North Sea: Landscapes of Coexistence
Transitional Territories Studio 2018-2019

MSc3 Research Report

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Theatre of Decay: Nature and Human Coexistence in the Toxic Landscapes in Rotterdam Port.

Index

Abstract

We're living in an era where spaces of logistics are further being detached from cities and urbanization to avoid choke points. But as these spaces migrate they leave traces of spaces permeating the city. What might be the impact of these logistical residual spaces whether large or very small on the expanding urban environment creating a clash, chaos and wastelands. The Port of Rotterdam is going under change concerning the petrochemical part. The reasons of decrease of oil in the last decade for the aim to shift to more sustainable energy production and for the increase of toxic spills on the ground and atmosphere. What would be the use of the abandoned toxic land of the petrochemical part of the Port, that once was storing oil, one of natures most needed source of for human survival, and refining it through burning.

Key words: Toxicity, Urban Voids, Silo, After Oil, Re Use

Territory

1. Territory: North Sea

1.1. Identity - Historical Precedents

Archaeological findings indicate that the area that now comprises the North Sea may have been a large area of plains in prehistoric times, until around 8,000-6,000 BC. The data suggests the area was inhabited before being flooded by rising water at the end of the last ice age. In 2008, a finding of approximately 28 Stone Age handaxes in material from the bottom of the North Sea strengthened the evidence of human settlements in the area. (1)

The North Sea, though often an area of conflict, has an extensive history of maritime commerce and trade routes between its coastal nations whose economies and industries were also able to exploit its resources. The earliest records of Roman explorations of the sea begin in 12 BC. From the Middle Ages until the end of the 15th century, before the development of good roads, maritime trade on the North Sea connected the economies of northern Europe, Britain, and Scandinavia with each other as well as with the Baltic and the Mediterranean.

Important overseas colonies, a vast merchant marine, and a powerful Dutch navy made the Dutch expand their harbours and ship building spaces. This was how the Dutch realized the necessity to maintain their ship docking platforms, logistic spaces. In the 16th century, the Netherlands became the preeminent economic power in the world. For the Dutch merchant marine the North Sea served more as a starting point for their oceanic voyages. It had become the gateway and crucial outlet allowing Dutch merchants direct access to world markets (2) Between 1700 and 1815, the North Sea saw only 45 years of peace, and could be regarded as the most dangerous eras to sail the sea.

After the war, the North Sea lost much of its military significance because it is bordered only by NATO member-states. However, it gained significant economic importance in the 1960s as the states on the North Sea coasts began full-scale exploitation of its oil and gas resources. The North Sea continues to be an active trade route. The countries bordering the North Sea all claim the 12 nautical miles (22 km; 14 mi) of territorial waters within which they have exclusive fishing rights. Today, After the discovery of mineral resources in the North Sea, Norway claimed its rights under the Continental Shelf Convention and the other countries on the sea followed suit. These rights are largely divided along the median line, defined as the line "every point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial sea of each State is measured." (3) the North Sea is more important as a fishery and source of fossil fuel and renewable energy, since territorial expansion of the adjoining countries has ceased.

(1) BBC NEWS | UK | Education | Lost world warning from North Sea". news.bbc.co.uk. Retrieved 2019-01-5.
(2) Donald J. Harreld, Brigham Young University. "EH.Net Encyclopedia: Dutch Economy in the "Golden Age" (16th-17th Centuries)"
(3) The Multilaterals Project, The Fletcher School, Tufts University (29 April 1958). "Convention on the Continental Shelf, Geneva"

1.2. Territorial Analysis

North Sea is a rather small body of water bordered by the mainland Europe and the British Isles. The Netherlands has the longest meeting ground with the sea. The coastline is 1,914 km long consisting of sandy beaches and sea dikes, which are public and create a layered protection of the cities and the territories behind them. Its many harbours, including the largest port of Europe, the Port of Rotterdam, and other smaller ports, enable both protection and porosity for rivers outlets and tidal inlets along the edge of the delta pan.

The North Sea's economy is defined by the oil and gas under the ocean bed, the marine life in the water and the wind currents in its atmosphere. The land nations that border it have been defined by their interactions with its landscape in their histories as traders, invaders, fishermen, and extractors. Today, the North Sea is home to the busiest shipping corridor in the world, some of the most heavily fished and trawled waters, as well as dense extractions of sand and oil. Rich North Sea countries import heavily and attract populations from all over the world, while financial centres such as London and Frankfurt and production centres such as the Rhine Industrial Region continually increase the flow of raw materials and waste across and into the North Sea.

The Intergovernmental Panel on Climate Change (IPCC) published its 15th report on the impact of climate change. It demonstrates the impact of a 1.5°C global temperature increase in comparison to pre-industrial levels. As a result of the melting of polar caps the northernmost regions will become more accessible, allowing for further human activities. On the one hand, this will have a positive economic impact on the regions concerned, yet it also has the potential of increasing the emittance of greenhouse gases and also might shift the economy North. Equally, at the coasts of the UK, the Netherlands, Belgium, Germany and Denmark the same rise in sea level bears a considerable flood risk. This reveals the relative change in expected annual damage between the periods of 2071 to 2100 and 1961 to 1990 as a result of flooding events under the RCP 4.5 scenario. What can be gathered is that France, UK, Denmark, and the Netherlands will experience the most increase in annual damage. (1)

The British and Norwegian sectors hold most of the remainder of the large oil reserves. It is estimated that the Norwegian sector alone contains 54% of the sea's oil reserves and 45% of its gas reserves. More than half of the North Sea oil reserves have been extracted, according to official sources in both Norway and the UK. For Norway, the Norwegian Petroleum Directorate gives a figure of 4,601 million cubic metres of oil (corresponding to 29 billion barrels) for the Norwegian North Sea alone (excluding smaller reserves in Norwegian Sea and Barents Sea) of which 2,778 million cubic metres (60%) has already been produced prior to January 2007. UK sources give a range of estimates of reserves, but even using the most optimistic "maximum" estimate of ultimate recovery, 76% had been recovered as of the end of 2010. (2)

Having Norway's natural oil reserves more than half of the North Sea countries combined, with the depletion of the Dutch Oil reserves combined with the melting of the polar which will increase Norway's influence in the oil market as it makes it more reachable and easier from the north pole for ships coming from countries who used to enter the North Sea from the south. This will render the North Sea's oil refinery in its biggest port in Rotterdam to look for a change in its program.

1. Kundzewicz, Z.W., Lugeri, N., Dankers, R. et al. (2010) Mitig Adapt Strateg Glob Change. 15: 641. https://doi.org/10.1007/s11027-010-9213-6

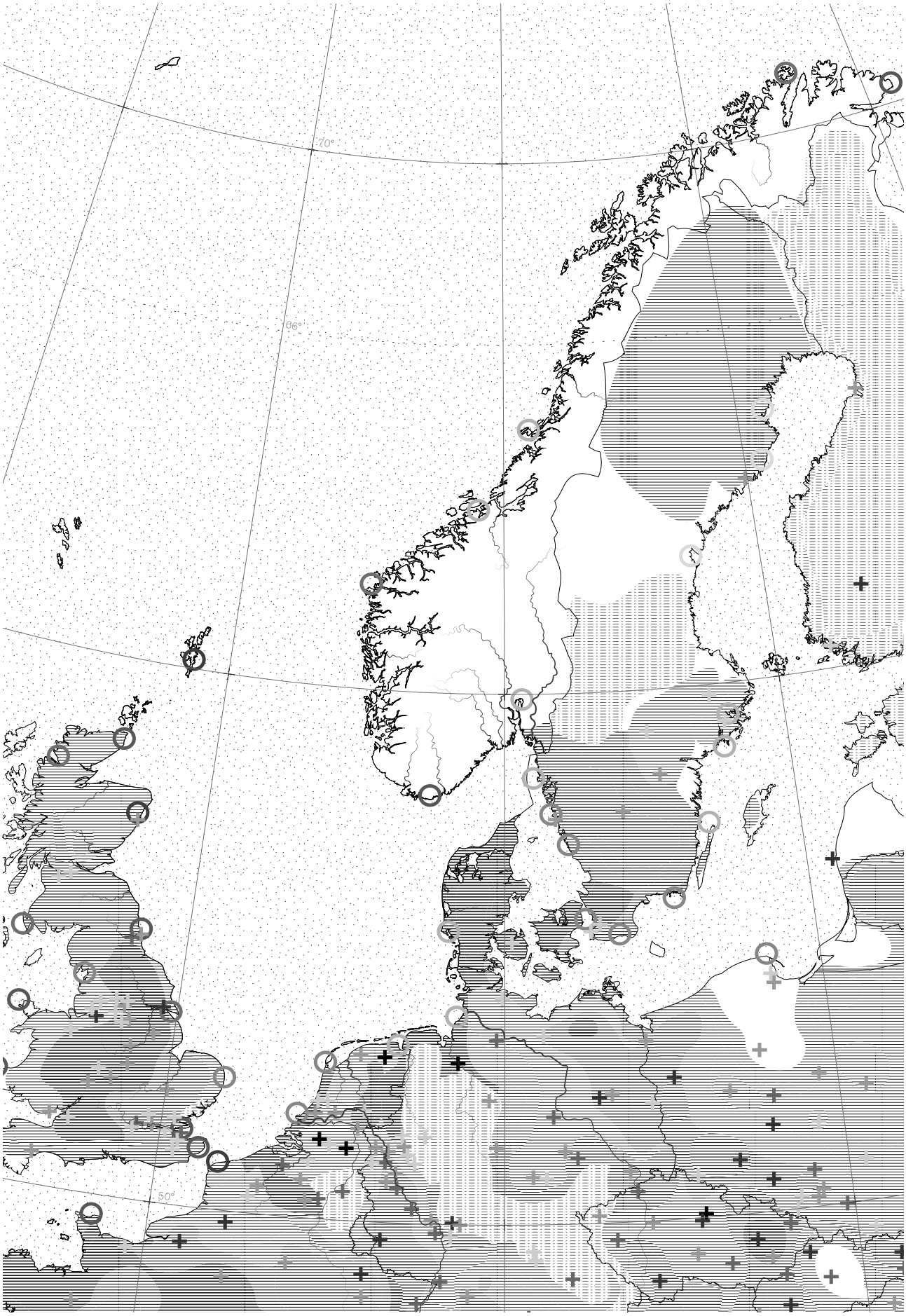
2. Jan Hagland,, Director of Information for the Norwegian Petroleum Directorate. "Oil & Gas in the North Sea - ExploreNorth".

Flood Projections in Year 2100

This map reveals the relative change in expected annual damage between the periods of 2071 to 2100 and 1961 to 1990 as a result of flooding events under the RCP 4.5 scenario. What can be gathered from this mapping is that France, UK, Denmark, and the Netherlands will experience the most increase in annual damage, whilst Portugual, Romania, Finland, and Estonia will experience the most decrease in flooding.

Additionally, this conclusion has been correlated with other sources, that project an increase in costal and river floodings in the same areas aforementioned, to reveal a similar pattern.

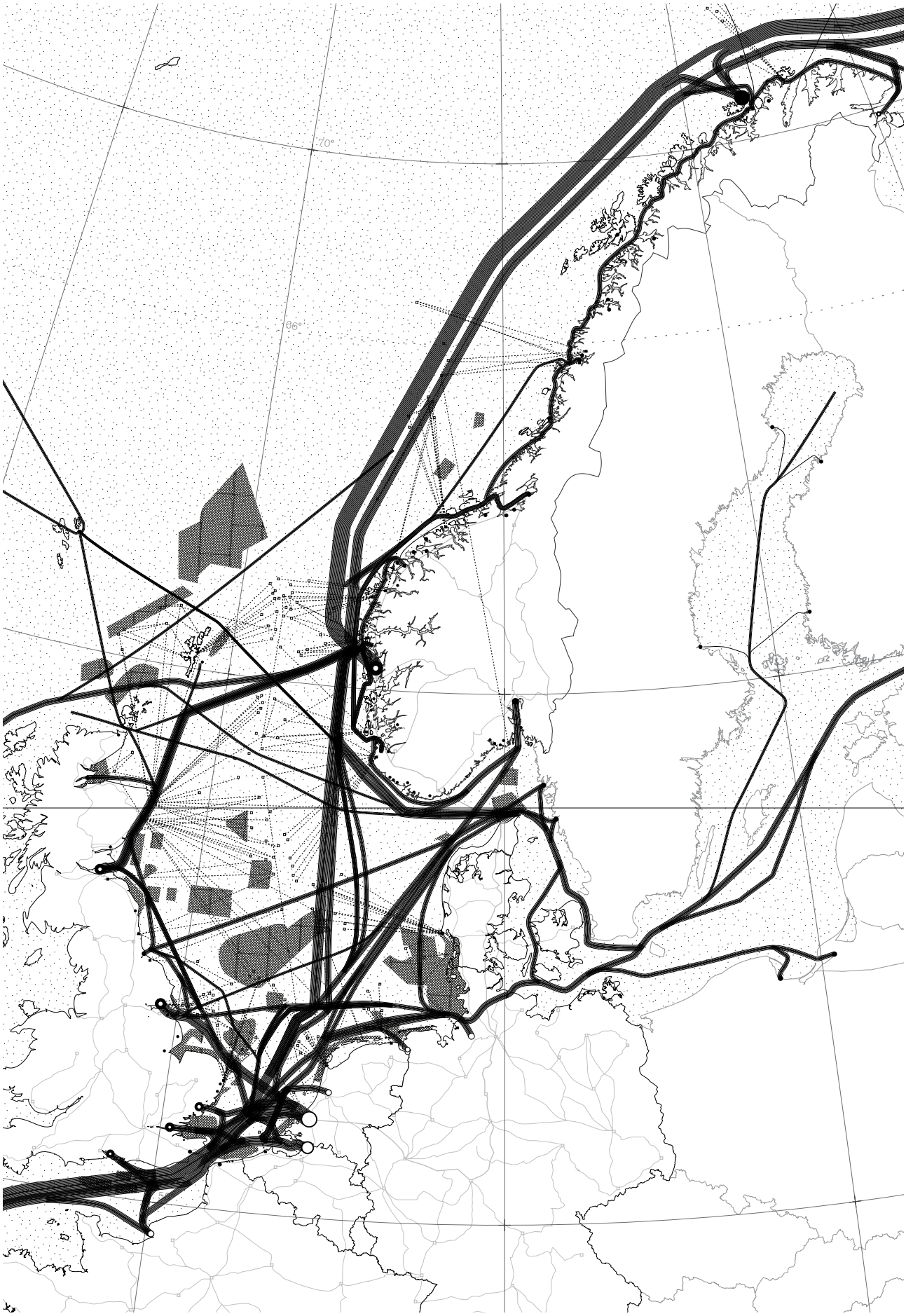
- Water
- Rivers
- Expected Annual Damage Change >400%
- Expected Annual Damage Change 151 to 400%
- Expected Annual Damage Change 51 to 151%
- Expected Annual Damage Change 26 to 50%
- Expected Annual Damage Change 11 to 25%
- Expected Annual Damage Change -9 to 10%
- Expected Annual Damage Change -24 to -10%
- Expected Annual Damage Change -49 to -25%
- Expected Annual Damage Change -74 to -50%
- Expected Annual Damage Change < -75%
- Chance of River Flooding in Urban Area >30%
- Chance of River Flooding in Urban Area 15-30%
- Chance of River Flooding in Urban Area 10-15%
- Chance of River Flooding in Urban Area 5-10%
- Chance of River Flooding in Urban Area 0.01-5%
- Frequency of Coastal Flooding by Multiplication Factor >100
- Frequency of Coastal Flooding by Multiplication Factor 50-100
- Frequency of Coastal Flooding by Multiplication Factor 25-50
- Frequency of Coastal Flooding by Multiplication Factor 10-25
- Frequency of Coastal Flooding by Multiplication Factor 5-10
- Frequency of Coastal Flooding by Multiplication Factor 1-5
- Frequency of Coastal Flooding by Multiplication Factor 0-1


70°
66°
50°

Altered Logistics Flow

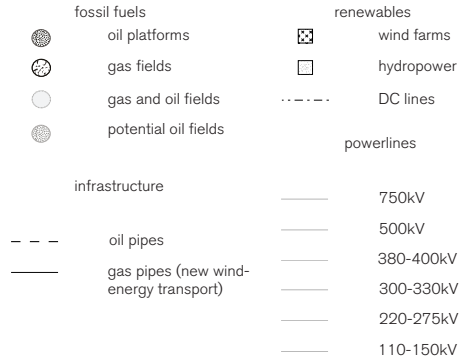
The map shows the projection model for logistic flows in 2150 in the North Sea. Dredging of the major harbors in the South is not feasible anymore. New cargo and vessel transfer ports are now located towards the North in Norway. With the opening of the North Arctic Sea route, new ports were openend into the sea on the edge of the fjords where the waterbed is deep enough for future ships.
Due to the hard Brexit, the United Kingdom was forced to increase their port capacities across the island. Most distribution enters from the Norwegian ports.

- harbor growth (fast)
- harbor growth (slow)
- shipping flows - density
- small harbor
- oil/gas platform
- service harbor - platforms
- service routes - platforms
- protected areas
- train infrastructure
- train stations


70°
66°

Energy Transition: Extra flows

With the energy transition coming a new time of cultivation of the North Sea will start. The change to renewables and the opportunities for wind energy on the sea will translate in the form of huge wind farms accounting for our energy need. Gas pipelines are reused to connect the offshore windfarms with the onshore power facilities.



Ships and oil

- Offshore oil and gas installations, with chronic oil spills being a big issue, especially in the Arctic.

- Ocean pollution levels 2013. Ships are a source of pollution via discharges, oil spills, and carbon emissions

■ [Transparent overlay] Concentration of different types of pollution
□ Ports
\ Ship routes
● Oil rigs

High concentration of plastic

Low concentration of plastic


70°
66°
50°

Concentration of pollution and soil types

The map shows where the concentrations of different pollutants are located and its relation to the concentration of sand in the top layer of soil. Because sand is a porous soil type, it is more susceptible to absorb pollutants, particularly viscous ones like oil. On the contrary, clay soils absorb pollutants more slowly.

[Transparent overlay] Concentration of different types of pollution

High concentration of sand

Low concentration of sand


70°
66°
50°

Projected Soil pollution in relation to land use

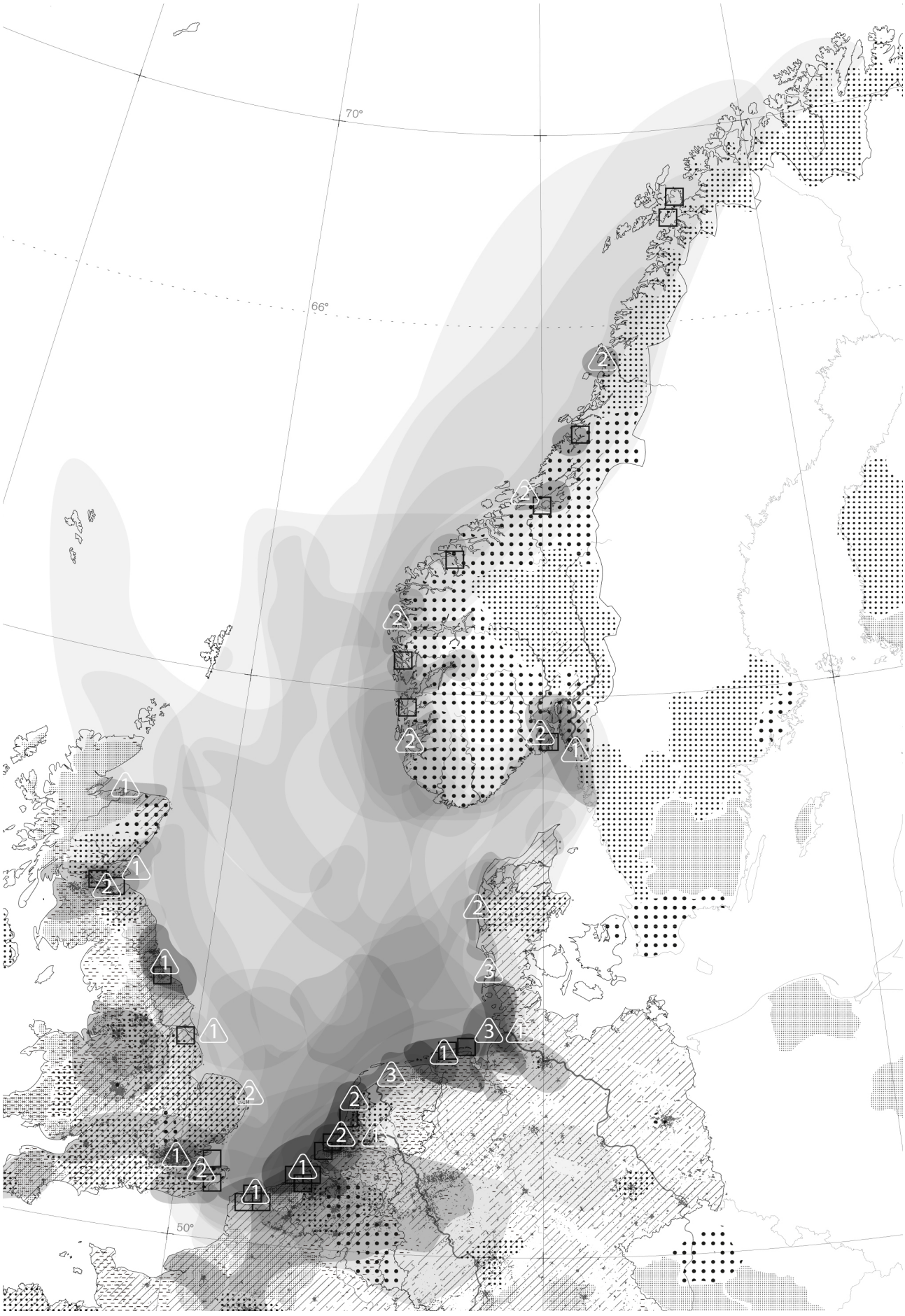
This conclusion map shows the relation between concentration of pollutants and human activity. Dark areas are particularly affected by pollution, which has negative effects on food quality, health, and biodiversity as some example. These areas would require to implement measures to both decrease further emissions and to remove current pollutants from their land, water and air.

