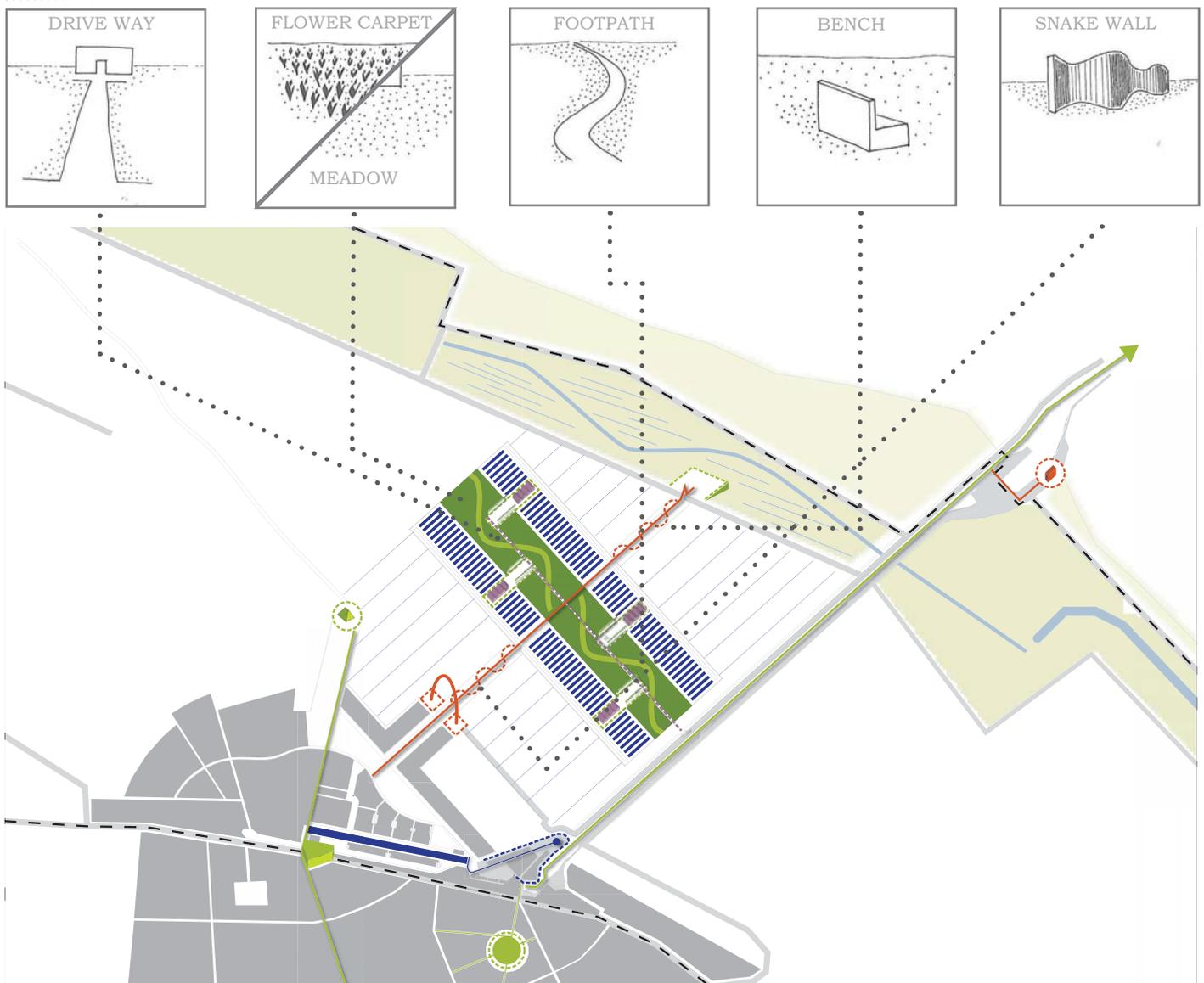


**18.4 – Experimental composition ‘crossing axes’**

This experiment is composed around two axes. One connects the village with the wetlands. The other axis connects the saline estates with a historic building along the marine canal (figure 4.32). The saline estates and cultivation ponds are now clustered around one common drive way. In this experimental composition are the following landscape architectural elements added: Drive way, meadow, footpath, bench and snake wall.

- **Drive way**  
This element forms the most important access to the estates. This main access is composed by the sequence of impressions in order to introduce the different parts of the context (van der Zwart, 2004: 78). In the composition connects the drive way the different estates through the meadow.
- **Meadow / Flower carpet**  
This element is a coverage of the soil. In case of the flower carpet is it a

**FIGURE 4.31 / Experimental composition ‘crossing axes’**



decorative and artificial coverage. The meadow is more a natural coverage by grasslands on which cattle can graze. The meadow is often used as transition between garden and landscape. (van der Zwart, 2004: 118, 132). In the composition is the meadow kind of a buffer between the different saline estates. The meadow still function as a transition between garden and landscape.

- **Footpath**

This element is a small path, which is actually a materialized stray from the main route. The path also is a tool of staging the landscape (van der Zwart, 2004: 85). The footpath is a important element in this composition because it forms the axis which connects village and wetlands, but also meander along the drive way through the meadow.

- **Snake wall**

This element is a longitudinally meandering wall. This meandering wall faces to the south in order to create micro climates. This wall is a visual strong element (van der Zwart, 2004: 105). In the composition is this snake wall applied to create sheltered places with benches along the axis.

- **Bench**

This element marks a special place in the landscape, from which the visitor have a specific view (van der Zwart, 2004: 90). In the composition is this snake wall applied to create sheltered places with benches along the axis.

