Future Relics

1.

"Possibility of Extinction"

Master Thesis: Research Report

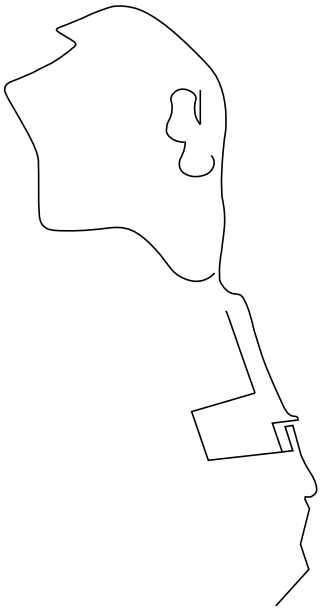
Luca Parlangeli

North Sea: Landscapes of Coexistence
Transitional Territories Studio 2019-2020

Future Relics

"About Doel's 'de-polderisation' and destruction in the Post-Anthropocene era"

Research Report



Luca Parlangeli

North Sea: Landscapes of Coexistence

Transitional Territories Studio 2019-2020

Index

Research Report

I.

Abstract

I. Abstract

Within the main geographical frames of the North Sea and the Scheldt estuary, the Doelpolder area stands out for the conflictual relationships between human settlements, environmental crisis, and man-made infrastructures, which are all paradigms of the so-called Anthropocene era. The site comprises the village of Doel, the natural reserve of Saeftinghe, the nuclear power plant of Doel and the largest dock of the Port of Antwerp in a 2 km long prone-to-flooding area, which is currently facing some anthropic phenomena such as pollution, infrastructural expansion of the harbor and dismantlement of the nuclear power plant.

In its process of northbound expansion at the expense of the estuarine territory and the polder-land, the Port of Antwerp has turned Doel into a ghost town by means of expropriation and economic pressure, while the flora and fauna of Saeftinghe are endangered by the alteration of their brackish habitat caused by pollution and water level rise due to both infrastructural growth and climate change. This everlasting dichotomy between natural and anthropized processes poses here the dualistic problem of extinction/preservation and if/how can architecture depict a self-healing survival scenario for this specific site in the Post-Anthropocene, attempting at climate change mitigation and nature metabolism at the same time.

Lines of Inquiry:

- A Pervasive Ecology of flows
- Flux, Erasure, Terraforming

River Inspector's House

Author: Luca Parlangeli
Inspired by: Claude-Nicolas Ledoux

Research Report

II.

Territory

a. The North Sea

All throughout history, the North Sea has been the theatre of many different events of military, religious, economic, and climatic kind which have made it one of the most spatially and infrastructurally dense bodies of water currently on Earth. For its resources, as well as for its advantageous geographic position, it has lately assumed a neuralgic role in both the European and the global context, becoming one of the richest and busiest shipping corridors in the world: not surprisingly, this maritime environment is also the location of the three major european ports.

In the North Sea, all the different factors - culture, economy, politics, nature - are extremely intertwined and equally contribute to the formation of the territory and vice versa. The North Sea's economy, for example, is currently mostly defined by oil, gas and sea fauna (under water) and the wind (on the surface), while its political borders were first defined after WWII but then revised and agreed permanently only after the discovery of the aforementioned mineral resources. For all the said reasons, the North Sea is considered a "Landscape of Coexistence": an extra-territorial space and an autonomous entity at the same time, with significant influence on the political, environmental, economic, and societal systems.

On one hand, it is clear how the sea has characterized the nations around it through the interactions with its landscape, moulding them into traders, fishermen, and extractors; on the other hand, the inhabitants of the region have reciprocated by leaving huge marks on the environment, which are result of anthropogenic practices such as coastal urbanisation, mass-fishing and energy production.

The perennial battlefront of land and sea becomes evident on the coastline. This virtual line which defines the dynamic interchange between sea and land, is today determined by very different agents and temporalities (day, season, year, decade, century, millennia): at the geological scale, climate change ciclically impacts and shapes the territory; At the daily scale, low and high tide define the habitats for many different species including humans (Lisiecki and Raymo, 2005).

Based on these premises, the possible economic and political future scenarios of the North Sea region are currently very dependent on the harshness and the speed of phenomena such as climate change, sea level rise, weather patterns, technological automation, and increasing migration trends, therefore also on human's political/social response to these factors.

The North Sea Equidistant Conic Projection

Scale: 1:100000
Source: Transitional Territories Atlas - 2019/2020


50°

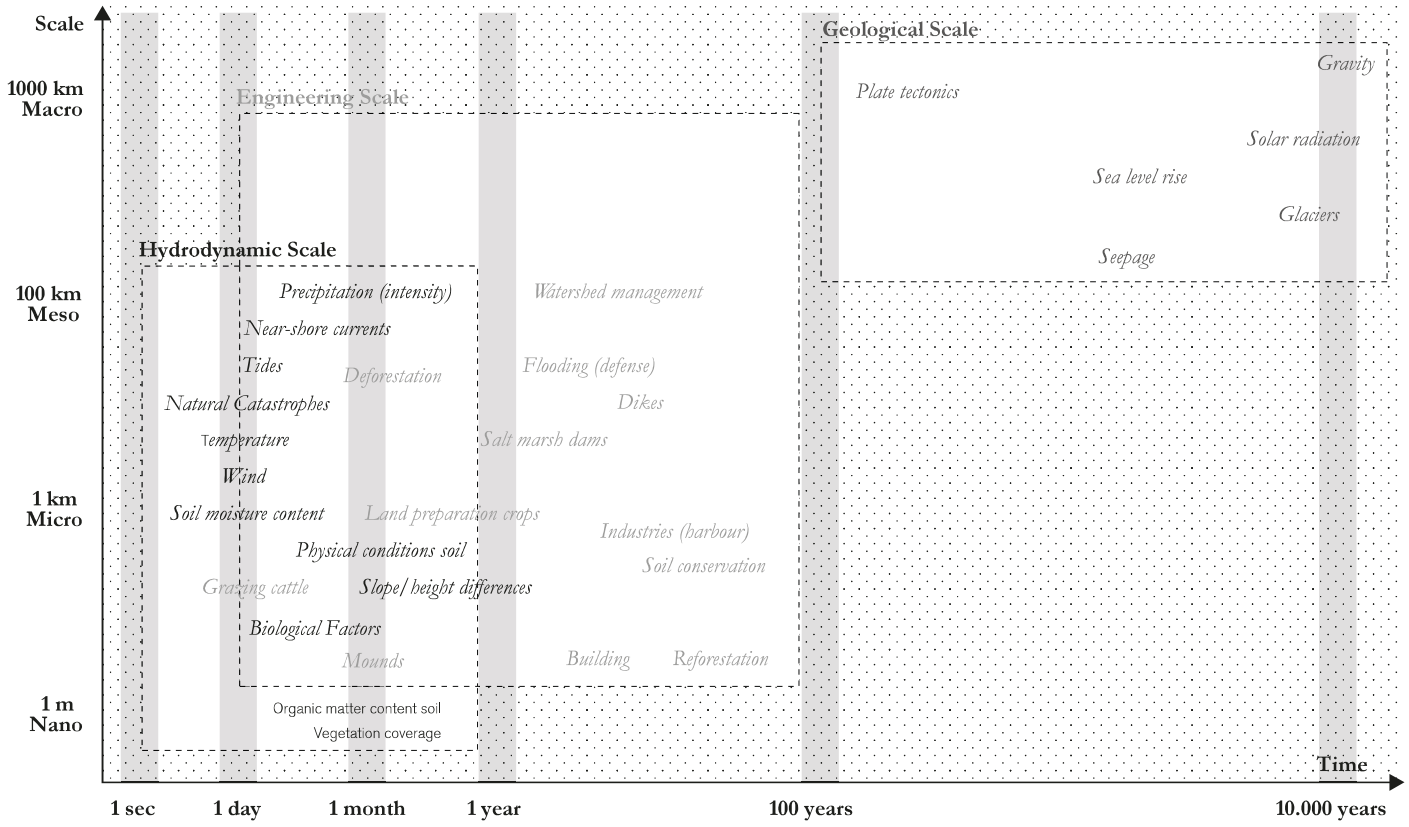
Geological and anthropogenic agents of change are defined in time and scale. According to the scale, an agent has a small or big influence on the interchange between land and sea. The impact of an agent on other agents, can however affect the other scales. Such is the case of wind, affecting a hydrodynamic scale, wind has the possibility to have an influence on flooding defenses, which may cause changes on an engineering scale.

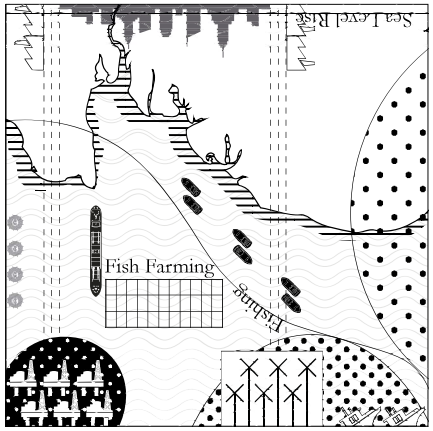
Human Factors

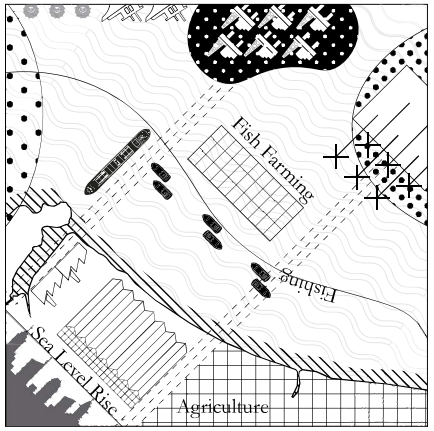
Eolic Energy
Water Quality
Trash
Shipping Routes
Oil & Gas Extraction
Over-fishing
Sand & Minerals Extraction
Cables & Pipelines
Tourism
Military Use
Cultural Heritage
Data
Migration

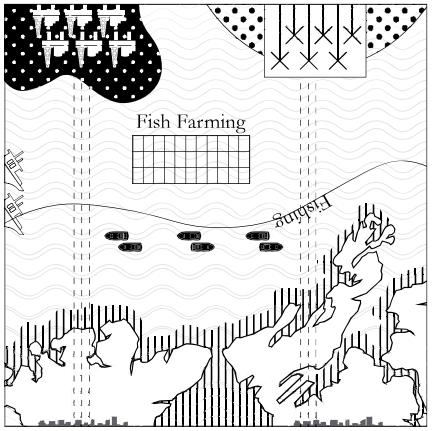
Natural Factors

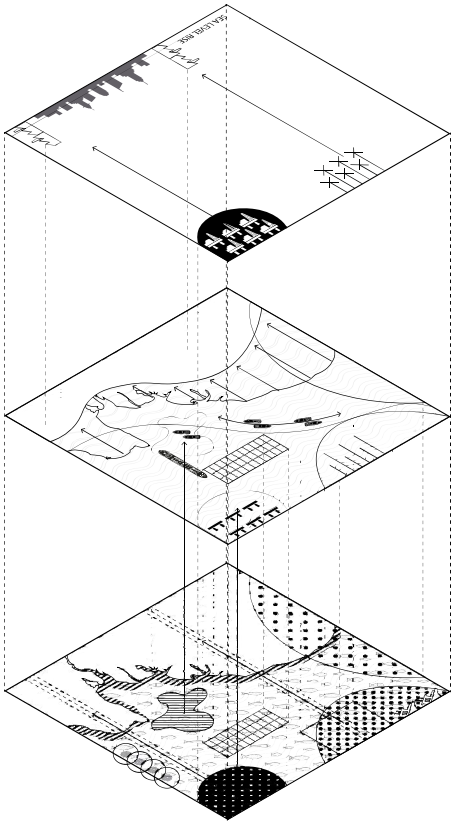
Nature and Biodiversity
Erosion
Flooding
Terraforming
Storm Surge
Polluted Grounds
Salinity
Carbon and Methane Emissions

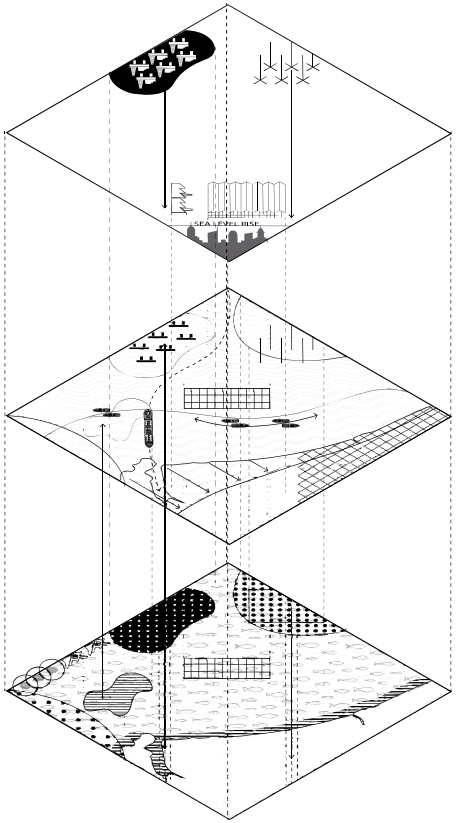


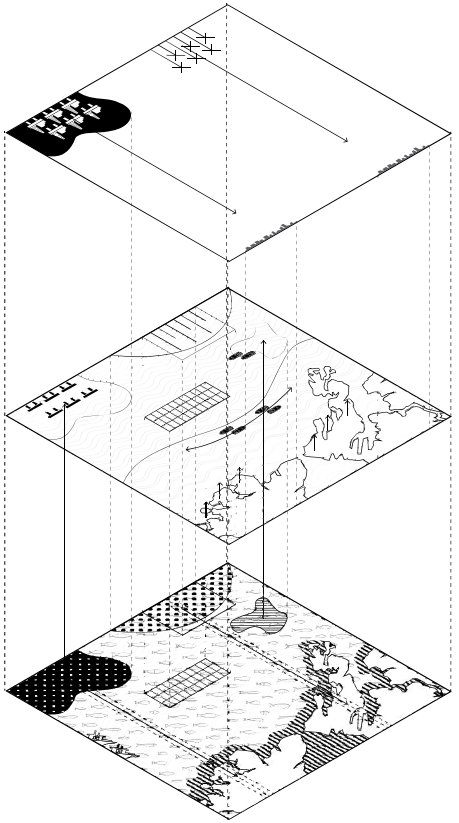

Sea Level Rise
Fish Farming
Fishing


Fish Farming
Fishing
Sea Level Rise
Agriculture


Fish Farming
Fishing




SEA LEVEL RISE



Anthropogenic Activities and Structures

Affected processes
(Gill and Malmud, 2017)

Function

Subsurface process

Material extraction
- Groundwater
- Oil/gas
- Subsurface infrastructure construction
- Subsurface mining

Materials addition
- Material (fluid) injection

Surface process

Land use change
- Vegetation removal
- Agriculture practice change
- Urbanization

Materialextraction
- Infrastructure construction
- Quarrying/surface mining

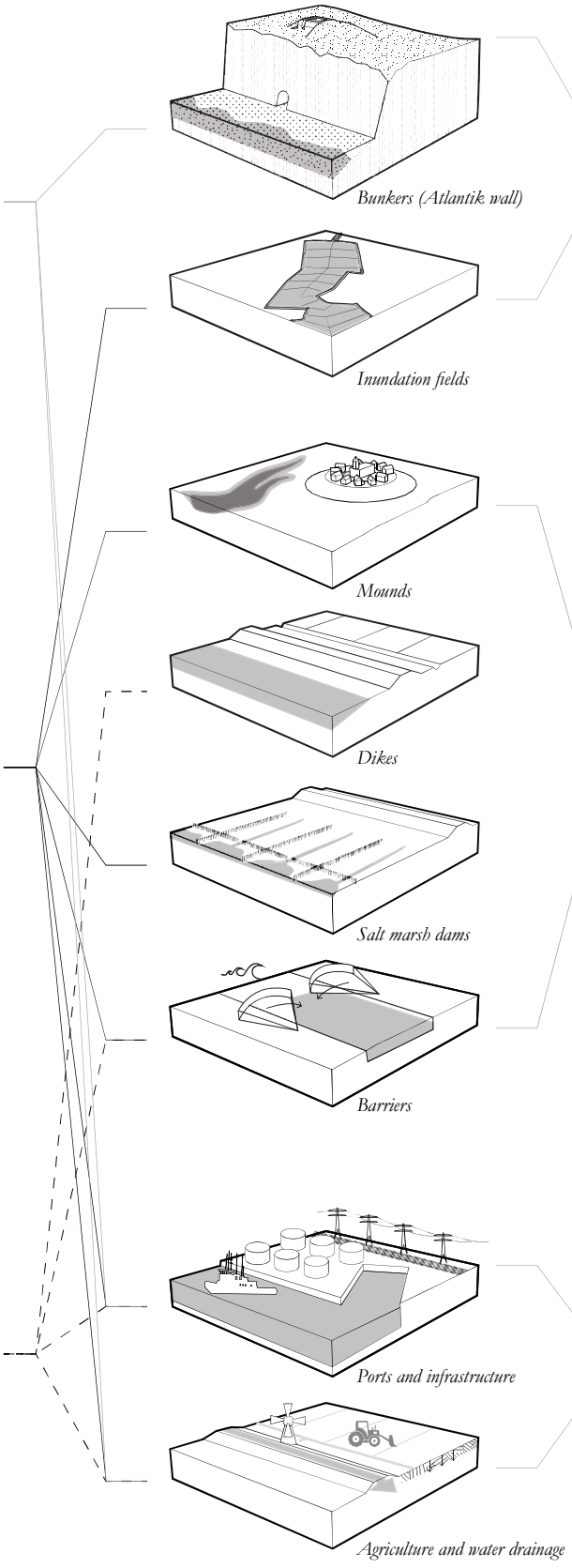
Material addition
- Infrastructure
- Infilled ground
- Reservoir and dam construction

Subsurface and surface process

Hydrological change
- Drainage and dewatering
- Water addition

Explosions
- Chemical explosion
- Nuclear explosion

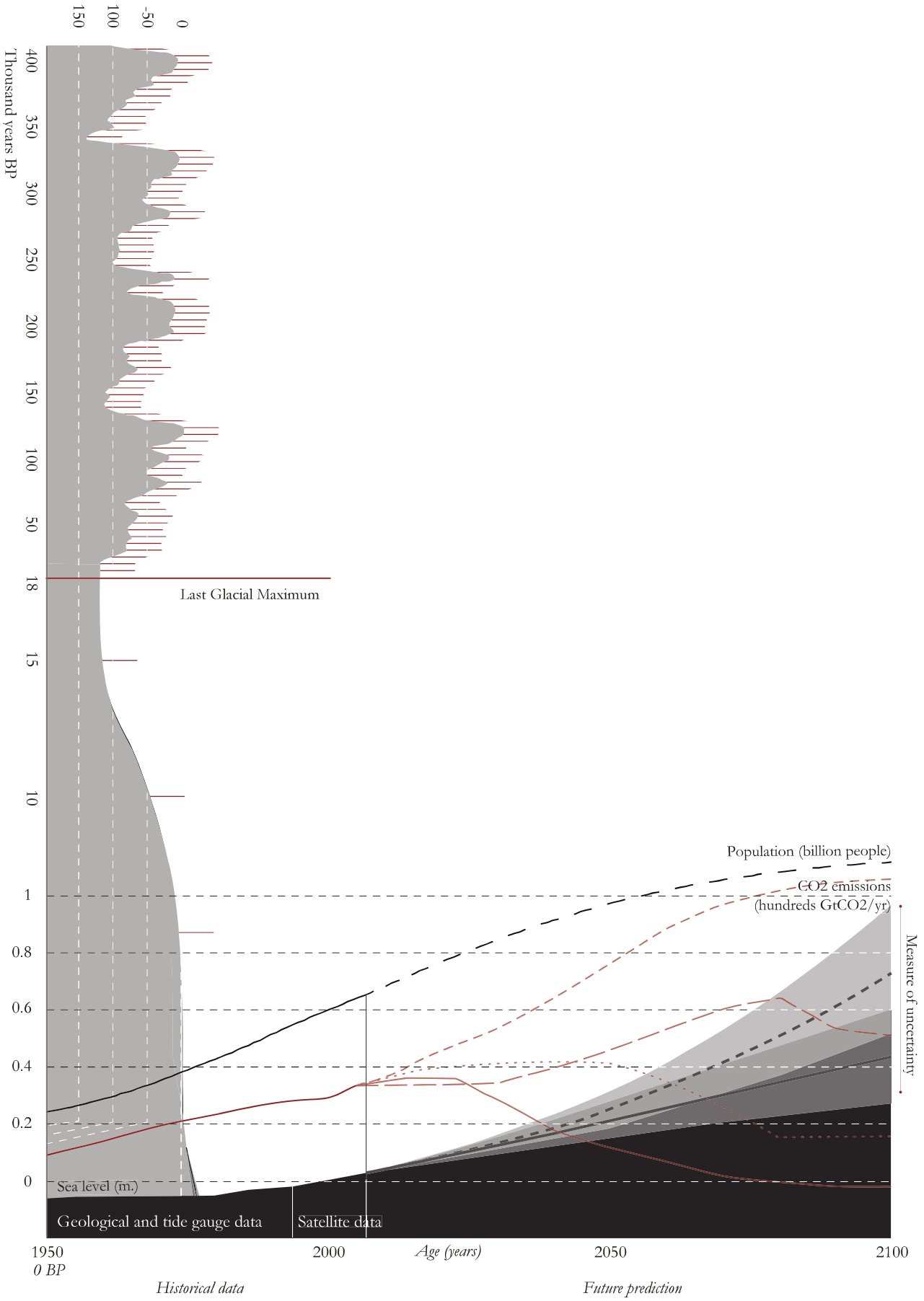
Fire

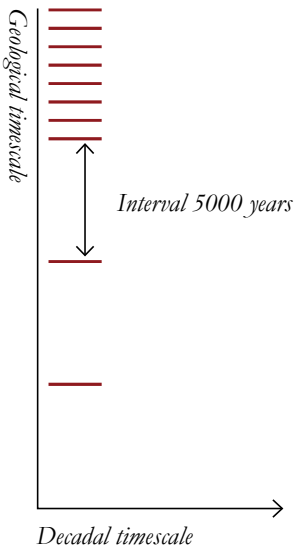


War defence
measures with the aim to protect and defend a territory during warfare.