Problem areas identified as industrial zones [1] there is less pressure to decrease the concentration of pollutants in relation to urbanized [2] or agriculture areas [3].

- Agriculture
- Grassland
- Industrial areas
- Ports
- Urban areas
- Area of slight population increase
- Area of medium population increase
- Area of high population increase
- Problem area in relation to industrial activity
- Problem area in relation to urban environments
- Problem area in relation to agriculture and cattle

High concentration different types of pollution

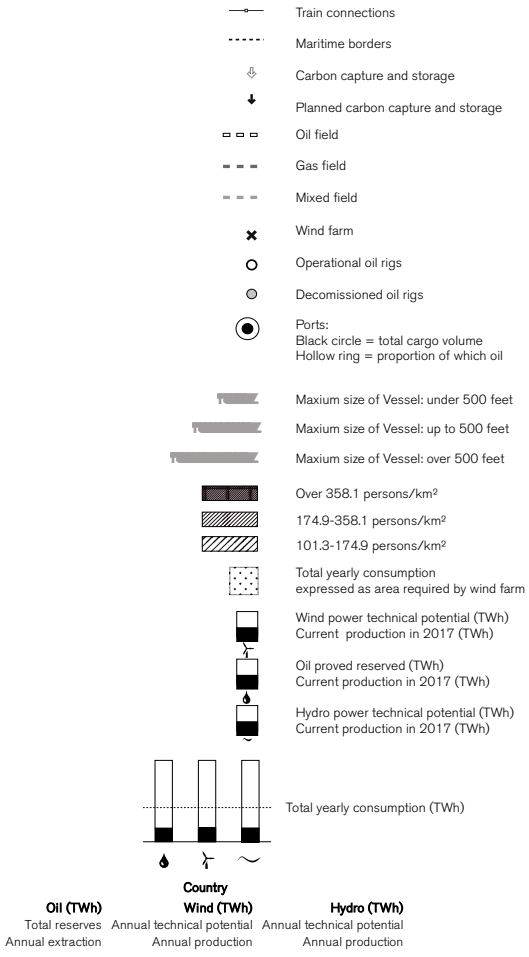
Low concentration different types of pollution

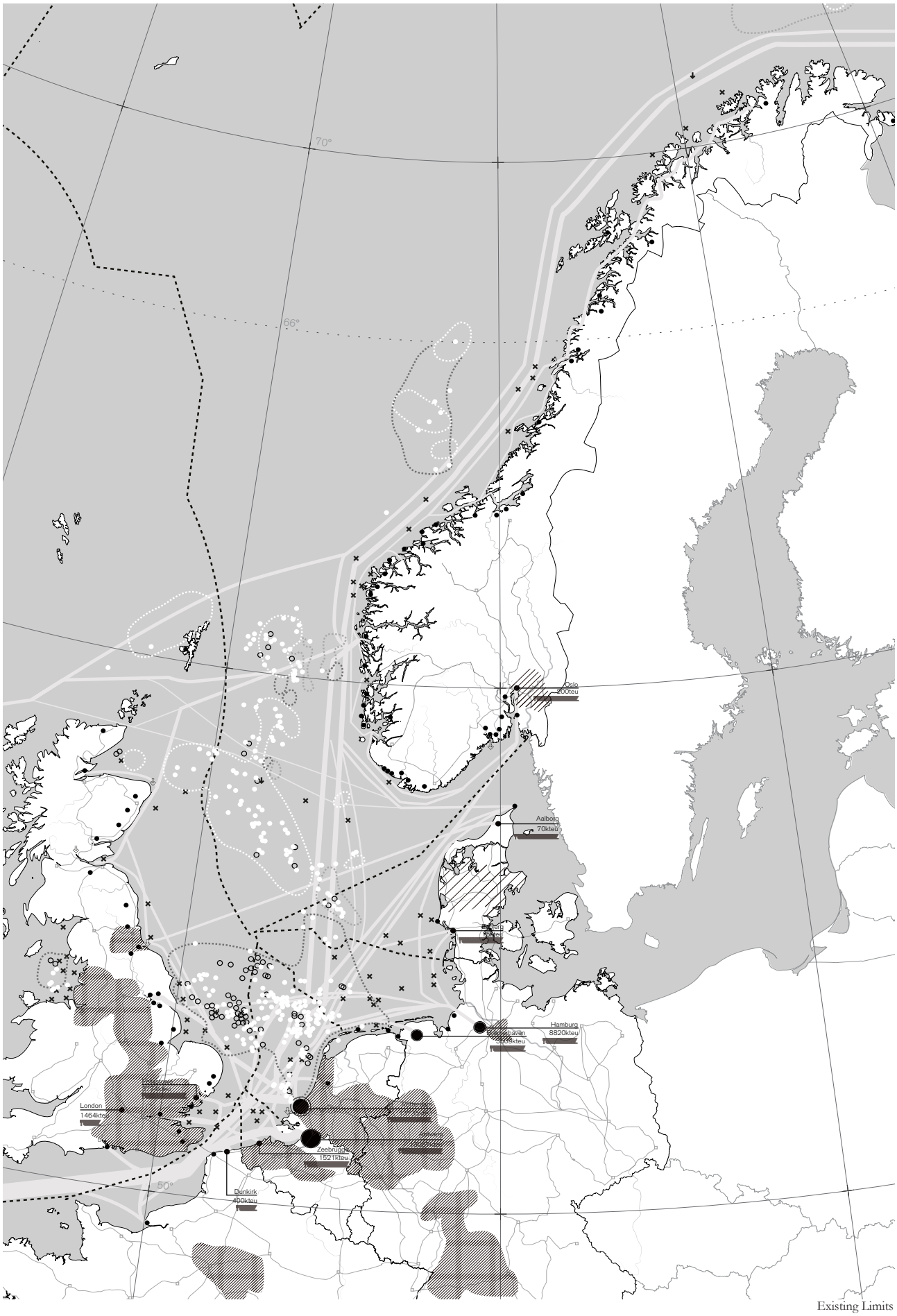

70°
66°
50°

‘Rest’ Scenario Speculative Map

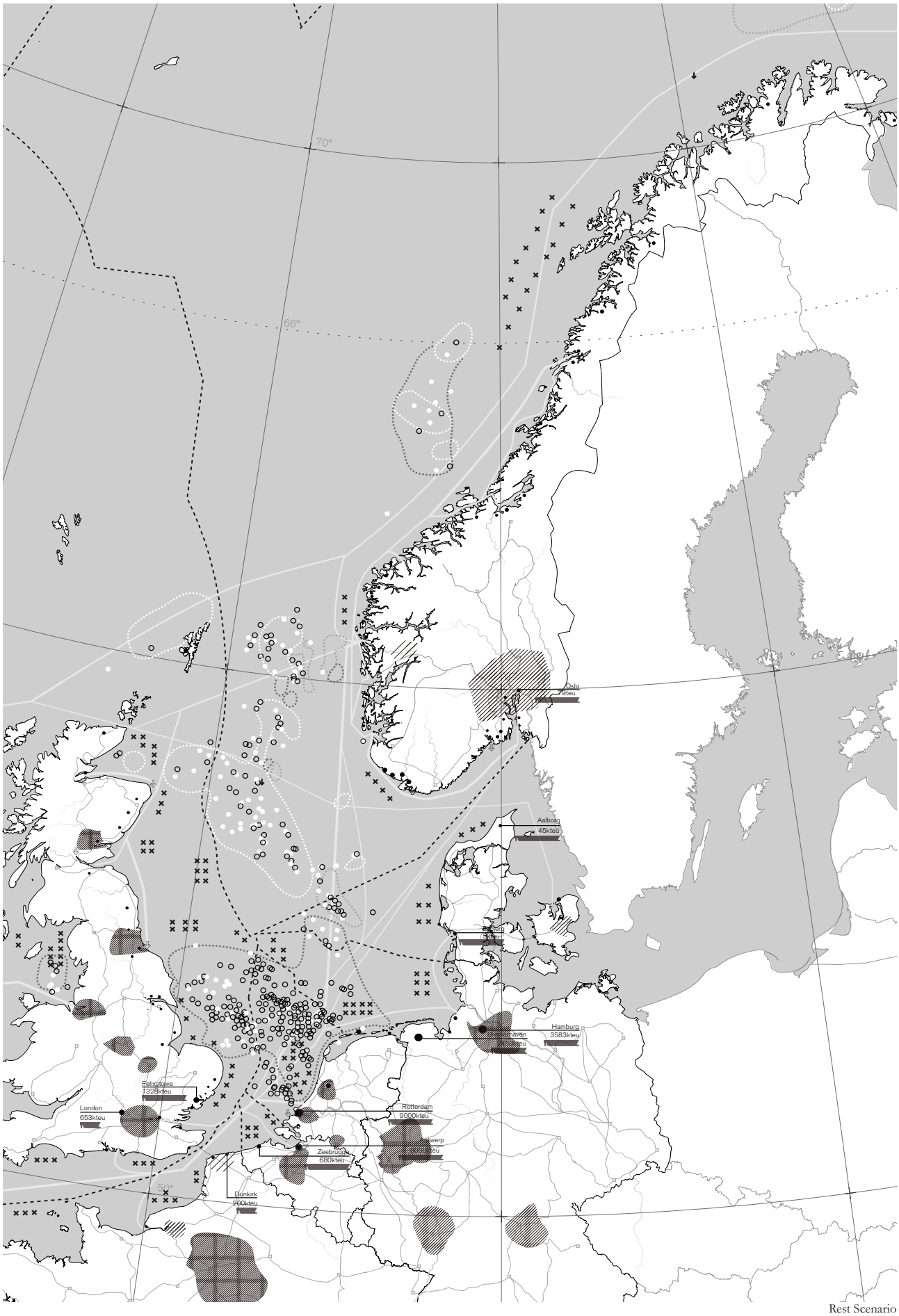
The ‘Rest’ scenario is characterized, on the one hand, by a large reduction of the level of economic interdependency, towards a more protectionist economic policy and, on the other, by a mild degree of climate change, resulting in a relatively low level of manifested impact. The scenario speculation process projects the capacity of each administrative unit of the territory to respond to the aforementioned changes and the potential patterns via which this will occur thoughout the territory.

Due to a closed market system the cargo shipment exchange between countries is heavily reduced. Countries will resort on importing basic needs for their population. Oil and cargo import shipping routes are reduced as each country will resort on producing their own energy from basic renewables, mainly wind energy for northern European North Sea countries and solar for norther countries who get more sunny days from the Mediterranean climate ex. France. Many oil rigs will be decommissioned. A closed economy caused a decrease in energy, low economic activity caused a decrease in population growth except for Norway whose population increased slightly. Rural areas will become less populated cities will shrink but density will stay nearly the same. More spread out cities will rise as central power to the main capital decreases. Oil refining ports will become less dominant and decrease in size which causes a change in their mono function. Countries like Norway and the United Kingdom would still be the major countries to export Oil to other countries outside the North Sea region a source of income, noting that both are outside the EU hence there is no regulation for CO2 production.


Train connections
Maritime borders
Carbon capture and storage
Planned carbon capture and storage
Oil field
Gas field
Mixed field
Wind farm
Operational oil rigs
Decomissioned oil rigs
Ports:
Black circle = total cargo volume
Hollow ring = proportion of which oil
Maxium size of Vessel: under 500 feet
Maxium size of Vessel: up to 500 feet
Maxium size of Vessel: over 500 feet
Over 358.1 persons/km²
174.9-358.1 persons/km²
101.3-174.9 persons/km²
Total yearly consumption
expressed as area required by wind farm
Wind power technical potential (TWh)
Current production in 2017 (TWh)
Oil proved reserved (TWh)
Current production in 2017 (TWh)
Hydro power technical potential (TWh)
Current production in 2017 (TWh)
Total yearly consumption (TWh)
Country
Oil (TWh)
Total reserves
Annual extraction
Wind (TWh)
Annual technical potential
Annual production
Hydro (TWh)
Annual technical potential
Annual production



Existing Limits



Rest Scenario

1. Territory: North Sea

1.3. Problem Statement

Following from the territorial analyses of the North Sea maps and their overlay, with the lenses of predicted sea level rise and flood predictions, logistic flows of oil and cargo and, oil ships trajectories and the concentration of pollution in relation to land use and soil types; the Port of Rotterdam shows an area of concern taking into consideration that it is the Europe's biggest port and the world's second largest will be facing a new altered transitional state.

The underlying factor for the development of the ports across the North Sea were the fossil fuel petrochemical sites that started to arise mid the previous century. But also fossil fuels, are the reasoning for decades of the environmental degradation to the landscape: in terms of soil pollution and loss of biodiversity. The current economical shifts towards sustainable forms of energy generation are expected to rapidly gain ground in Europe, as well as throughout the world. It would appear that over the coming decades a transition from a linear, fossil economy to a circular, bio-based economy will unfold in Europe. (Willems, Eijk van der et al. 2016) Petrochemical site bordering the North Sea will start to undergo gradual decommissioning. Hence, leaving behind them toxic wastelands that cant be used for human activities for several decades, due to high toxicity levels. The Netherlands one of the nations that border the North Sea. It's Port of Rotterdam is home to the busiest shipping ports in the world and has the biggest oil refinery in Europe; Royal Shell refinery in Pernis. The territory will be confronted with a scenario situation where there is a much lower oil refining that will render it's oil infrastructure to decay.

1.4. Research Question

What will happen to the petrochemical sections in the port that are close to urbanization after oil?
Port's spaces of logistics are further being detached from cities and urbanization to avoid choke points. But as these spaces migrate they leave traces of spaces permeating the city.

Sub-questions

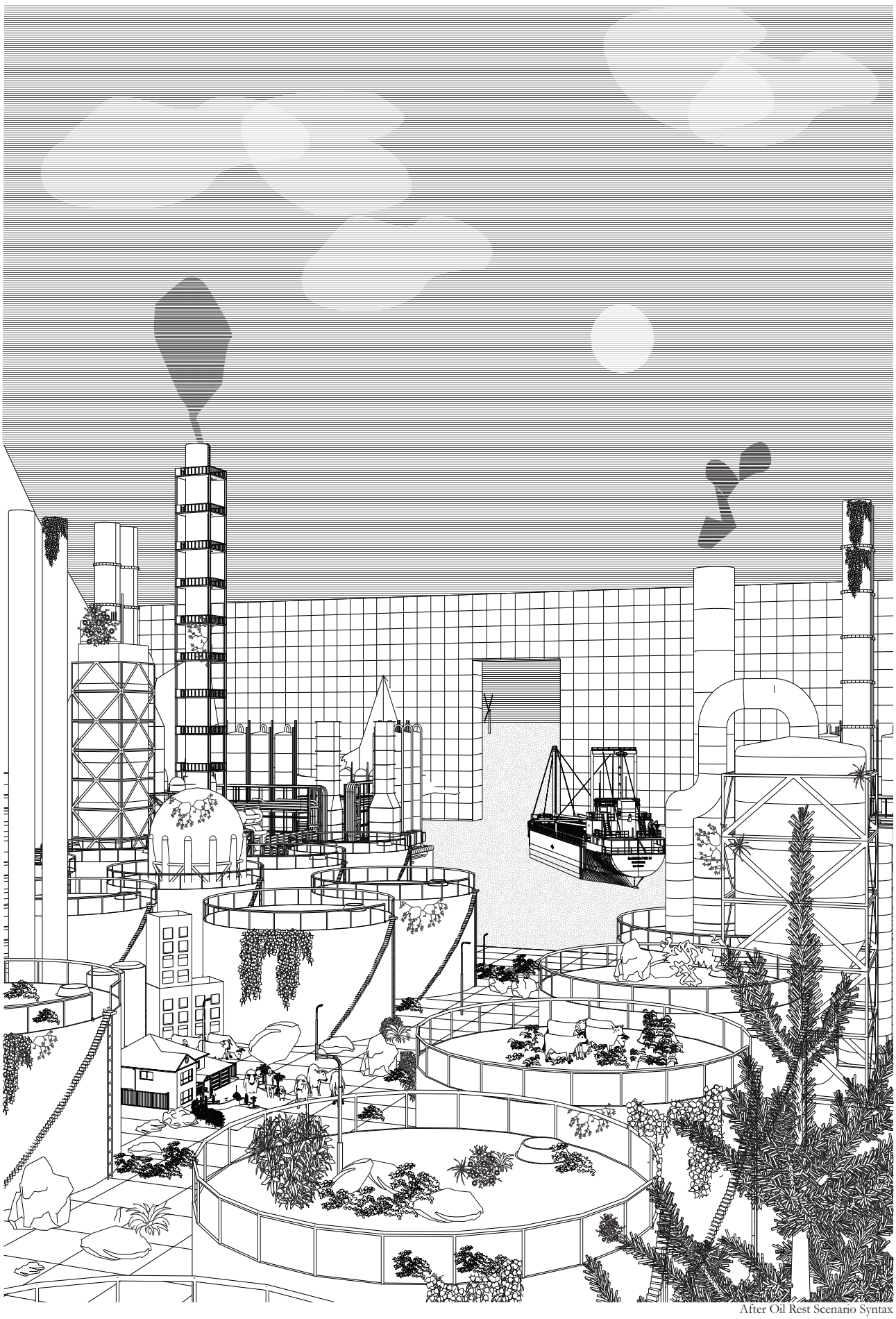
1. How did the harbour of Rotterdam develop?

2. In scenario witnessing an increase of economic degradation, de-growth in a Post Anthropocene age how would this expansive infrastructure react and what would it become and or become of it?

3. What might be the impact of these logistical residual spaces weather large or very small on the expanding urban environment creating a clash, chaos and wastelands?

4. How to invest on abandoned infrastructure that was serving our needs on a climate and resource cost as a method to rethink the relations between the realities we live in.

5. Coming from the line of thought that the Rotterdam Port *is a big void detached from the city what are the voids in the port? What qualities do they hide? And how can these voids contribute to the activation of the bigger void?*



After Oil Rest Scenario Syntax

Site

2. Site: Shell Pernis, Rotterdam Port

2.1. Identity - Historical Precedents

From the fishing markets in the 15th century, to the petro-chemical industries in the 20th century, the world class port, port of Rotterdam "is one of the most important junctions for the trade of goods in the world, and an international logistics hub. (Wurpel, Akker van den et al. 2013) Furthermore this trade based mainly on fossil fuels, "provide a constant basis underlying Rotterdam's growth, and more than half of the throughput today is based on oil and oil products." (Wurpel, Akker van den et al. 2013)

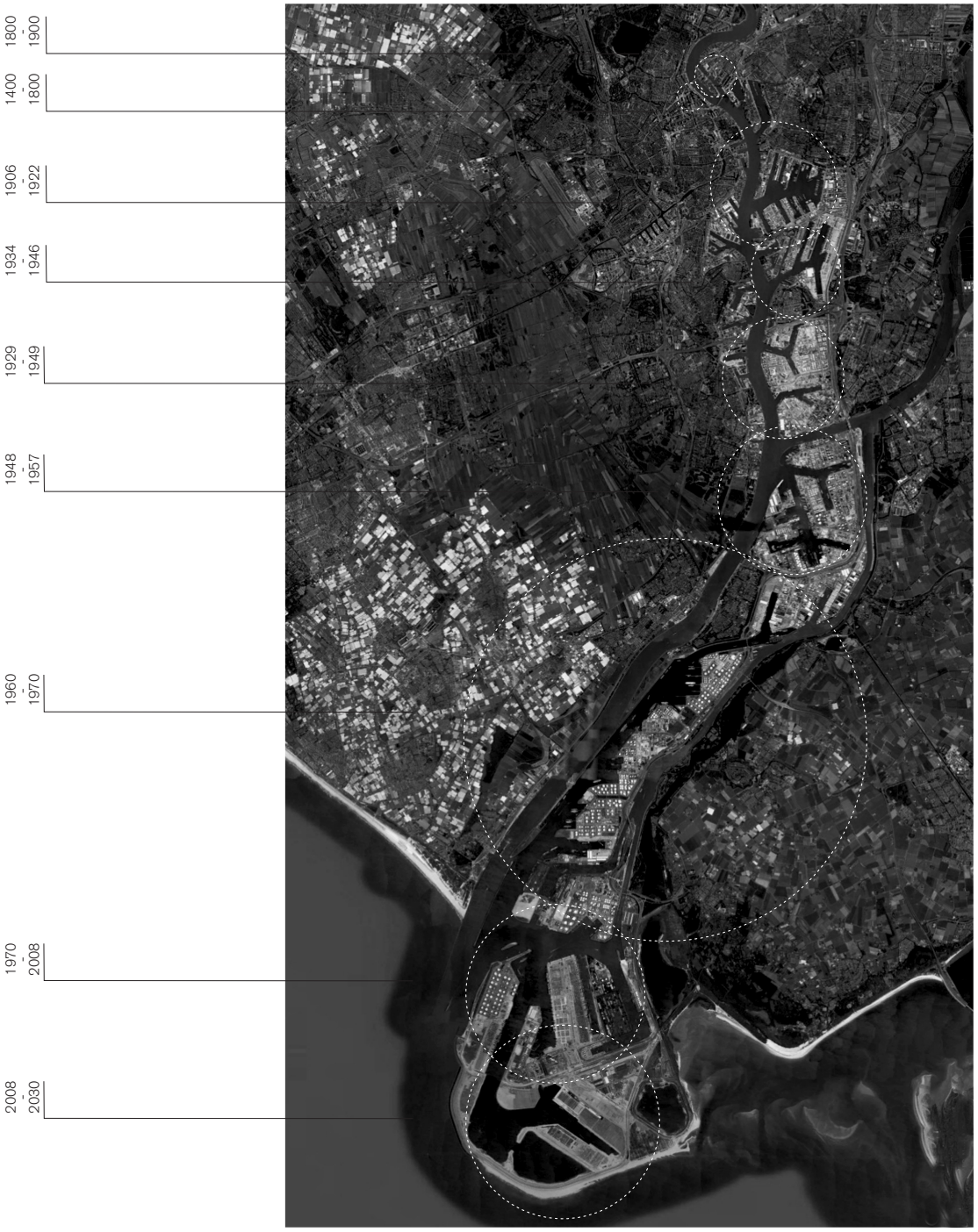
The port of Rotterdam is the biggest port in Europe, and is currently being expanded with the Maasvlakte 2 area. Due to the nature and size of activities that take place in the port of Rotterdam and the hinterland, it unmistakably impacts the environment. (Boer & Verbraak, 2010) The port of Rotterdam is a 40 km long terminal located at the confluence of two mega-systems, the Holland's North Sea zone and the Rhine Maas Delta. This favorable geographical location allowed the port to be the connection between the faraway locations from the "Russian oilfields to the Suez Canal, to China, to Brazil and the Panama Canal" passing trough the hinterland and the German Ruhr district. (Steenhuis 2015)