**FIGURE 4.32 / Silo apartments along marine canal**



source: <http://www.estateinvest.nl/in-ontwikkeling/75>

**18.5 – Experimental composition  
‘structuring parterre d’eau’**

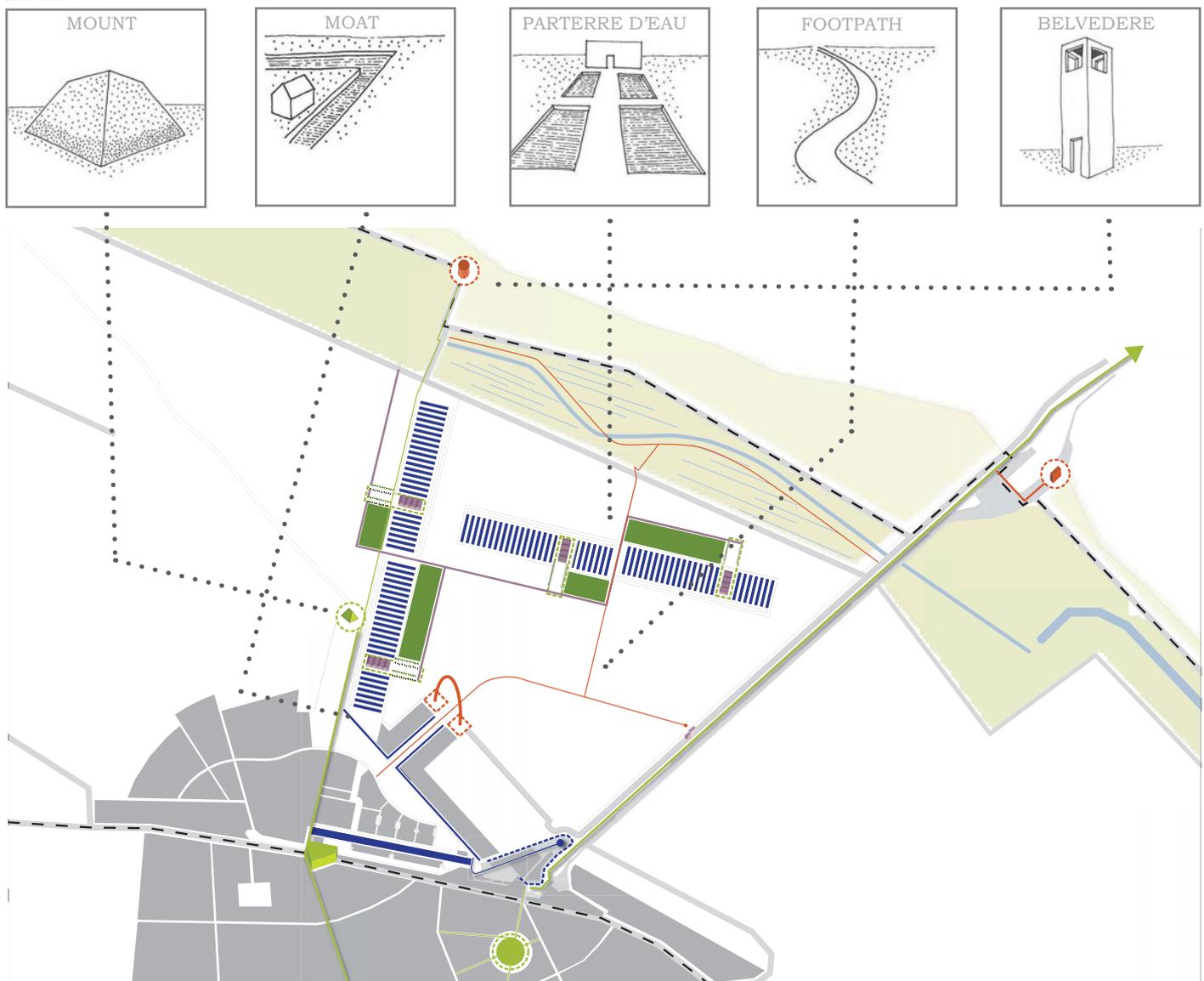
This experiment differs from the other two experimental compositions, because the elements of the saline aquaculture are now not composed in one cluster, but as axes. Due to this different composition become the cultivation ponds the connecting element between village and wetlands along the Haringvliet. This is interesting because now a second axis between village and wetlands along the Haringvliet are water elements. The new axis is

also a continuation of the axis that connects the saline ‘aanwaspolder’ with the ‘opwaspolder’, which is marked by the mound and the canyon. The gate which originally marks the axis of the connection between village and wetlands is now just an entrance to the village at the edge of the wetlands for saline crops.

• **Mount**

The mount is an artificial hill. Due to the height difference, the mount often function as viewpoint (van der

**FIGURE 4.33 / Experimental composition ‘structuring parterre d’eau’**



Zwart, 2004: 77). In Middelharnis is the mount constructed of residual soil which remained from the new building side. The mount function as viewpoint but also as orientation point and is located on the axis which connects 'opwaspolder' and 'aanwaspolder'. In this composition does the mount no longer marks the endpoint of the axis, but does it mark the crossing of the creek, axis through the 'opwaspolder' and also the axis of aquaculture to the wetlands.

- **Moat**

This element is a dug watershed. This element function as barrier but also as technical element for the water management (van der Zwart, 2004: 153). In this composition is it only used to form a barrier. It also makes that the extension of the neighbourhood is located on islands in the constructed marina's, one with recreational boats and the other one with houseboats. Living on the water.

- **Parterre D'eau**

In this composition is the parterre d'eau not just some mirror ponds in front of a building, but do they form a axis of mirror ponds in front of the edge of the village and connects to the wetlands.

- **Footpath**

This element is a small path, which is actually a materialized stray form the main route. The path also is a tool of staging the landscape (van der Zwart, 2004: 85). In contrast to the previous experiment is this footpath function in the connection between village and Haringvliet by meandering through the wetlands for saline crops. The footpath connects the gate to the village, with the historic silo building

and also the recreational route along the wetlands on the edge of Goeree Overflakkee.

- **Belvédère**

This element is a location which offers a beautiful view at all sides. This element with a strong present on a dramatic position in the landscape. Mostly an endpoint of route or axis (van der Zwart, 2004: 91). In the composition is the belvedere located at the end of the axis with the cultivation ponds. It could be an observation cabin for bird watching in the outer dike wetlands.

### 18.6 - Conclusion

From these three experimental compositions is the composition 'structuring parterre d'eau' the most convincing. One of the reasons is the connecting and structuring function of the water elements for aquaculture in this composition. This in contrast with the other two compositions in which the elements for aquaculture are clustered and were located in between village and wetlands. In these compositions were the structuring elements routes and sightlines. Due to their connecting and structuring function in the composition become the water elements for aquaculture much more embedded in the landscape. This composition, structuring parterre d'eau, will be the basis for my design. This composition fits in the strategy of a saline landscape in which nature, agriculture and recreation is developed next to each other. Development of these aspects next to each other is possible because of the zoned landscape in which the saline landscape forms the transition between village and delta water. Because it is still an agricultural production landscape will it stay a geometrically designed landscape.