Flood defence
measures with the aim to secure flood risk management of vulnerable areas

Human exploitation
Measures with the aim to support (economic) human activities and movements.


150
100
-50
0
Thousand years BP
400
350
300
250
200
150
100
50
18
15
10
Last Glacial Maximum
Population (billion people)
CO2 emissions
(hundreds GtCO2/yr)
Measure of uncertainty
1
0.8
0.6
0.4
0.2
0
Sea level (m.)
Geological and tide gauge data
Satellite data
1950
0 BP
2000
Age (years)
2050
2100
Historical data
Future prediction



Pace of change

The timeline, elaborated during the research phase of the Transitional Territories Studio 2019/2020, shows the sea level rise at the geological time-scales and its pace, as well as a decimal time-scale with present and future predictions of sea level rise until 2100.

Although changes can be relative when considering a timeframe of thousands of years (sea levels within a glacial interval have changed with more than a 100m) they become of relevance when considering the shorter timespan of urban renewal processes. However, they cause problems in 'modern' times (decadal timescale), since the static man-made infrastructures do not have the capacity to respond to the changing conditions at a certain speed.

Future predictions are based on the different emission-scenarios of the IPCC synthesis report (IPCC, 2014), the so-called RCP's (Representative Concentration Pathways), describing the development of greenhouse gasses.

The scenarios are then compared with different predictions of CO2 emissions (red line), and expected (world) population growth (black) on a global level, already showing a very uncertain rate of changes.

- CO2 emissions (hundreds GtCO2/yr)
- RCP 8.5 (hundreds GtCO2/yr)
- RCP 6.0 (hundreds GtCO2/yr)
- RCP 4.5 (hundreds GtCO2/yr)
- RCP 2.6 (hundreds GtCO2/yr)
- Global mean sea level rise 2.6 (m.)
- Global mean sea level rise 8.5 (m.)
- Population

The North Sea: Seabed

Scale:

Source: Transitional Territory Atlas - 2019/2020

Plastic in Seabed

Litter

Windfarms

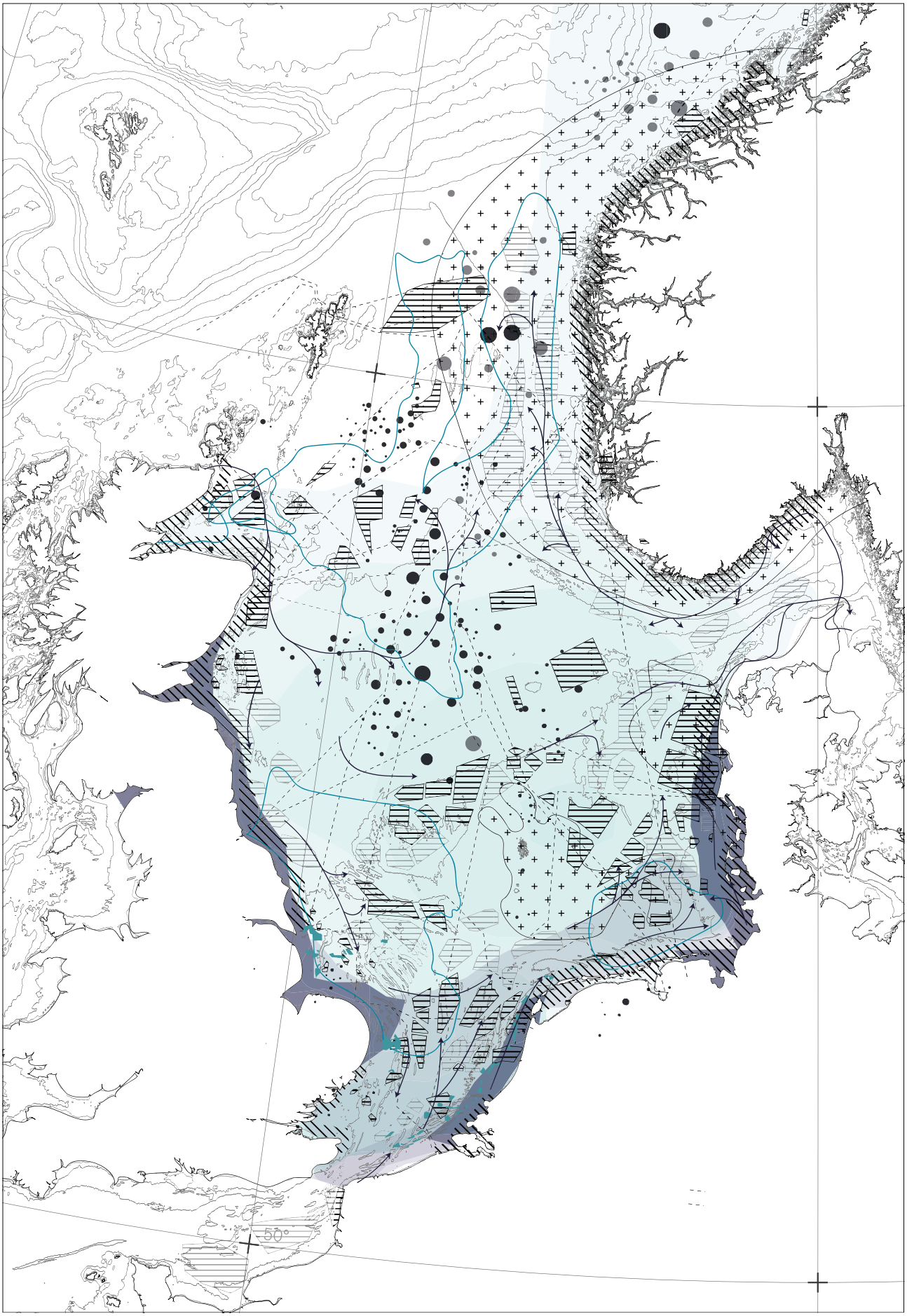
Oil and Gas fields

Dredging

Aquifers

Mussels and Proteins

Sedimentation Area


50°

The North Sea: Underwater

Scale

Source: Transitional Territory Atlas - 2019/2020

Water Pollution

Overfishing

Natura 2000

Marine Protected Areas

Windfarms

Biodiversity Concentration

Fluvisols

Albeluvisols

Andosols

Gleysols

Luvisols

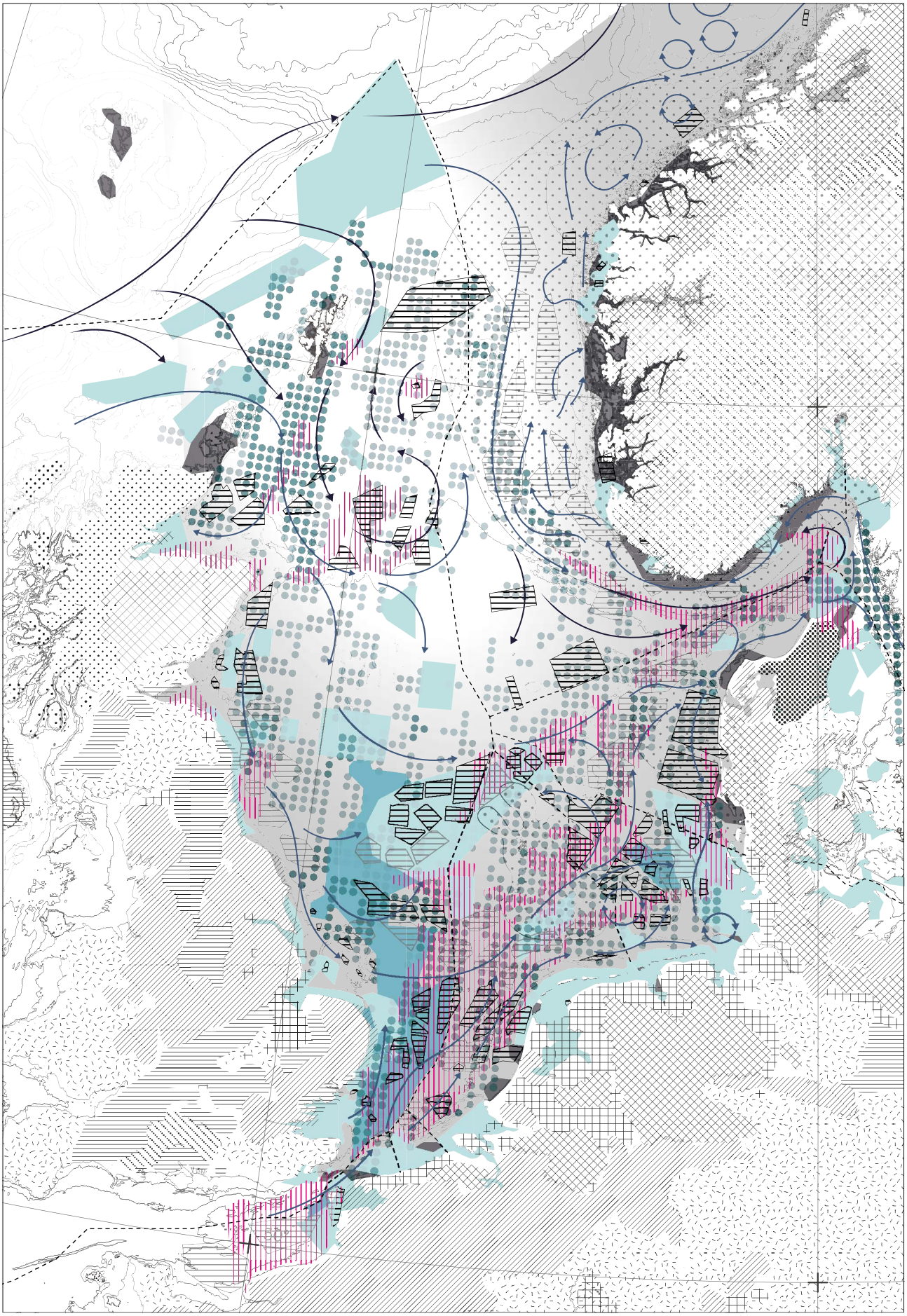
Cambisols

Podzolz

Histosols

Leptosols

Arensols



The North Sea: Surface

Scale

Source: Transitional Territory Atlas - 2019/2020

Unesco Landscape Areas

Flooding Risk Areas

Industrial Areas

Soil Exploitation

Windfarms

Grassland

Unesco Heritage Sites

Ports

Landing Points

Dumping Sites

Unesco Industrial Sites

Oil Rigs

Refineries

Barrier, sandy dune islands

Predominantly cliffs: structured rocky appearence, rugged open character

Cliffs of various sizes, pebble beaches, gentle topography

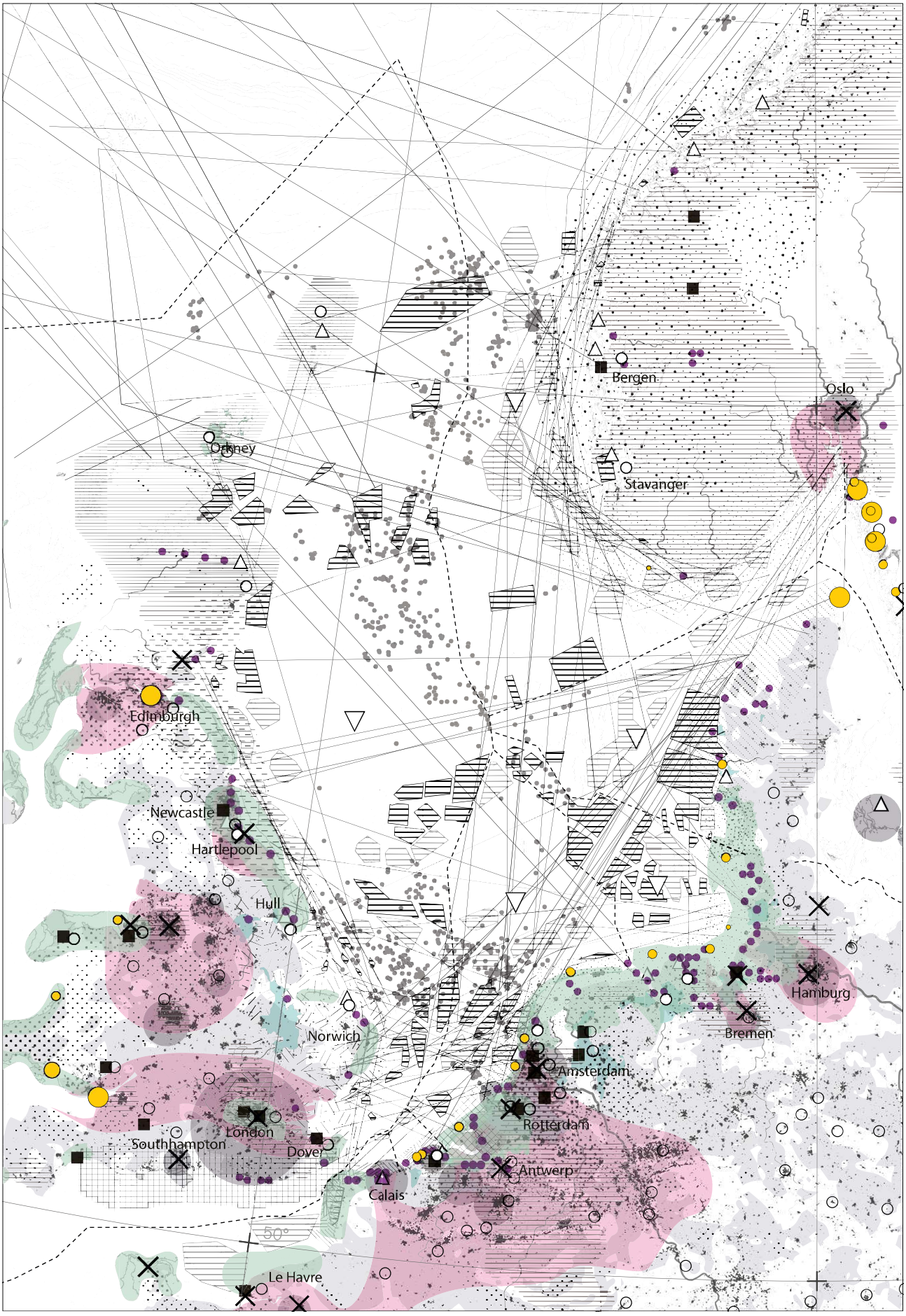
Low-lying land alternating with soft glacial rock cliffs, open coast has man made defence

Most mountainous part of the skerry type coast with deep fjords

Varied landscape of cliffs composed of soft an hard rock, and most major coastal structure types

Extended shallow coast, sandy beaches and coastal dunes

Skerry coast, small rock formations before the mainland, dissected and structured


Bergen
Oslo
Orkney
Stavanger
Edinburgh
Newcastle
Hartlepool
Hull
Norwich
Hamburg
Bremen
Amsterdam
Rotterdam
Antwerp
London
Southhampton
Dover
Calais
50°
Le Havre