Records show that there has been settlement in the area currently known as Rotterdam since around the 900's. A large dam was built in the 1260's, changing the name of the town to "Rotterdam." Shortly after becoming a city in 1340. The most significant development came near the end of the 1800's in response to the ineffectiveness of the natural coastal features for industrial shipping. The marshy, shallow delta caused issues for industrial vessels, and a custom created shipping canal was conceived. This Nieuwe Waterweg ("New Waterway") was completed in 1872, also serving to connect industry along the Rhine and Meuse rivers to the North Sea. (http://twente.co.uk/a-history-of-the-port-of-rotterdam/)

There are a number of plans for the future of The Port of Rotterdam, outlined in the Port of Rotterdam Authority's Port Vision 2030 project. Port Vision 2030 relies on two "pillars," the first is for Rotterdam to become the leading Intra-European cargo hub, by galvanising existing infrastructure and logistics chains and opening up its facilities to new types of cargo. The second pillar focuses on making Rotterdam an integrated hub of industry by 2030, alongside Antwerp, Moerdijk and Terneuzen. The port has a history of ties with the energy and petrochemical industry, and these developments seek to bolster ecological focus with sustainable energy sources across the complex. https://www.portofrotterdam.com/en/files/history-port-of-rotterdampng

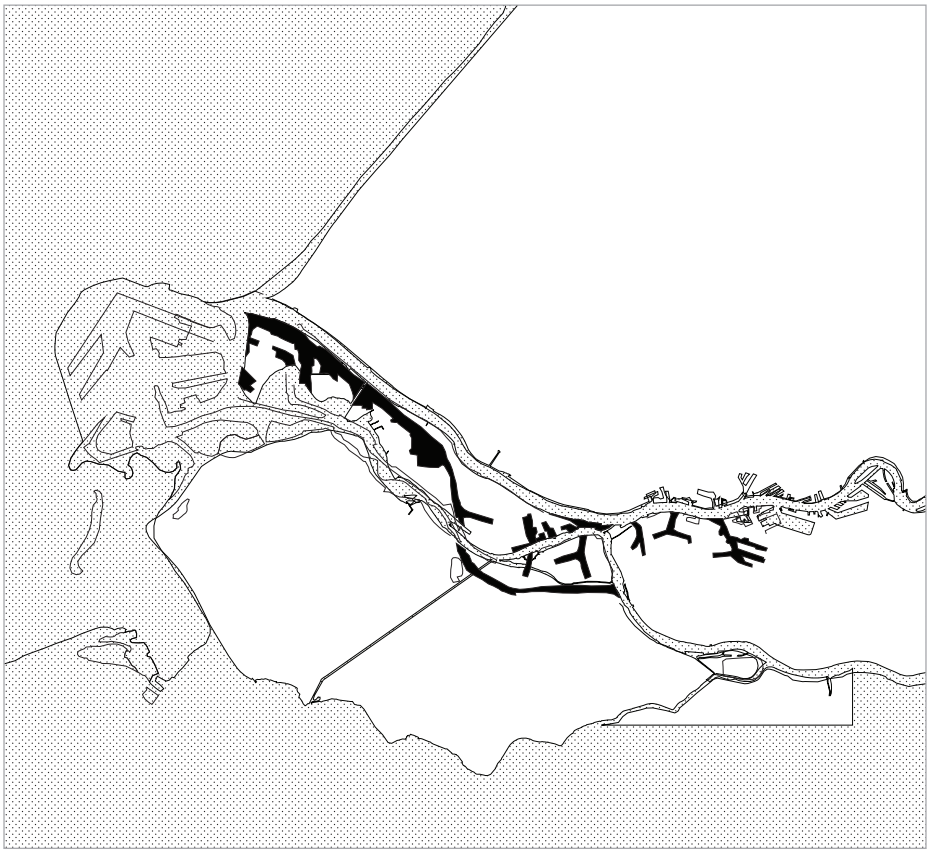
The story of Rotterdam and its port reveal some key lessons for any company involved in logistics. Focus on flexibility and improvement, and improve wherever possible. As the the Port Vision 2030 page proudly states: "Industry and logistics have been the pillars of the port of Rotterdam for decades, thanks to its favourable location and an entrepreneurial spirit."

Port Evolution, Detaching from City


1800 - 1900
1400 - 1800
1906 - 1922
1934 - 1946
1929 - 1949
1948 - 1957
1960 - 1970
1970 - 2008
2008 - 2030

Port of Rotterdam 1900 Before Deredging

Port of Rotterdam 20018 After Dredging and Expansion



Port of Rotterdam Present Condition

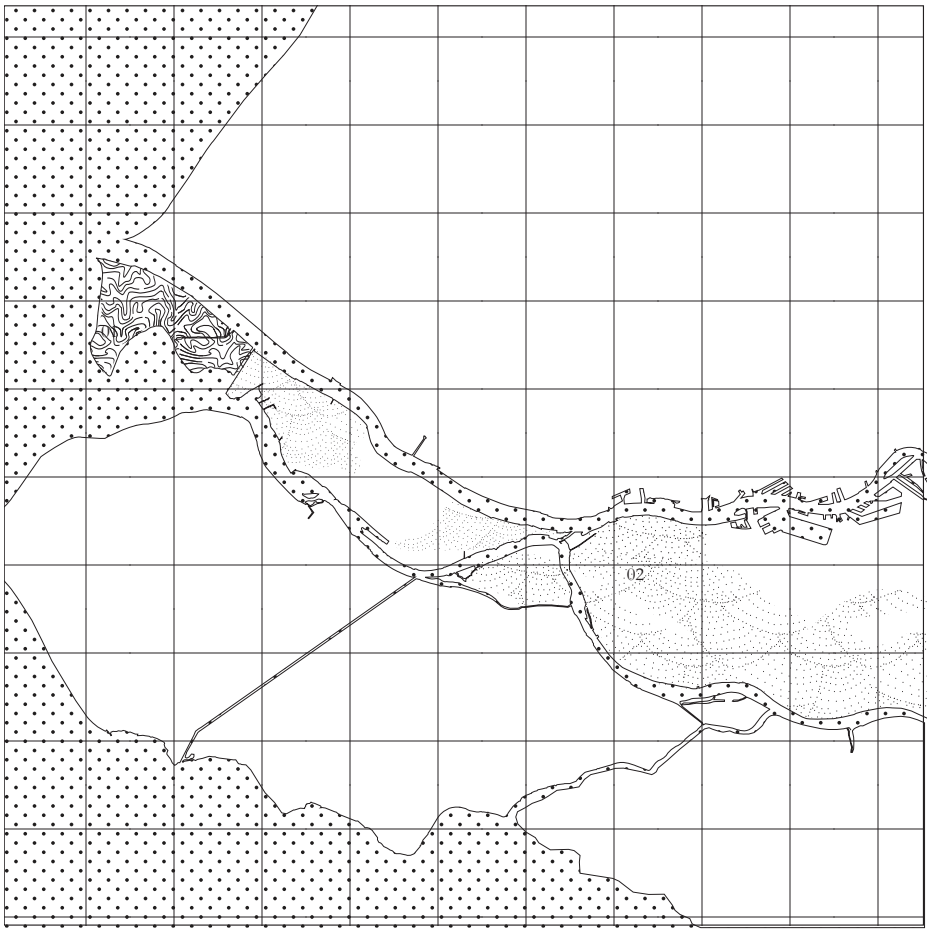
Port of Rotterdam in Scenario of Dike Breaking & Rotterdam Drowning

Agriculture and Nature Reserve 1925

01 Nature Reserve
02 Agricultural Lands

Flaura and Fauna Present

Vedran, Skansi TU Delft Graduation
Report



 *Perdix perdix*	 *Charadrius hiaticula*	 *Anthus pratensis*	 *Oenanthe oenanth*	 *Linaria cannabina*	 *Ochlodes sylvanus*	 *Phaneroptera falcata*
 *Tringa totanus*	 *Alauda arvensis*	 *Anas clypeata*	 *Sterna hirund*	 *Accipiter gentilis*	 *Epidalea calamita*	 *Candidula*

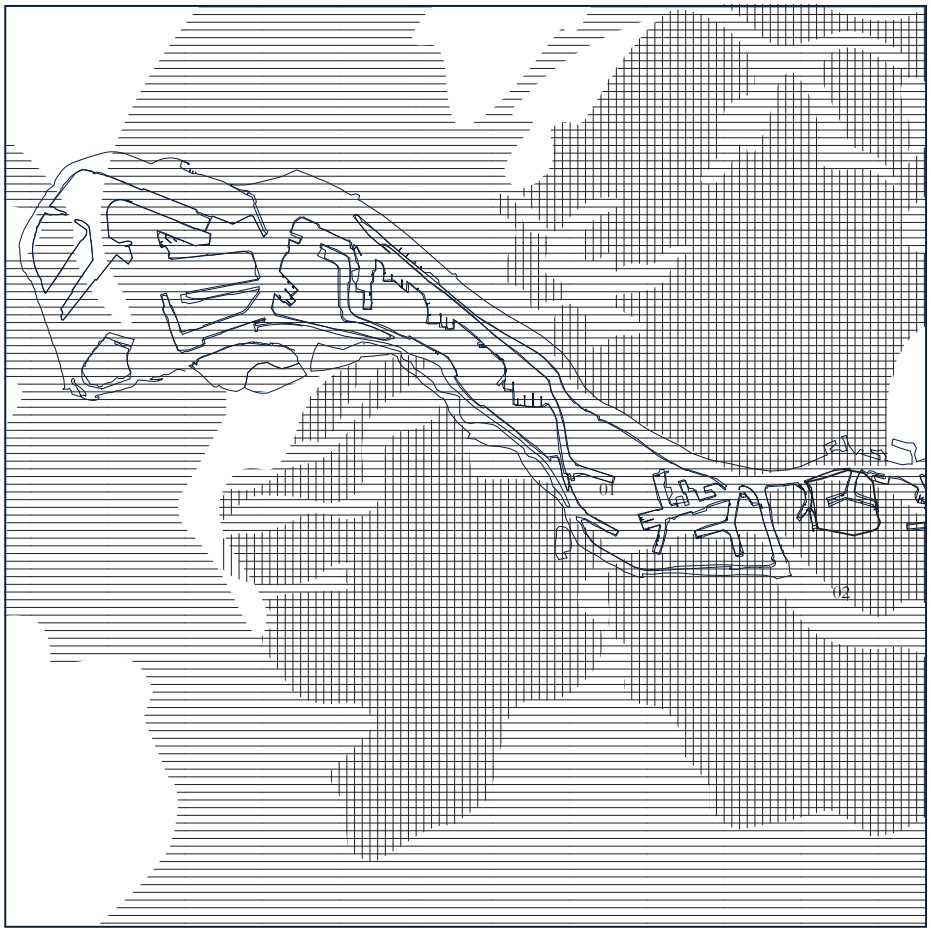
 *Sedum reflexum*	 *Liparis loeselii*	 *Epipactis palustris*	 *Dactylorhiza incarnata*	 *Dactylorhiza praeterm*	 *Anacamptis pyramidalis*	 *Anacamptis morio*
 *Ophrys apifera*	 *Parnassia palustris*	 *Parietaria diffusa*	 *Sagina nodosa*	 *Linum catharticum*	 *Euphrasia stricta*	 *Odontites vulgaris*

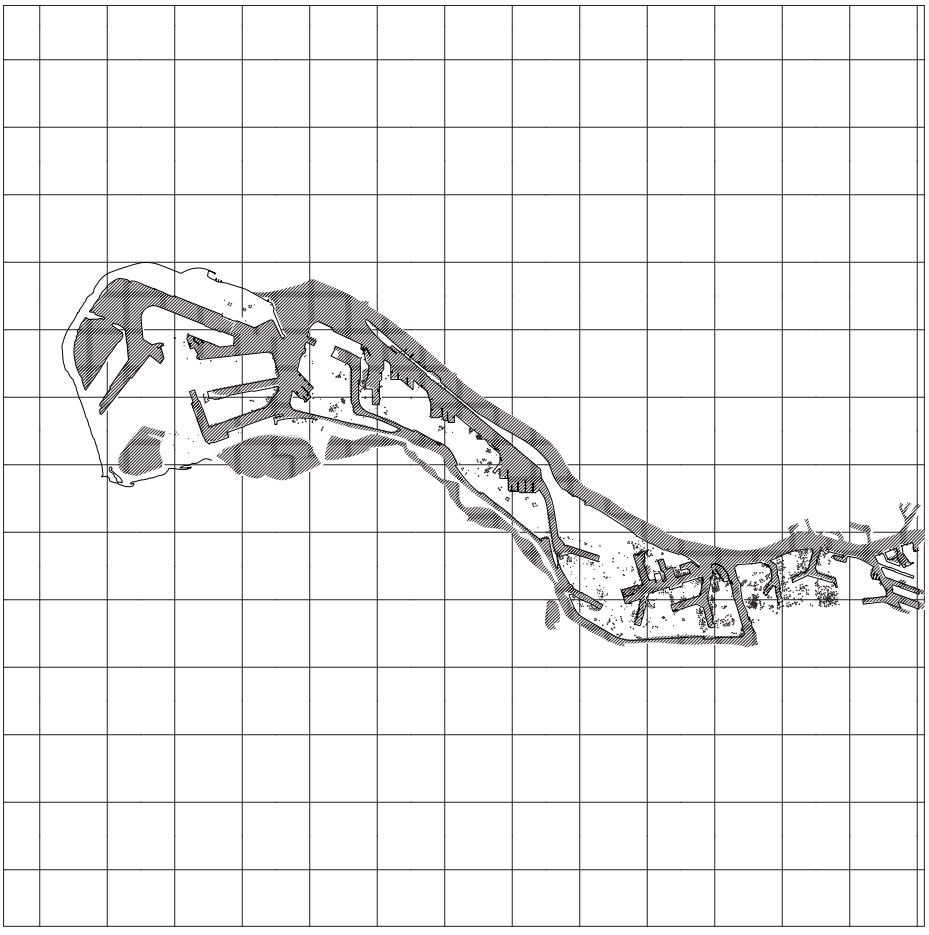
Rotterdam Port Soil Types

01 Sea Clay and Sand
02 Sea Clay and Sand with Peat

Rotterdam Port Soil Contamination

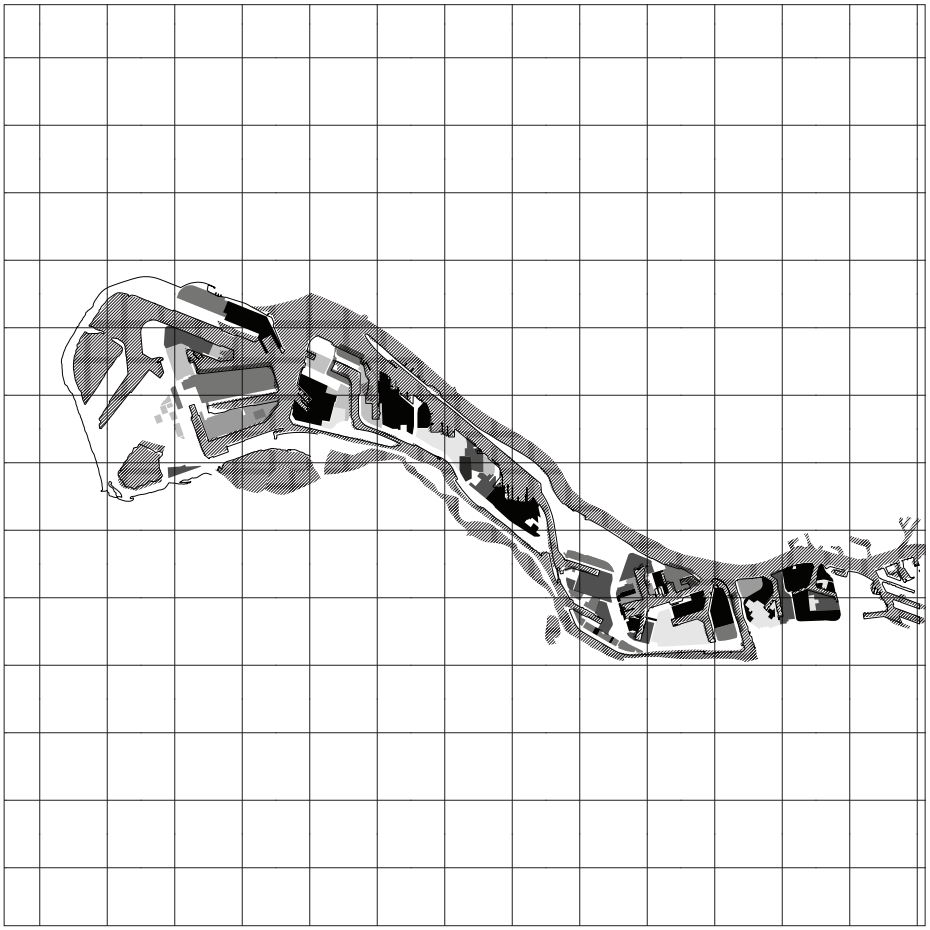
Vedran, Skansi TU Delft Graduation
Report