FIGURE 4.34 / Composition & design of zoned landscape

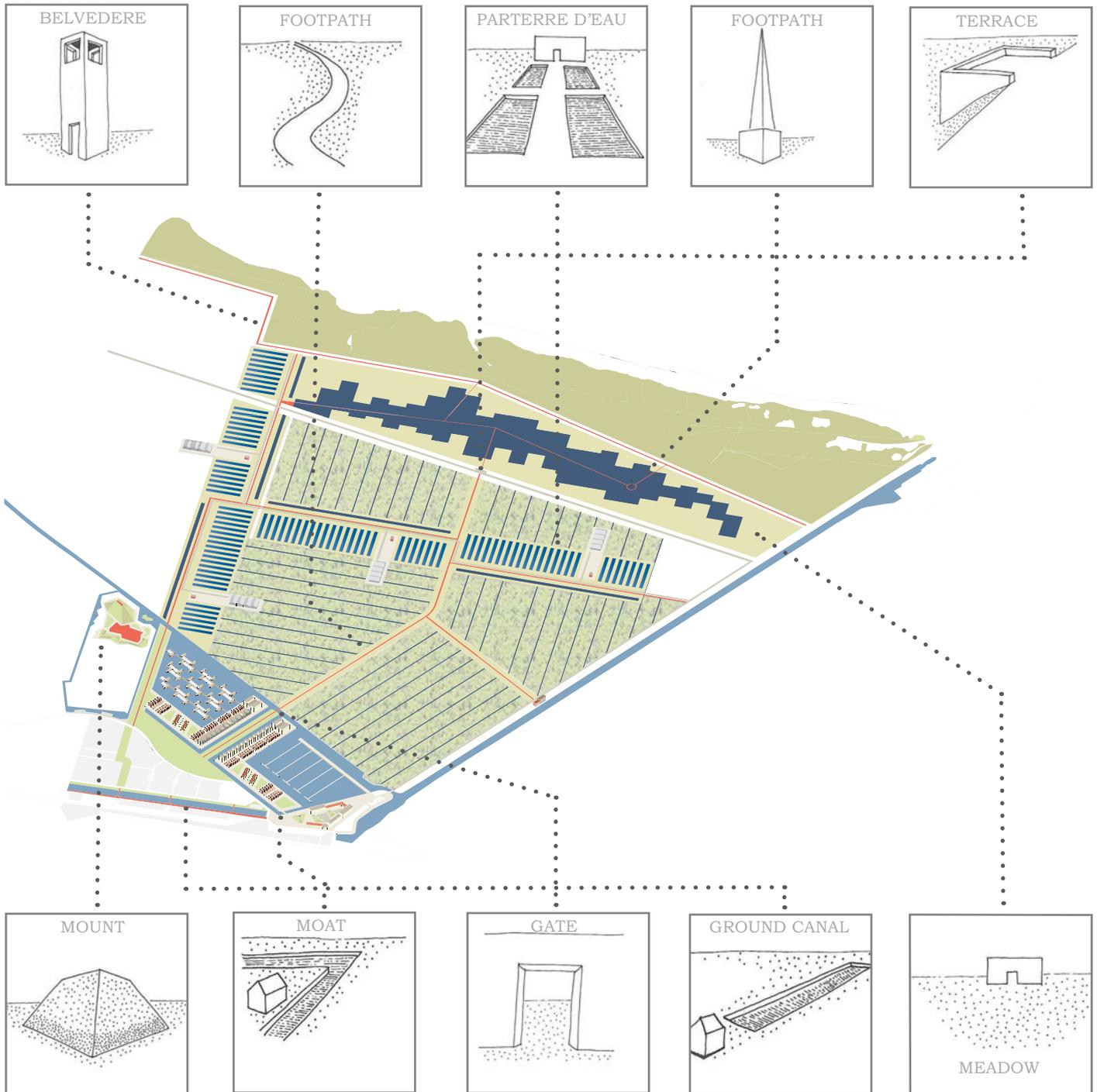


FIGURE 4.35 / Agricultural wetland with zeekraal



source: <https://publicwiki.deltares.nl/display/KWI/5.2.1.3.+Zilte+landbouw+in+Zeeland>

**19.1 - Transition opwaspolder and aanwaspolder**

This transition is not only the transition between the freshwater opwaspolder and the saline aanwaspolder, but also the transition between build environment and agricultural landscape. From the design experiment become clear that there are not that much connections between these two zones. In order to strengten te spatial quality of this transition area are in between zones constructed, in which routes are created which form a link between the two main axes which connects 'opwaspolder' and 'aanwaspolder'. (figure 4.36)

**19.2 - Saline estate**

The saline estate consists of cultivation ponds and wetlands for saline crops. Because of the need for soil balance are the ponds constructed as elevated grounds. Over the saline estates are walking trails surrounded by meadows. One of the walking paths over the saline estates, in between the saline wetlands, is accentuated by the gate (building) and the obelisk. (figure 4.37)

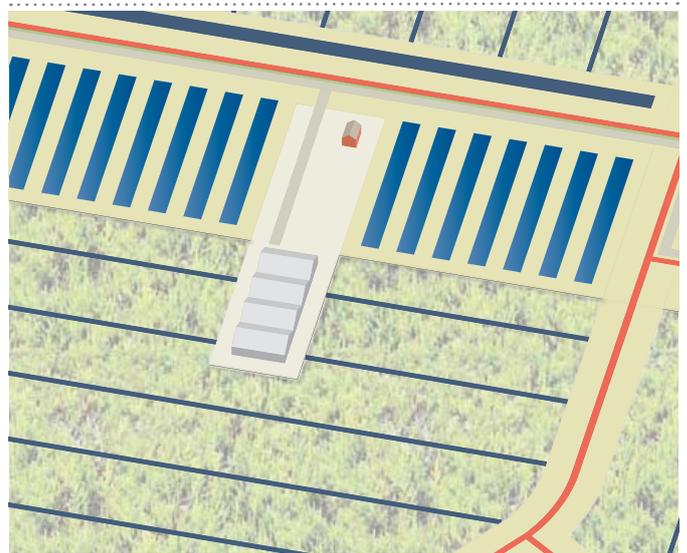
**19.3 - Transition land and water**

The transition between land and water is in the current situation a dike with wetlands in the outerdike area. In the transformed transition are in the inner dike area also wetlands constructed. These wetlands forms a seepage lake which supply saline water for the aquaculture. At the same time forms this wetland in combination with the planking, obelisk and observation cabin a link in the saline/fresh chain along the edge of Goeree Overflakkee. (figure 4.38)

**FIGURE 4.36 / Vingerling & marina**



**FIGURE 4.37 / Saline estate with aquaculture**



**FIGURE 4.38 / Constructed wetlands**



FIGURE 4.39 / Vlietheuvel in the current agricultural landscape along old creek



FIGURE 4.40 / Section of edge settlement with marina in relation to Vlietheuvel and creek

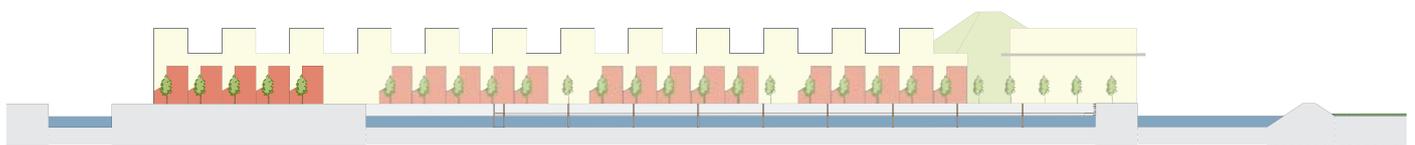
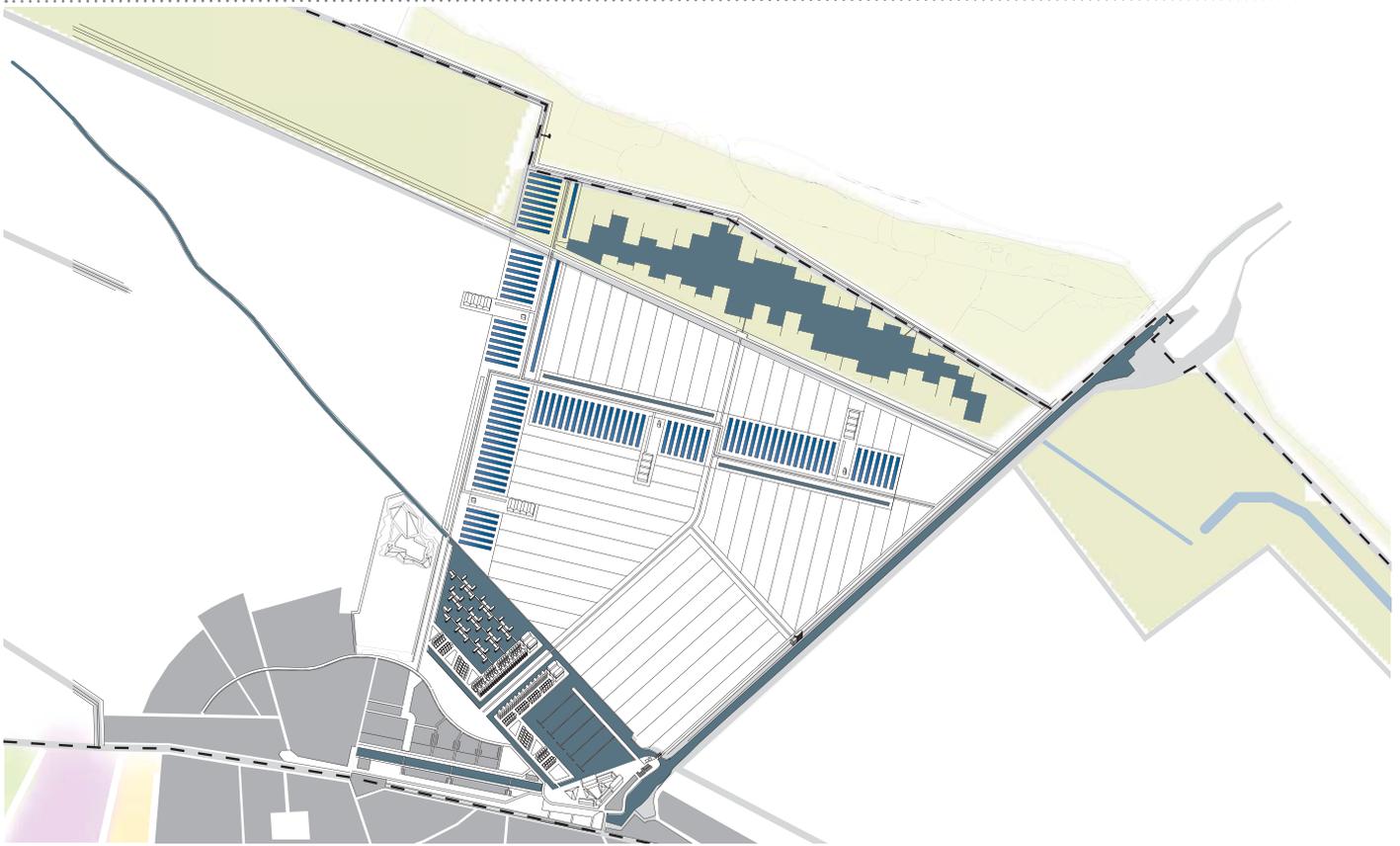