The North Sea: Habitats

Scale

Source: Transitional Territory Atlas - 2019/2020

Seabed Habitats

Microflora

Seapen

Reefs

Mussel Beds

Seagrass

Others

Seabird Habitats

Plankton

Megafauna Communities

Harbour Porpoise Distribution

Invasive Species Farming

Shellfish

Salmon

Invasive Species

Sardines

Anchovies

Sea Bass

Projected Cod

Maximum

Medium

Minimum

Projected Haddock

Maximum

Medium

Minimum

The North Sea: Chemical Danger

Scale

Source: Transitional Territory Atlas


Acidification

Hipoxic Sites

Dumping Sites


Polluted Coasts


Organic Carbon


Plastic in Water


Phosphor and Nitrogen due to urbanization


Eutrophication


CO_2 Emissions


Oxygen


Salinity Problem Areas

Heavy Metals


Chromium


Cadmium


Arsenic

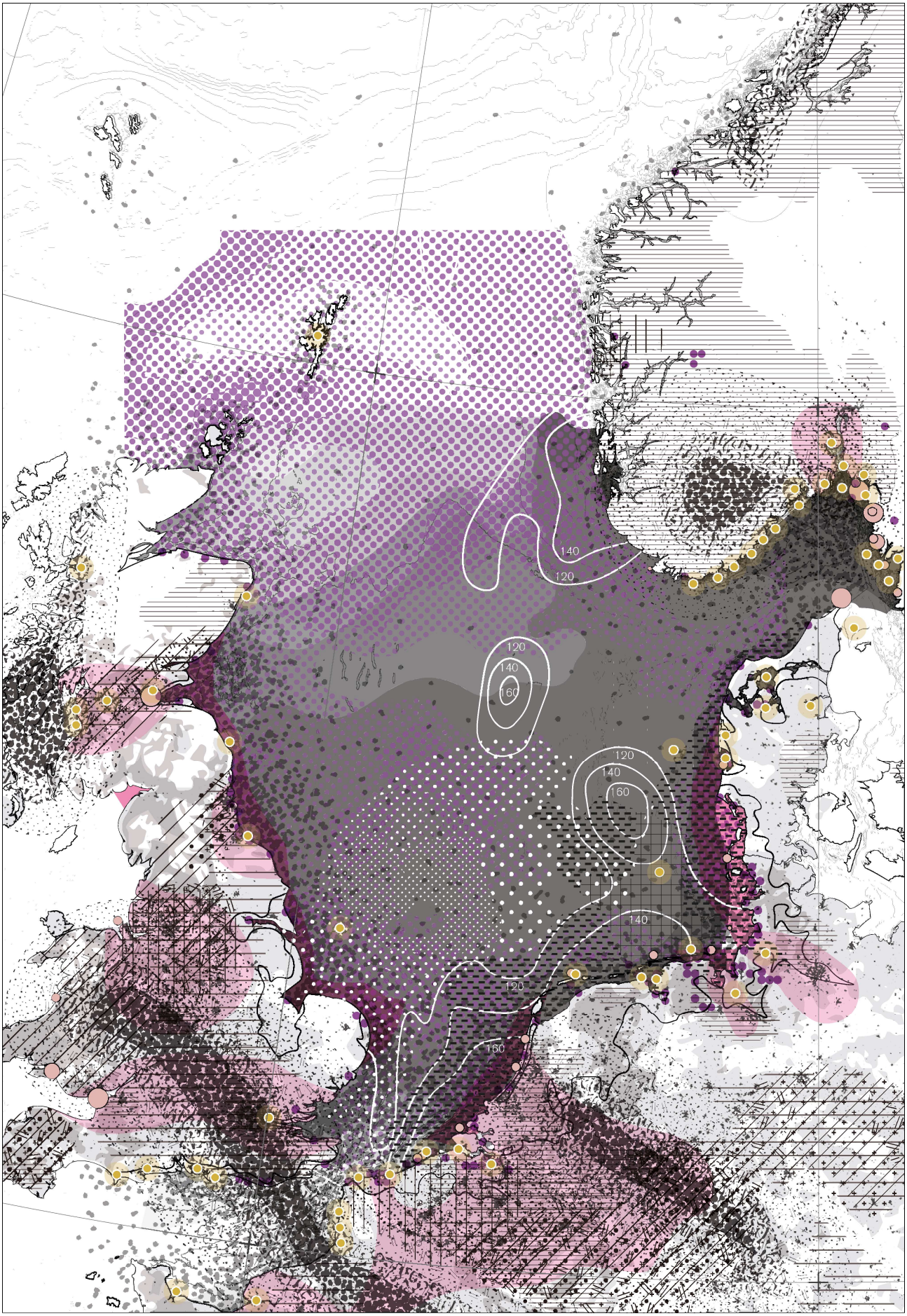

Zinc


Led


Mercury


Nichel


Copper


140
120
120
140
160
120
140
160
140
120
160

The North Sea: Anthropocenic Condition

Gradient of Antroposcenic Intensity

Areas of Highest Biodiversity and Habitats concentration


Oslo
Stavanger
Edinburgh
Newcastle
Hartlepool
Hull
Norwich
Hamburg
Bremen
Amsterdam
Rotterdam
Antwerp
London
Southhampton
Dover
Calais
Le Havre

The North Sea: Estuaries

Estuaries are incredibly dynamic environments, where temperature, salinity, turbidity, depth, and flow vary daily according to the tides. These characteristics make estuaries highly productive habitats but also very fragile, as many species struggle to survive year-round (Osborne, 2017). Moreover, because of their advantageous morphological and geophysical conformation, they are frequently elected as venues for the construction of port cities: twenty-two out of thirty-two of the largest cities of the world in the Nineties were located on estuaries (Ross, 1995). For this reason, estuary ecosystems are nowadays threatened by human activities such as pollution, overfishing, and sewage, and also altered by upstream factors such as waste, pollutants, sediments and heavy metals. According to the World Resource Institute, the catchment area of the Scheldt Estuary is the most densely populated area compare to its level of industrialization, suffering from hypoxic conditions up to 30 kilometers in length across the estuary.

The North Sea: Major Ports

1. Mass Estuary - Rotterdam
2. Scheldt Estuary - Antwerp
3. Elbe Estuary - Hamburg

1.

2.

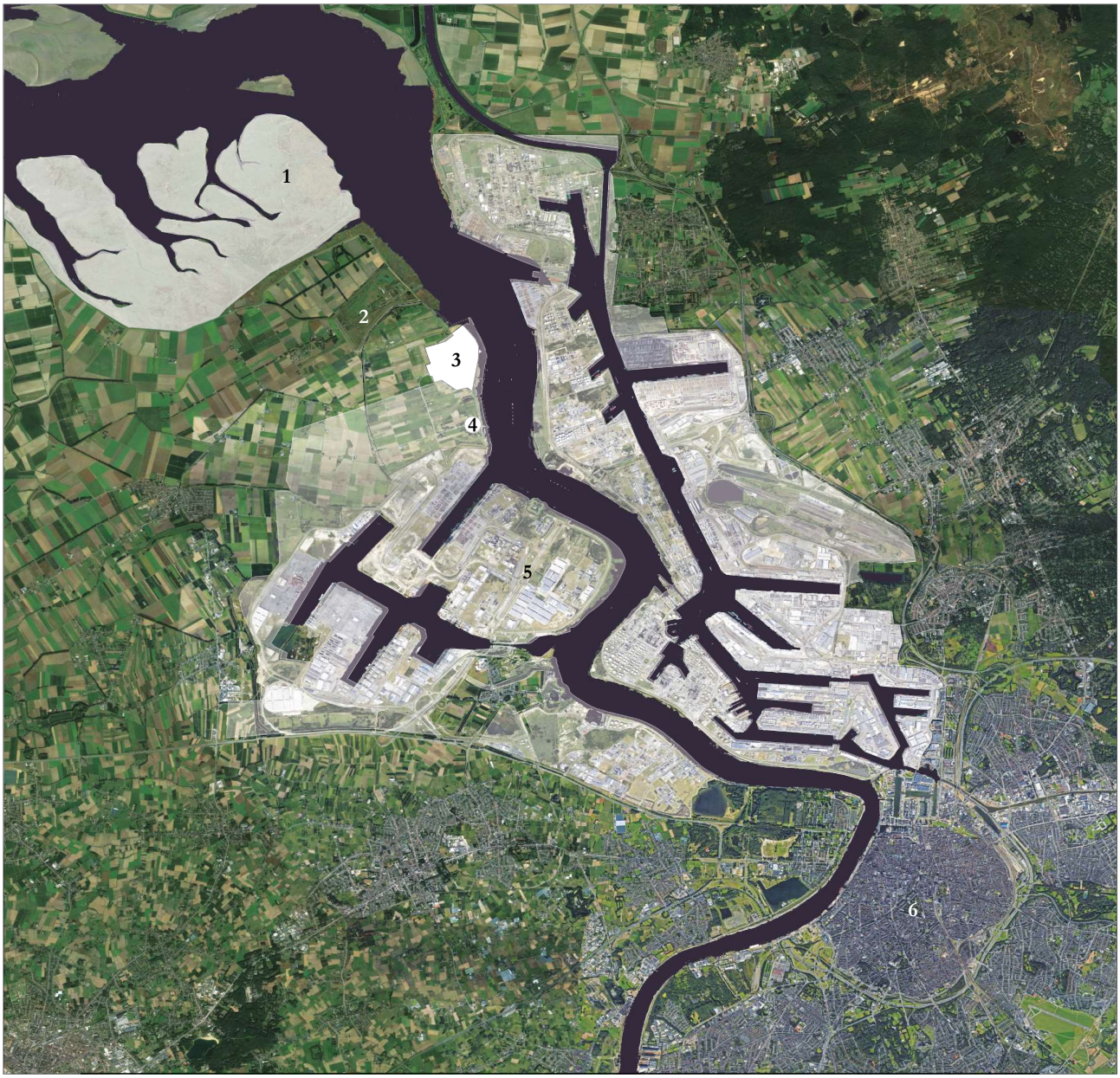
3.

The Scheldt Estaury

The Scheldt Estuary area comprises the ghost-village of Doel, the natural reserve of Saeftinghe, the nuclear power plant of Doel and the largest dock of the Port of Antwerp (Deurganckdock) in a 2 km long prone-to-flooding area, which is currently facing complex anthropic phenomena such as pollution, infrastructural expansion of the harbor and dismantlement of the nuclear power plant.

In its process of northbound expansion at the expense of the estuarine territory and the polder-land, the Port has turned Doel into a ghost town by means of expropriation and economic pressure, while the flora and fauna of Saeftinghe are endangered by the alteration of their brackish habitat caused by pollution and water level rise. the Doelpolder and the town of Doel are emblematic of the ongoing conflictual relationship between human settlements, environmental crisis, and man-made infrastructures: the site is in fact situated between a swampy tidal area constituting natural reserve (the drowned land of Saeftinghe), a nuclear power plant and the Port of Antwerp.

Beside the common problems related to climate change and water level rise, the area had to face and succumb to the destructive process of growth of the Port infrastructure, which is currently the second biggest in Europe. After having vastly expanded towards north over the last five decades by engulfing the natural habitat of the estuary and the former polder-land near the national border, the Port is now threatening the survival of Doel town and the estuarine ecosystem of the natural reserve of Saeftinghe. The traces of this anthropizing action are not just recognizable from the contradictory landscapes of the banks of the Scheldt, but also from the story of the inhabitants of Doel and from the flora and fauna of Saeftinghe, once more demonstrating the critical conditions of a transitional territory, where architecture, culture, water, and natural events are inextricably intertwined.



Scheldt Estuary

1. Drowned Land of Saeftinghe
2. Doelpolder
3. Doel Nuclear Power Plant
4. Doel Town
5. Port of Antwerp
6. Antwerp


M S C

A Conflictual and Contradictory Landscape

Nuclear Power Station from Doelpolder

Container Ship from Saeftinghe Natural Reserve

A Conflictual and Contradictory Landscape

Saeftinghe from the Doel Dike

Doel Town from Doel Dike

Antwerp Timeline

Middle Ages

From a small settlement in a curve of the Scheldt, Antwerp started to develop into a city since the Middle Ages onwards. The city developed in a concentric manner. Around the irregular pattern of narrow streets, belts of defence canals were laid out that were recycled into inland shipping infrastructure with every new expansion.

1500

In "the Golden Age" the increasing port activity and the quickly growing population called for the layout of a new city area at north. The new port area quickly developed into the heart of Antwerp's economy until the Fall in 1585, when shipping traffic was blocked by the Netherlands until the end of the eighteenth century.

1800

The first docks were ordered by Napoleon in the early 19th century, turning Nieuwstad into a military base. The numerous inlets and canals mainly functioned as a sewer system for households and were gradually covered over to avoid desease. By the end of the century the Scheldt was straightened to accommodate heavy port infrastructure.

1950's

Former Brialmont defence walls were dismantled to accommodate the Small Ring Road. In 1958 the northern polder towns became part of Antwerp. Large parts of the polders were transformed within the scope of successive port expansions.

1960's

Further port expansions caused former port areas in the inner city to fall into decline and the new Ring road soon clogged with congestion and urban segregation.

1970's

Antwerp, like other European cities, faced urban exodus and economic expansion, causing deterioration of the city.

1980's

Civil society organisation 'City on the Stream' strongly appealed to the city administration to take action, pressing for the renewal of neglected port areas such as Eilandje ('Islet'), Scheldekaaien ('the Scheldt quays') and Nieuw Zuid ('New South').

1990's

The city initially endorsed 'City on the Stream' projects by starting an international design contest with proposals by several designers (Toyo Ito, Manuel de Solà-Morales). With the 1997 Spatial Structure Plan for Flanders, the government forced provinces and municipalities to draft long-term visions for their own territory.

2000's

The 2006 three-tier Spatial Structure Plan for Antwerp by Bernardo Secchi and Paola Viganò introduced a punctual strategy for the renewal of the city through interventions in public space.

b. Port of Antwerp

The Scheldt estuary has been strategically important for commerce and politics since Roman times. The beginning of Antwerp as port city can be dated around the 12th century with England, Zeeland, and Germany as preferred connections, but the 16th century is considered as Antwerp's Golden Age, as the port benefited from being the crossway of products and travellers on their way towards the inland. However, after the city was taken by the Spanish in 1585, the Dutch Republic imposed a blockade to shipping on the Scheldt, starting an historical diatribe between the Netherlands and Belgium.

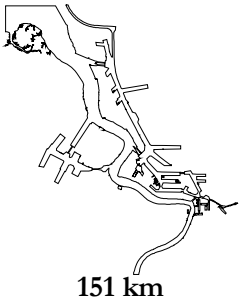
The shipping on the Scheldt could start again only under Napoleon, at the end of the eighteenth century: he was also responsible for the first substantial expansion and strenghtening of shipyards and docks. With Belgium independence from the Netherlands in 1830, the treaty of the Scheldt made the river accessible through the payment of a toll (until 1863). Furthermore, thanks to the industrial revolution and the technological progress, trades to Africa and Asia started and hinterland commerce continued to boom, making Antwerp a European and international trading hub.

After the Second World War, Antwerp was not completely destroyed and the port could soon resume its process of industrial and infrastructural growth: starting from 1956 (Marshall plan, Ten Year Plan), Antwerp has gradually become Europe's biggest chemical cluster. The expansion northwards continued with the realisation of the biggest lock at the time in the world (the Zandvliet lock). Nevertheless, after reaching the border with the Netherlands, the port expansions began on the left bank: in 2005, the first vessel entered the gigantic tidal Deurganck dock, which has doubled the port's container capacity by providing an extra 7 million standard containers units.

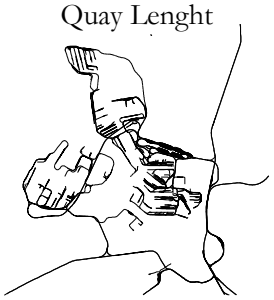
Nowadays, the port of Antwerp is aiming to a steady but sustainable development: an agreement with nature conservation organisation Natuurpunt was signed 20 years ago in order to "*reconcile the seemingly contradictory interests of nature and port development*" (Peter Symens). The Scheldt treaties are fundamental to the fulfillment of this goal: for this reason, agreements were made with the Netherlands about accessibility, flood protection and nature conservation: in recent years, there have been a number of water management projects that have deviated from business as usual and made a shift from hard engineering to softengineering. Reconstructed wetlands, aerated lagoons, flood adaptive landscapes and rainwater gardens are all concepts that work with natural forces in the development of resilient water-based urbanism and port infrastructure.

(https://www.portofantwerp.com/)

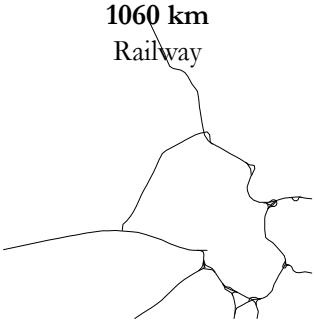
Total Port Surface (12,000 ha)



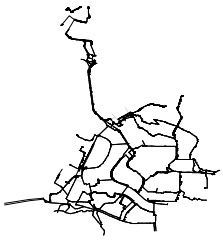
151 km
Quay Lenght



1060 km
Railway



410 km
Roads



350 km
Pipelines

5%
of Belgian GDP

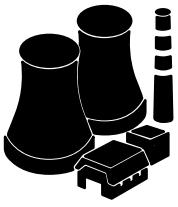
Environmental Emergencies

15% emissions of Flanders No_x

16% of Belgium CO_2 emissions

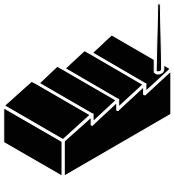
22 million of industrial waste unsorted per year

In 2018 Exceeded European limit of NO_2/m^3

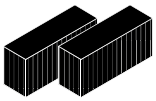


94% of water is used for the cooling towers

Economy

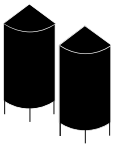


7 out of 10
Main international chemical companies

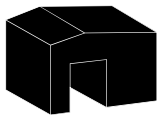


15 million TEU
Container Capacity

7,5 million m^3
Liquid bulk storage capacity



680.000 million m^3
Silo storage capacity



6,15 million m^3
Dry storage capacity

Port of Antwerp Timeline

12th century – 15th century
"The Golden Century".

Antwerp functions as a tourist and cargo port to England, Zeeland and Germany. The port can count three moorings and three docks. Storm tides provoke natural deepening of the river, seaships can access the port directly and trade booms accordingly.

At the time the city falls into Spanish hands, the port has 10 mooring jetties and eight docks, consequently the Dutch impose a blockade forcing Antwerp to decline into a purely local inland port.

1585
Closure of the Scheldt.

18th century – 19th century
"The Napoleon Era".

Napoleon Bonaparte sees Antwerp as a strategic outpost in the war against Britain and decides to expand building new docks and shipyards.

1811
Construction of the first dock, later renamed "Bonaparte dock".

1813
Construction of the "Willem Dock".

The available length of quay expands six-fold and the volume of exports too. The Red Star Line shipping company starts operating and eventually will carry two million emigrants from Antwerp to America. The other main field is semi-finished iron and steel products.

1860-1890
The growth

1863
Abolition of Scheldt toll.

On 16 July, a deal between Belgium and The Netherlands, revokes the toll imposed by the Dutch and the Scheldt is open again to commercial shipping once more. Development takes off until the point where the port reaches 1 million tonnes of freight in five years.

1907
Construction of Haven dock and Royers lock

1928
Construction of Van Cauwelaert lock, Leopold dock and Hansa dock

20th century

The Scheldt quays are straightened (1875-1911), the "fleets" are filled in and the northbound expansion continues with the construction of new locks. The transport towards the hinterland happens mainly by rail and barge.

1929
25 million tonnes of freight. (breakbulk)

1900-1930

The First World War only temporarily interrupt the activities and does not impact the strong growth in freight volume. Antwerp is at this point the third-largest port of Europe: handling facilities are built and the first industrial companies set up here, establishing the port as a world-reknown distribution centre.

The port of Antwerp certainly played an important role in the Second World War as it was equipped with modern facilities and well connected to the hinterland. After the conflict, the port quickly grew into the largest modern petrochemical cluster in Europe.

1945-1964
After Worl War II

1948
Marshall Plan

The "Marshall" dock was specially designed to handle petroleum products. As a result of this, the rising volumes of oil imports account for half of the growth and other imports for one quarter.

1951
Construction of Petroleum dock

1960's
Modern Era

The port activities are radically changed by the new developments in transport technology and handling of goods (standardised loads and containers).

Thanks to the investments provided by the Ten Years Plan of the Belgian government, the port doubes the volume of docks by rapidly expanding to the North along the Right bank as far as the Dutch border.

1956-1965
Ten Years Plan

1964
50 million tonnes of freight

1966
Big boxes

Container ships make their appearance: *Gylsen Stevedoring,* the freight-handling subsidiary of the Belgian national shipping company, unloads the first container with 43,820 boxes, or nearly 300,000 tonnes of containerised freight.

1967
Construction of Zandvliet lock and Canal docks B1, B2 and B3

1970's

From the 1970s, the port starts to expand on the Left bank.

The container volume alone quadruples, bringing out the necessity of deepening the Scheldt and building terminals to accomodate bigger ships.

1980's

1990
The Europa terminal is officially inaugurated.

The Europa terminal is the first of two tidal terminals expansions. The possibility of avoiding the locks saves time thus directly impacts the freight volume.
The second round of deepening allows ships with a draught of 11.9 m to sail the Scheldt despite the level of the tide.

1994-2004
The port returns to the Scheldt

1997

The North Sea terminal starts operating, Antwerp Port Authority becomes an independent municipal company.

1994-2004
The port "returns" to the Scheldt

2004
150 million tonnes

2004 - 2015
2nd Port in Europe

The port of Antwerp grows by 50 million tonnes of freight volume over a period of ten years, becoming the second-largest port in Europe. The port community is now starting to plan for a sustainable development of the port.