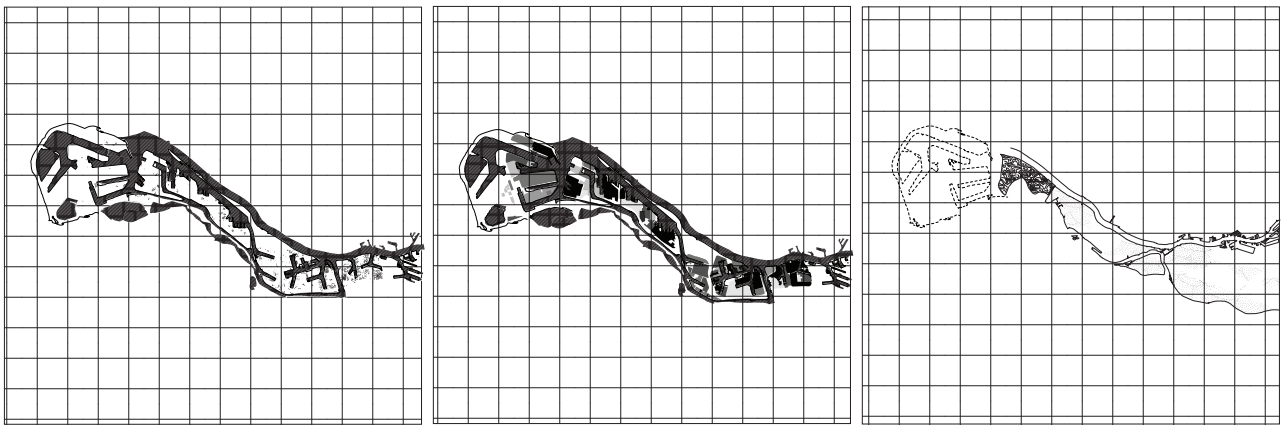

01
02



Rotterdam Port Soil Types

01 Chemical Storage
02 Oil Refinery
03 Chemical Manufacturing
04 Dry Bulk
05 Bio Powerplant
06 Other
07 Coal



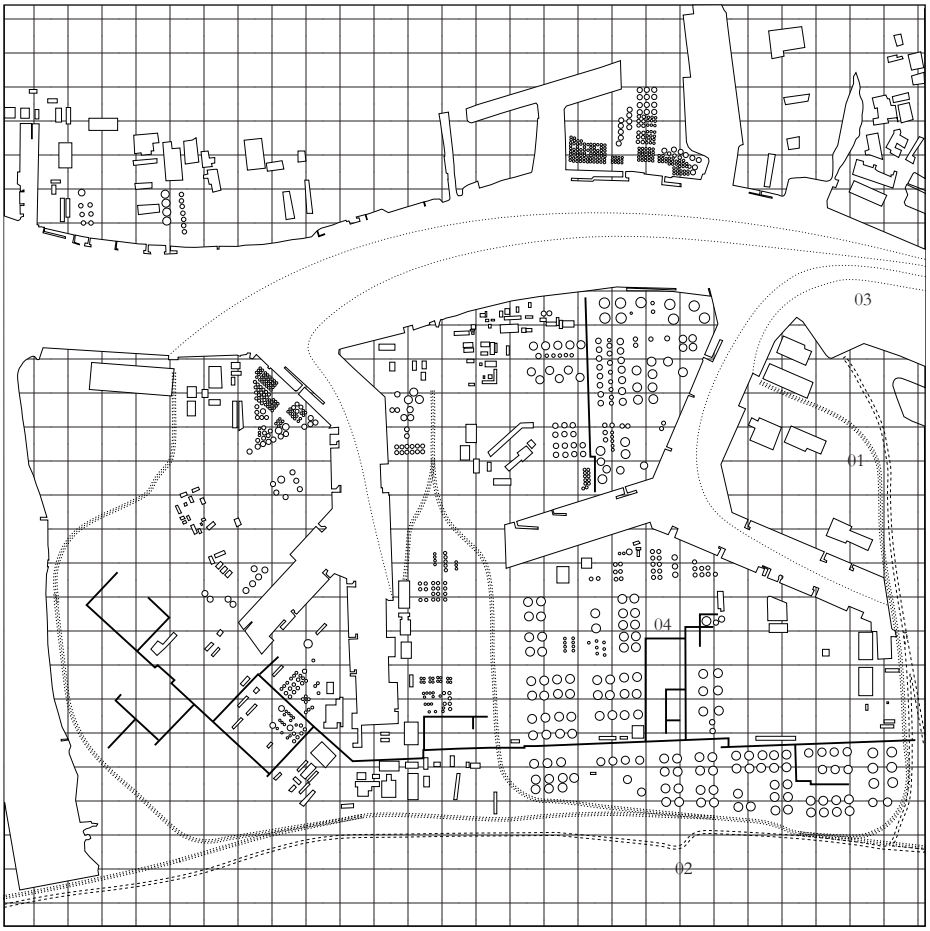


Overlay of Contamination, Program and Land use

Site Allocation and Access Points

Scale: 1:1000

01 Train Tracks
02 Highway
03 Boat
04 Elevated Path


03
01
04
02

Site Challenge 1 : Toxic

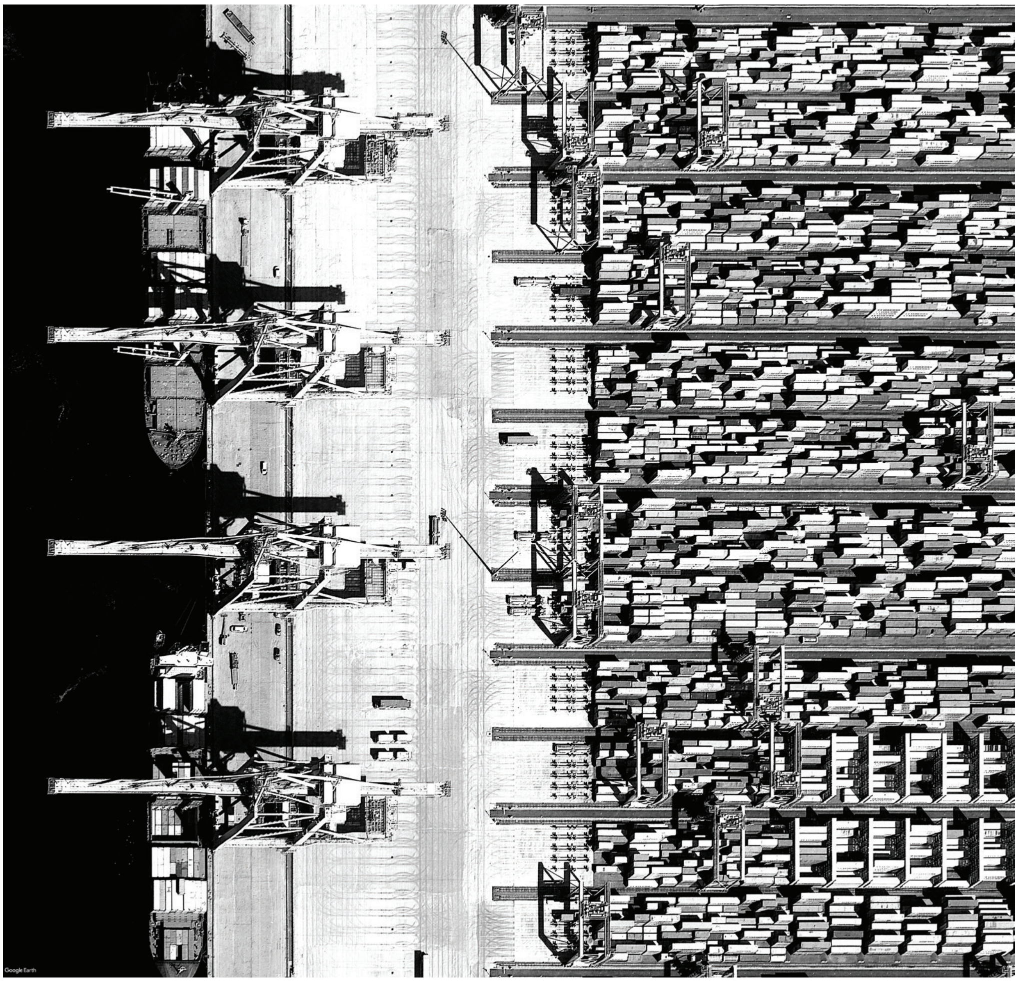
The main industry in the port are petrochemical activities and oil refining, followed by coal and gas fired power plants. "Soil contamination is mainly located close to waste land-fills, industrial/commercial activities diffusing heavy metals, oil industry, military camps, and nuclear power plants. "(Panagos, Liedekerke, & Yigini, 2013) Soil contamination is caused by the presence of man made chemical alterations in naked ground.

Certain areas in the Port of Rotterdam before the industrialization used to be nature reserves and focal point for the birds migration. It is not strange due to the fact of presence of the brackish water, an interchange between the freshwater head and the saline mouth of the delta lie a number of zones marked by intermediate salinity values, each with distinct characteristics per-taining to the water clarity and type of substratum, thus hosting different communities of organisms. (Nienhuis, 2008) The nature reserve De Beer which was once at the mouth of the New Waterway, was a wonderful example of a dynamic dune system where the sea had free rein. Large beach plains made an ideal location for a number of coastal breeding birds such as the common tern and the sandwich tern. De Beer developed into a nature reserve, also unique for its size (1,300 hectares) in the Netherlands. (Buijsman, 2007)

Site Challenge 2 : Automation

According to the Port of Rotterdam's Port Vision 2030 report, the Port wants to achieve a .Cluster industrial activities in Rotterdam. An increase the share of renewable resources used to generate energy. To develop biobased chemistry. To ncrease production capacity and renew production assets. Improve the Rotterdam port's value for money ratio. Make more efficient use of the available space. Maintain sufficient flexibility in the port's spatial development. Make more effective use of the existing infrastructure.

The APM Terminals Maasvlakte II Rotterdam facility is constructed on land entirely reclaimed from the North Sea and designed as a zero-emissions multi-modal hub to reduce truck traffic in favor of barge and rail connections to inland locations. The facility is the first to use remotely-controlled STS gantry cranes, moving containers between vessels and the landside fleet of 62 battery-powered Lift-Automated Guided Vehicles (Lift-AGVs), which transport containers between the quay and the container yard, including barge and on-dock rail facilities. The Lift-AGV's also represent the world's first series of AGV's that can actually lift and stack a container. A fleet of 54 Automated Rail-Mounted Gantry Cranes (ARMGs) then positions containers in the yard in a high-density stacking system.

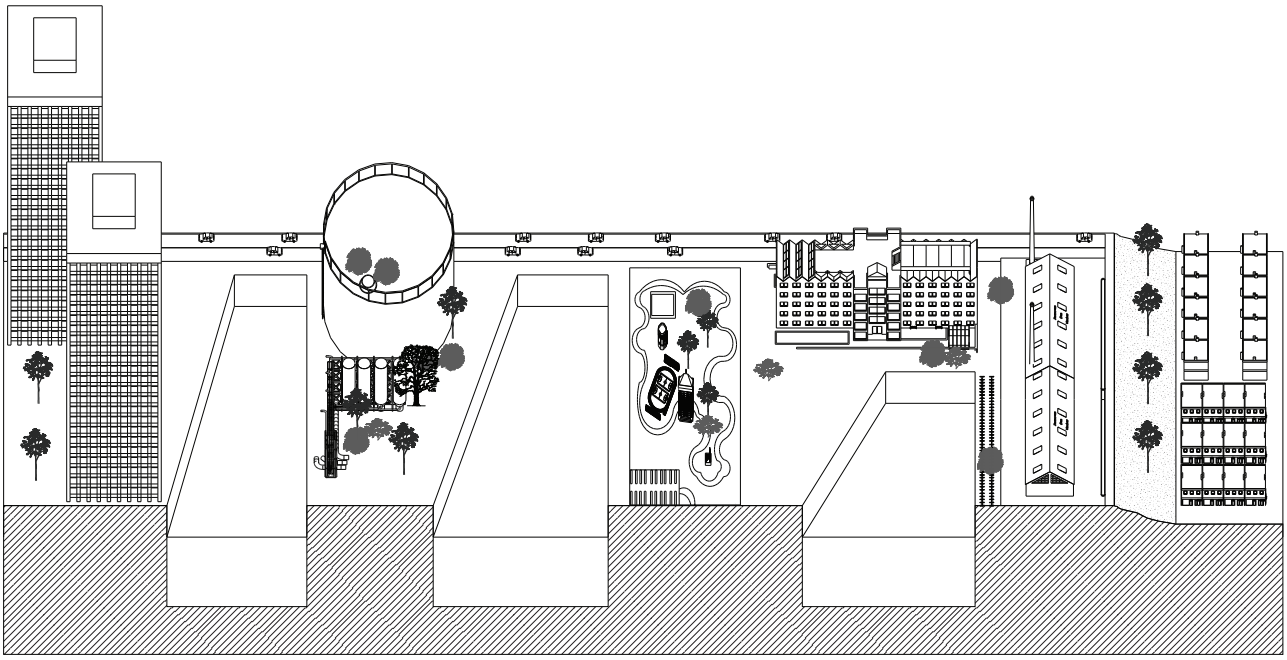

Google Earth

Voids, Islands on the Port Island

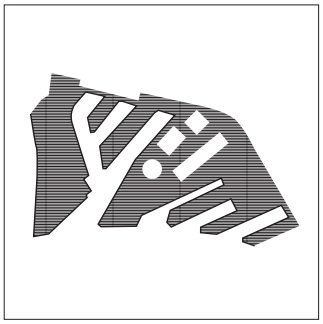

Rozenburg
Pernis
Merwe-Vierhavens
Heijplaat
Quarantine

M4H, Merwe-Vierhavens

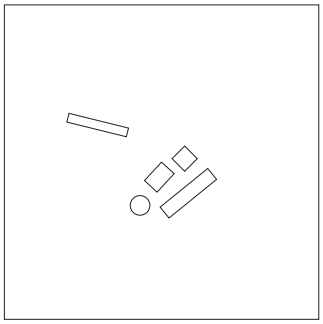
Mental Mapping Section



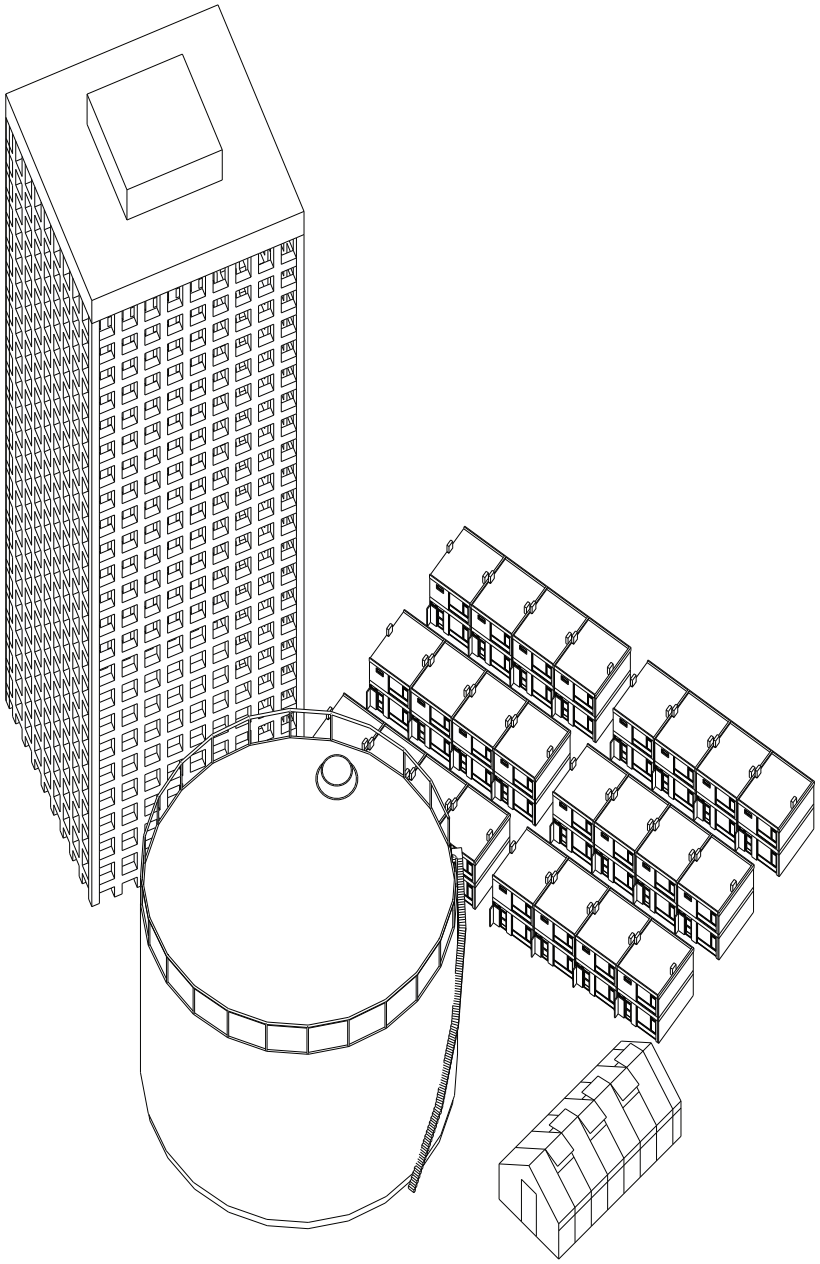
Island Definition



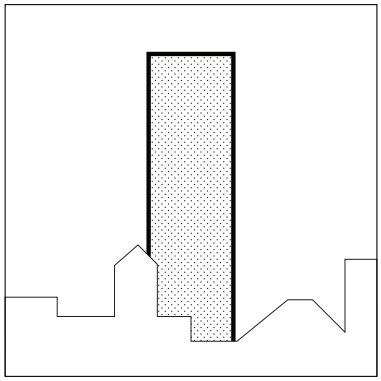
Edge with Water

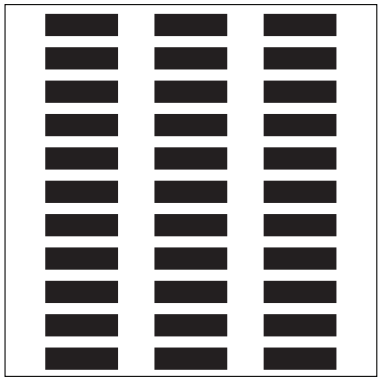


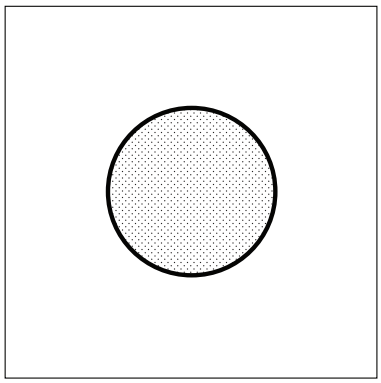
Interest

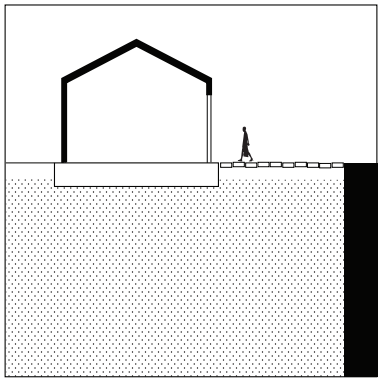


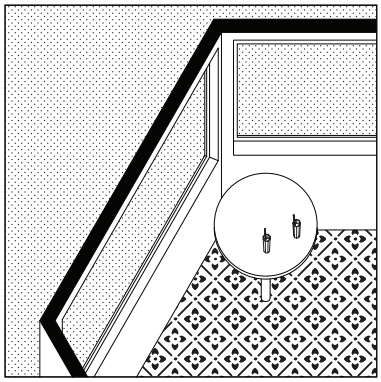
Tower Social Housing Silo Vegetables





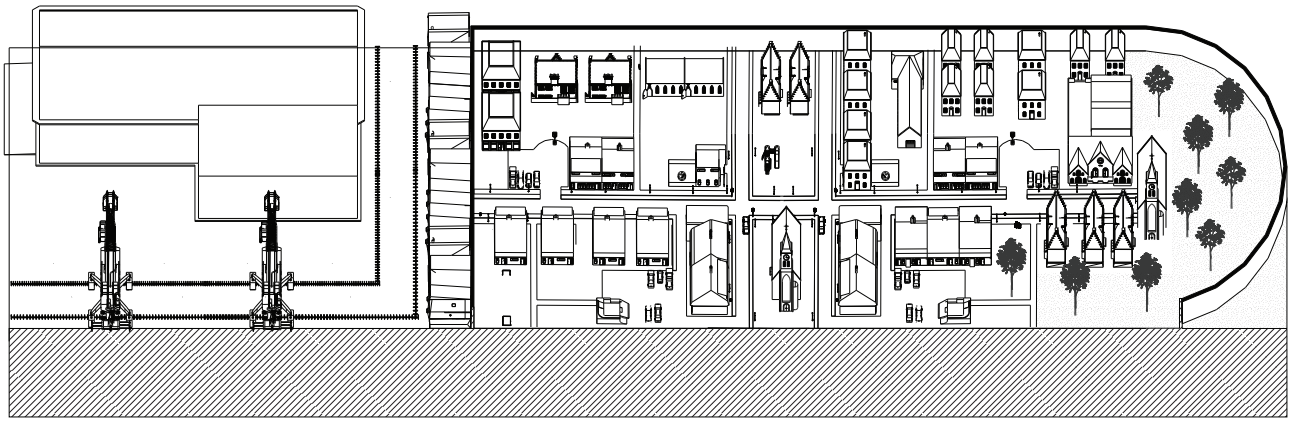


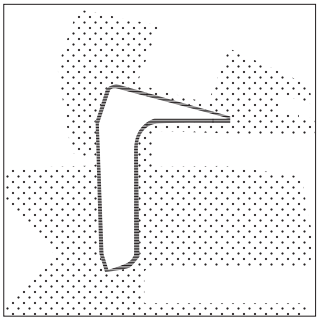




Heijplaat

Mental Mapping Section





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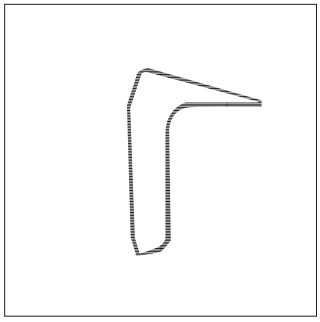
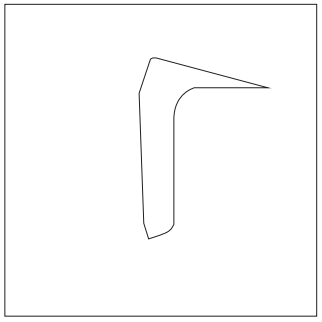


Edge with Water



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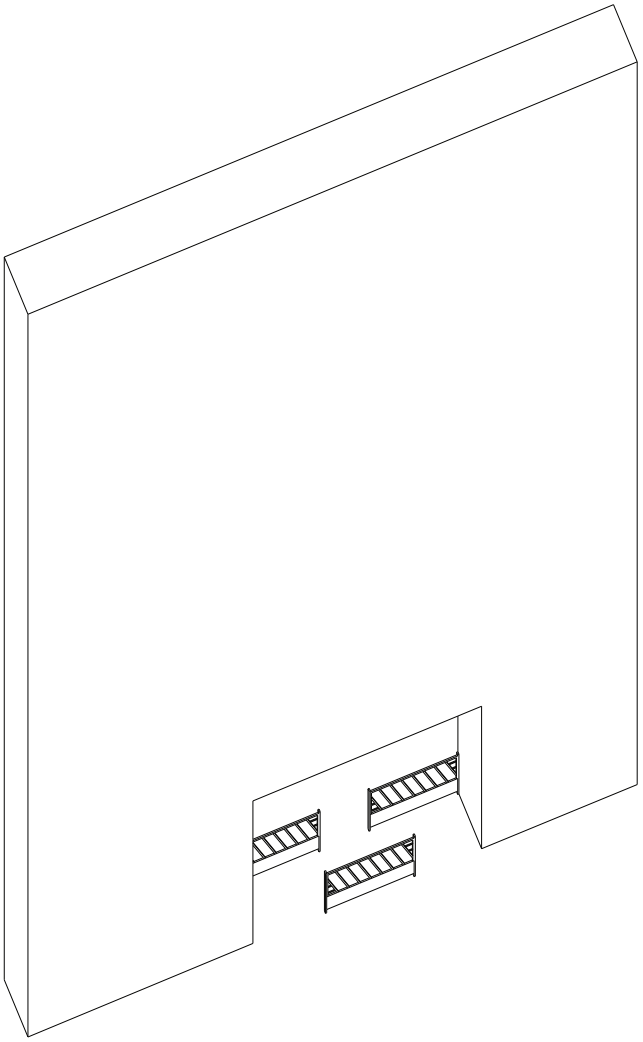
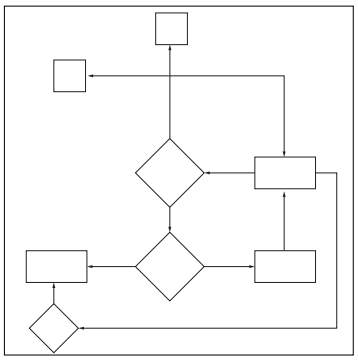
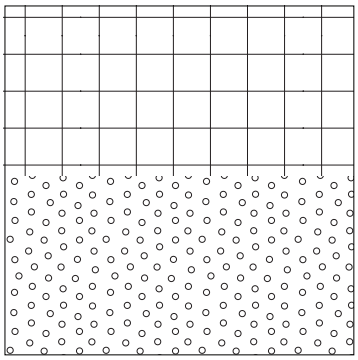
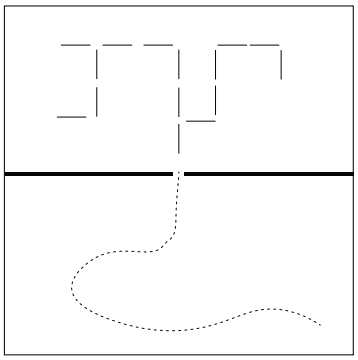
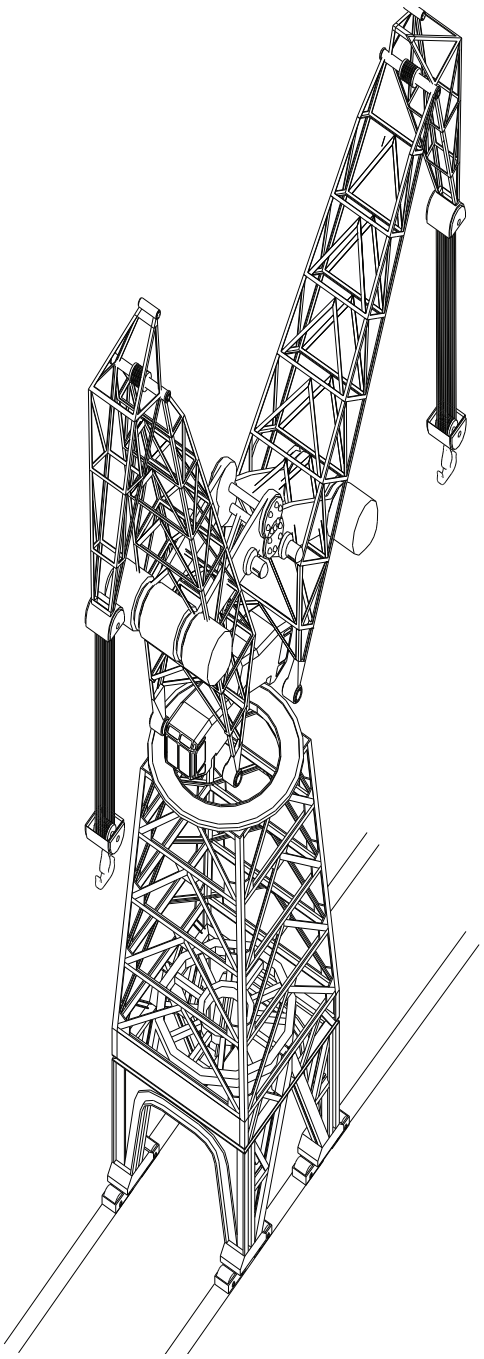