FIGURE 4.41 / Hiking trails through connecting landscape and sightline highlighted by obelisk



FIGURE 4.42 / Water as structuring element in connecting landscape between settlement and delta



cultivations agricultural fields



QUINOA

asperges

GERST

SPELT

SUIKERBIET

cultivations ponds



SCHAALDIEREN



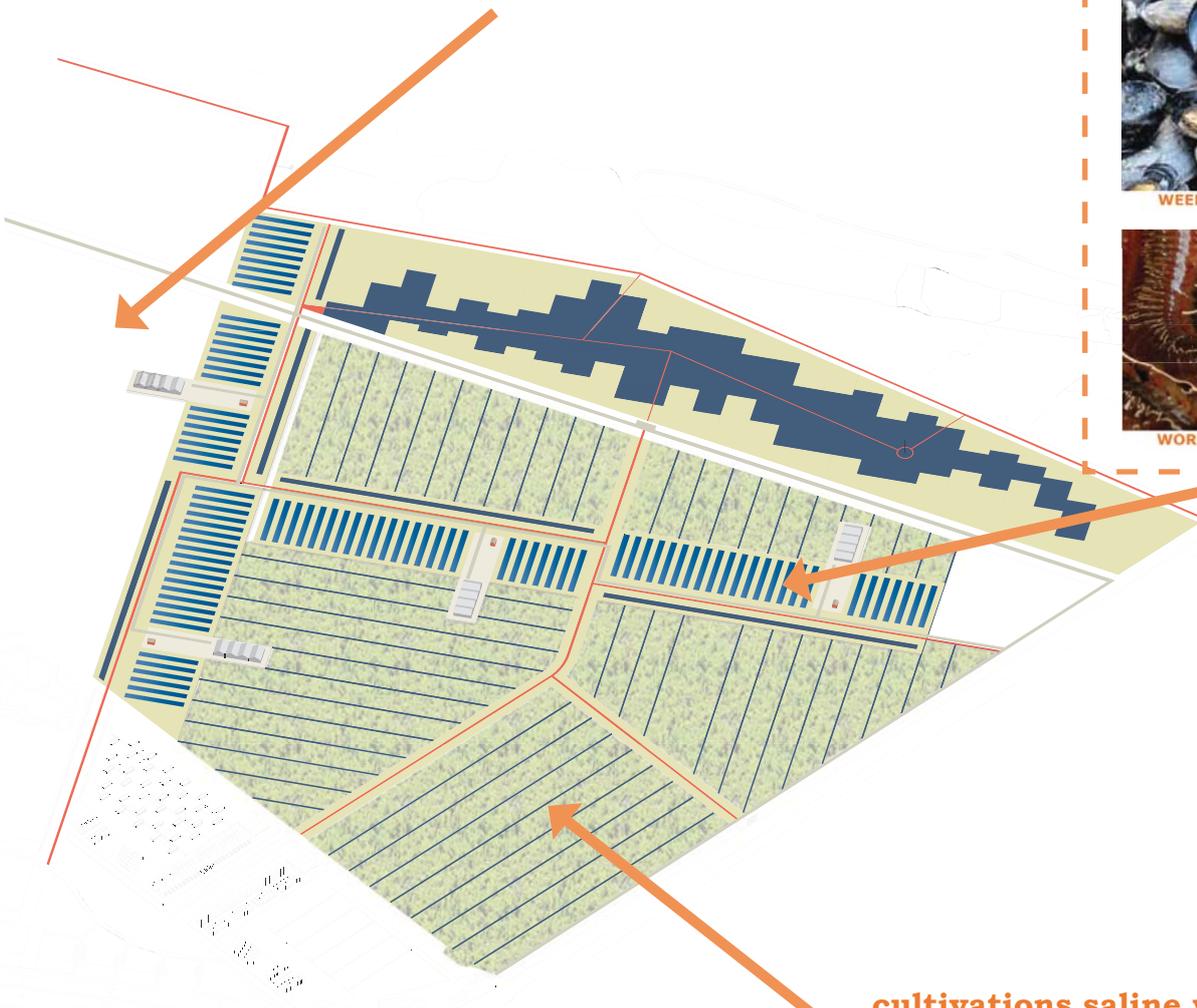
VISSEN



WEEKDIEREN



WORMEN



cultivations saline wetlands



ZEEKRAAL

ZEEASTER

ZEEKOOL

SCHORREKRUID

ZEEWIER

In the Southwest Delta are the main assignments flood defence, freshwater supply, ecology and fragmentation of the urban delta. This fragmentation occurred because urban regions developed on the edge of the estuarine landscape of Rhine, Meuse and Scheldt. The characterless in between landscapes are disturbing the relation between urban regions and delta landscape. Due to climate change are interventions for flood defence and the freshwater supply necessary. However, these interventions can also be utilized for the assignment of an ecologic restored delta and improved relation between urban regions and delta landscape. In the transition between the urban region Rijnmond and delta landscape are these assignments most related to each other. Research and design on this transition is the answer on the research question:

**How can interventions for an ecologic restored and climate proof delta contribute to a dynamic connecting landscape between urban region's and the delta landscape, but also to an enhanced spatial quality of the transition between settlement and water?**

The main themes are climate change and current spatial structures and how they can contribute to a connecting landscape. Awareness of the spatial structures in the Southwest Delta is important in adaptation to new economies and ecologies without loss of identity. These spatial structures are defined by economic and ecologic networks which needs to be able to adapt to changing environments. These networks become better integrated if meaningful and vibrant public spaces are connected to them. There are

three important economic networks on the scale of the Southwest Delta. One consists of urban regions linked by railways and highways. The other one is the shipping route between the ports of Antwerp situated in the basin of the river Scheldt and Rotterdam situated in the basin of the rivers Rhine and Meuse. The last one consists of a parallel infrastructure of roads across the Deltaworks which makes the delta accessible for recreation.