2005
Inauguration of the Deurganck dock

The opening of this new tidal dock is fundamental for the port, as this 2.6 km long and a 450 m wide dock can manage the latest generation of giant container carriers.

Scheldt Estuary Development Outline

Four treaties are agreed upon between Flanders and the NL: the first about the deepening of the river, nature conservation projects and flood safety measures; the second on collaborative policies for the estuary; the third for the joint shipping traffic control and last on respective pilotage fees.

2006
Rail Master Plan

The Port Authority continues developing initiatives, like the construction of the Liefkenshoek rail tunnel crossing the river and connecting the port area on the left bank to the eastern hinterland. The total length of this new rail connection is 16.2 km, with 18 million tonnes of freight annually moving by rail.

2007
Barge Master Plan

The Barge Master Plan consists of around 20 projects. The Flemish government raises the bridges of the Albert canal in order to facilitate the transport of higher barges with containers. Barge and rail inland transport benefits mobility and is more environment-friendly.

2010
Deepening of the Scheldt completed

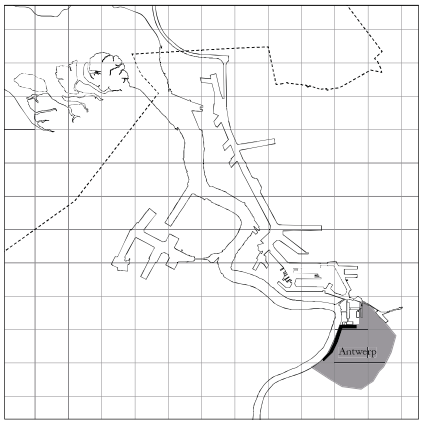
2011
Second lock on the Left bank

Construction starts at the head of the Deurganck dock, of a new lock. This infrastructural project is crucial for the Flemish government to keep pace with the growth of the port. Liquid bulk in particular is increasing, demonstrating the success of the strategy of converting the former breakbulk sites into tank storage.

2015
MSC Zoe

The MSC Zoe, the largest container carrier in the world, moors in the Deurganck dock.

2020



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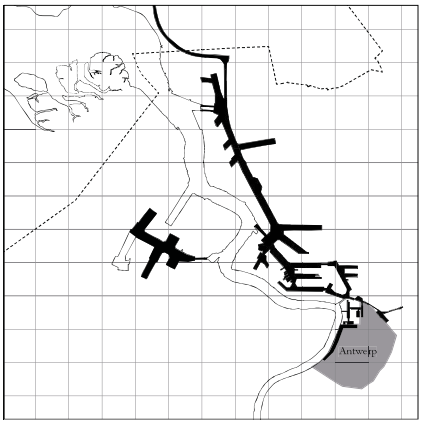

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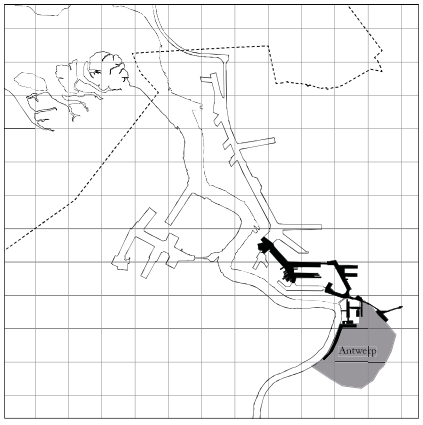

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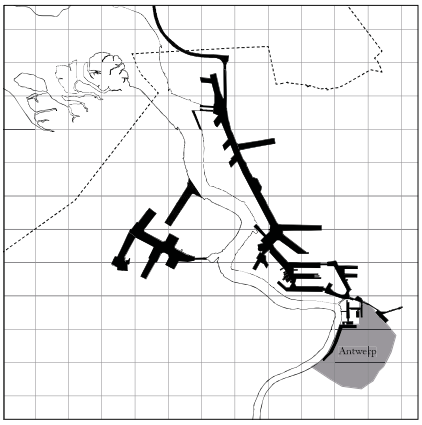

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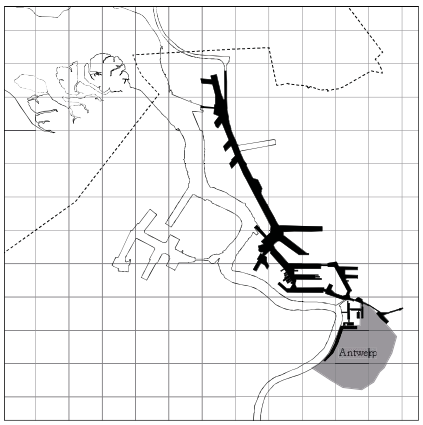

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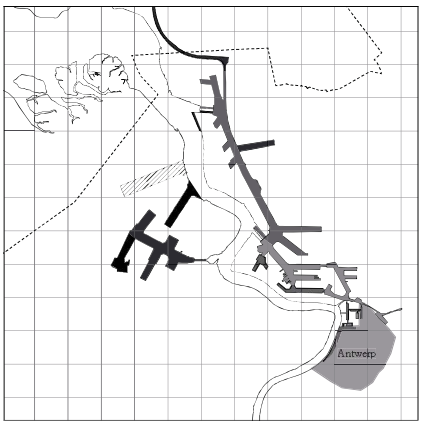


6.

Port of Antwerp

Distribution

Industry

Cargo Handling

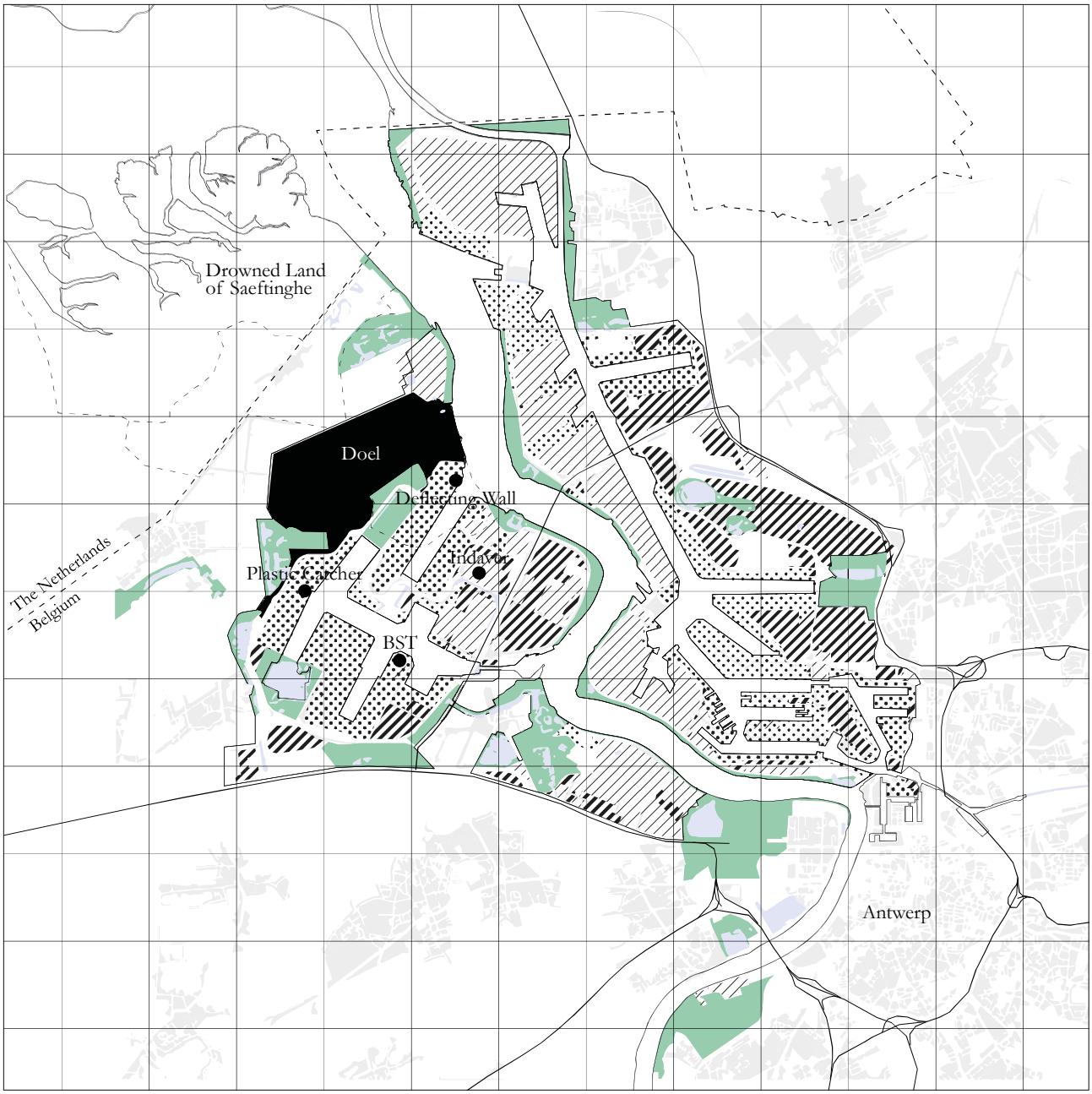
New Port Expansion

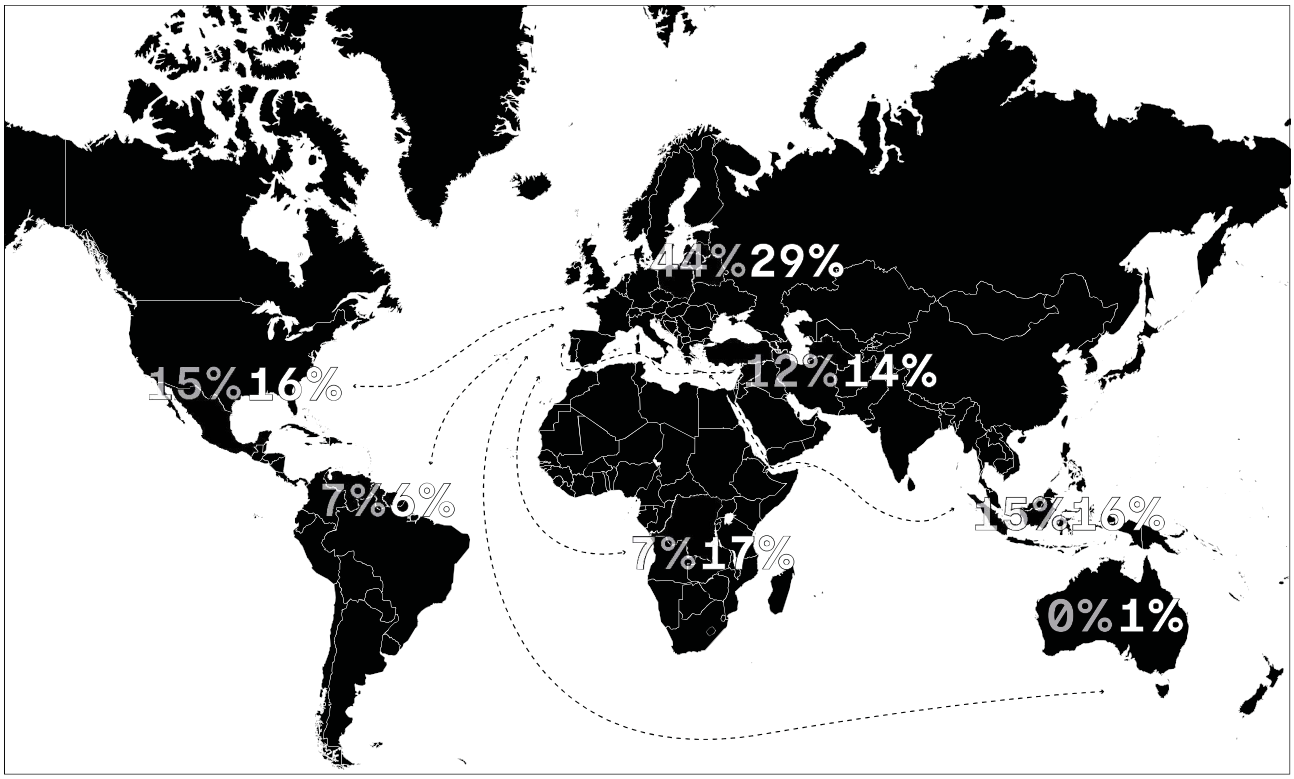
Green Areas

Inland Waters

Port History:

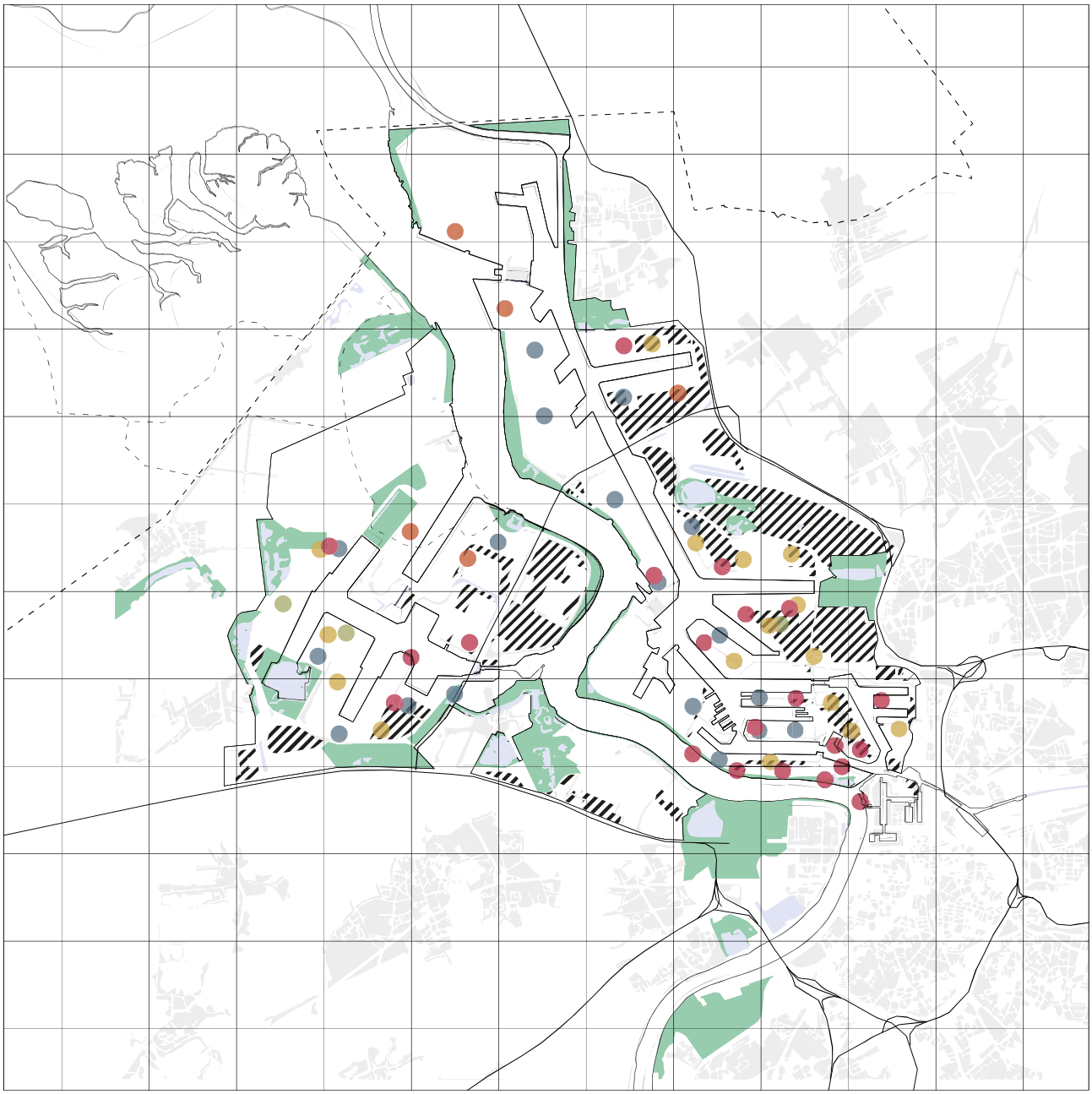
1. Old River Port: Before 19th Century
2. Renovation of Old Port: 1811 - 1930
3. Marshall Plan Expansion: 1951 - 1965
4. Waaslandkanaal + Delwaidedok: 1970 - 2000
5.Deurganckdock + Verrebroekdok: 2000 - 2010
6. Current State


Drowned Land
of Saeftinghe
Doel
Deflecting Wall
Indaver
Plastic Patcher
BST
The Netherlands
Belgium
Antwerp



Port of Antwerp - World Level Infrastructure

The port is administered by an autonomous municipal body with a separate corporate identity, called Antwerp Port Authority. The corporation owns the docks, including port's equipment, and the industrial sites on the Right Bank while is responsible for the management of the port on the Left Bank, to ensure the application of uniform policies on both sides of the river. General land development and industrialisation on the Left Bank is in the hands of an intermunicipal corporation, while the Port Authority is responsible for planning, modernising and maintaining the infrastructure of the port, and for operating its own equipment, including floating cranes, shore cranes, tugs and dredgers. The Antwerp Port Authority then leases sites and land.