Separation Wall

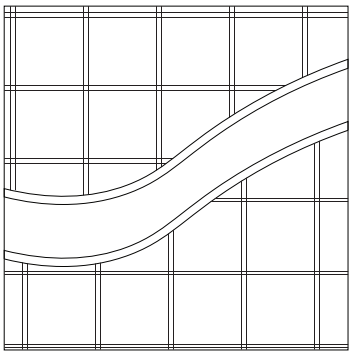


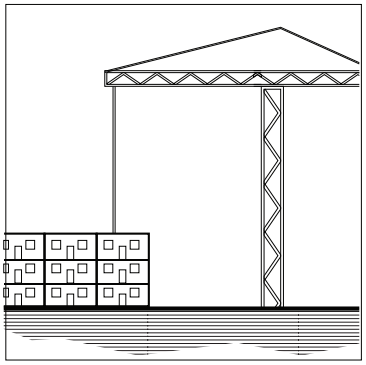






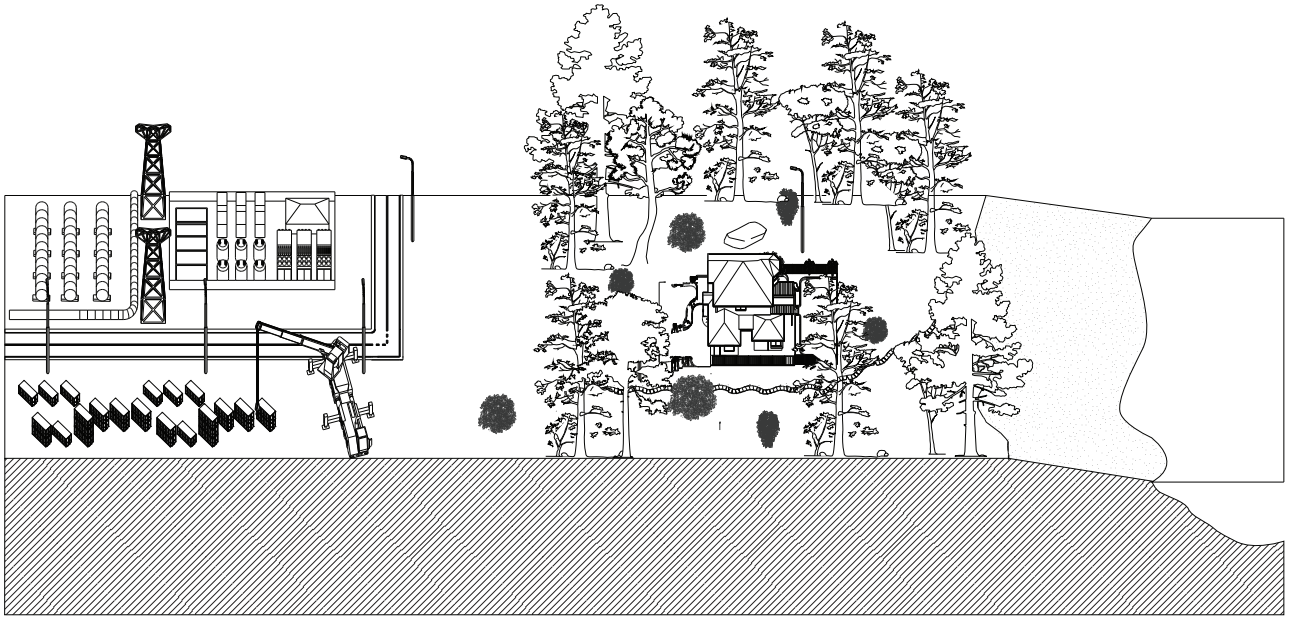
Crane

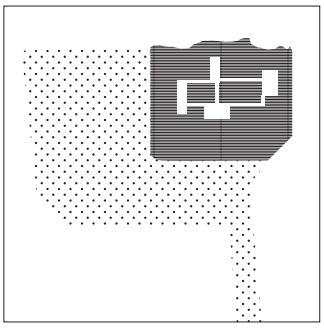




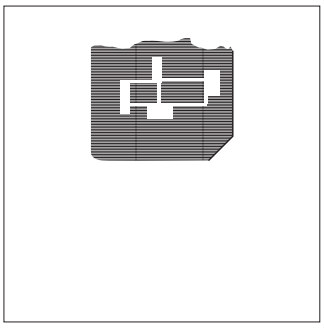
Quarantine

Mental Mapping Section

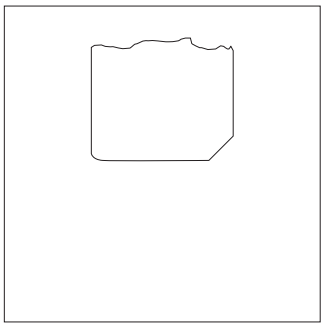




Island Definition



Edge with Water



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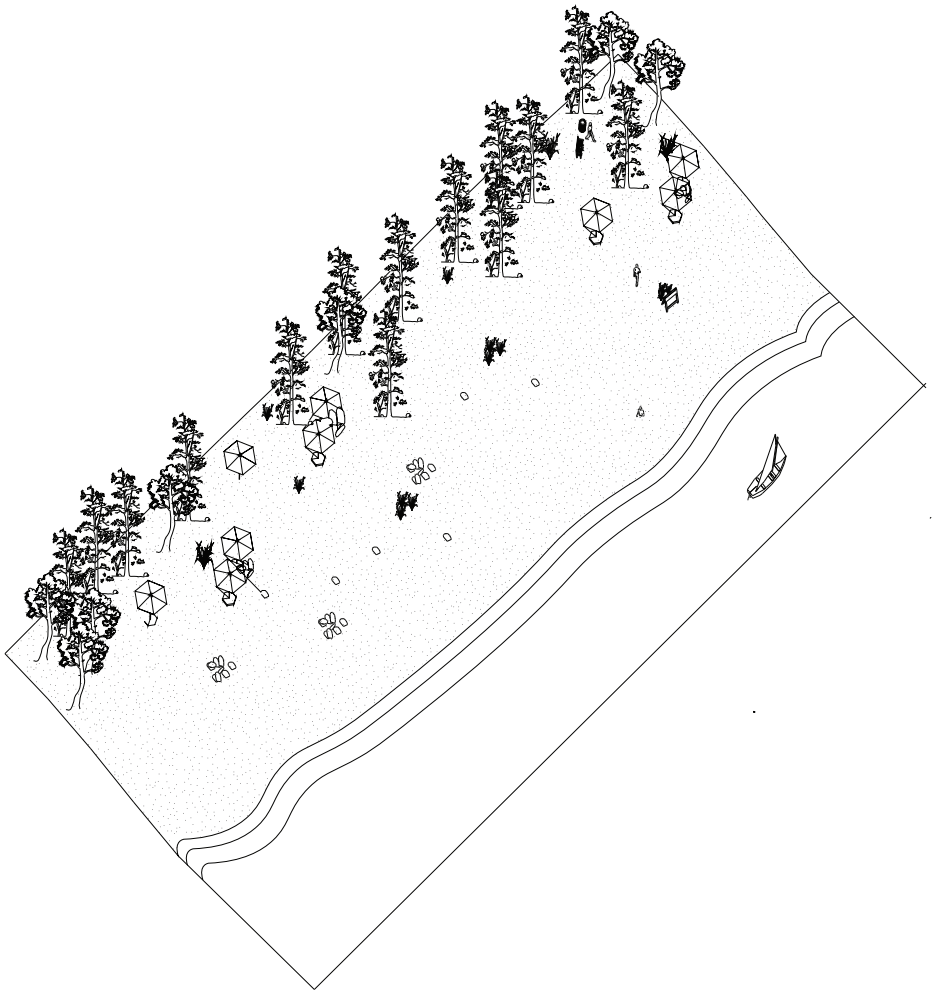
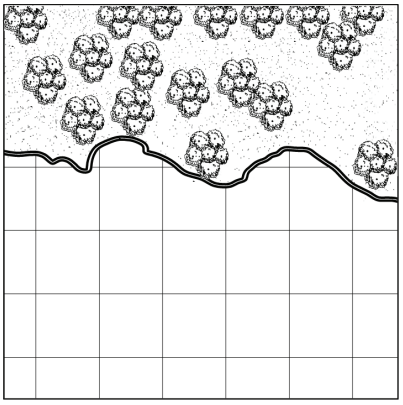
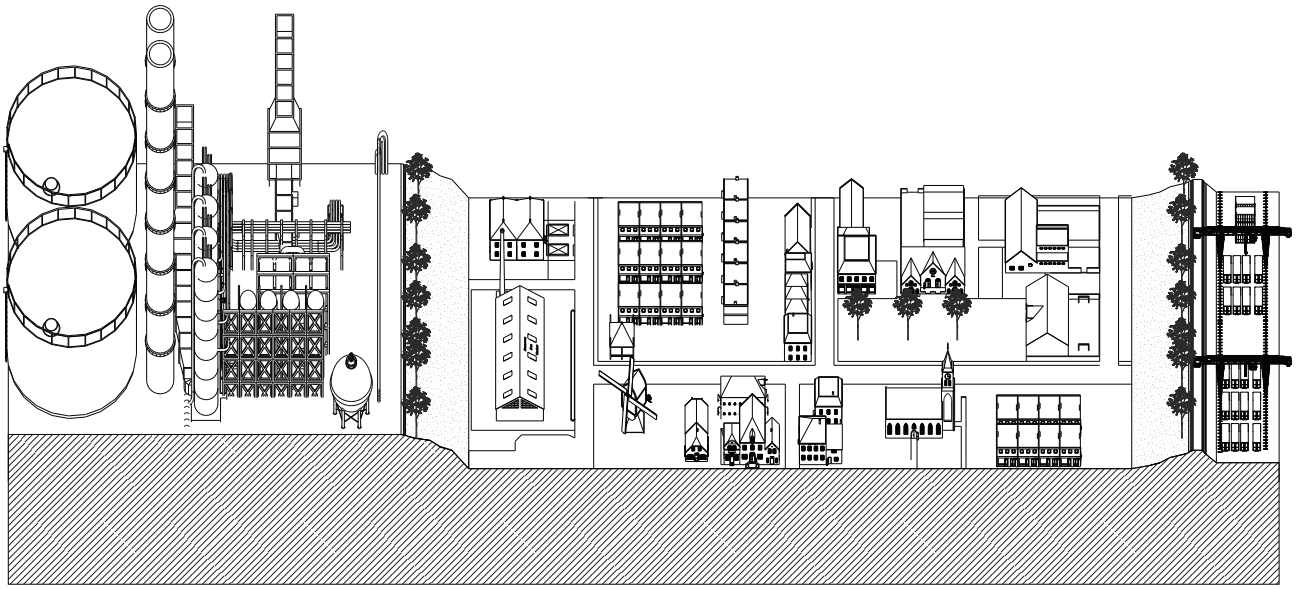


Beach



Pernis

Mental Mapping Section



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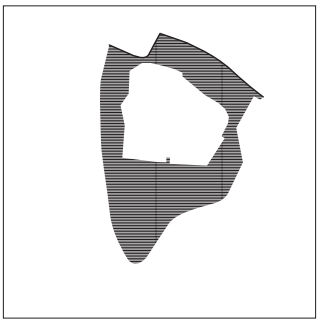
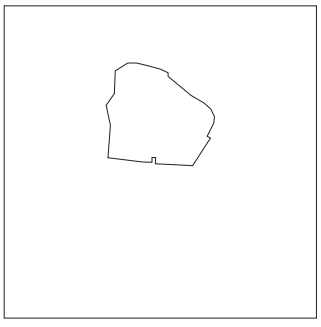


Edge with Water



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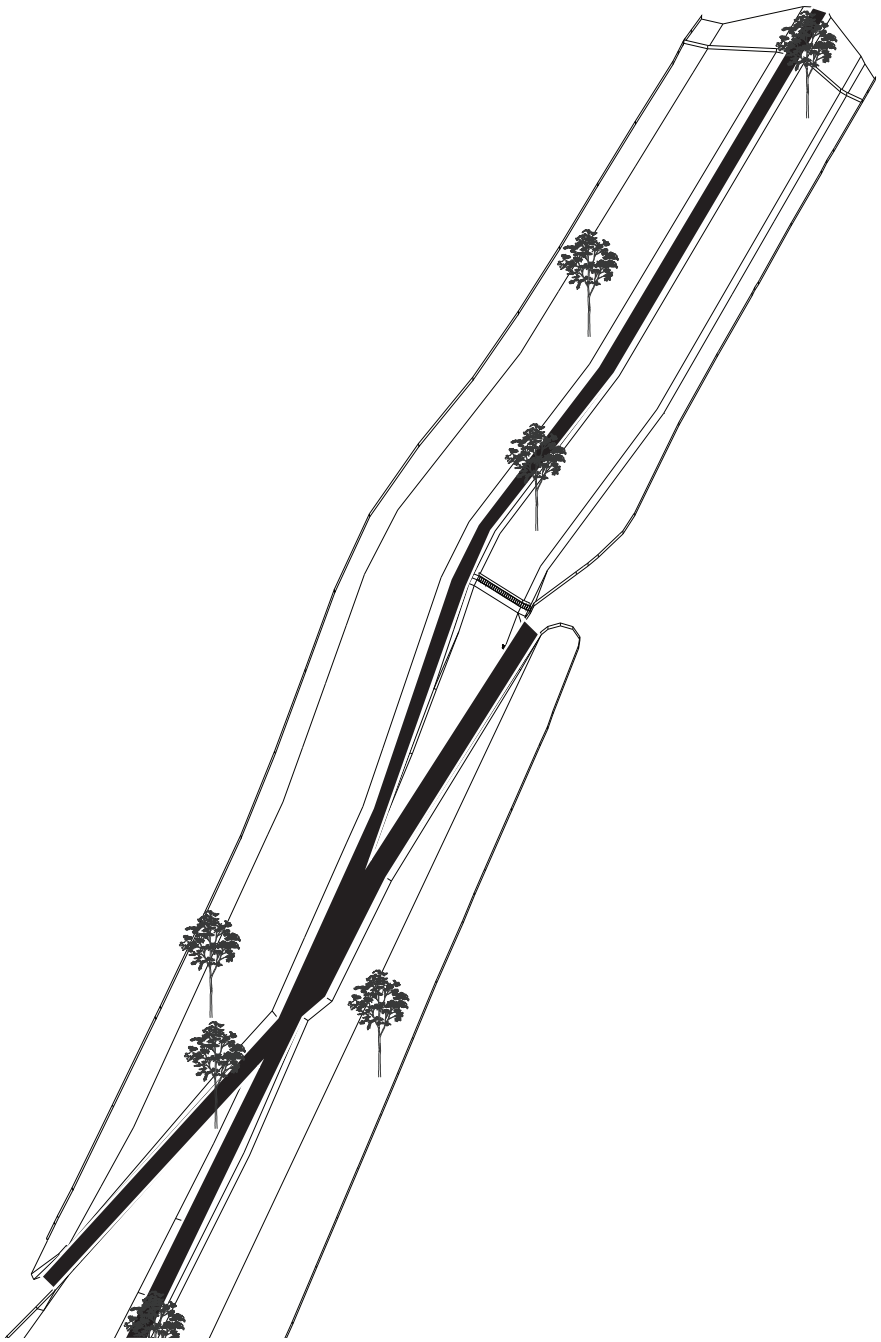
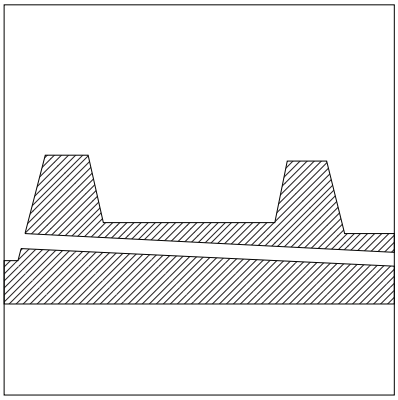
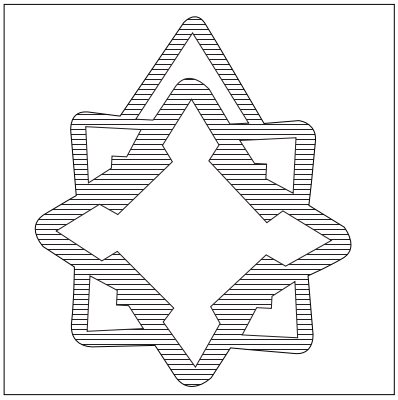
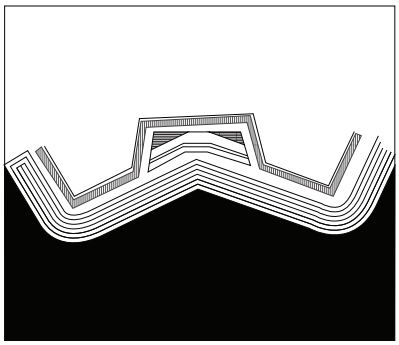


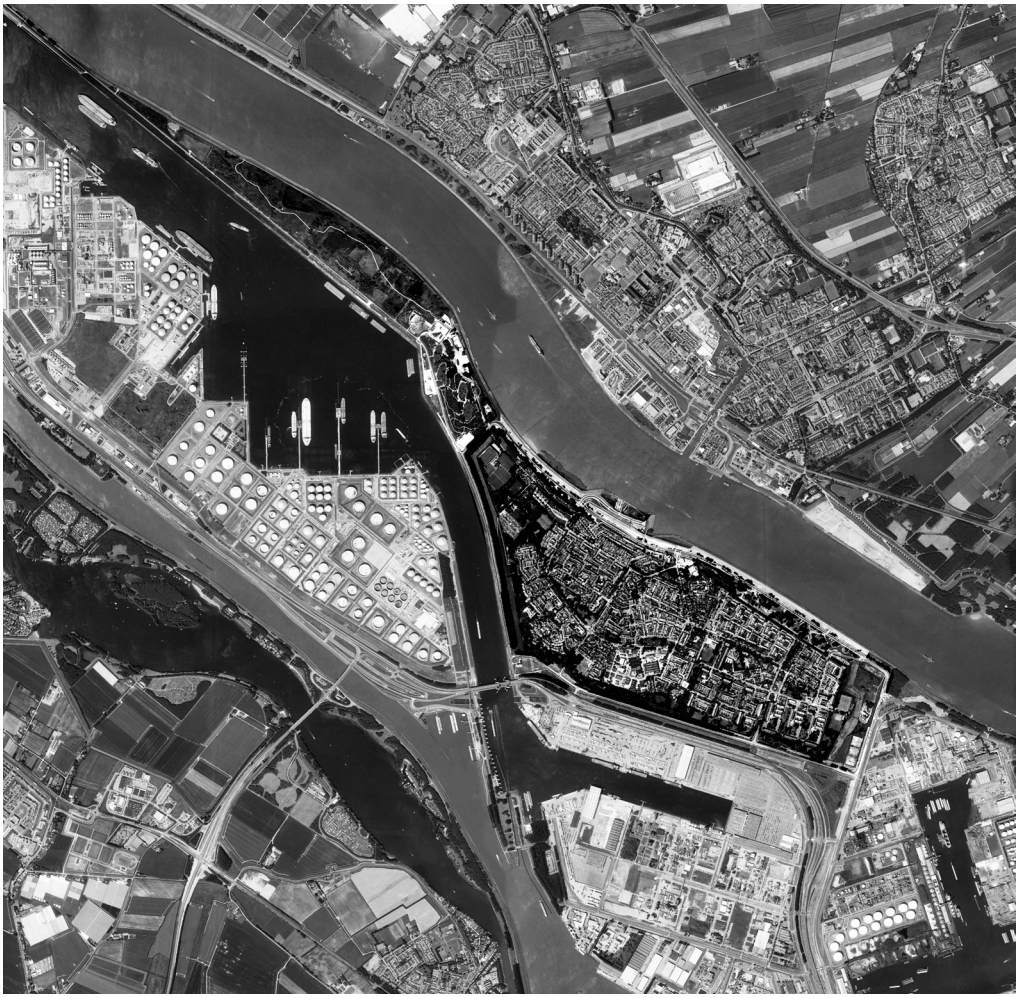
Dike



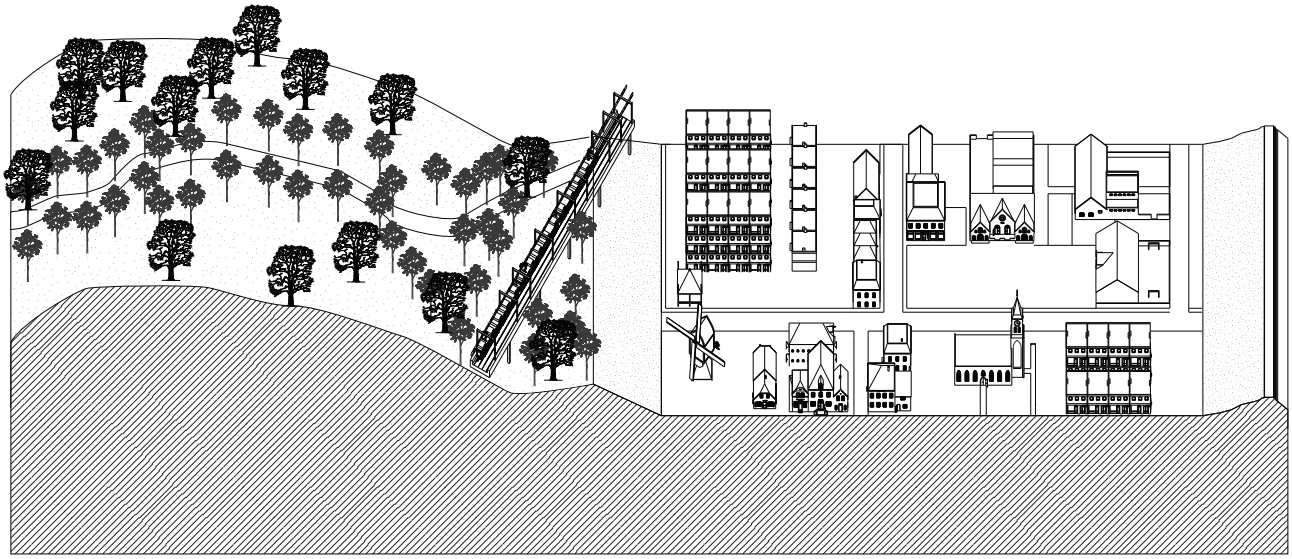


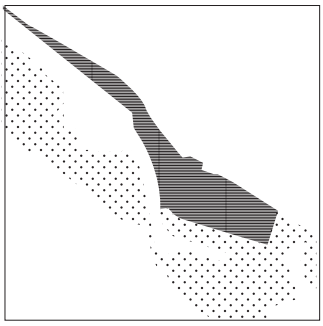


Rozenburg



Mental Mapping Section





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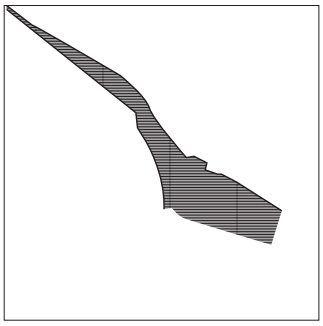
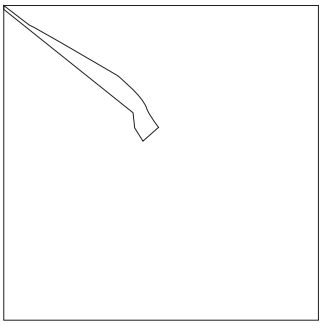