The ecologic networks of the delta consists of the main water system and the regional water systems. The main water system forms a structuring element on scale of the Southwest Delta. Adaptation to climate change is utilized for restoring ecology and contributing to a connecting landscape between urban regions and delta landscape. The ecology can be restored by reconnecting the water basins, return of tides by reconnecting with the North Sea and river discharge through the delta. Restored dynamics of the delta contribute to an improved spatial quality of the transition between land and water. The dike which forms the current border between land and water is transformed into transition area which integrate nature, recreation and flood defence. Besides that discharge of the river through the delta contributes to a restored ecology, it also contributes to the safety of the urban region of Rijnmond in case of peaks in river discharges.

The manner in which the urban region Rijnmond is temporary closable for peak discharges affects the potential of the connecting landscape of Voorne-Putten. Hellevoetsluis occupies a strategic position in the connecting landscape between urban region

Rijnmond and delta landscape. In the past was Hellevoetsluis strategically located and part of a water defence line of which the fortress still is a remnant. Thereafter was Hellevoetsluis situated on networks which connected the city Rotterdam with the delta. The Canal of Voorne used to be the access to the ports of Rotterdam. Thereafter connected a network of steam trams and ferries the islands in the delta with Rotterdam. In the current situation has Hellevoetsluis lost its strategic position. In the connecting landscape are networks enhanced, accessible and restored for recreational purposes to make Hellevoetsluis a strategic node for recreation in the connecting landscape between urban region and delta landscape.

As result of the restored dynamics and ecology in the Southwest Delta is there a reduced availability of freshwater in the main water system. The demand for freshwater from the regional water systems needs to be adjusted to the availability of freshwater from the main water system. Therefore are two strategies which consists of resisting salinisation and allowing salinisation. Because of the contrast between saline and non saline zones arises a dynamic landscape. Water forms the spatial carrier and structuring element in the saline landscape which integrate agriculture, nature and recreation. The concept of a zoned landscape fits well in the spatial structure of Goeree Overflakkee with its ring-street-villages which lost their relation with the water, which only consists because of a harbour canal due to further land reclamation. Additional landscape architectonic elements enhance the spatial composition of the saline landscape, which is structured by the

elements of saline aquaculture. These elements are axes of cultivation ponds and constructed wetlands.

Adaptive ecologic and economic networks are the structuring elements in the connecting landscape. On the scale of Goeree Overflakkee forms water the structuring element in the zoned landscape in between settlement and main water system. Underlying ecologic and climate-related changes are the result of internal salinisation and reduced availability of freshwater from the main water system. On the scale of the Southwest Delta is the transition between urban region and delta landscape structured by networks. The potention of the connecting landscape of Voorne Putten is influenced by the chosen interventions for an ecologic restored and climate proof delta.

The recommendations for further research are related to the main water system and the regional water system. This research concerns the impact of changes and interventions in these systems, but also the functioning of the system in itself. Also is the redevelopment of the canal of Voorne subject for further research on the transformation from barrier to connecting element between the two parts on either side of the canal. Finally, connecting of the Haringvliet with the Grevelingen will divide the island Goeree Overflakkee in two islands. Changes in the Southwest Delta will determine in what way ecology and discharge in this waterconnection will be developed.

### 21.1 - Main water system

The main water system consists of river landscape, Southwest Delta and the IJsselmeer. The rivers divide the available freshwater over the Southwest Delta and the IJsselmeer. For ecologic recovery of the Southwest Delta and the IJsselmeer is return of tides by reconnecting with the North Sea and river discharge through the delta necessary. A restored ecology has a major impact on the freshwater supply and flood defence. The deltavariants 'branched discharge' and 'extended discharge' are a possible starting point for the concept of the connecting landscape in the Southwest Delta. These deltavariants determine how the Southwest Delta is related to the rest of the main water system and how the freshwater from the rivers should be distributed over the Southwest Delta and the IJsselmeer. These variants also determine the way in which the river discharge is directed through the delta, which affects the way of closable open Rijnmond.

In case of the deltavariant 'branched discharge' are climate dikes needed along the discharge branches Haringvliet, Volkerak and Oosterschelde. This delta variant is best compatible with a closable open Rijnmond in which the Meuse function as a controlled freshwater system with sealocks in the Nieuwe Waterweg to prevent inland salinisation. This will have a major impact on the shipping routes between Rotterdam and Antwerp, but also for shipping routes to the hinterland. However, it also means that Voorne-Putten and the Hoeksche Waard can develop to a more urban recreational landscape because of the high safety level. This will strengthen the position of Hellevoetsluis as gateway between urban region and delta landscape.

In case of the deltavariant 'extended discharge' are the water basins Haringvliet, Grevelingen and Oosterschelde reconnected. Therefore is a connection between Haringvliet and Grevelingen across the island Goeree Overflakkee needed. Due to the extended discharge contains the Haringvliet its function as freshwater supply, which makes it less necessary to construct sealocks in the Nieuwe Waterweg. This variant is adjusted to temporary storage in case of peak discharges which can not directly be discharged on the North Sea. The moveable barriers for a closable open Rijnmond are positioned on the underside of IJsselmonde and can be closed in case of peak discharges. This means that Voorne-Putten and Hoeksche Waard can improve their relation to the main water system with its restored ecology and dynamics. Because of this improved relation to the delta landscape can Voorne-Putten

and Hoeksche Waard be developed in a dynamic landscape in which urban structures and delta landscape overlap and contrast with each other.

### 21.2 - Regional water systems

In the regional water systems is internal salinisation the motivation for interventions. These interventions also contribute to the concept of the connecting landscape, but on a different scale. My answer to this assignment for the regional water system is the zoned landscape, which is divided in zones in which salinisation is allowed and zones in which salinisation is not allowed. In the saline zones forms water the structuring element by means of axes of cultivations ponds and constructed wetlands. In the non saline zones is the current water system transformed in a water system with divided supply of freshwater and discharge of saline water. Both, saline aquaculture on land and a divided water system needs further research on application and integration in relation to its environment.

### 21.3 - Hellevoetsluis

Hellevoetsluis is a fortress town on the edge of the Haringvliet. Within the concept of the connecting landscape forms Hellevoetsluis the gate between urban region and delta landscape by improved and restored networks for recreation. Besides strengthening its position in the connecting landscape are their also assignments for spatial development within Hellevoetsluis itself. In the current situation forms the canal of Voorne a barrier through the city. There is no relation between the shopping mall in the center and the waterfront with the veerhaven and fortifications. The canal of Voorne is not navigable for recreational boating

because of the shopping mall and infrastructure across the canal. The assignment for further research is redevelopment of the canal and the shopping mall into an area which forms a spatial relation between the two parts of the city, connects the center with the waterfront and is accessible for recreational boating.

### 21.4 - Goeree and Overflakkee

Because of the changes in the Southwest Delta to adapt to a ecologic restored and climateproof delta will the island of Goeree Overflakkee be divided in two islands Goeree and Overflakkee. In relation to one of the deltavariants which will be chooses and developed will the use and dimensioning of the passage differ. In case of the 'extended discharge' will the demensining of the passage be determined by discharge volumes. In case of the 'branched discharge' is the passage accesible for recreational boating and does it function as a tidal landscape which can be developed for aquaculture.

The research and design done in this graduation project requires an interdisciplinary approach for a better understanding of the impact that strategic interventions on the larger scale have on the spatial composition on the smallest scale. Therefore are interrelationship between various types of networks at different scale levels and a understanding of space-time condition of the landscape of interest to urban deltas.