Containers
Rolling
Dry bulk
Breakbulk
Liquid bulk

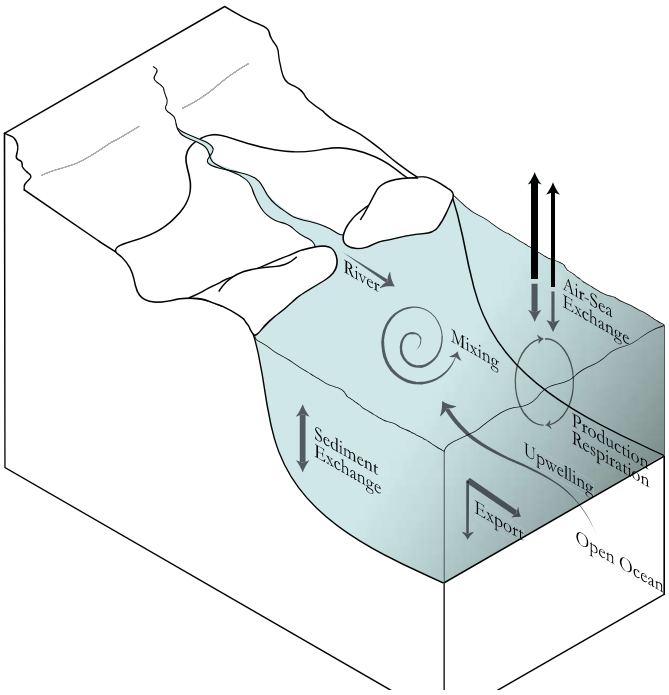
Port Authority (public)
Management of Territory:
• investments
• concessions
Management of Infrastructure:
• docks, quays
• bridges, locks
• land
Trade facilitation
Vessel traffic management
Marketing & Branding

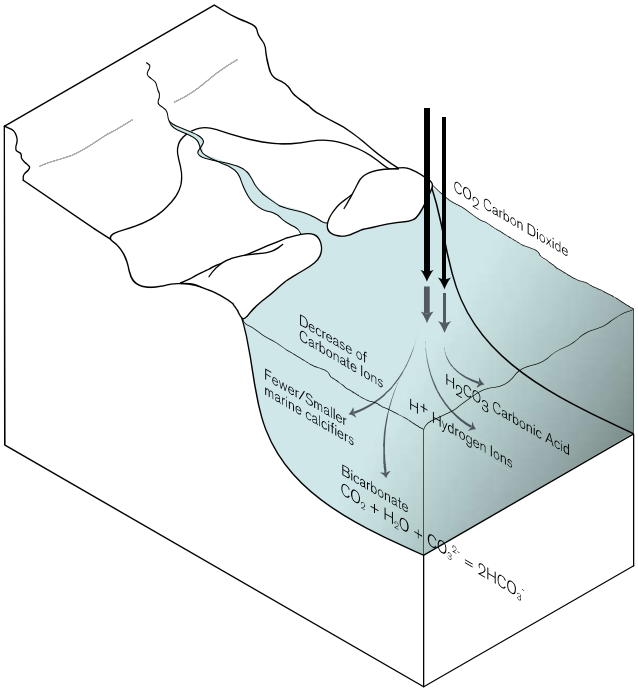
Port companies (private)
Management of superstructures:
• terminals
• cranes
• equipment
• warehouses
Handling of the cargo

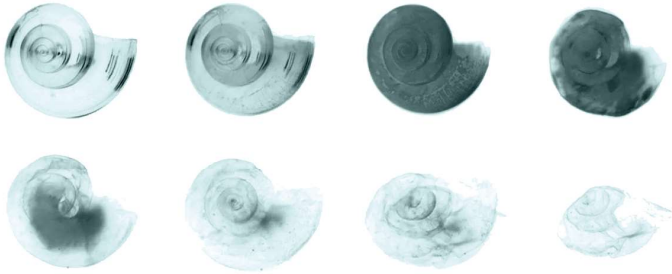
Impacts of a Port on the Habitat

	CAUSES	CHANGES	IMPACTS	SOLUTIONS
MORPHOLOGY	Breakwaters Dikes Docks	Habitat Loss New Habitat Artifical Habitat	Lower Recruitment (Nursery) Change In Trophic Balance Fragmentation Of Ecosystem Decrease Of Connectivity	Eco-Engineering
		Dredging	Currents-Sediments Relation Property Of Sediment Chemistry And Turbidity Disturb To Benthic Material	Disposal in Strategic Site Based On The Quality of Material
CHEMISTRY	Oil Spills Litter Spills Grease Spills	Water Pollution	Eutrophication Sediment Re-Suspension Harmful Algal Blooms Mortality Of Shellfish, Fish, Marine Mammals Or Seabirds Loss Of Commercial Fish Human Poisoning	Eco-Friendly Sand Extractions Mitigating Measures Strong Legislation
	River Mounds Sea Pollution Industrial Processes	Contaminated Sediment	Undermine Reproduction Of Sea Snails Damage On The Benthic Community Effects On Biodiversity Of The Coastal Ecosystem	Biomarkers to Assess and Prevent Potential Risks
	Marine Trasport Rail Traffic Industrial Sectors Port Operations	Air And Noise Pollution	Ocean Acidification (From Dust, Gasses, Metals) Effects On Marine Mammals (Stress, Change Of Behaviour)	Modification of Transport Low-Sulphur Fuel Greener Design Sound Mitigation
BIOLOGY	Ballast Water Hulls Of Ships	Introduction Of Alien Species	Indirect Effects Inter-Species Invasions Of Estuarine Habitats Increase In Biodiversity Potential Pathogens	Strict Rules New Antifouling Methods Water Treatment Techniques To Prevent Biofouling

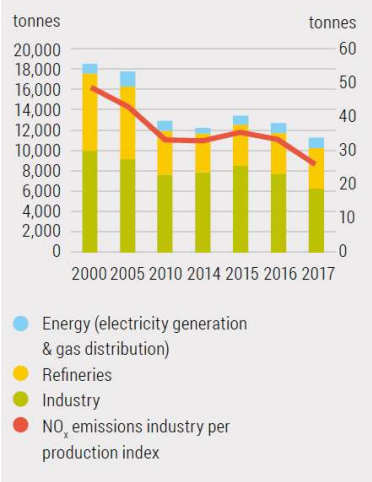
Ocean Acidification & Carbon Cycle





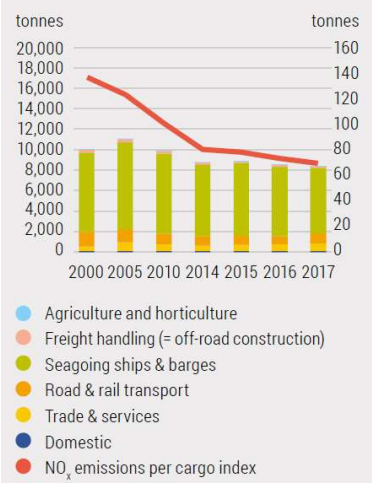


Estimated emissions of nitrogen oxides (NO_X by the energy, refinery and industrial sectors)
Right-hand axis: NO_X emissions per production index



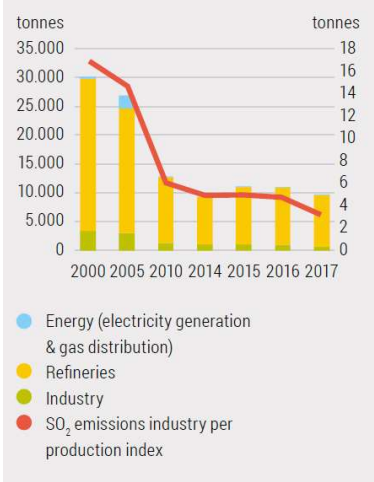
Source: VMM; source production index: Voka Chamber of Commerce Antwerp-Waasland

Estimated emissions of nitrogen oxides (NO_X by the other sectors)
Right-hand axis: NO_X emissions per production index



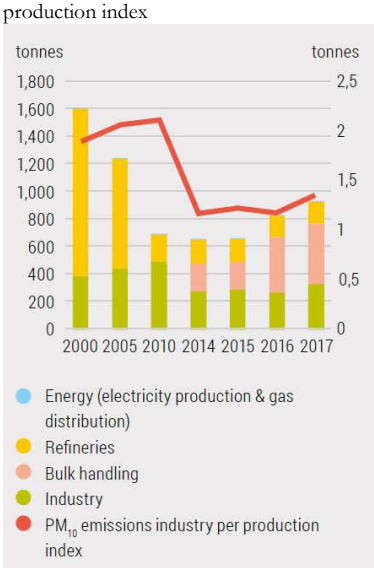
Source: VMM; source cargo index: Antwerp Port Authority

Estimated emissions of sulphur oxides (SO_2 by the energy, refinery and industrial sectors)
Right-hand axis: SO_2 emissions per production index



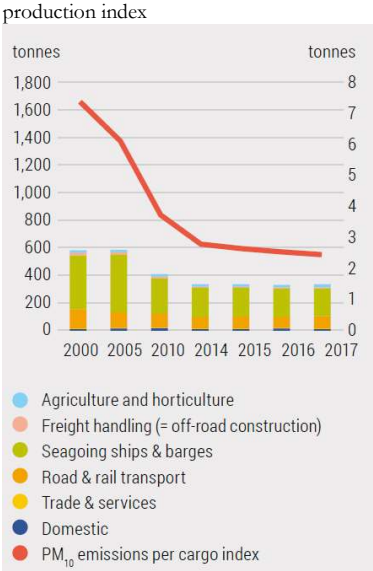
Source: VMM; source production index: Voka Chamber of Commerce Antwerp-Waasland

Estimated emissions of particulates (PM_{10} by the energy, refinery and industrial sectors)
Right-hand axis: PM_{10} emissions per production index



Source: VMM; source production index: Voka Chamber of Commerce Antwerp-Waasland

Estimated emissions of particulates (PM_{10} by the energy, refinery and industrial sectors)
Right-hand axis: PM_{10} emissions per production index

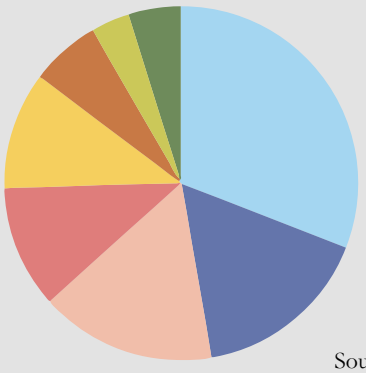


Source: VMM; source cargo index: Antwerp Port Authority

Running average of water quality in the Antwerp docks, compared to the norms

Source: VMM

Relative Proportion of collected industrial waste types in the Port of Antwerp



	tonnes
Industrial residual waste	**22,608**
Grade A wood	**10,604**
Ferrous Metals	**10,358**
Paper/Cardboard	**7,976**
Grade B wood	**6,754**
Plastic Foil	**4,422**
Hard Synthetics	**2,951**
Other collected flows	**2,951**

Source: Valipac

Other sustainable initiatives according to the Annual Sustainability Report of the Port of Antwerp are:

Projects
- "Ecluse" steam and pipes network
- "Blue Gate Antwerp": water-related business park
- "Large Scale Rain-water Installation"
-"Hydroturbines"
- "CCUS" project: carbon capture & utilization
- "Zero Pellet Loss" initiative to avoid plastic in water
- "Scrubbers: degassing facilities"

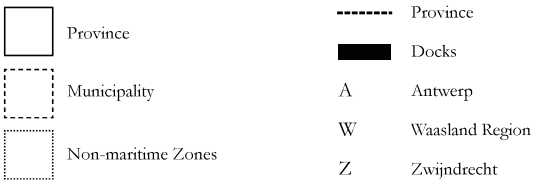
Transportation
- "DeWater Bus"
- Hydrogen Boats
- Green Ships Reward

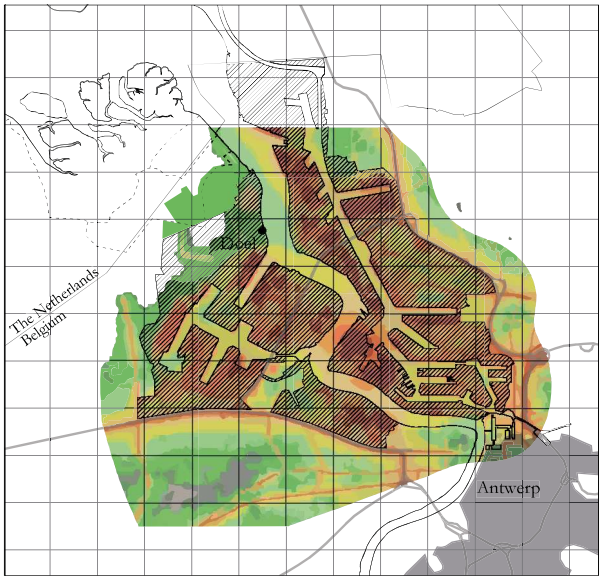
Implantations
- Indaver waste management and treatment
- "Belgian Scrap Terminal" in Kallo

Port of Antwerp

1. Noise Pollution
2. New Expansion

3. Municipality

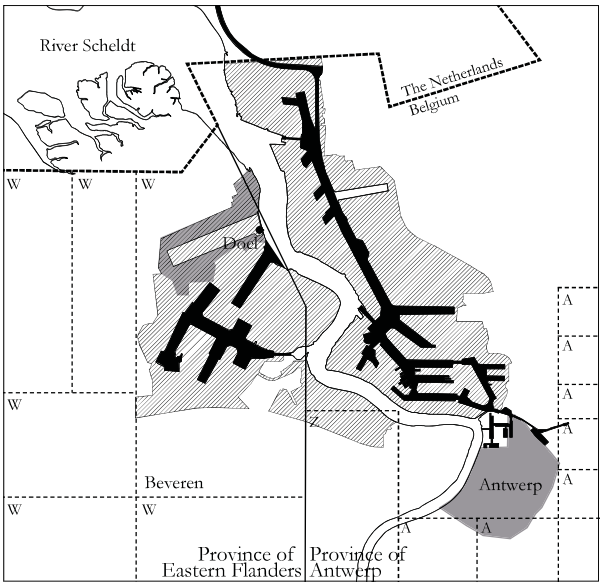



Doel
The Netherlands
Belgium
Antwerp

1.


Hedwigepolder
Doelpolder
Prosperpolder
Doel
The Netherlands
Belgium
Antwerp

2.


River Scheldt
The Netherlands
Belgium
W
Doel
A
Beveren
Antwerp
Province of Eastern Flanders
Province of Antwerp

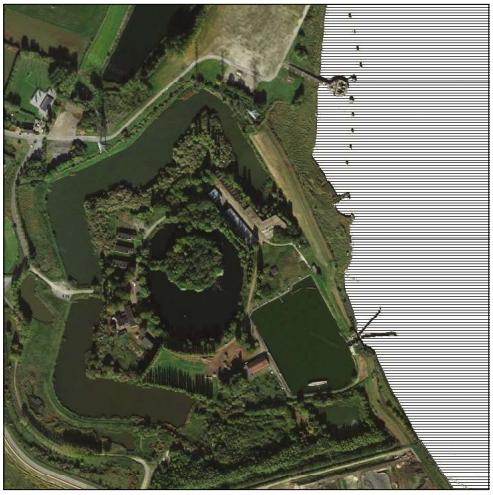
3.

Infrastracture of the Port

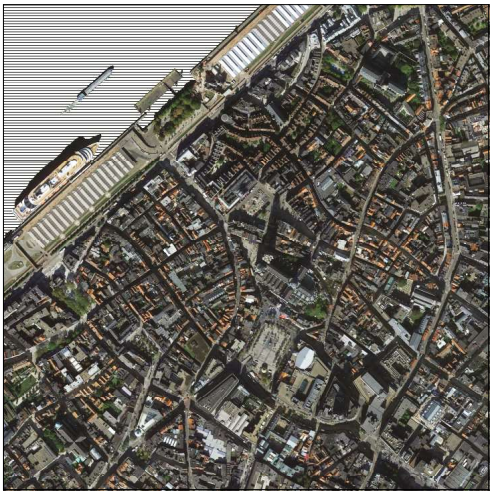
Suburban

Urban

Suburban

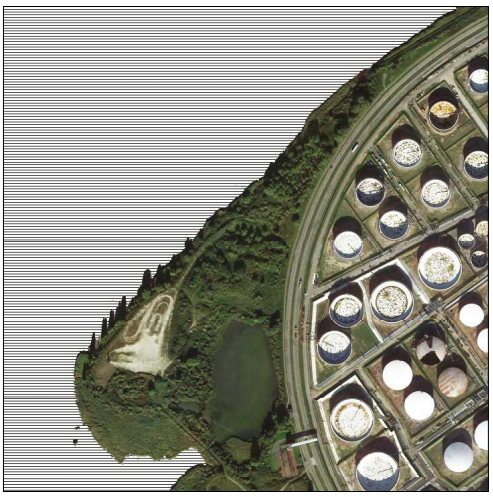


Scheldt



Urban

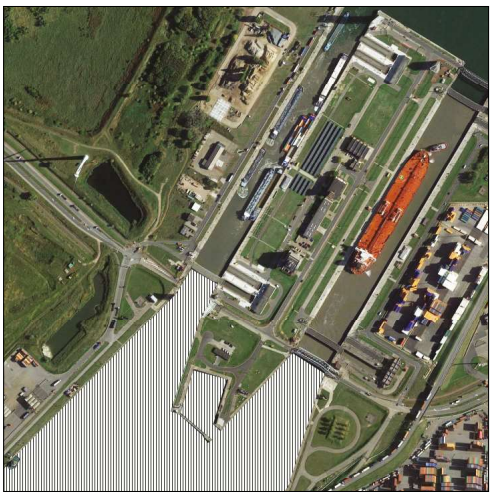
Industrial



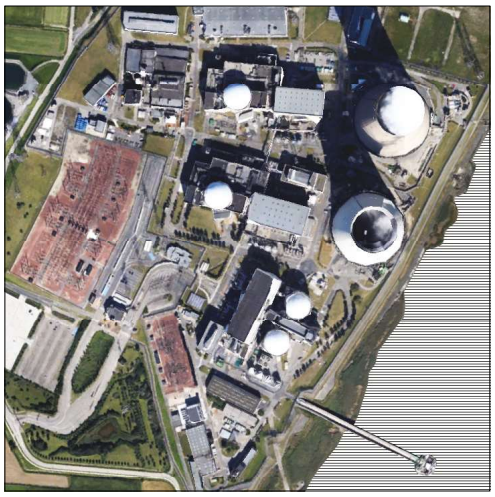
Industrial

Rural

Infrastructural



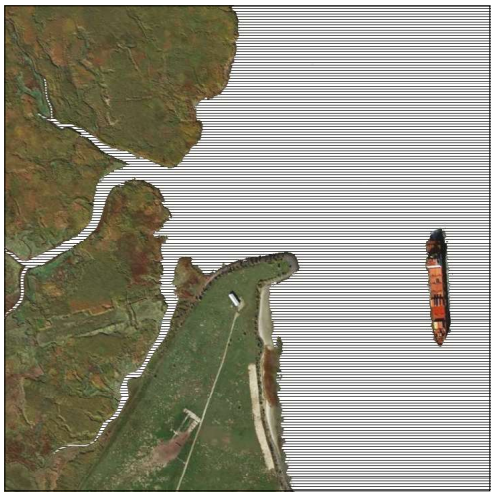
Industrial



Scheldt

Industrial

Natural

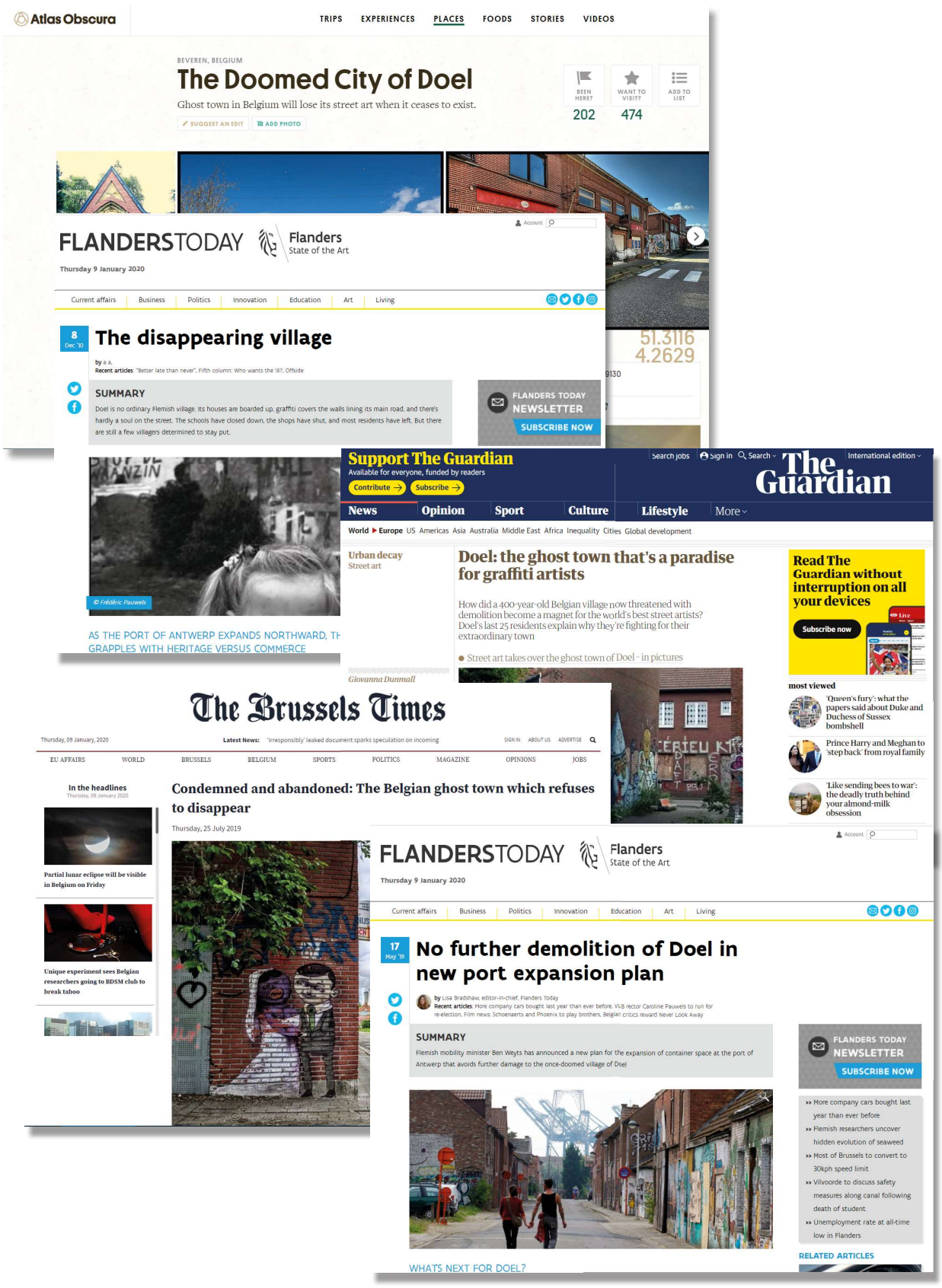


Agricultural

c. Doel

Over the last five decades, the Port of Antwerp has been expanding towards north by engulfing the natural habitat of the Scheldt estuary and the former polder-land near the national border. The process of expansion took place first on the right bank until the border with the Netherlands and subsequently on the left bank, to the point that at the present time, the port is threatening the survival of the town of Doel: the private company Lso acquired the whole area and started the process of forced leave for its inhabitants as the town was the appointed venue of the next port expansion. As planned in 1975, this further development provided the demolition of the whole settlement and the excavation of a new massive dock ("Saeftinghe dock") instead. As a consequence of this political-economic and infrastructural pressure, the village was abruptly abandoned and turned into a ghost town with only 25 inhabitants left, from 1300 living here during the '70s.