Edge with Water



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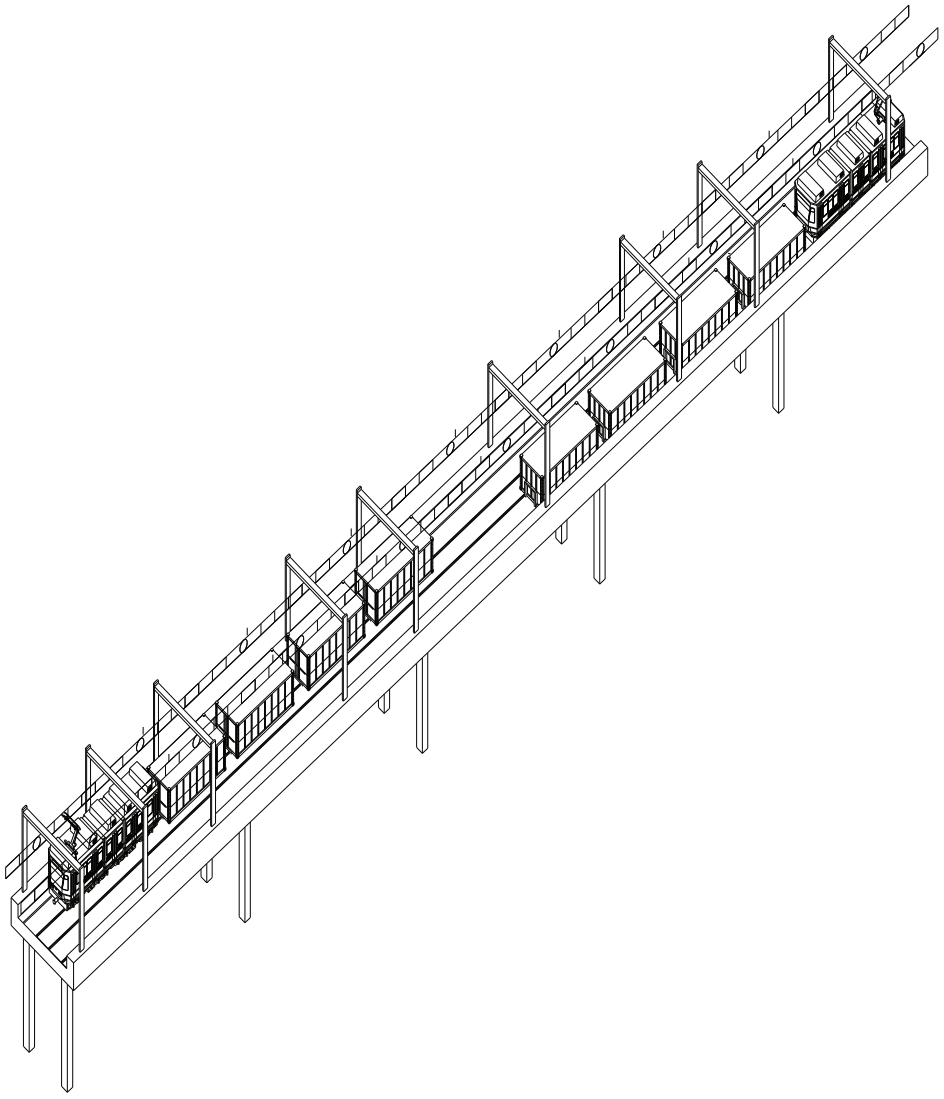
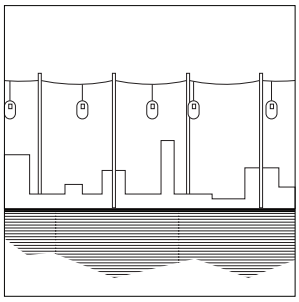
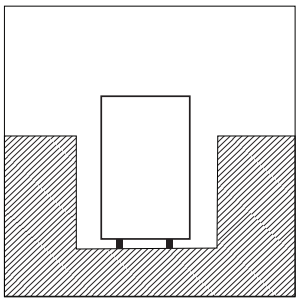


Elevated Path





2. Site: Pernis Petrochemical Site

2.3. Problem Statement

Port of Rotterdam pushes out and detaches of the city as it gets more technologically advanced and evolutionized. It's an island by itself, but as the city becomes more expensive to live in people are pushed to cohabitate in the residual logistic space of the port. Parts of this advanced infrastructure are highly automated and aren't adaptable for human habitation as they're toxic grounds. With a possible future nature taking over, it will unlock these previously machined toxic residual spaces as future commons to the future humans (species).

We're living in an era where spaces of logistics are further being detached from cities and urbanization to avoid choke points. But as these spaces migrate they leave traces of spaces permeating the city. What might be the impact of these logistical residual spaces weather large or very small on the expanding urban environment creating a clash, chaos and wastelands. The Port of Rotterdam is going under change concerning the petrochemical part. The reasons of decrease of oil in the last decade for the aim to shift to more sustainable energy production and for the increase of toxic spills on the ground and atmosphere. The Port's strategy is to push automation over these chemical sites that happen to be sites bordering Rotterdam city.

The Port will be looked through its interaction with its landscape first by looking at its morphological history as a trading port, importing and exporting logistic space as a national identity, although it's detached metaphorically, and it's future identity of decay. Structurally it has the highest altitude above water up to 6 meters compared to the city of Rotterdam. Rotterdam port is the island that will stay afloat with high climate change for a country under sea level might be it's re birth, toxicity allows evolution for a new nature. An Architecture of void that brings memory to site that lacks it. An Architecture that is temporal and yet adaptable to the future scene of the port.

2.4. Design Question

How can the future land which is toxic in our age unlock a future common? How can/ what is the architecture of emptiness to achieve the coexistence of human memory in the toxic landscapes of the Rotterdam Port?

Sub-questions

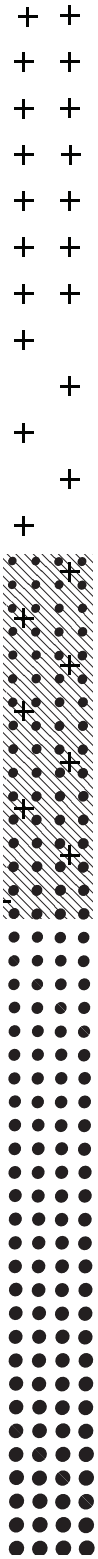
1. How to invest on abandoned infrastructure that was serving our needs on a climate and resource cost as a method to rethink the relations between the realities we live in.

2.How can the new state of residual logistic space be a habitat for new nature to coexist with infrastructure?

3. How to reconnect different types of decaying economic infrastructure together with ecological nature evolution in the context of rising bordering practices around the North Sea to unlock a new common?

Collision of Site Challenges

01 Automation
02 City
03 Toxicity
04 Isolation


01
03
02

Problem Analysis

3. Problem Analysis

3.1. Research Framework

Research Methods - Analysis Methods

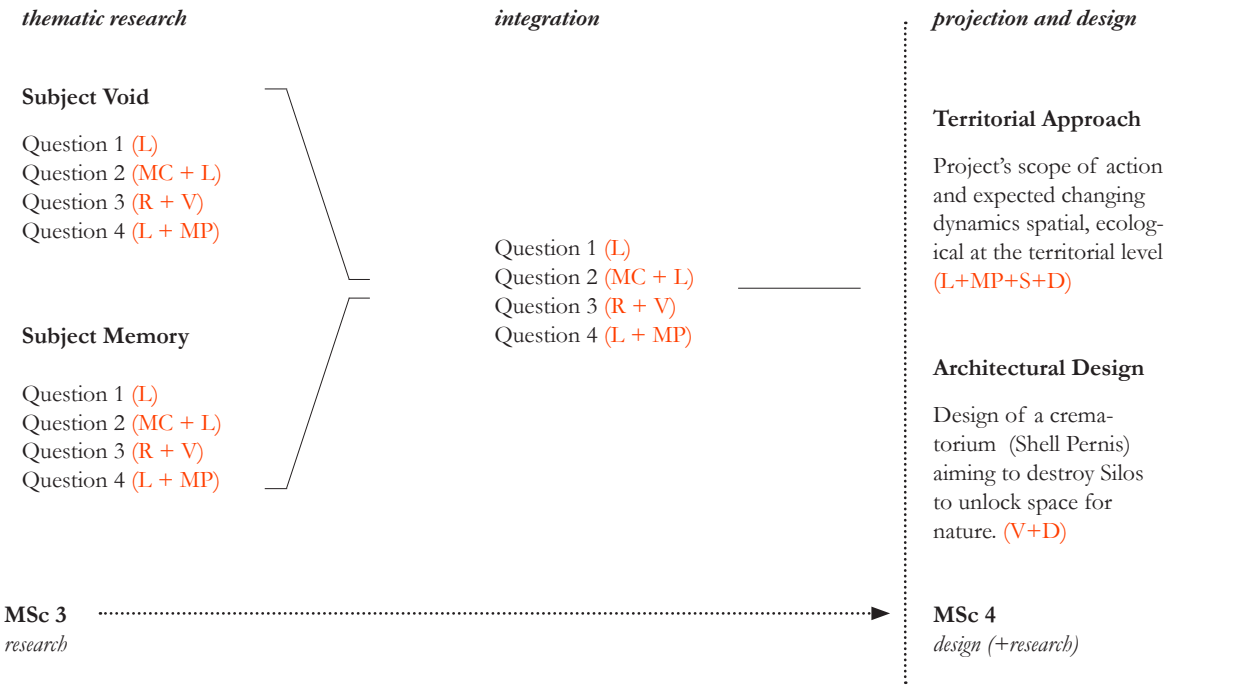
Research by design on territorial scale that poses complex changing environmental challenges for a future project proposal is helpful. To plan a future proposal cannot be based solely based on existing conditions and programs, moreover the research proposal is about sites, territories, in transit hence changing with shifting programs that are being altered. Therefore, the design research process should be able to give back multiple times, therefore it has to be reflexive. When studying territories, we can't disregard the political, economic, ecological and geographical factors into study. The agency of mapping is a research tool as a creative practice which uses the finding s to give new findings. Even when mapping scientific objective data our consciousness is active by selecting what information to display and this is where the produced map becomes a project by itself and is not neutral but subjective, hence mapping is a method of studying a phenomena specially when mapping experiences, Corner states that the experience of space cannot be separated from the complex events that happen in it.

Designing scenarios suits the complex problems to be analysed because it helps in synthesizing creative leaps in thinking. With mental maps are part of the behavioural geography and were the early studies done that have intersected geography and the actions of human beings. I was able to translate my personal spatial experience into a visual format. Going to site in order to conduct documentation of experiences on the site is fieldwork research. To approach a site, I had to set practical strategies on how to conduct the documentation. Having the chance to visit the site multiple times allowed me to feel the atmosphere of the space through different times of the week and different hours. Sketching instances and coding them in a sketch book along with taking a series of photographs and then trying to analyse and decode the material to extract relevant information to present a narrative at the end, from the decoded 'collected' objects and recompose/ collage and reorder them helps me achieve a program that relates to my site experience which resulted in conceptualizing the architecture project zoomed in from the territorial macro scale issues.

To complete the synthesis of scientific data mapping with site experiential mental mapping, case studies will be looked into. Taking a case study method, allows for a comparative approach between what is proposed to be designed with a previous example that has the same logic and relevance (scale, intention, materials, approach) which triggers for a critical reflection process to see what is working correctly in the proposed intention and what is not depending on the surrounding context of course.

3.1. Research Framework

Research Methods



L	Literature Study
MC	Mapping Current State
MP	Mapping Projections
S	Scenario Planning
R	Reference Analysis
V	Visit
I	Interview
D	Research by Design

3. Problem Analysis

3.2. Subjects

Toxicity

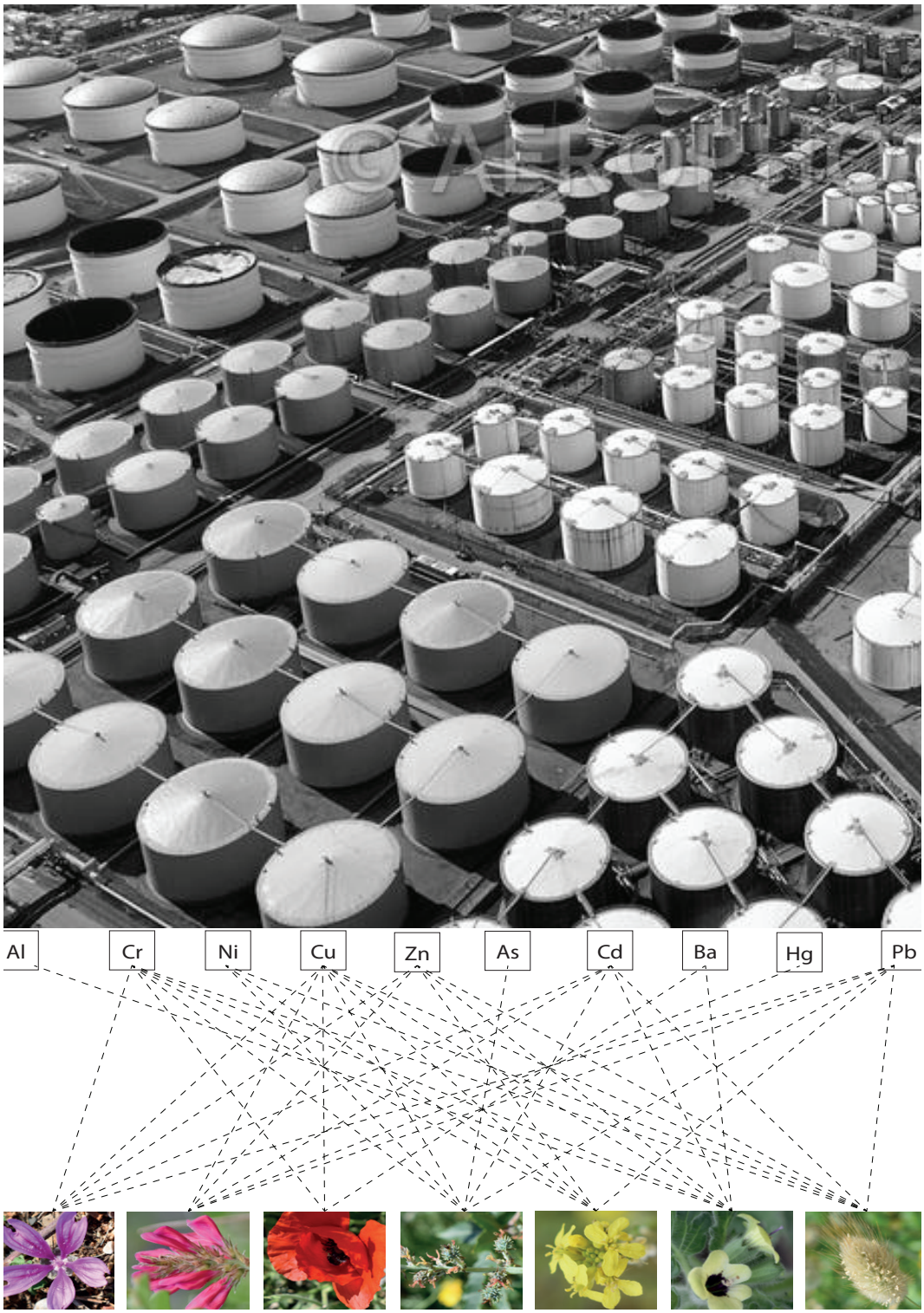
The term generally describes a substance's 'quality of being toxic or poisonous' to an organism or, if present in a greater scale, to a whole environment. These substance are elements, most of all metals or petro-chemicals. Yet toxicity is evidently relative to whom or what it is effecting. A famous old saying notes: 'The dose makes the poison'. Thus, it is possible to die from drinking too much water, yet lives have been saved by small doses of arsenic.

The main industry in the port are petrochemical activities and oil refining, followed by coal and gas fired power plants. "Soil contamination is mainly located close to waste land-fills, industrial/ commercial activities diffusing heavy metals, oil industry, military camps, and nuclear power plants. "(Panagos, Liedekerke, & Yigini, 2013) Soil contamination is caused by the presence of man made chemical alterations in naked ground.

Hyperacculators are capable of growing in soils with high concentrations of metals that actively and selectively absorb these metals through their roots, and concentrate extremely high levels of metals in their tissues, either in order to safeguard themselves or as a quirk of nature. Some make themselves poisonous in order to not get eaten by predators, others just as a quirk of nature. Phytoremediation is a tool to address post-industrial, contaminated sites all as being evident all over the world.

Potential Plant to Grow on Site

Source: Theatrum Toxicum, Complex Projects, TU Delft, D. Arakji & N. Tietje, 2018


Al
Cr
Ni
Cu
Zn
As
Cd
Ba
Hg
Pb

Toxicity

Toxicity commonly has a negative connotation. The present day debates about the epoch of the Anthropocene, about evolution and extermination, feed this definition.

The thesis work explores the topic of toxicity within the territorial framework of the Petro-Chemical section Of the Rotterdam Port. The 90 squared kilometre area south of Rotterdam city centre narrates the story of Rotterdam, its history in industrial evolution, challenges and constant transformation during the last century.

Over 150 years ago, George Perkins Marsh already noted:

v'...man is everywhere a disturbing
agent. Wherever he plants his foot, the
harmonies of nature are turned'.

And humans do, in fact, cause toxicity and the chemical Section of the port presents a striking example. But humans did not invent toxicity, it has been there before us. Toxicity, allows evolution and extermination. Is it not rightful to be part of the 'Planetary Garden', and must therefore not be seen as something solely negative. Toxicity, finally leads us to a future vision in which the roles might be turned; the relationship between man and nature.

Lake Natron in Tanzania

Source: The Independent UK 2019
Africa's most toxic lakes are a paradise for fearless flamingos

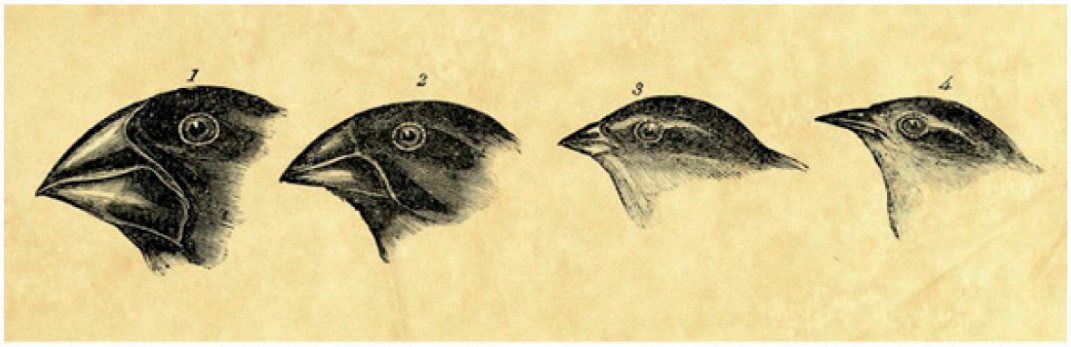
It is evident that, in the aftermath of industrialisation, concentrations of toxins in the natural environment have increased in countless places around the world to an extent that all living organisms have to deal with this consequence in one way or another. Toxicity allows evolution and extermination if we reflect on how life on earth began; how it ended for some species and how it became ready for humans to colonize it. Can toxicity of the environment allow biodiversity in the long run? What if we acknowledge the present situation without trying to repair it through heavy interventions but let nature heal itself? Phytoremediation for instance describes the process and ability of plant species to reverse contamination of soil, water and air. The term stems from Greek phyto meaning 'plant' and Latin remedium meaning 'restoring balance'. In recent years, we have increasingly taken advantage of this quirk of nature, and the term hyperaccumulator has become common vocabulary in the field of eco-conservation. Today, over 400 plants are known to absorb – or better yet, hyperaccumulate – toxins. Some do so in order to make themselves poisonous to not be eaten by other species, others just by chance. It does not come as a surprise that humans are now utilizing this knowledge, trying to speed up the process of remediation where previous generations have contaminated the media of nature.