### 22.1 - Research and Design

In the graduation studio Delta Interventions were a lot of strategies and developments brought to the attention. Thereby starts the research on climate change and the impact on the Southwest Delta at a general level. This makes it later in the proces more difficult to define precice the subject of the graduation project. An other aspect of the research is the theory paper, which should contribute to the knowledge for the design. Because this theory paper has to be submitted before you actually starts with the design, turned out that the paper could have been more specific and better related to the subject of the graduation project. Afther the subject for the graduation project wad specific defined, became further research into the water system much more integrated in the process of design. Research and design were both about strategic interventions and their impact on spatial composition on the smaller scale, but also interconnecting of various networks on different scales.

### 22.2 - Theme of the graduation studio

The graduation studio Delta Interventions is focussed on flood defence and climate change of the urban delta and the opportunities which

arise from interventions for a climate proof delta. However my graduation project also focus on the Southwest Delta and the impact of climate change are there other interests as well. These interests are a restored ecology and the transition between urban regions and delta landscape. Because the interest have shifted from only urban region to the relation between urban region and delta landscape became the connection between them more important. Instead of looking at the impact of climate change on the waterfronts in the urban delta, became water a structuring element in the transition between urban region and delta landscape. Water and landscape became networks which could be interconnected with all types of networks on different scales.

### 22.3 - Methodical line of approach

From the methodical line of approach in the graduation studio was the historical analyses the most direct applied method which was supplied by the graduation studio. The method of historical analyses is developed in order to get a better understanding of the urban delta. Due to the historical analyses became cleare which interventions had impact on which scale. Interventions on networks at the scale of the Southwest Delta would influence the economic development of an area. Interventions on the landscape at the scale of the islands influence the relation between settlement and the delta. Interventions on the spatial composition at the scale of the settlement influence the identity and spatial quality of the environment. These insights helped to organize further research and design Besides historical analyses are case studies and design experiments applied to contribute to the research and design.

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# Contemporary Metropolitan Delta Regions

## Landscape Urbanism as contemplating and structuring discipline

Dennis C. Flikweert

1302744 / dennisflikweert@hotmail.com

Delft University of Technology, Department of Urbanism  
8th Graduation Lab Urbanism Conference

**Abstract** – Landscape Urbanism, arises from critics on post-modernism, is the answer on corresponding global issues of the contemporary agglomeration (Waldheim, 2006). First of all is the relation between the city and the landscape disturbed. This is visible in large characterless areas in between the city and the landscape, which are characteristic for the agglomeration (Tummers and Tummers-Zuurmond, 1997). Second are the agglomerations mainly located in delta regions, because of their beneficial economic, cultural and recreational possibilities. However those regions are vulnerable because of their complex ecology and the impact of changing climate (Meyere, Bobbink and Nijhuis, 2010). Finally the contemporary agglomeration lacks identity as result of the monotonous culture which is the result of technology and capitalism. This lack of identity is strengthened because of the growing industry of tourism and recreation, which is why cities want to present themselves even more. Due to transformation of architectonic objects and fragments of the urban fabric into cultural products, cities and their identity is less distinguishable from each other (Shannon, 2006). Landscape Urbanism could arise because the existing disciplines are not able to come up with a solution for the disturbed balance between the city and the landscape in the contemporary metropolitan region. The critics on post-modernism exist off three aspects from which the inability of the current disciplines shows. First the inability to create meaningful and lively public space. Second the inability to consider the city as historical construction of the collective memory. Final the inability to create public space which interact with multiple publics (Waldheim, 2006). In the discipline of Landscape Urbanism is landscape the contemplative and structuring element. In suburbia and the urban utopia of the 20th century was the landscape also a basic element. The French theorist Marot says that methods and typologies from them can serve as a starting point for this new discipline (Shannon, 2006). However is the context of the contemporary metropolitan region one of a different scale and is the relation between the city and the landscape blurred.

**Key words** – Metropolitan delta regions; landscape urbanism; collective memory; public space

### 1 Introduction

‘Urban deltas represent an extreme variation of a general phenomena in the urbanized world, the combination of an urban system with a natural system. Both systems influence each other but have also their own dynamics. Urban deltas are an extreme variation of this combination because of the complexity of the urban system as well as of the natural system’ (Meyer and Nijhuis, 2011: 1) Practice of design and planning in the contemporary metropolitan delta region is very complex. This complexity is reflected in the relation between urban and rural, in structuring the urban expansion. A balance

which is all ready been disturbed with as result characterless transition zones. In order to intervene in the urban patterns of the agglomeration, understanding of this balance and ways in which they have been structured are necessary.

The combination of complex urban and natural systems strength the idea of importance of this balance between urban and landscape. Are the traditional disciplines of design and planning still able to structure the urban patterns of the agglomeration in this dynamic territory with its changing economy and ecology. How to prevent loss of identity as result of adaptation to these

economic and ecologic changes? The answer to this question, is the debate on a new discipline named landscape urbanism. A discipline which is, according to Marot (2003), a subversion in urbanism, with an approach from site to programme, focussing on the artificial landscape.

In order to make this new discipline more concrete, attitudes for an approach of landscape urbanism are described, to be able to use landscape as efficient instrument in structuring the urban patterns of the agglomeration. From this abstract level of balance between urban and rural, more important are the tools to create meaningful and vibrant public spaces, embedded in robust and flexible networks, to prevent characterless transition zones.

## 2 Disturbed balance

The disturbed balance between city and landscape can be found in distance, contrast and identity (Tummers and Tummers-Zuurmond, 1997: 7-40). Holding on to the model of the compact city, further urban expansion will result in unacceptable distance between urban and rural. In the districts in between is an area created with lack of identity and contrast. The disturbed balance could be restored by a diminished distance and strengthened contrast between them. Distance can be diminished by integrating the landscape in the structure of urban fabric. By the inclusion of the landscape in the spatial urbanisation patterns, which are difficult to define, could the blurred contrast be enhanced. The inversion of the relation between urban and rural becomes visible in the contrast between compact city and the surrounding landscape, which seems to return at the borders of the internal landscape. This kind of urbanism, in which contrast between country and town has a structuring role is called agglomerative urbanism.

## 3 Disposition of the city

Inversion plays an important role in composition systems within architecture and urbanism. Perception of the properties of spatial structures and the use of composition elements within urbanism are needed to establish a conscious reversal.

Spatial reversal within growth processes of large urban agglomerations show a limited malleability (Tummers and Tummers-Zuurmond, 1997: 97-117). The growth stages of urban agglomerations show on the map complex transitional forms of urban and rural in a discontinuous pattern. The compact city is enclosed by urban agglomerations with all kind of open spaces. The border of this urban agglomeration consists of a transition zone in which urban patterns expand into the surrounding landscape. In the rural area surrounding the agglomeration are the villages again recognizable settlements in a continues open landscape. Within these transitions there are various arrangements and compositions of urban and landscape elements. The composition and arrangement of these elements is called the disposition of the city in which the compact city is based on central disposition. However in the urban agglomeration and its complex transitions between town and country, is the peripheral disposition of major importance.

## 4 Concept of peripheral disposition

An important contribution to the professional knowledge, according to properties of the urban structures in agglomerative urbanism, is the oeuvre of architect-planners Martin, Van der Laan and De Bruyn. Central themes which come forward in their research of new typologies are: series and systems, forms and counter forms, central and peripheral disposition. Both Marin and De Bruyn are concerned with the role of open spaces in regional structures and the peripheral disposition on the regional scale (Tummers and Tummers-Zuurmond, 1997: 69-94). De Bruyn describes a series based on evolving forms of society and its corresponding urban structures. The contemporary global polis is extremely complex and consists of various polis structures. Structures which are determined by the contrast of form and counter form, the contrast between mass and open space. De Bruyns vision on the role of urban design is one of adjusting the urban structure to the changing society. The functioning of the older urban structure will disappear completely, but remain present as memory in the processes of transformation. De Bruyn translated his analyses of series

and contrast into a concept of peripheral disposition. This concept concerns a typology which consists of three elements: ground, perimeter development and special buildings in the open interior space.