The association Doel 2020 (founded in 1998) has always been legally fighting to avoid the bulldozing of the town and promoting initiatives and projects for its revitalization. In 2019, after years of trials and lawsuits, the government proclaimed the cancellation of the expansion project of the port, guaranteeing the survival of the town, but what is left today is a post-apocalyptic hamlet squeezed between the dikes, the cranes and the chimneys, mostly used by graffitists as an en-plein-air museum.



Doel Chronicles

Doel is the last of the Belgian polder-villages on the left bank of the Western Scheldt. It was reclaimed from the river in the 17th century as an island surrounded by seawalls and purposefully flooded land, and then transformed into a polder. For the last two decades, this 400-year-old village has been fighting for survival against the economic and the infrastructural pressure of the Port of Antwerp: the village was in fact meant to be destroyed to clear way for another gigantic dock according to a project of expansion which was planned from the Sixties. Since then, the Port Authority state-funded corporation has been expropriating and buying properties at a price sometimes 3 times higher their real estate value. Moreover, because of the economic interests behind the dispute between Doel survival and the Port expansion, very little was done by the authorities in the last decades to prevent the town from the continuous looting and arson actions. In 1997, the only 350 villagers left founded the group Doel 2020 with the aim of ensuring the long-term existence of Doel by turning it into an open-air graffiti museum. Through this association, the few left inhabitants have been battling to preserve the village, which still today features lush nature, culture and precious heritage: the first stone-mill in Belgium and a listed early 17th-century house that belonged to Peter Paul Rubens's family. After years of legal battles and uncertainty, in May 2019, the Flemish government announced that it had selected the so-called ninth alternative for the expansion of the port of Antwerp, which would spare Doel and propose a different strategy for the expansion of the port. Anyway, the town's fate is still uncertain today as only 25 inhabitants are left and the village feels, like photographer Virginia Mayo said "like Chernobyl without the accident".
In this future scenario, Doel would be safe and still standing within an hour cycling from Antwerp, at the end of a route passing through rows of shipping containers, cranes, and logistic centres, but it will never be the village it once was. The town is nevertheless a symbol of stubbornness, pride and resilience, it always has been since the village was created by reclaiming land from the river. Many floods and wars turned the Doelse polders into a conflict zone the same way that, over the past 30 years, the approach to spatial planning has caused a permanent uncertainty that has caused many residents to leave the villages and farms.

Doel Isolation

Waterbus

Car

Bicycle Bus

Bus 31

Doel

1. Doel Past Activities

Farms

Heritage

Services

Cafè & Restaurant

Shops

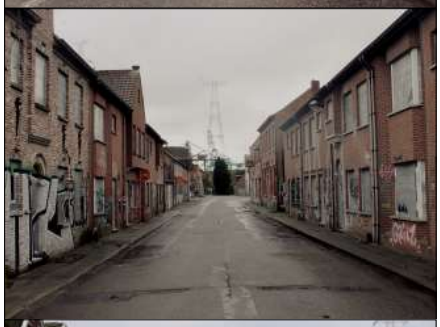
Tank Stations

2. Doel Preservation

1.

2.

Doel Photo Reportage



Desolation

Doel Photo Reportage

Graffiti

Gardens of Abandonment

Detached Houses

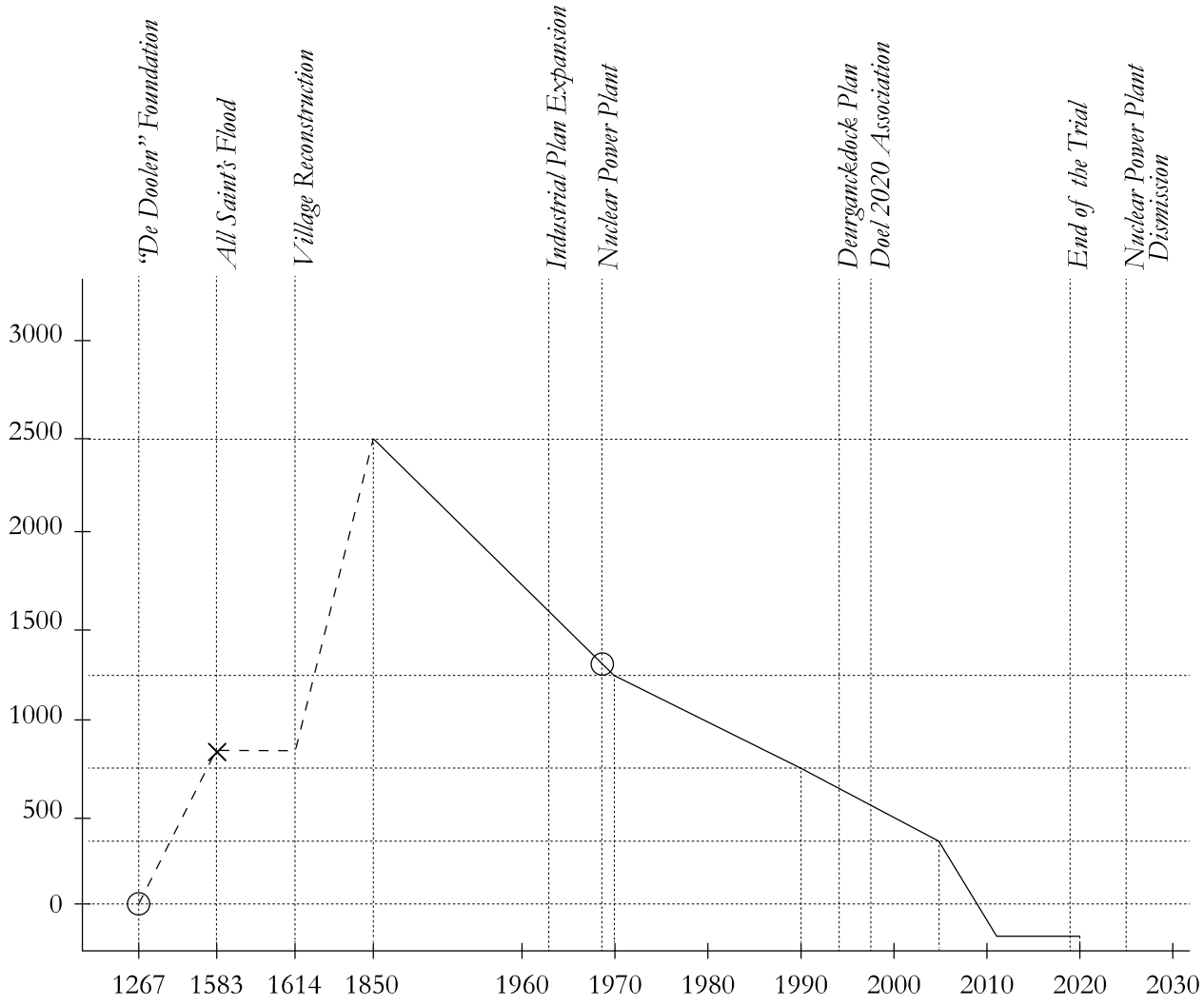
Harbour

Polder

Natural Reserve

Doel Abandonment

1267: *Village "born from the river", named "De Doolen" after the islands in the Scheldt*
1570: *Medieval Polder lost to floods (All Saint's Flood)*
1614: *Re-construction of the village and the polder forming an island*
1850: *2500 inhabitants*
1963: *First plans for port expansion, new docks and industrial grounds*
1967: *Start of expropriation process*
1969: *Nuclear Power Plant opening*
1970: *1300 inhabitants*
1975: *General Urban Development Plan for the expansion of the Port*
1990: *800 inhabitants*
1995: *Deurganckdok Plan*
1997: *Association Doel 2020 - Project of village of artists with a maritime museum*
2004: *418 inhabitants*
2007: *359 inhabitants*
2013: *28 inhabitants*
2019: *End of the trial, guarantee of Doel survival*
2020: *25 inhabitants, no shops, no school*
2025: *Nuclear Power Plant dismission*


"De Dooden" Foundation
All Saint's Flood
Village Reconstruction
Industrial Plan Expansion
Nuclear Power Plant
Deurgamckedock Plan
Doel 2020 Association
End of the Trial
Nuclear Power Plant Dismission
3000
2500
2000
1500
1000
500
0
1267
1583
1614
1850
1960
1970
1980
1990
2000
2010
2020
2030

Later, when the many beautiful memories
have taken the place of my sorrow,
I may be able to articulate
what I can now only tell with tears

d. Doel Nuclear Power Plant

In general, nuclear energy provides around half of Belgium's domestically-generated electricity and is the country's lowest-cost source of power.

As described by the wikipedia page of the Doel Nuclear Power Plant:

"*The Doel Nuclear Power Station is one of two nuclear power plants left in Belgium at the present time. The plant, which covers an area of 80 hectares, includes 4 reactors and is located on the bank of the Scheldt river, near the village of Doel, on the outskirts of the city of Antwerp.*
The station alone represents about 15% of Belgium's total electricity production capacity and 30% of the total electricity generation. Built in 1969, the plant holds the record in Europe as the closest nuclear facility to a densely populated area, with 9 million inhabitants within a radius of 75 kilometres. The plant was expected to end its lifecycle in 2015, but the shutdown of the reactors was recently postponed to 2025.

Two reactors, which started operating in 1975, were scheduled to close after 40 years of operation. However, in 2015 the Belgian government passed a law to extend the lifetime of the reactors by a decade. The Court has now ruled that law is unconstitutional, following a case brought by environmental organisation: Bond Beter Leefmilieu and Inter-Environnement Wallonie."

With a height of 176 metres, the two cooling towers are the most visible structures in the Port of Antwerp. Due to their proximity to the Dutch-Belgian border, the towers are visible even from the Dutch provinces of Zeeland and western North Brabant.

https://en.wikipedia.org/wiki/Doel_Nuclear_Power_Station

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Belgium unprepared for phasing out nuclear power by 2025: grid operator

By Dap

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Shut your nuclear plants, Germany tells Belgium

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Germany urges Belgium to shut nuclear reactors temporarily

20 April 2016

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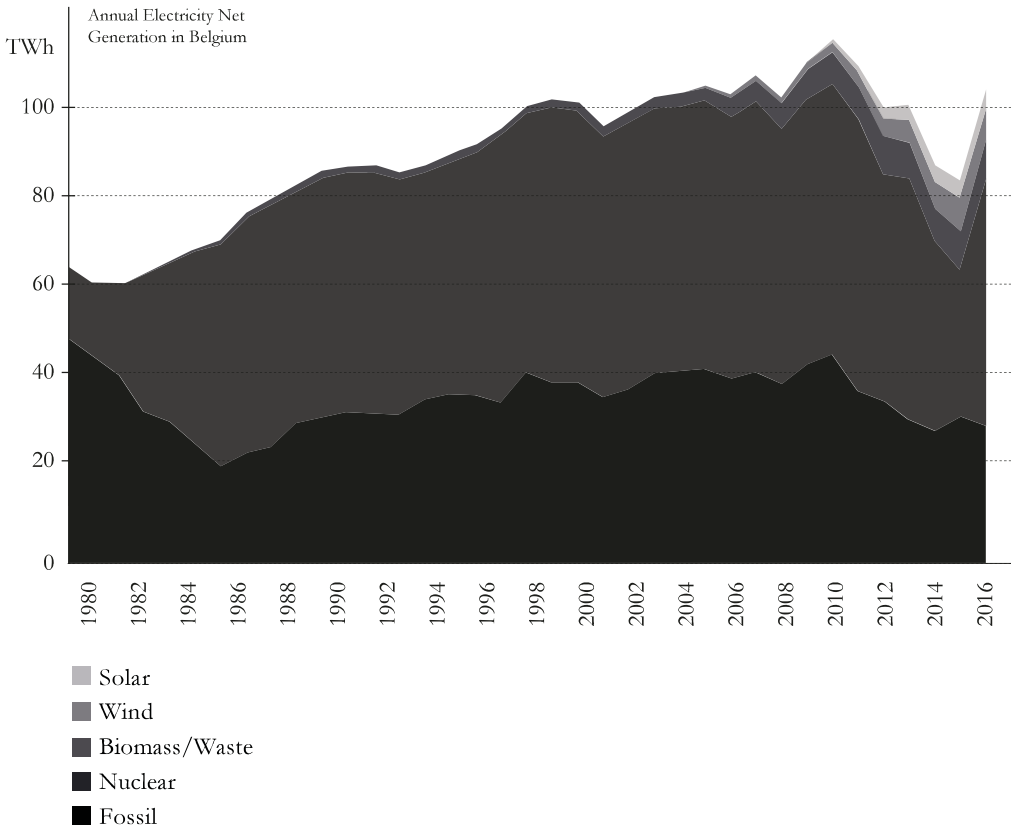
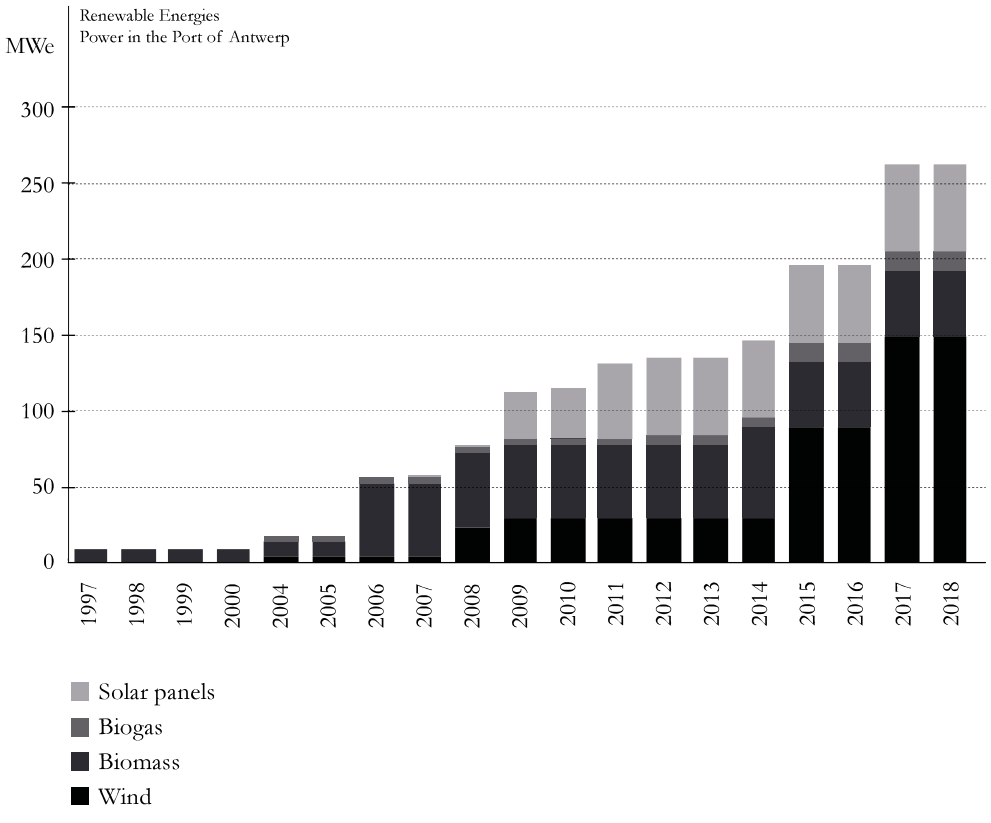
NEWS

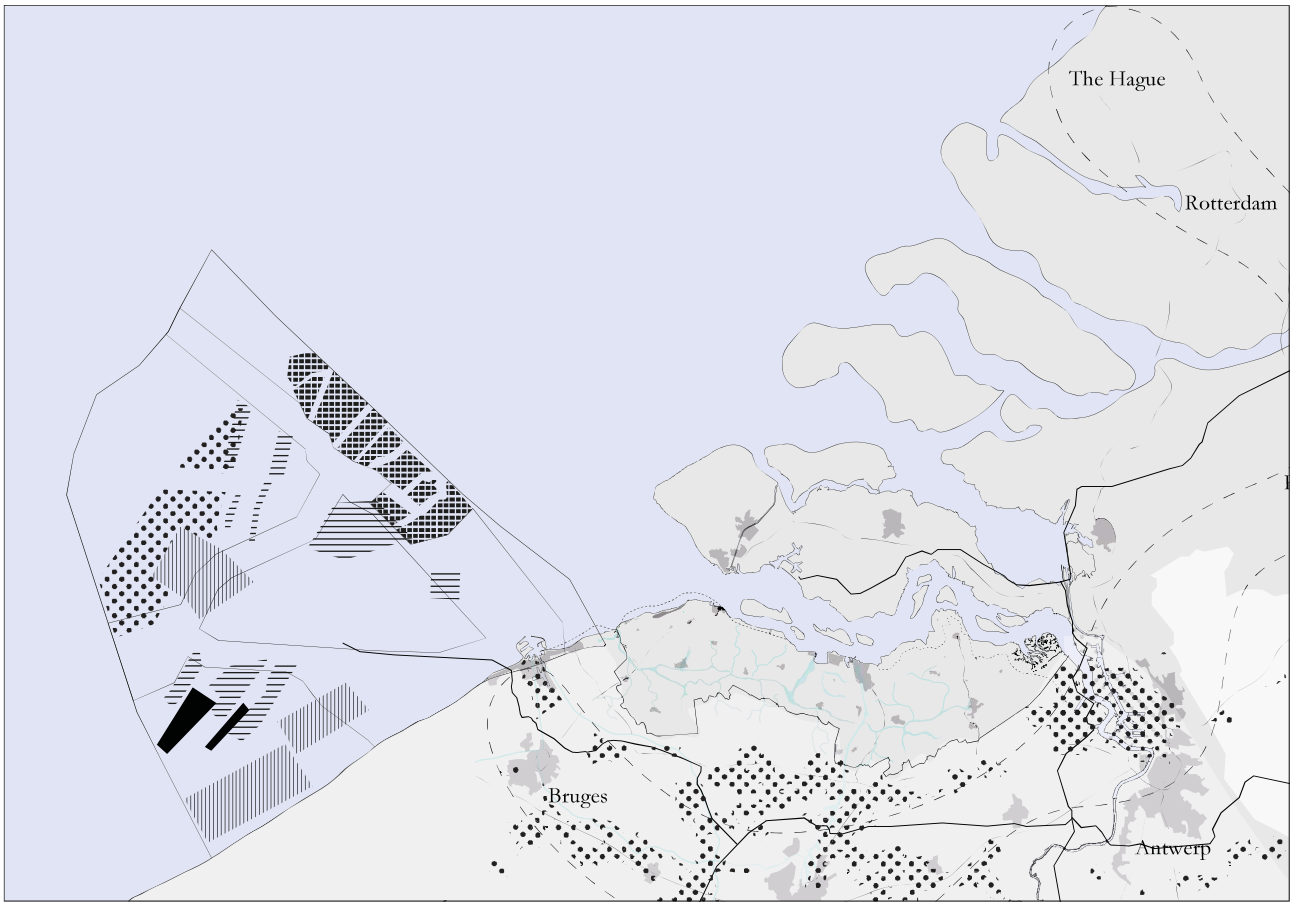
Belgium broke law but can keep nuclear plants open, EU court rules

Belgium's self-imposed deadline for giving up nuclear power is not far off. Environmentalists look forward to the end of the atomic era, but not everyone thinks the country is ready to change course.