The role of nature and humans and their interrelationship guides our approach towards toxicity. In order to explore and examine the movements and processes related to toxicity in the Port of Rotterdam, it is looked with a twofold view. What humans consider toxic some animals and plants not necessarily do. They have might even modified their molecular structure in order to adapt to new environments. What is toxicity? Toxicity of the human mind, health, soul and or environment?

An 'adaptation' is a mutation or genetic change, that helps an organism, such as a plant or animal to survive in its environment. It is passed down from one generation to the next. As more and more organisms inherit the mutation, the mutation becomes a typical part of the species. The mutation has become an adaptation.

Birds Beak Evolution

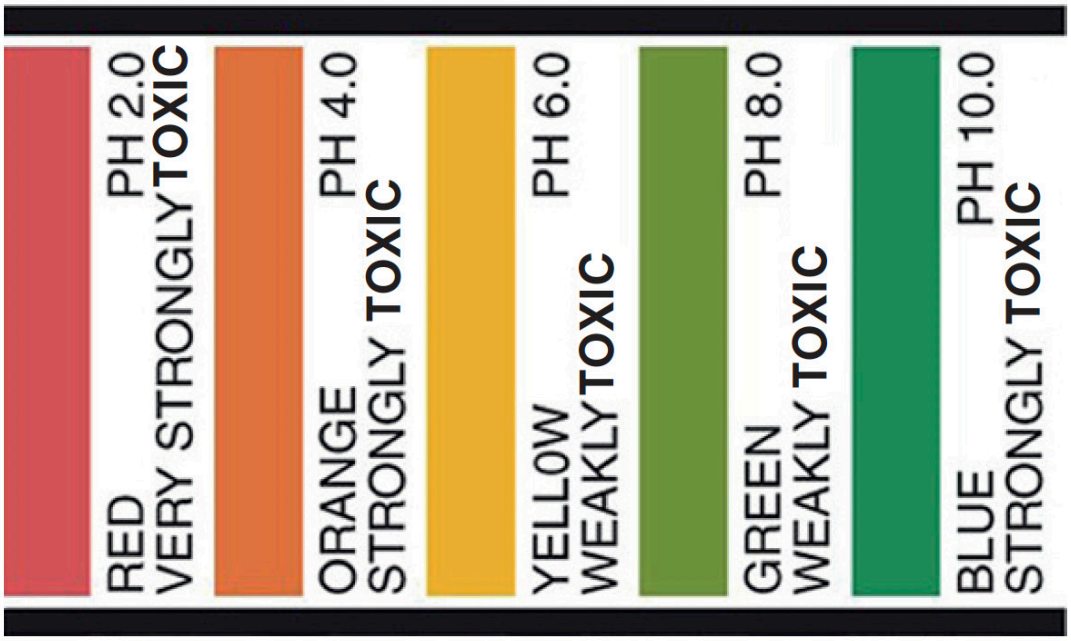
Source: Theatrum Toxicum, Complex Projects, TU Delft, D. Arakji & N. Tietje, 2018



ADAPTATION INDICATOR PAPER

For approximate pH determinations of aqueous solutions. Accuracy = ± 1.0 pH

COMPARE MOIST STRIPS WITH CHART



3. Problem Analysis

3.2. Subjects

Voids

"The voids of the city are spaces which disrupt the urban tissue, leaving it incomplete and throw into question the use of those spaces. Sometimes called urban ruins, they are at the limit between private and public space, without belonging either to the one or to the other. Urban voids are containers of memory, fragments of the built city and the 'natural' environment; memories of the city which constitute a random, unplanned garden."
Noll and Scupelli, 2009,

The common notion still remains that wastelands are of no value until developed. However these types of spaces hold a unique and valuable role in the future of humanity as we question notions of progress and strive for more sustainable models of living. Urban wastelands support inner city biodiversity, provide open space and represent freedom from the controlled built environment. As metaphors wastelands typify the cause and effect of our constant (re) development.

Doron Argues that naming something a void contributes to creating the void, the terminology used is not descriptive but constitutive. He also describes such interventions of regeneration as acts of re-colonization on an urban scale. The urban voids located along single-functioning infrastructures present the opportunity for an architectural intervention. Different spatial experiences may be created, as well as the implementation of public programs, with the goal to revive the area. These residual spaces can be used to "thicken" the infrastructure, in order to produce a multifunctional one. Stan Allen,1999.

Doron, G. M. (2016). The Dead Zone & the Architecture of Transgression. Delft: TU Delft. https://doi.org/10.4233/uuid:177004e0-68fe-430b-a085-3baf7c57fd47

Allen, Stan. "Field Conditions." Points Lines: Diagrams and Projects for the City. New York: Princeton Architectural, 1999. Print.

Voids of Rotterdam Port

01-04 Rozenburg Island
05 Heijplaat Residential Side
06 Residential Next to Petrochemical
07 Quarantine Beach
08 M4H Undeveloped Harbour


01


05


02


06


03


07


04


08

The Non Place

The Port is seen as a 'non place' where human beings are anonymous to it and do not hold enough significance to regard it as "place". A it lacks personal memory and perception. Non-place is a place where humans do not live in, which the individual remains anonymous and lonely. (by the French anthropologist Marc Augé). The Project takes the toxic non place and transforms it into a transitional restricted space for humans for a certain period of time when the ground is recovering from toxicity and then as nature grows wild it expels the humans out yet retaining their memories in it from a non place to another non place.

The Void as Programme

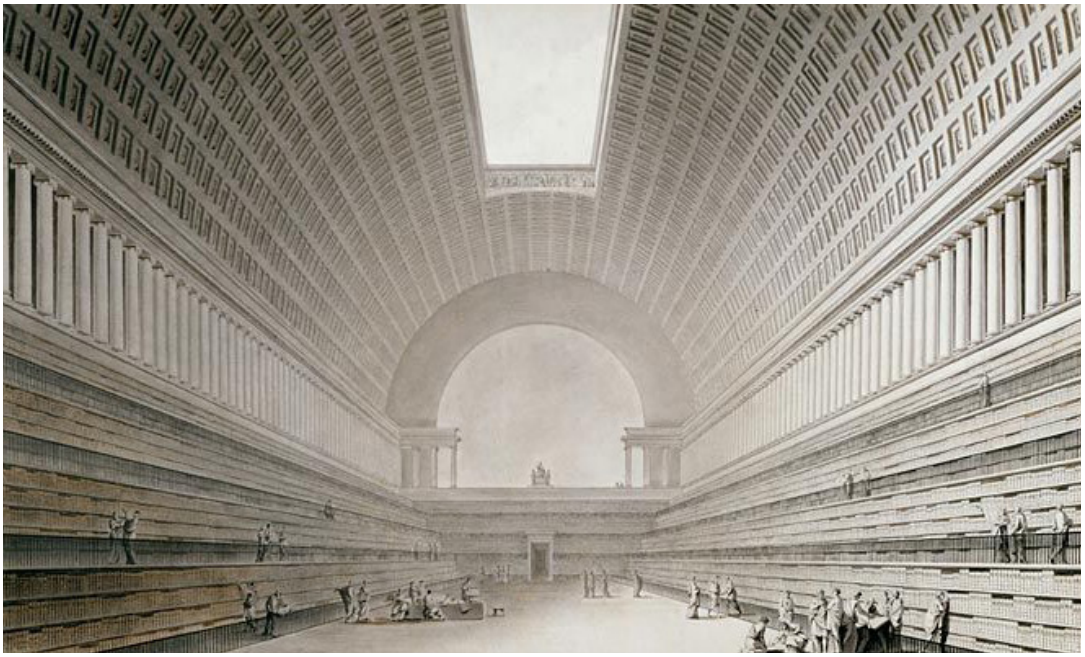
There are programmed spaces where the void or emptiness is of utmost importance. Where we try to minimise the functional - or render them invisible.
Planetariums aim to create the illusion of the cosmos - the great abyss. A simulation of total darkness punctuated only by points of light. Religious buildings or emblematic political buildings tap into the void to create the connection with the sublime - volumes that inspire awe through vastness. We look to the foyer of a bank or powerful institution where the expression of power is made through the excess of emptiness.

The intimate emptiness which lies within the humans. Henri Lefebvre refers to space being produced by people. That it is a performance, an event which relates to our daily lives and therefore all spaces. This type of space becomes most manifested in the spaces of performance. The book ' The Empty Space' by Peter Brook points out that within emptiness we can create other spaces.

For Artis Yves Klein and his "Leap into the Void" was resembling that the theater was a spectacle enacted without actors, without stage design, without a stage, without an author and without an audience. The theater of the future was, for Klein, an empty room: the theater of the void. In the framework of the port of Rotterdam the theater is that of nature. The actors are the plants and the design set objects are that of the abandoned oil silos and oil refinery.

Bibliothèque du Roi Étienne Boullée

Leap into the Void Yves Klein



The Object

Panorama

A panorama (formed from Greek “all” + “sight”) is any wide-angle view or representation of a physical space, whether in painting, drawing, photography, film, seismic images or a three-dimensional model. (1)

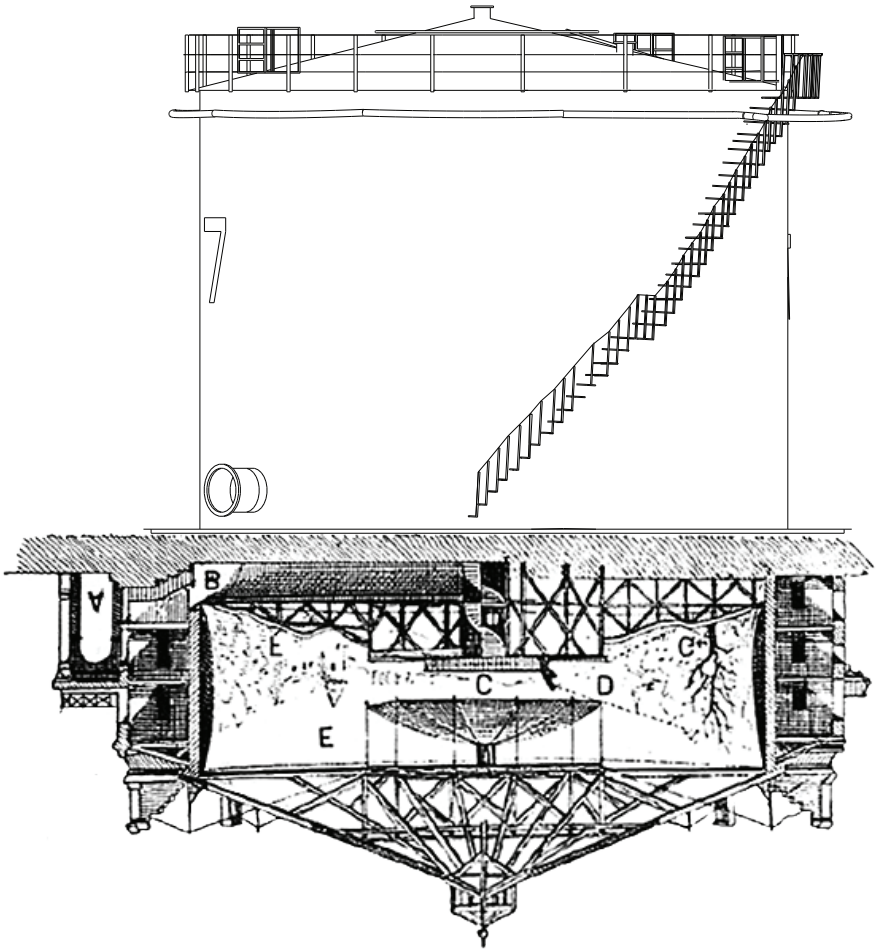
The term theatre commonly describes a scenic representation of events as artistic communication between actors and an audience. A theater may refer to a building in which theater is played, the process of theatre-playing, or generally a group of people who make theatre. It is often is a collaborative form of fine art using live performers, actors or actresses, to present the experience of a real or imagined event before a live audience, typically on a stage. The performers may communicate this experience to the audience through combinations of gesture, speech, song, music, and dance. Elements of art, such as painted scenery and stagecraft such as lighting are used to enhance the physicality, presence and immediacy of the experience.

Because theatre is a spatial and temporal art, it became the laboratory of simultaneity. Like modern architecture, it conceived space in new ways; like narrative arts, it reordered time. In the case of spatial matters, it shared in the new ideas of architectonic order. Around the turn of the century architects began to reconceive space and construction, as Stephen Kern points out: “Whereas formerly they tended to think of space as a negative element between positive Journal of Dramatic Theory and Criticism elements of floors, ceilings, and walls, in this period they began to consider space itself as a positive element, and they began to think in terms of composing with ‘space’ rather than with differently shaped ‘rooms’” (Journey of Academic Theory and Criticism,1999 p.20)

Literally and metaphorically the Silo is an introverted island object in a toxic landscape and so is the Port of Rotterdam. From it’s first moment until now, the port has been pushed away from the memories and sight of Rotterdammers. The Silo would be a display of human actions happening inside it while remaining obscure to the outside city. The silo becomes a theatre of everyday life.

(1) Motion picture - Expressive elements of motion pictures”. Encyclopedia Britannica.

Object Silo Pernis, Rotterdam



18th centuary Panorama

Polycentricity

Polycentric: Adjective, meaning "having more than one center," derived from the Greek words polús ("many") and kentrikós ("center")

The emergence of new typologies of polycentric city-regions

Polycentric urban forms either result from a growing intra-urban decentralisation of the large metropolitan agglomerations or grow together out of former single cities merging into one extensive city-region. Examples of this latter type in Europe include e.g. the Randstad in the Netherlands. (Michael Petrek & Thorsten Burklin p.180)

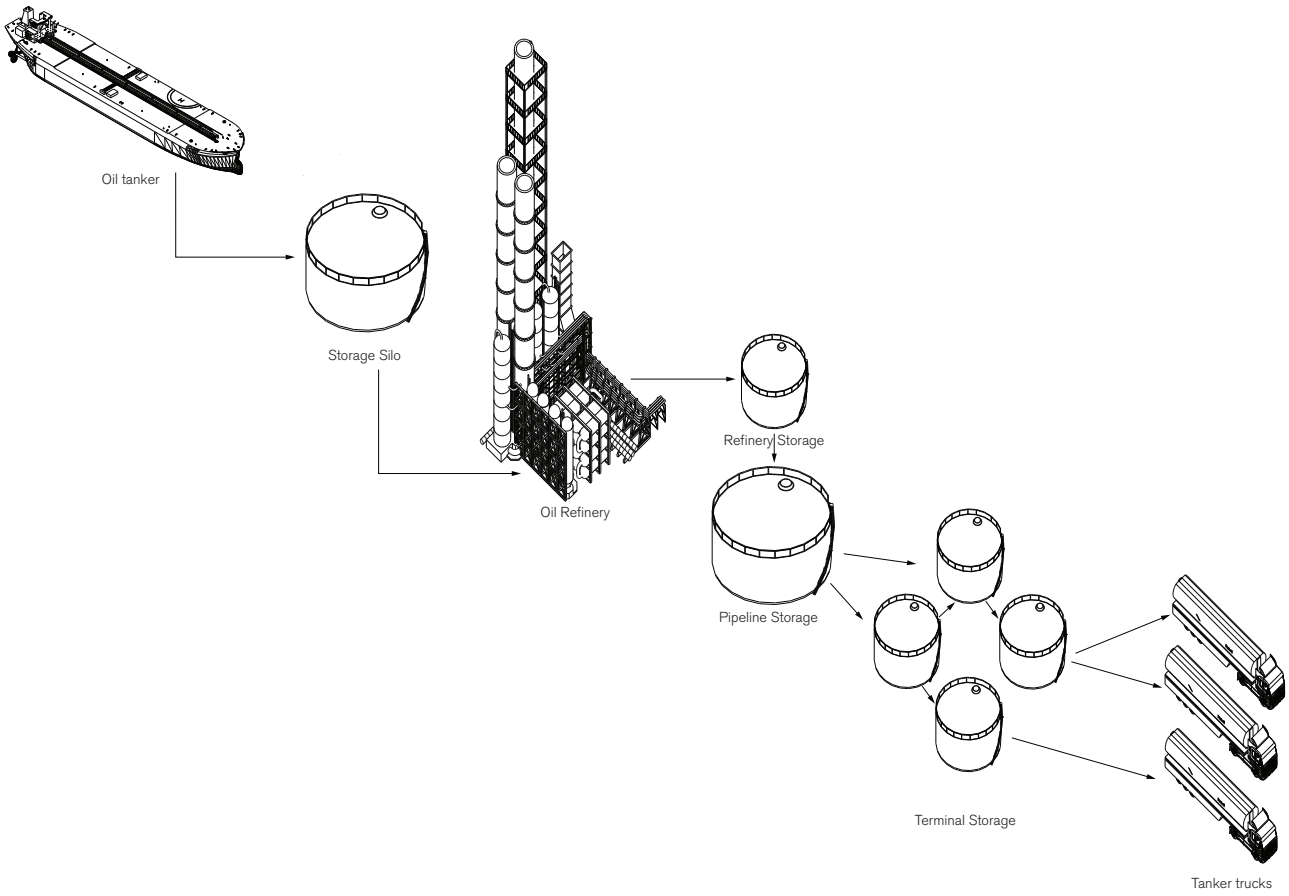
Since more than half of the world's population currently lives in urban settlements, a proportion that is expected to increase to more than 65 percent by 2050 (UN, 2014). The larger agglomerations are a complex spatial configuration of places and flows that are polycentric by nature, or at least they demonstrate a certain development of a multi-center structure. Recently, the focus on agglomerations' polycentric structure has attracted a great deal of attention from both researchers and policymakers, who must manage the economic, social, and environmental challenges that the population of these metropolitan agglomerations will experience in the coming decades. (Masip, J.)

The sketch by the British architect Cedric Price comparing the history of urban development with the forms of an egg makes it clear: the former distinct logic of a 'dominating' centre and a 'dependent' periphery no longer applies to contemporary city-regions. The (historical) centres of our cities from pre-industrial as well as industrial times have lost their previous function as the focal points of the urban structure and as priority locations for civic life, jobs, services, culture and consumption. They have become a functional element just as many others within the large-scale structuring of the post-industrial agglomerations of today. At the same time, a multitude of new 'centres' and activity poles has emerged at the urban fringe – with different functional specifications, shape, formal or informal, permanent or ephemeral characteristics.

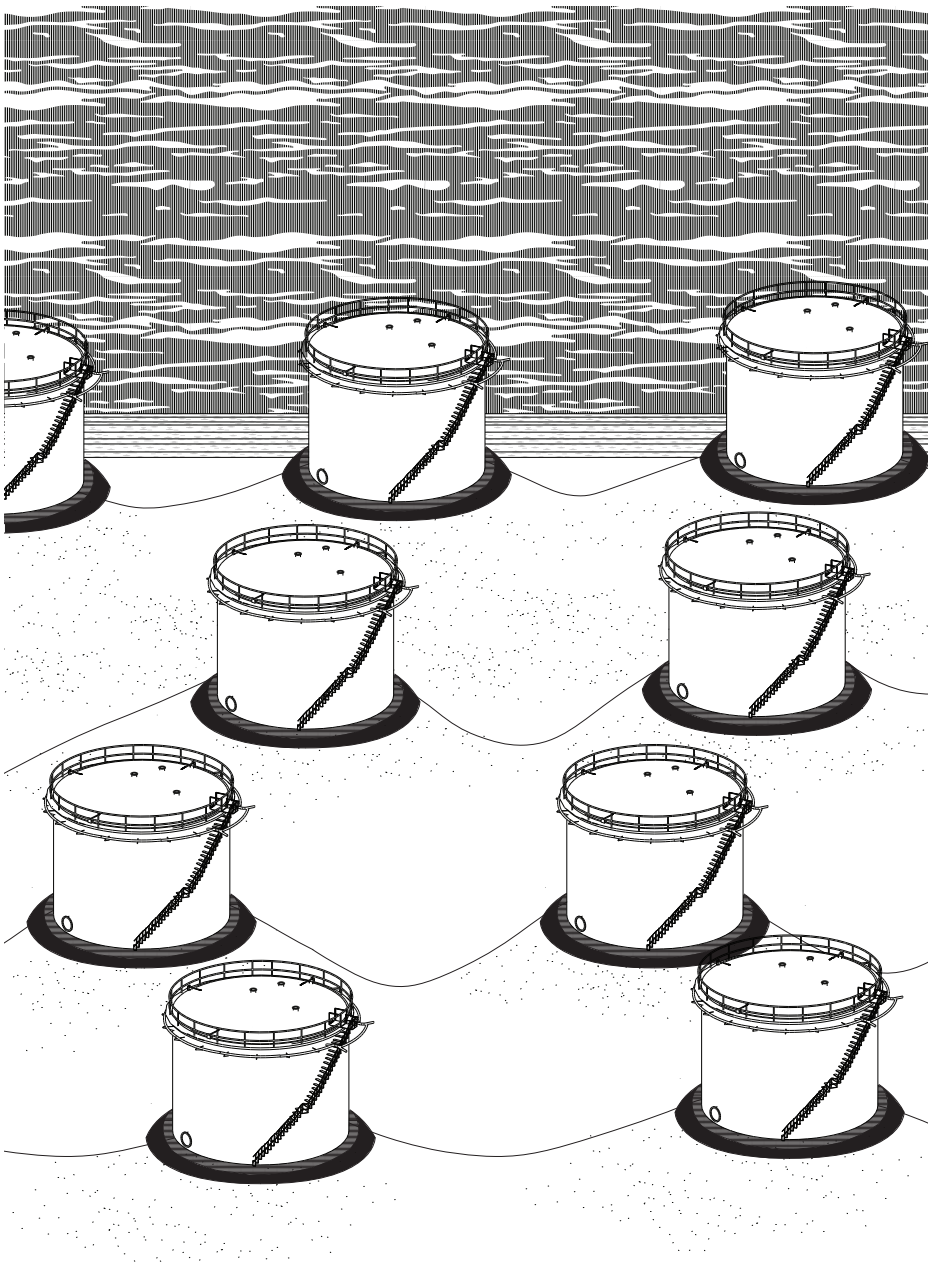
The way the silos work is comparable to a polycentric system yet they depend on the refinery. But once the refinery get decommissioned the silos would function in a polycentric system, autonomous yet collaborate together in production.