### 5 Inversion in town planning

When open space in the urban fabric accommodates special elements in its perimeter zone, it creates multiple use. This interaction of elements and space on the scale of the urban agglomeration corresponds to the concept of peripheral disposition of De Bruyn. The process of spontaneous inversion of recognizable urban cores in continuous open landscapes need to be supplemented by consciously capturing of open spaces in the continuous urban agglomeration (Tummers and Tummers-Zuurmond, 1997: 116-124). In the Netherlands is the spatial structure of the ideal urbanization pattern defined by a suburban urbanization pattern, assuming a regional life pattern of its inhabitants. This life pattern is defined by consciously chosen places for living, work, use of facilities and recreation on the scale of the metropolitan area. The experience and the identity of the available open spaces of the agglomeration depends on the choice of central or peripheral disposition. Within peripheral disposition the open space will function as green core in the urban structure. The open space will be maintained in a changing urban structure, but will adapt to new patterns of life and a changing position in the urban structure. The implementation of the concept of peripheral disposition will increase the quality and quantity of the development possibilities of the agglomeration and is applicable for green cores on all scales. The urbanization pattern can be disordered by two opposed movements. On the one hand will shortage of space result in compactness and central disposition. On the other hand an convenient urban expansion will result in too low densities, causing a too weak support for facilities and employment.

### 6 Metropolisation

The term agglomeration refers to large urban complexes and its characteristic and gradually growth of distinct villages and towns into an continuous agglomerative structure.

In the designed agglomeration is this consciously achieved. Increasing demands are made on the pattern of urbanisation to increase the degree of mobility and freedom offered by everyone's living conditions. The existing dispersion of main centres and subcentres requires a supplement on the older networks, which are mainly focussed on main centres to enlarge the mobility and freedom. Besides that there is more attention for historical characteristics, which are part of the identity of urban living. There is as well more appreciation for the value of landscape, which is caused by the scale of the designed agglomeration. By means of park systems are ecology, historical landscape and recreation interwoven into one complex system. Controlling of growing metropolises is possible by spatial models which can have various urban forms (Tummers and Tummers-Zuurmond, 1997: 186-211). Sometimes these urban forms remain stable and sometimes they gradually transform into another. Within the spatial models is a distinction made between mass models and spatial models. The form in mass models consists of the form of the urban settlement. The satellite is the most common mass model. The park system is the most common spatial model, which define first the open spaces that determine the form of the agglomeration. In many metropolitan regions which are developed by the model of the satellite appears to reach an end of the urban expansion. However these metropolitan regions can be transformed into agglomeration based on park systems. Transformation of existing metropolitan regions and creating new ones, is based on the following aspects:

- The ability to spatial articulations of the urban agglomerations, which means that the arrangement of the open space is determined by compositional patterns
- Interaction between open spaces and urban agglomerations, such as providing recreational opportunities and distinctive residential options.
- Spatial landscaping of the ecological infrastructure, taking into account the structure of the subsoil and landscape construction, which result in very specific and territorial concepts

**7 Landscape Urbanism**

Starting point, supervised urban growth of large urban complexes to metropolis, is based on architecture in which site is approached from programme. The site is produced by manipulation, unfolding and representation of programme. The development of the metropolitan area is based on the suburban condition, which asked for an inversion of the architectonic approach. Programme should be approached from site, which means that programme is related to experience and representation of the site. Marot(2003) distinguishes two subversions of urbanism in which one is focussed on development of the metropolis and the other is focussed on the suburban condition of the metropolitan area. He called these subversions successively super-urbanism and sub-urbanism. Sub-urbanism is because of its approach from the site also known as landscape urbanism. Landscape came back on the political agenda because of global attention for ecology, climate change, tourism, city branding and the impact of urban growth in combination with decentralisation. The traditional way to look at the relation between the agglomeration and the landscape is in terms of contradictions, urban concentration and infrastructure. Landscape was used to compensate the negative effects of urban development in the form of city parks, greenways, street planting and gardens (Corner, 2006). Within super-urbanism landscape has been implemented as permanent quality of the urban fabric, with its flexibility in use and programme. However the landscape elements still comply with architectonic conventions like enclose, control and programme.

**8 Distinctiveness from traditional disciplines**

What makes landscape urbanism distinctive from other disciplines? Landscape design is not just drawing down of information on a larger scale, because the impact will be bigger than the actual site (Czerniak, 2006). The reason for this is that landscape design not only concerns physical transformation, but social and cultural impact as well (Weller, 2006). This is, according to Hight (2006), the result of the existence of a longer

and a shorter timescale. The difference in timescales is related to the distinction of structuring function and use, but as well on the relation of urbanism to landscape. Mostafavi (2003) mention that urbanism is based on the construction of the surface and of buildings. Urbanism sees landscape as materialised surface. From the point of view of Landscape architecture, which recognise the changing nature of the land, landscape becomes a variable element of the urban fabric. Together with the understanding of landscape not only as economic value, but as public space as well, urbanism missed the instruments to counter the flattening of culture and identity (Shannon, 2006). Shannon quotes the landscape architect Katy Poole which has written in relation to public infrastructure: ‘Through roughly 150 years of industrialization we have come to believe that the politics of efficiency are beyond question and that standardisation the ultimate expression of democracy is’ Christopher Hight(2006) calls landscape urbanism the promise of innovation, emerged from a crisis in which the traditional disciplines are thought to be incapable of dealing with the contemporary scale of the built environment. Therefore its important to compare the ways in which assignments are approached from each discipline, the ethics defined by Hight(2006: 24), “Architecture traditionally operates through an ethics of stasis, truth, wholeness and timelessness; Urban planning operates via control, determinism and hierarchy and landscape design appears to offer an ethics of the temporal, complexity and soft-control with a commensurable spatial and organizational repertoire”.

**9 Attitudes for an approach of landscape urbanism**

Landscape urbanism, as mentioned before, is a site based design practice, related to infrastructure, ecology, dedensification and sprawl. More and more the task of this practice is in post-industrial, post-agricultural and vague transition areas. This distinction of artificial landscapes gives voice to the role of landscape as efficient instrument. An distinction which also requested to recovering of the landscape through the imposition of a new order of flexible organisation

and reprogramming. This recovery and reorganisation can be realized by the overlying of ecological and urban structures, which create systems of interconnected networks that are complement to existing networks. Creating interconnected networks complement to existing ones will result in adaptive territories without losing identity. In case of post-industrial areas it's clear that the vanished industry caused the need to recovery and reorganisation. In post-agricultural areas, the agriculture is overtaken by tourism and recreation. However the artificial landscape of agriculture, which gives identity to its area, is not based on aesthetic and symbolic aims, but on pragmatic considerations concerning its productivity. This lack of cultural identity has to be restored, but also based on the witnesses of the regions history. In order to use landscape as instrument in the process of adaptation to new economies without losing identity the following attitudes are important:

- **Processes over time:** Processes of urbanisation are more of influence on forming urban connections/relations than spatial form of the city that would do. This does not mean the spatial form should be excluded, but it should be brought into relation with the processes of urbanisation (Corner, 2006). Therefore should the process-driven characteristics of the city, including all actors and forces which influence them be taken into consideration, mobilized and redirected. Therefore it's important to view the entire territory of the metropolitan delta region in which processes and exchanges are influenced by new forces and relationships to prepare the ground for new activities and patterns. However there is the design of site through ecology. Ecology has long been seen as development of the environment of nature. Since it's included the city we have to understand the relation between cultural, social, political and economic environments in relation to this environment formed by natural processes (Czerniak, 2006).
- **Horizontality:** This theme of horizontality is based on the switch from a vertical organized society towards a horizontal organized society. The vertical organization consists of hierarchy, centrality and dominance. The horizontal organization is

polycentric, interconnected, dedensification and expansion (Corner, 2003). This aspect of interconnected is related to surface, which function as secondary structure in the urban fabric, which offers opportunities for new development (Corner, 2006). On this topic of the horizontal organization, are all ready a lot of utopias in which the relation between town and country is defined.