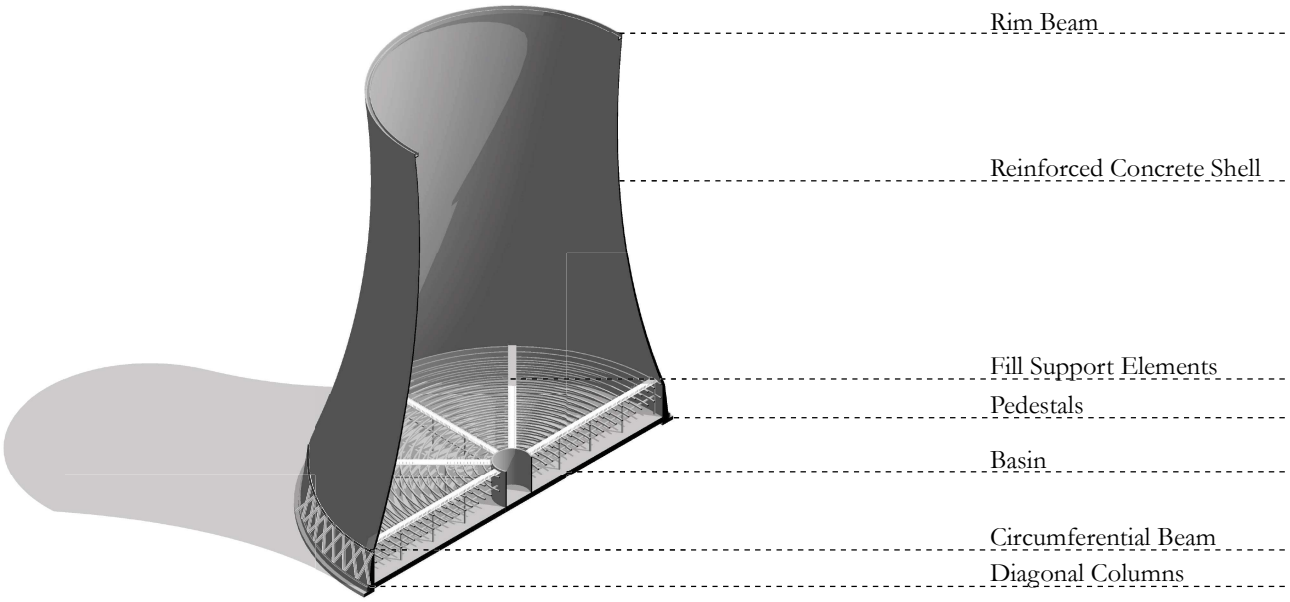


(source: VREG and Antwerp Port Authority)



Belgium Renewable Energies Plan

- Windfarms
- Exploitation Areas
- Fishing Zones
- Potential Renewable Energies
- Wave and Tidal Energy


Rim Beam
Reinforced Concrete Shell
Fill Support Elements
Pedestals
Basin
Circumferential Beam
Diagonal Columns

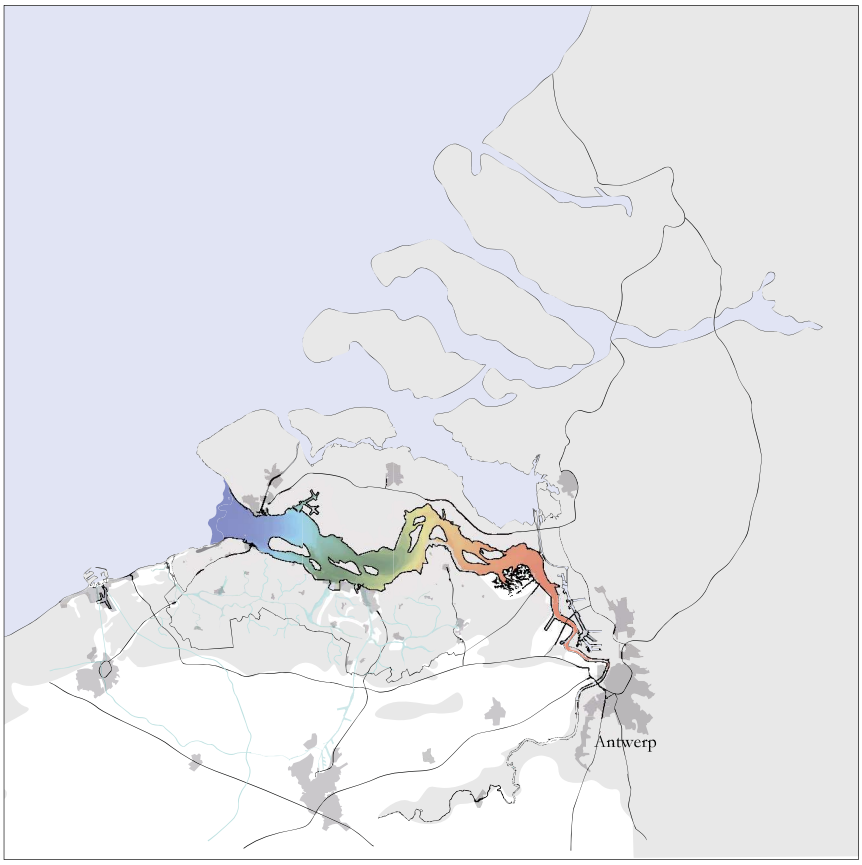
e. Drowned Land of Saeftinghe

Description as reported in the official website of the Drowned Land of Saeftinghe:

"*The Drowned Land of Saeftinghe is a large-scale, salt marsh wilderness, situated in the Scheldt estuary. As the name suggests, it used to be inhabited. In late medieval times it was a flourishing area of polders, villages, and castles, of great strategical importance for controlling and accessing the harbor of Antwerp. During the 14th and 16th centuries, heavy storm floods devoured large areas of this land making it what today is the largest intertidal area in Europe.*

Saeftinghe is a vast brackish intertidal area, covering 3600 hectares (36km2). It gives an insight into what the ancient landscape of Zeeland would have once looked like, ever-changing with the ebb and flow of the tides. The water of the Western Scheldt enters and retreats with every tide via a system of creeks. The three main entrance creeks branch out into Saeftinghe, forming a dense network of smaller creeks and gullies, allowing tidal water to extend all the way to the seawall. The Western Scheldt is an estuary, where the fresh water of the River Scheldt mixes with the saline water of the North Sea – this is what makes the water of the Western Scheldt brackish."

https://www.saeftinghe.eu/en/landscape-and-history



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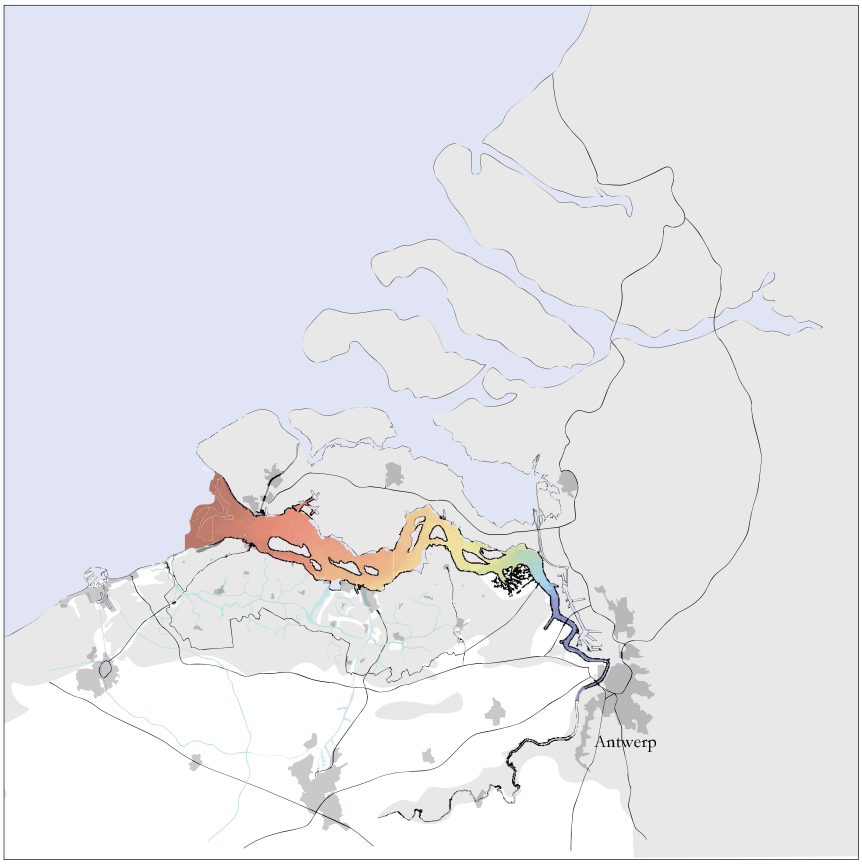


2.

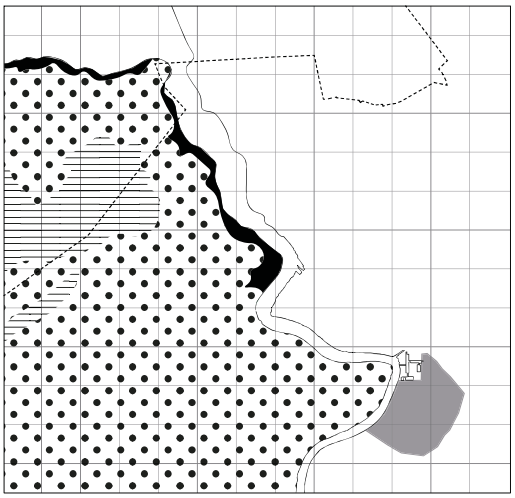
Waasland History & Evolution

Peat/Swamp

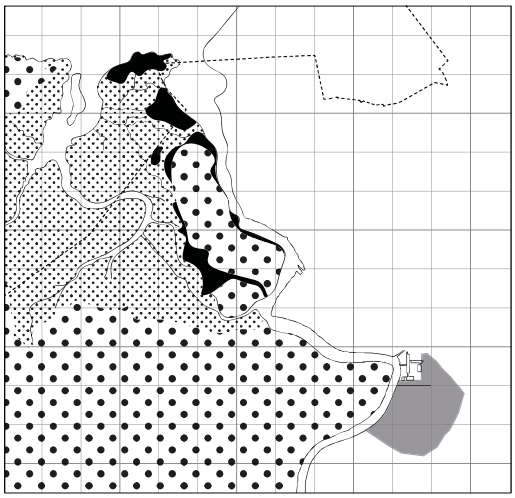
Embankment

Salt Marsh

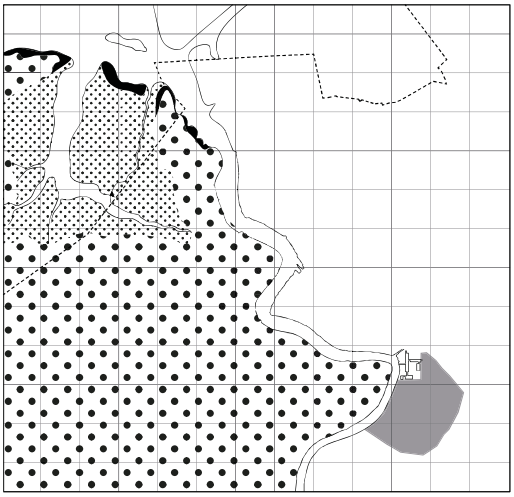
Mudflat



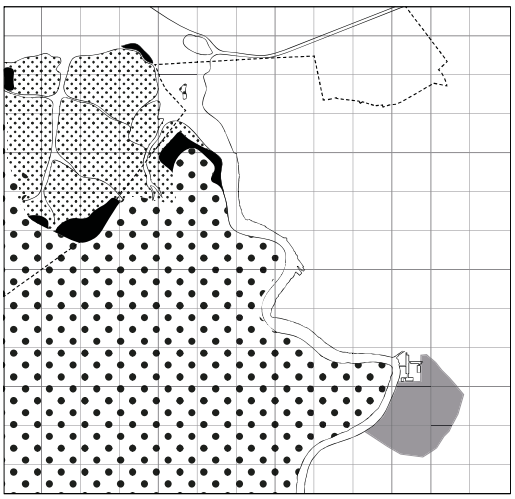
1570



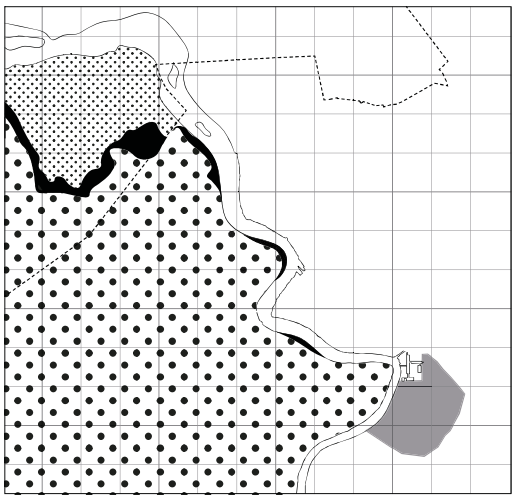
1625



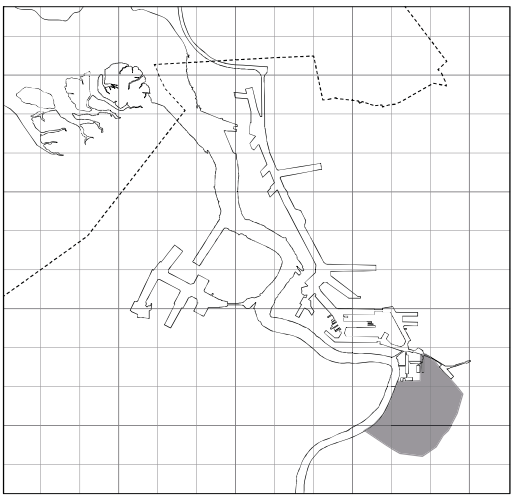
1690



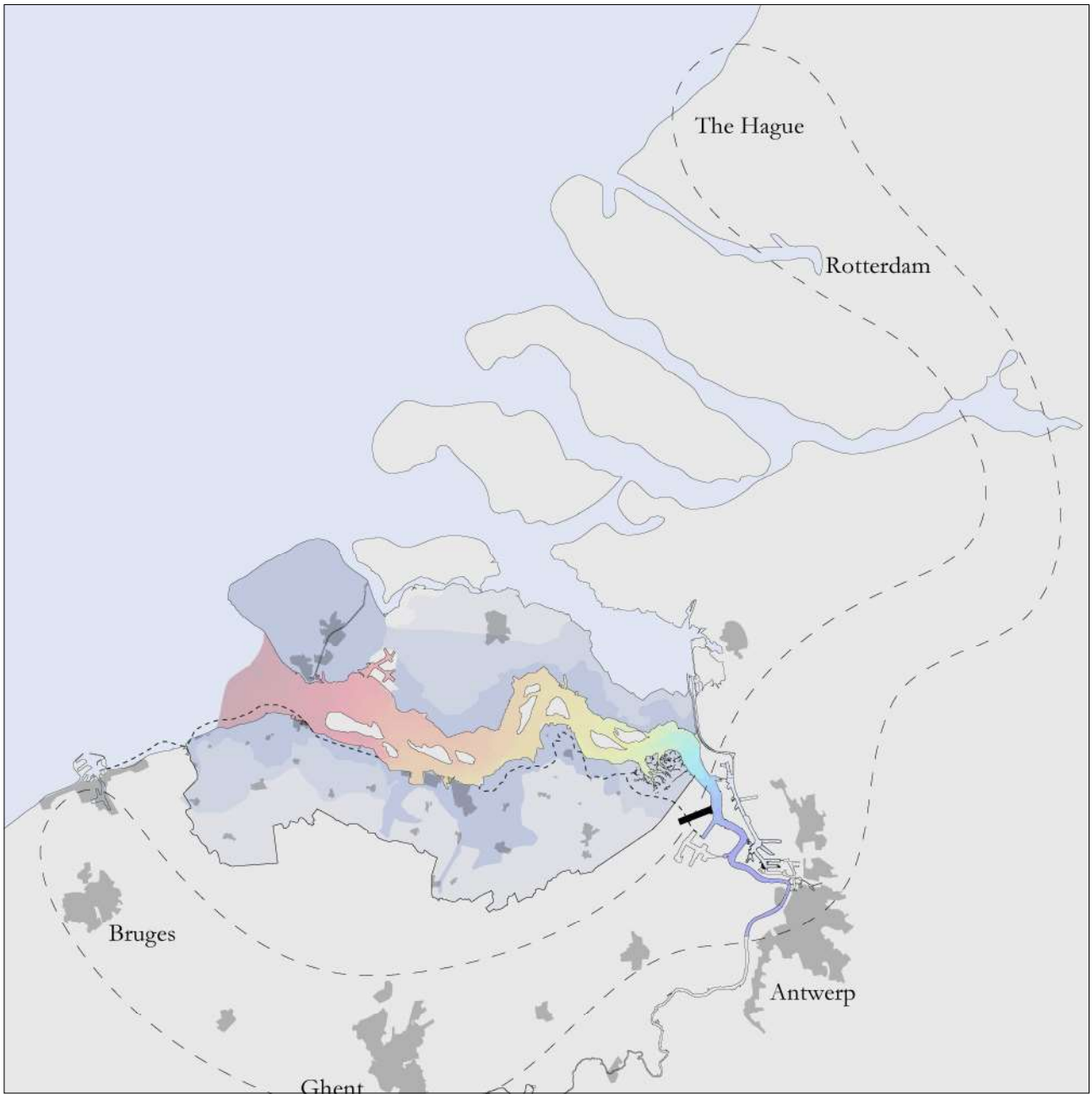
1790



1850

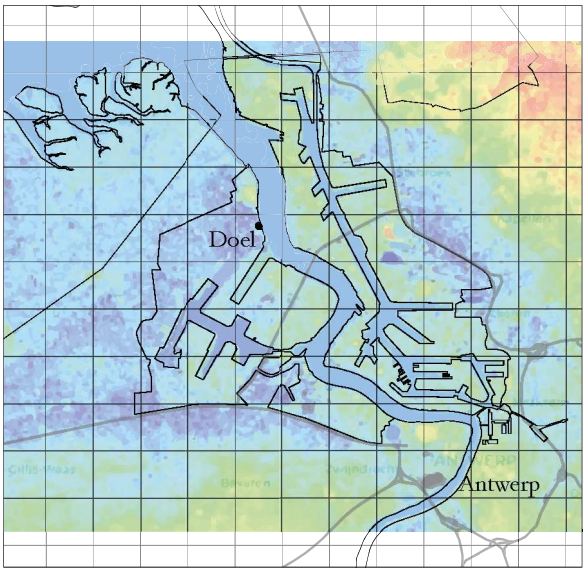


1950



Scheldt Hazards

1. Elevation Map
2. Sea Level Rise
3. Green Infrastructure



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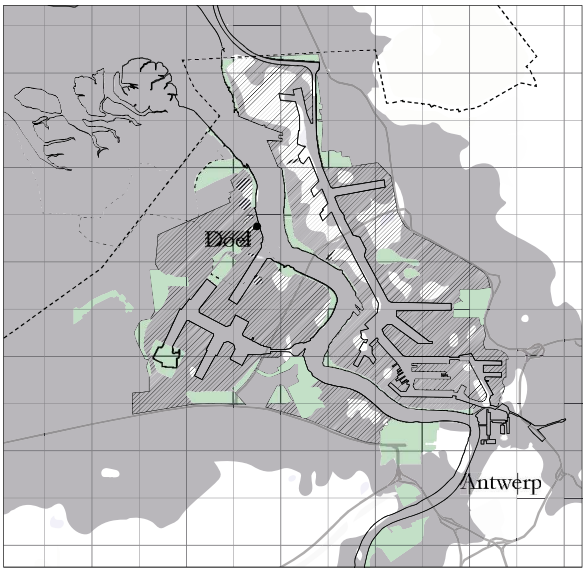


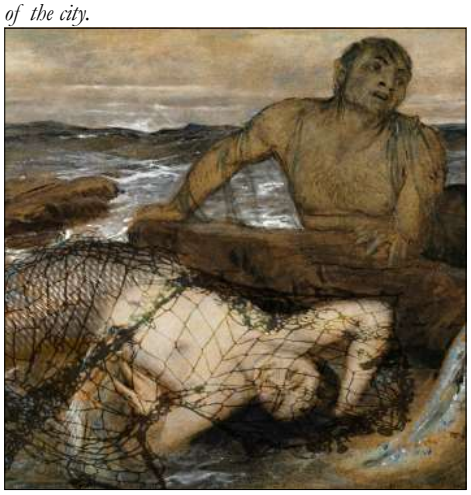
3.

Legend of Saeftinghe

Saeftinghe used to be the most prosperous town on the banks of the Scheldt, its inhabitants were dressed in silk and the city was decorated in silver and gold.

Because of its wealth, people of Saeftinghe grew vain and proud, their hearts corrupted by greed to the point where they casted out the immigrants attracted by the wellness of the city.

One day during a fish expedition, a fisherman accidentally caught a mermaid. Despite her warning the inhabitants to change their ways and lifestyle, they didn't.

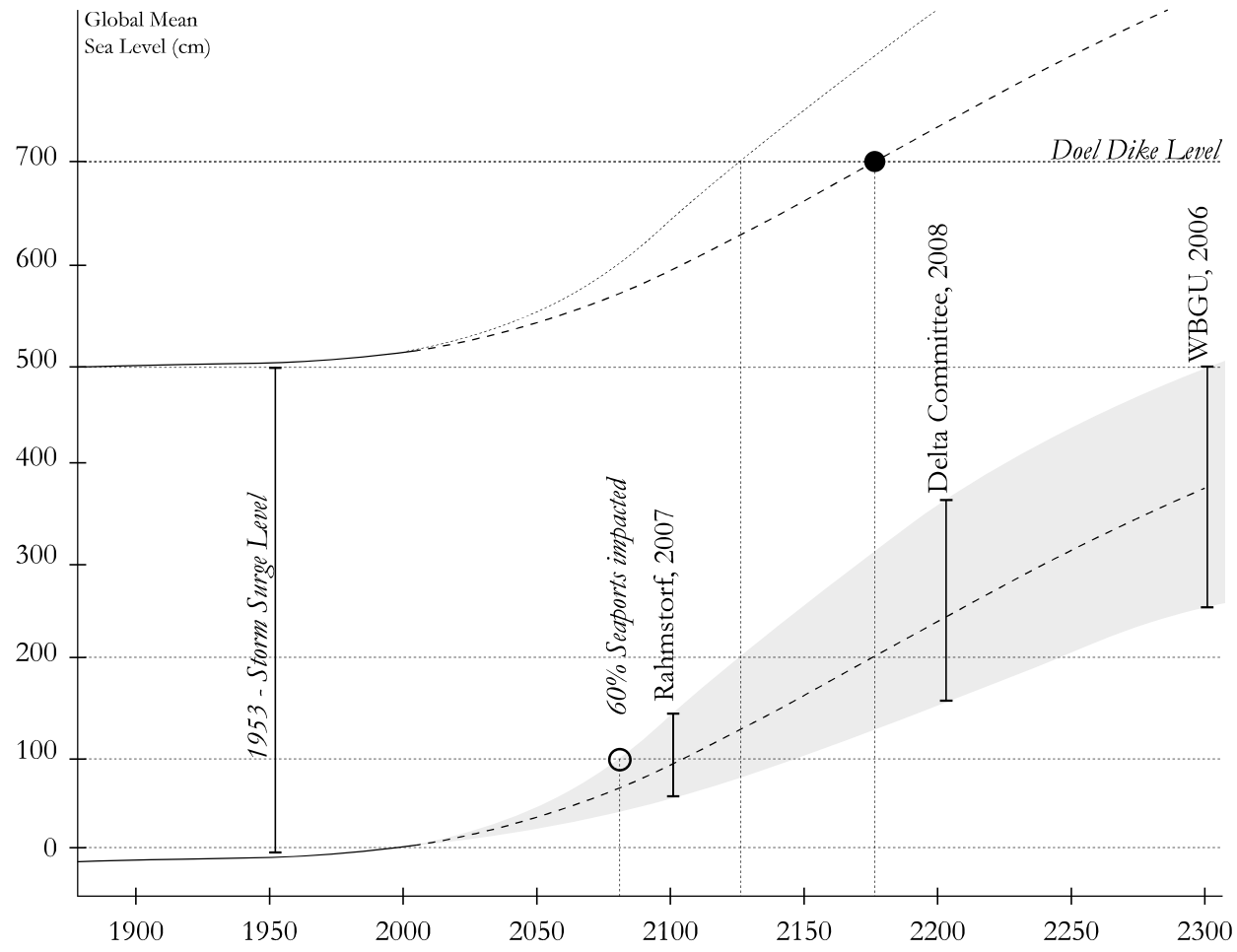


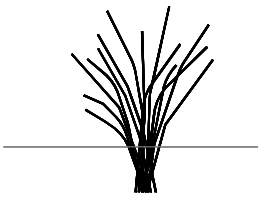
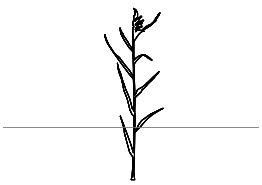
When the merman came to reclaim his wife, they refuse to set her free thus provoking him to cast a curse on them: "Saeftinghe will fall, only its towers will stand tall".

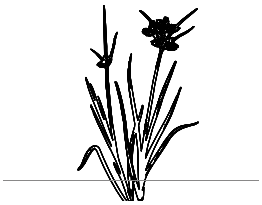
When All Saint's Flood came, the citizens had forgotten to take care of their dikes because too distracted by their cupidity and the land drowned. Only its towers were emerging from water.

On foggy days, a tower bell calls for help from the sunken town and sometimes in the fog you might see the 'ghosts' of the spirits of the inhabitants of the three towns killed in the flood.

Sea Level Rise Timeline











































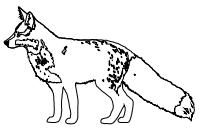













Research Report

III.

Sources & Bibliography

Bibliography

Osborn, Katherine (2017). *Seasonal Fish And Invertebrate Communities In Three Northern California Estuaries* (M.S. thesis). Humboldt State University.

Ross, D. A. (1995). *Introduction to Oceanography*. New York: Harper Collins College Publishers.

Pritchard, D. W. (1967). "*What is an estuary: physical viewpoint*". In Lauf, G. H. (ed.). Estuaries. A.A.A.S. Publ. 83. Washington, DC. pp. 3–5.

McLusky, D. S.; Elliott, M. (2004). *The Estuarine Ecosystem: Ecology, Threats and Management*. New York: Oxford University Press

Boswell, J., (2016). *Notes from the Wasteland: Competing Climatic Imaginaries in the Post-Apocalyptic Landscape*. In: Graham, J., Blanchfield, C., Anderson, A., Carver, J., & Moore, J., (2016). *Climates: Architecture and the Planetary Imaginary*, Lars Muller Publishers. pp.41-50.

Gonzàlez Vives, C., (2016). *Dehydrated Architecture*. In: Graham, J., Blanchfield, C., Anderson, A., Carver, J., & Moore, J., (2016). *Climates: Architecture and the Planetary Imaginary*, Lars Muller Publishers. pp.329-337.

Graham, J., Blanchfield, C., Anderson, A., Carver, J., & Moore, J., (2016). *Climates: Architecture and the Planetary Imaginary*, Lars Muller Publishers.

Keenan, J., M., (2016). *The Resilience Problem: Part 1*. In: Graham, J., Blanchfield, C., Anderson, A., Carver, J., & Moore, J., (2016). *Climates: Architecture and the Planetary Imaginary*, Lars Muller Publishers. pp.159-162.

Keenan, J., M., (2014). *Material and Social Construction: A Framework for the Adaptation of Buildings*. In: *Enquiry: Journal of Architectural Research*, vol.11, no.1.

Alberti, M., (2016). *Cities That Think like Planets. Complexity, Resilience, and Innovation in Hybrid Ecosystems*, University of Washington Press.

Grosz, E. (2013). *Time Matters: On Temporality in the Anthropocene: Elizabeth Grosz in Conversation with Heather Davis and Etienne Turpin*. In: Turpin, E., (2013). *Architecture in the Anthropocene: Encounters Among Design, Deep Time, Science and Philosophy*, Open Humanities Press.

White, I., & O'Hare, P. (2014). *From Rhetoric to Reality: Which Resilience, Why Resilience, and Whose Resilience in Spatial Planning? Environment and Planning C: Government and Policy*, 32(5), 934–950.

Wu, J. & Wu, T., (2013). *Ecological Resilience as a Foundation for Urban Design and Sustainability*. In: Pickett S., Cadenasso M., McGrath B. (eds) Resilience in Ecology and Urban Design. Future City, vol 3. Springer.

Images

pg.76
Diagrams belgium electricity generation, retrieved and edited by author from "*Energy in Belgium*" in Wikiwand
Diagrams renewable energies, retrieved and edited by author from Port of Antwerp Sustainability Report

pg. 86:
Master of the St Elizabeth Panels, *The Saint Elizabeth's Day Flood*, (c. 1490 - c. 1495)
Peter Bruegel the Elder, *Massacre of the Innocents* (c.1565-1567)
Collage by author from *The Fog Warning* by Winslow Homer (1885)
Arnold Bocklin, *Triton und Nereide* (1877)
Collage by author from *The Stages of Life* by Caspar David Friedrich (1835)
Collage by author from *The Stages of Life* by Caspar David Friedrich (1835)

pg. 87:
Sea level rise diagram: edited by author from https://www.declineoftheempire.com/2010/07/the-rising-sea.html

Cartography

Cartography: edited by author from Transitional Territories Studio Atlas (2019-2020)

Base Map:
EA. (2002). Soil type. Retrieved 09-10-2019, from: https://www.eea.europa.eu/data-and-maps/data/soil-type. Modified by authors in qGIS.

Bathymetry:
GEBCO. (n.k.). Global grid. Retrieved 10-10-2019, from: https://www.gebco.net/. Modified by authors in qGIS.

Floodings NL:
Nederland Waterland. (n.k.). Watersnoodramp 1953.
Retrieved 23-10-2019, from: https://sites.google.com/site/nederwaterlandje/pakketten. Image traced by authors in illustrator.

Alfieri, L., Burek, P., Feyen, L., and Forzieri, G.(2015). Global warming increases the frequency of river floods in Europe, Hydrol. Earth Syst. Sci., 19, 2247–2260, https://doi.org/10.5194/hess-19-2247-2015, 2015.

Rivers discharging into North Sea, catchment areas:
EEA. (2001). Eutrophication in Europe's coastal waters. Retrieved 12-11-19, from: https://www.eea.europa.eu › Topic_Report_7_2001

EEA. (2012). European catchments and Rivers network system (Ecrins). Retrieved 23-10-2019, from: https://www.eea.europa.eu/data-and-maps/data/european-catchments-and-rivers-network#tab-gis-data
Modified by authors in qGIS.

Qw. (2019). List of rivers discharging into the North Sea. Retrieved 10-10-19, from: https://nl.qwertyu.wiki/wiki/List_of_rivers_discharging_into_the_North_Sea

Currents, Water masses & dispersal Fluvial Waters:
Laevastu, T (1983) Scnal atlas of the marine environment .Vol 4 Am Geogr Soc, New York

Otto, L , Zimmerman, J T F . futnes, G K, Mork,
M , Saetre, R, Becker, G. (1990). Review of physical oceanography of the North Sea. Neth J Sea Res 76(2-4), p 161-238

Connolly, P. L., Kelly, E., Dransfeld, L., Slattery, N., Paramor, O. A. L., & Frid, C. L. J. (2009). MEFEPO North Sea Atlas: Making the European Fisheries Ecosystem Plan Operational. Liverpool: University of Liverpool.

ICONA (1992). North Sea atlas for Netherlands policy and management. Amsterdam: Stadsuitgeverij Amsterdam.

Seabed sediments:
Van Alphen, J.S.I.J. (1990). A mud balance for Belgian-Dutch coastal waters between 1969 and 1986. Neth.) . Sea Res. 25 (1/2), p. 19-30. Eisma, D., Irion, C. (1988). Suspended matter and sediment transport. In: Salomons, W-, Bayne, B.L., Duursma, E.K., Förstner, U. (eds.).

Anthropogenic agents:
Gill, J,. Malamud, B.. (2017). Anthropogenic processes, natural hazards, and interactions in a multi-hazard framework. Earth-Science Reviews. 166. 10.1016/j.earscirev.2017.01.002.

Waddenbied. (2019). Terpen. Retrieved 13-10-19, from: http://www.waddenzeeschool.nl/uploads/encyclopediedata/content-waddenbieb.php?template=template-waddenbieb&language=0&online=0&keep_empty_divs=0&title_inside_lead=0&edit=0&id=3180&item=Terpen

Soil biodiversity loss & intensive human exploitation:
Orgiazzi, A., Panagos, P., Yigini, Y., Dunbar, M. B., Gardi, C., Montanarella, L., & Ballabio, C. (2016). A knowledge-based approach to estimating the magnitude and spatial patterns of potential threats to soil biodiversity. Science of the Total Environment, 545, 11-20.

Timeline events:
Rijkswaterstaat (n.k.). De Deltawerken. Retrieved 02-10-2019, from: https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/waterkeringen/deltawerken/index.aspx

Maione, U., Majone-Lehto, B., & Monti, R. (Eds.). (2000). New trends in water and environmental engineering for safety and life. Rotterdam: CRC Press.

Gov.UK (2014). The Thames Barrier. Retrieved 02-10-2019, from: https://www.gov.uk/guidance/the-thames-barrier

KNMI (n.k.). Watersnoodramp 1953. Retrieved 02-10-2019, from: https://www.knmi.nl/kennis-en-datacentrum/achtergrond/watersnoodramp-1953

Mauch, F. (2012). The great flood of 1962 in Hamburg. Environment & Society Portal, Arcadia, no. 6.

Encyclopaedia Britannica (2019). Battle of Jutland. Retrieved 02-10-2019, from: https://www.britannica.com/event/Battle-of-Jutland

Encyclopaedia Britannica (2019). The war at sea, 1914-15. Retrieved 02-10-2019, from:
https://www.britannica.com/event/World-War-I/The-war-at-sea-1914-15

Tucker, S.C. (2016). World War II: The Definitive Encyclopedia and Document Collection. California: ABC-CLIO

NorthSee (n.k.). The history of shipping of the North Sea. Retrieved 02-10-2019, from: https://northsearegion.eu/northsee/s-hipping/the-history-of-shipping-of-the-north-sea/

Officer of the watch (2013). Alexander L. Kielland Platform capsize accident - investigation report. Retrieved 02-10-2019, from: https://officerofthewatch.com/2013/04/29/alexander-l-kielland-platform-capsize-accident/

Macleod, F. and Richardson, S. (2018). Piper Alpha: The Disaster in Detail. Retrieved 02-10-2019, from: https://www.thechemicalengineer.com/features/piper-alpha-the-disaster-in-detail/

5m elevation contour line:
CReSIS (n.k.). 5 Meter Inundation. Haskell Indian Nations University. Retrieved 8-10-2019, from: http://cdn.antarcticglaciers.org/wp-content/uploads/2013/07/euro-sea-ice2.jpg

EEA. (2002). Five meter elevation contour line. Retrieved 8-10-2019, from:
https://www.eea.europa.eu/data-and-maps/data/five-meter-elevation-contour-line
Modified by authors in qGIS.

Population and ports:
ArcGIS Hub. (2018). World cities - population. Downloaded 10-10-2019, from: https://hub.arcgis.com/datasets/6996f03a1b364dbab4008d99380370ed_0?geometry=-94.441%2C-66.873%2C97.512%2C82.375&selectedAttribute=POP
Modified by authors in qGIS.

Population growth:
Roser, M. (2019). Future Population Growth. Retrieved 23-10-2019, from: https://ourworldindata.org/future-population-growth

Roser, M., Ritchie, H. and Ortiz-Ospina, E. (2019). World Population Growth. Retrieved 23-10-2019, from: https://ourworldindata.org/world-population-growth

Climate change, Sea level rise & CO2 emissions:

IPCC (2014). Climate change 2014: Synthesis Report. Retrieved 23-10-2019, from: https://ar5-syr.ipcc.ch/ipcc/ipcc/resources/pdf/IPCC_SynthesisReport.pdf

National Oceanic and Atmospheric Administration (2017). Global and regional sea level rise scenarios for the United States. Retrieved: 23-10-2019, from: https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf

NSIDC (2019). Facts about glaciers. Retrieved 02-10-2019, from: https://nsidc.org/cryosphere/glaciers/quickfacts.html

Briney A. (2019, July 27th). An Overview of the Last Global Glaciation. Retrieved 02-10-2019, from: https://www.thoughtco.com/the-last-glaciation-1434433

Labeyrie L.D., Duplessy J.C. and Blanc P.L. (1987). Variations in mode of formation and temperature of oceanic deep waters over the past 125,000 years. Nature Vol. 327, p. 477-482.

Storms J. (2019). Towards a +3 m rise in sea leven: planned strategies or Russian Roulette? Powerpoint presentation. SLIKC – Sea level Impact Knowledge Collective, TU Delft, delivered 27 September 2019.

Salinity and Pollution:

A 2Dh hydrodynamic model of the Scheldt estuary in 1955 to assess the ecological past of the estuary.
https://www.researchgate.net/publication/256987996_A_2Dh_hydrodynamic_model_of_the_Scheldt_estuary_in_1955_to_assess_the_ecological_past_of_the_estuary

Waasland History Evolution:
Edited by author on I. Jongpier maps in "*Excursion Waasland Scheldt polders and Land van Saeftinghe*" (March 19, 2013) by Iason Jongepier1,3, Katrien Heirman1, Tine Missiaen1 & Peter Vos2

Websites

https://en.wikipedia.org/wiki/Doel_Nuclear_Power_Station
https://www.portofantwerp.com/static/duurzaamheidsverslag/en/DHV5_ENG_LR_spreads.pdf
http://www.saeftinghe.eu
http://docplayer.net
https://www.antwerpen.be/docs/Stad/Stadsvernieuwing/9746949_urbandevelopment_English.pdf

"Not all those who wander are lost"

Luca Parlangeli

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