- **Imaginary:** Imaginary of the project is often used to sell the project. In contrast to this imaginary can also be used to query, explore, reorganize perceptions and synthesize different insights. From this point of view it's important to use techniques from both disciplines, landscape and urbanism for an in depth study. Techniques drawn from landscape are: mapping, cataloguing, triangulating, surface modelling, implanting, managing, cultivating, phasing and layering. Techniques drawn from urbanism are planning, diagramming, organizing, assembling, allotting, zoning, marketing (Corner, 2003).
- **Networks:** As mentioned before is the interaction of different systems important. To be able to do so, networks need the capacity to absorb, transform and exchange with its environment. James Corner (2003: 63) says that stability and robustness derive from its dynamics in its capacity to handle and process movement, difference and change. This responds to the flexibility asked from the urban fabric and landscape to react on changing needs and demands of changing economy, relations and use.
- **Collective memory:** The inability to create meaningful and vibrant public space is due to the lack of identity and flexibility. In relation to the identity it's important to have an active regard for the memory of site. Second it's important to have a vision of site and design as processes to create flexible spaces, which are connected or included in the networks. They actually improve the stability and robustness of the networks. These aspects, included in the attitudes of an approach for landscape urbanism are, according to Marot, rooted in the culture of garden design, landscape architecture of which the foundation is in suburbia.

## 10 Collective memory on site

To many sites are redeveloped without reference of the history of site. The era of urban expansion comes to an end. Question is how to accommodate sites, of which most of them derived from the suburban condition. As mentioned before is the practice which treats this territorial development, landscape urbanism, which redirect the emphasis from programme to site, which define site as the matrix of design and programme as a tool to explore, read, reveal invent and ultimately represent the site. (Marot, 2003: 5). Marot define landscape urbanism as a subversion of urbanism, which recognizes suburbia as a tradition of design and thinking which is included in the design of landscape architecture. Originally is suburbia a world of living and recreation, located in the landscape and economically depended on the city. Typical of the classic suburbia is the direct relation to nature, which is designed in the combination of the picturesque park landscape and the picturesque village. The picturesque landscape was created by means of identity, variation and staggered alignment (Fishman, 1946).

## 11 Art of memory

All ready mentioned is the relation of memory on site and a meaningful and characteristic public space. This relation between memory and space is described by Yates in his description on the art of memory. An art in which stories can be remembered because parts of it are linked to architectonic spaces in a building. Because the order is fixed in the sequence of places in the building, the parts of the story are remembered in the right order (Marot, 2006: 10). When the art of memory is translated to the practice of landscape urbanism, site function as framework for the memory on site. This framework is based on one or several fixed itineraries, which seems to eliminate less structured spaces, which are actually artificial landscapes, which are in concern of landscape urbanism. A similar form of representation is found in garden design. Marot (2006: 20) describes the art of gardens as an in situ representation or imitation of the elements, motifs an patterns of transformed nature as they were found in the territory surrounding the site. In this

perspective, the territories transformation into landscape, can be compared to the project of constituting systems of places which transform visions of the future and history into landscape as well. Memory could be seen as a process of reconstruction, but the act of reconstruction does not imply effacement of earlier states. Marot concludes from Halbwachs the social frameworks of memory that a urban landscape is a stable and dominant memory. Stable because it is based on a framework, which has served as a fixed point of organisation over a long term and dominant because other memories will be linked to them as to a centre of organization. An other conclusion which Marot(2006: 30) has drawn from Halbwachs is that we only can retain the past by preserving it in the material surroundings. This is because each of our impressions banishes the one that came before, nothing remain in our minds.

## 12 Practice of collective memory on site

The person who has landscape architecture redefined as an art of in situ representation of territories and their transformations is Smithson by investigating the picturesque tradition. In his adventure of the sense of identity of the American suburb, he describes the absence of elements in suburbs framework, on which the mind can focus to rebuild its memory. Where Smithson was focussed on the American suburb is the architect Georges Descombes focussed on the processes which formed European suburbia. Those are industrialisation of the agricultural economy and territorialization of the urban economy. A design of Descombes for a park in Lancy, along the river the Voiret, near Geneva, is designed as contemporary memory place in this suburban situation, because the intervention is restraint, careful in stimulating our attention instead of fully occupy it. It also does because its enhanced awareness of the strata instead of materialize them. This awareness of strata is elaborated in the tunnel-bridge and its lighting-shaft link not only the crossing structures, but also the strata of today and yesterday. Where the park stretches further along the river, at the place where an orchard used to be, the project adapted the logic of the orchards and organizes the programme on three lines.

### 13 Conclusion

In order of design and planning in the context of the contemporary metropolitan delta region is an understanding of the existing agglomerations necessary. The structuring of these agglomerations was controlled by two spatial models, the mass model and the spatial model. Many agglomerations are structured on the mass model of the satellite, which is reaching its limits of expansion. On the other hand are many agglomerations structured on the spatial model of the park system. Agglomerations which are based on the satellite model can be transformed into that of the park system through creation of open spaces according to the concept of peripheral disposition. However urban expansion controlled by the park system can be disturbed by shortage of space or by too convenient expansion.

Landscape came back on the political agenda because of global attention for ecology, climate change, tourism, city branding and the impact of urban growth in combination with decentralisation. The way we looked at the relation between landscape and agglomeration was in terms of contradiction, urban concentration and infrastructure in which landscape compensates the negative effects of urban development. But the debate on finding new ways of structuring the patterns of urban expansion came up with a new approach, landscape urbanism. This approach is based on site as matrix of the design, in which landscape is the variable structuring element. In order to use landscape as instrument in the process of adaptation to new economies without losing identity, the following attitudes were defined: processes over time, horizontality, imaginary, networks, collective memory.

Of those attitudes, imaginary, networks and collective memory are more like tools for practice of landscape urbanism. The other attitudes are more for understanding the effects of processes and relations on networks and places. In order to create meaningful and characteristic public spaces, the tool of collective memory is the most important one. The relation between memory and space is described by Yates as the art of memory. When this art is translated into the practice of landscape urbanism, site

function as framework for the memory of site. Because this framework is based on one or several fixed itineraries, it is more applicable to artificial landscapes. Important artificial landscapes of the metropolitan delta region are post-industrial, post-agricultural and the suburban urban expansion patterns. The art of memory is comparable to the art of gardens, which is an in situ representation of the surrounding landscapes. In the art of memory there is in situ representation of its historical composition of elements.

### 14 Recommendations for the graduation project

The graduation project is about understanding the impact of climate change on the metropolitan delta landscape. It is hardly to recommend to use the tools of imaginary and collective memory of landscape urbanism as methods for the projects. For using these tools it is good to look at techniques and instruments in the practice of landscape urbanism.

Second it is important to create on the larger scale networks, which have the capacity to absorb, transform and exchange with its environment, if it is urban or rural, in order to react on changing economy, ecology and use.

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