(1) Michael Petrek & Thorsten Burklin Potential and Challenges of Polycentric City Regions: A Case Study of Frankfurt Rhine Main, 2014
(2) Jaume Masip-Tresserra , Polycentricity, Performance and Planning: Concepts, Evidence and Policy in Barcelona, Catalonia

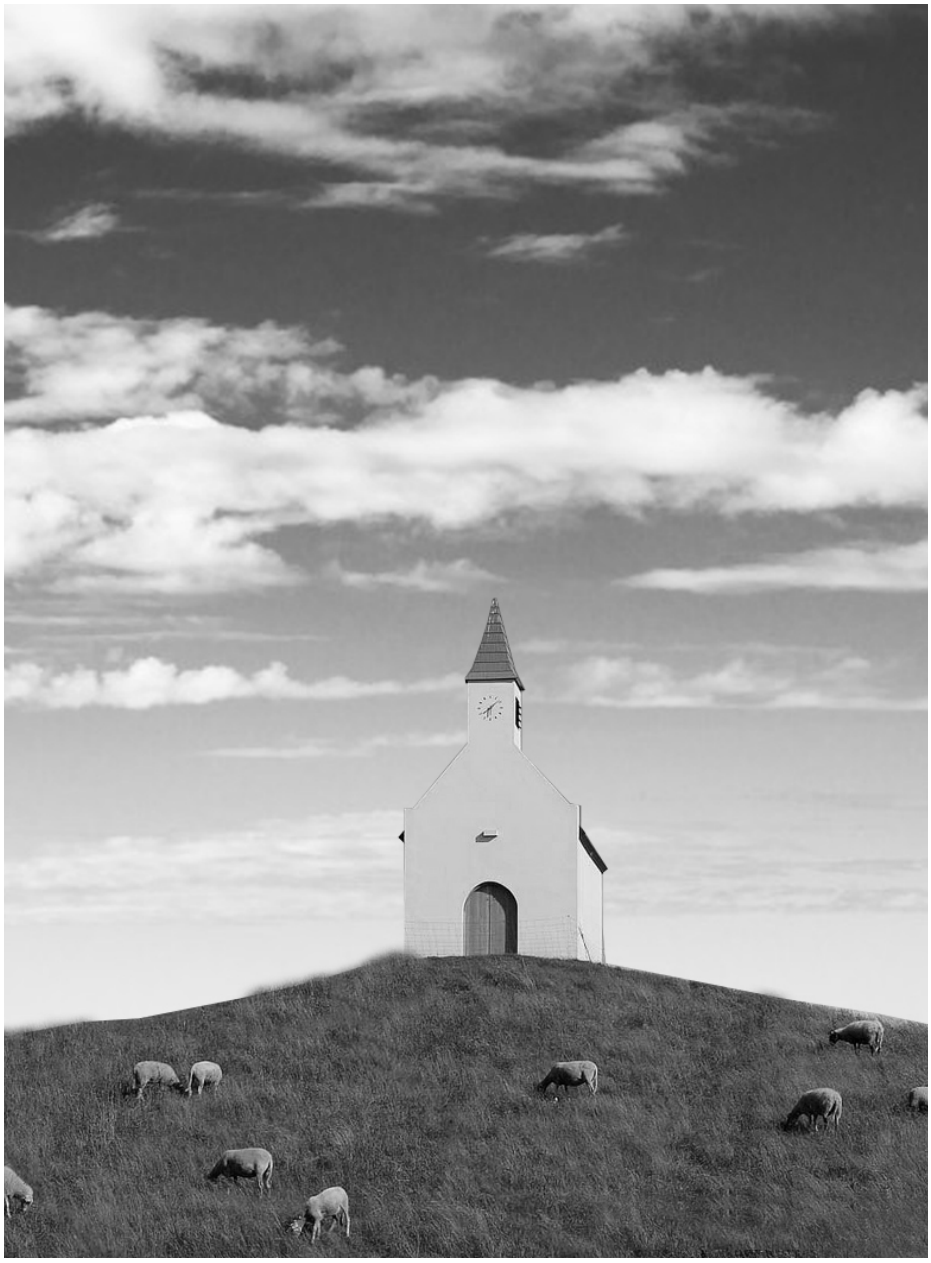
Cedric Price, Polycentric Sketch



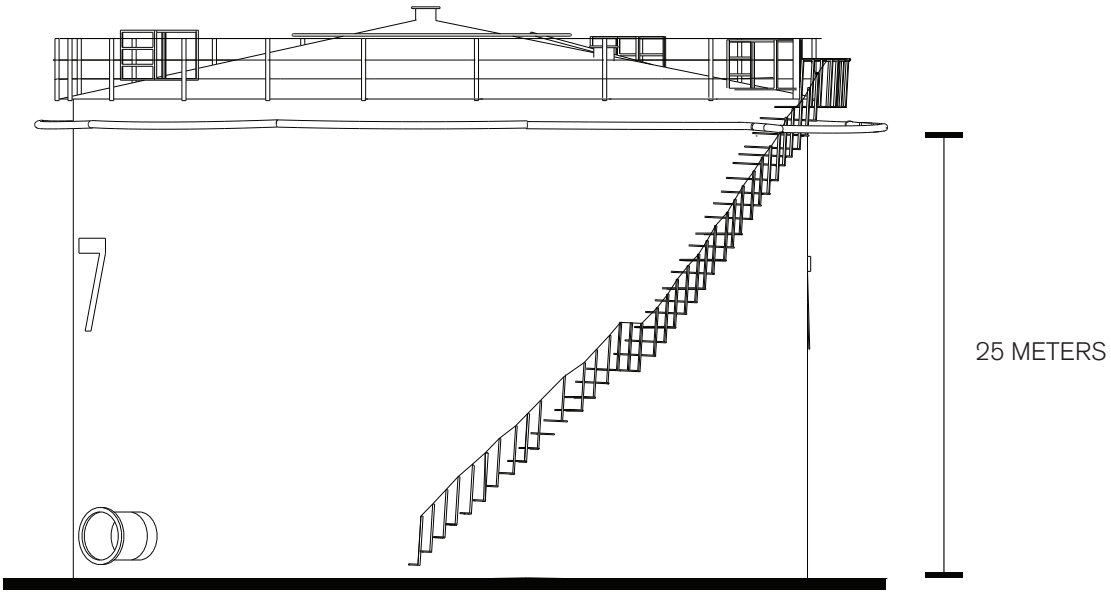
Silo System Operation

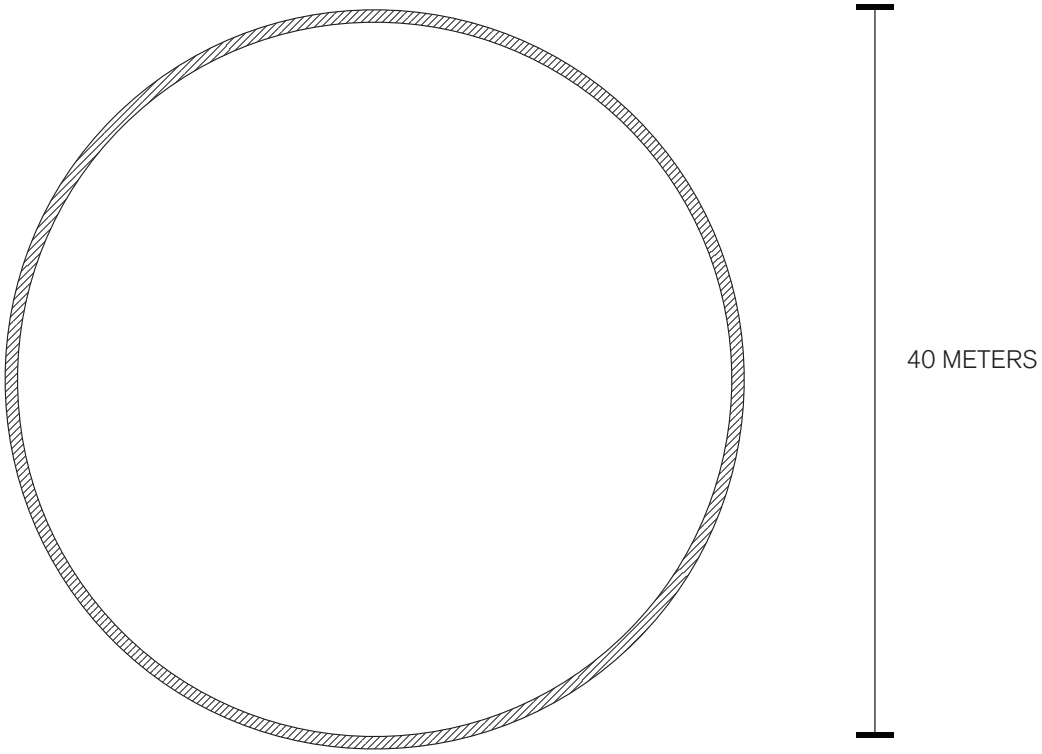


Silos are raised above the ground for Technical purposes, to prevent them from contacting the ground to reduce erosion



Churches in the Netherlands were raised on terpens (man made earth mounds) to prevent them from flooding and to ensure a safe escape for the villagers


7
25 METERS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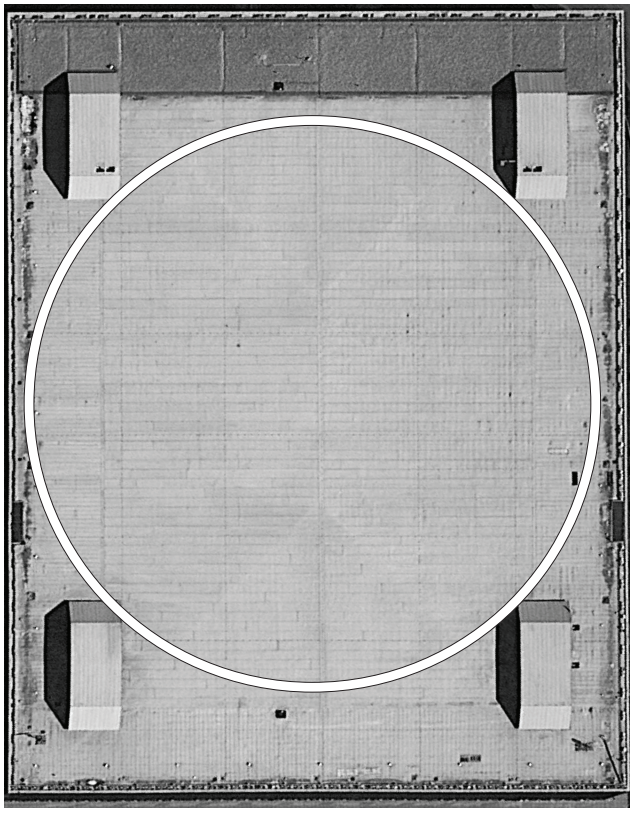
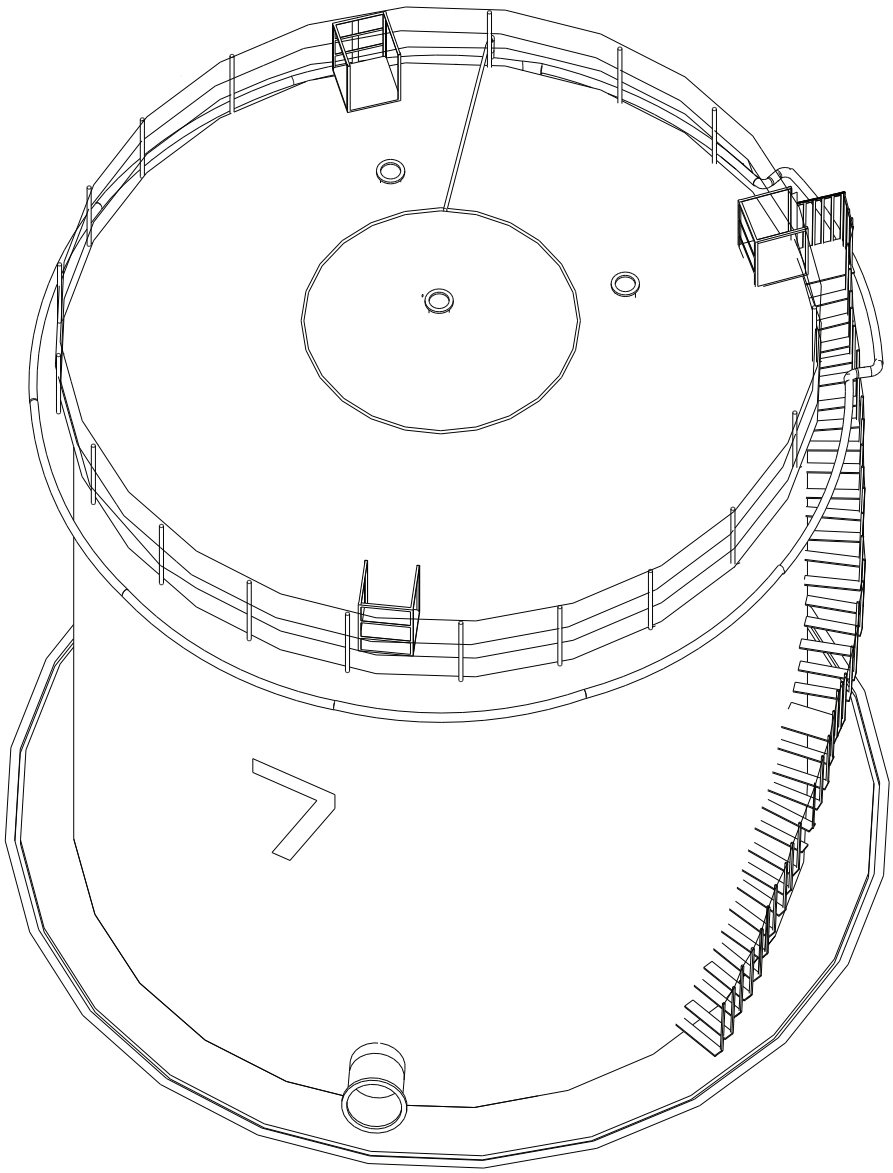
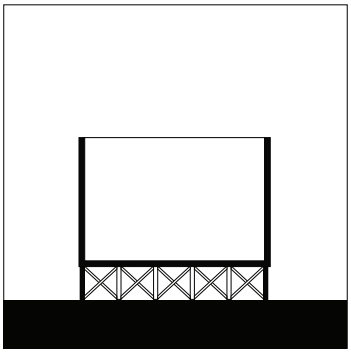
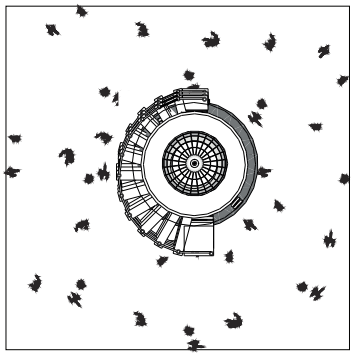


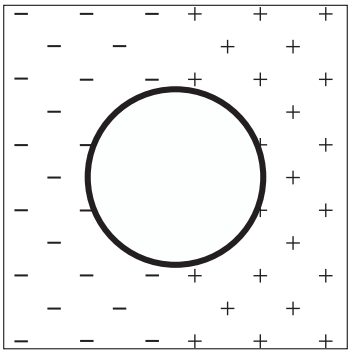
Ziggo Dome, Amsterdam 17,000 spectators

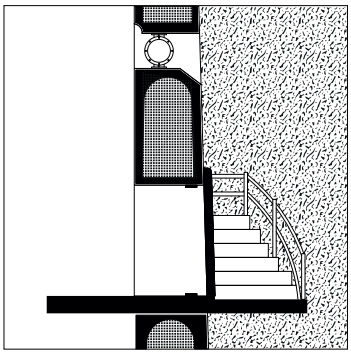
Amsterdam Center, Netherlands. Typical Dutch urban planning

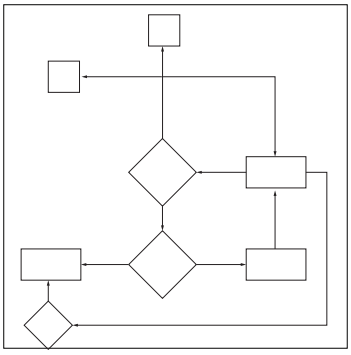


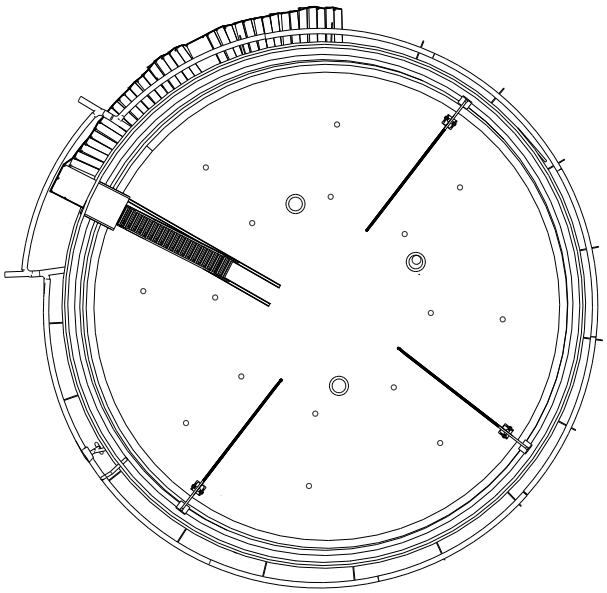


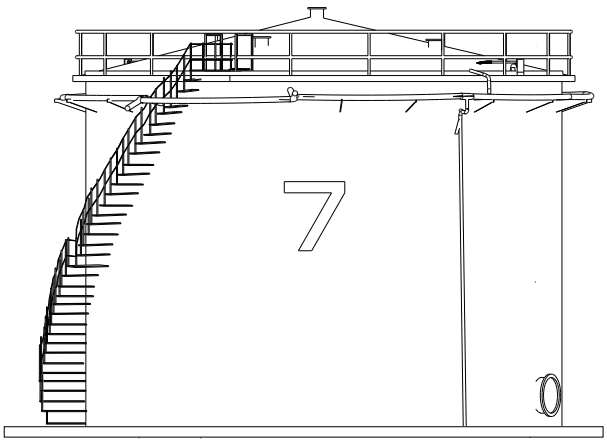












Silo Plan

Silo Elevation

Types of storage tanks

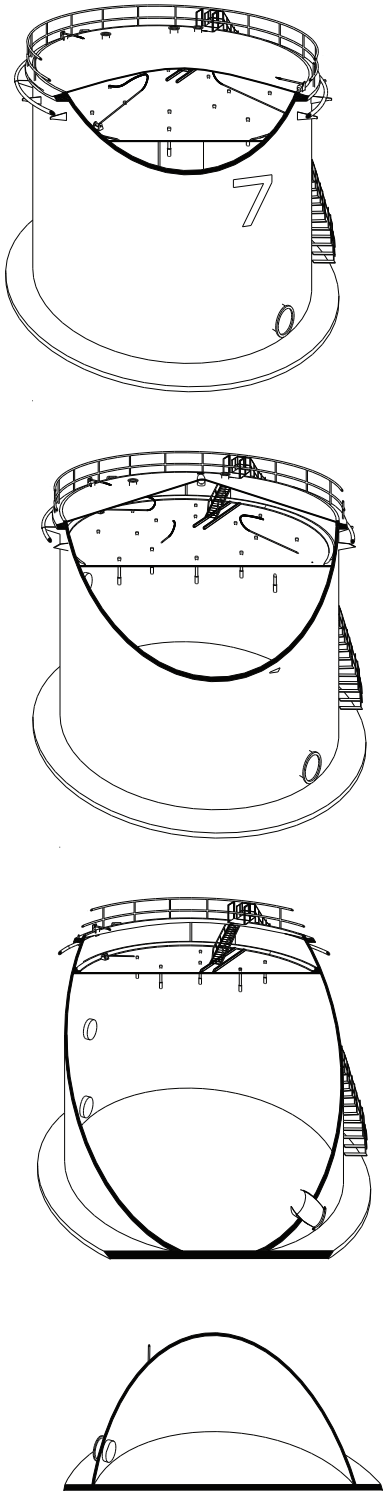
Storage tanks come in all sizes and shapes. Gross capacities can range from 100 bbl to over 1.5 MMbbl in a single storage tank. Corresponding tank sizes range from approximately 10 ft in diameter to over 412 ft in diameter for some of the largest floating-roof tanks ever constructed. Production tanks construction practices

The type of construction selected for a storage tank depends on the size of tank required and might be dependent on the type of product being stored, the location and space available for storage, prevailing weather or site-specific conditions, and local safety or environmental considerations. Before the development and perfection of welding processes, petroleum storage tanks used either bolted or riveted construction techniques. The tanks would be designed and supplied as segmental elements for final assembly on site.

Riveted tanks dating back to the early 1900s can still be found around the world—many still in service. It is safe to say, however, that recurring maintenance costs and increased environmental and safety concerns dictate that older riveted tanks be replaced with new, state-of-the-art storage tanks.
Field-welded storage tanks easily meet industry needs for increased storage capacity whether at a remote production site, at the refinery, or at the marketing terminal. As noted, earlier single-tank capacities have exceeded 1.5 MMbbl of storage with tank diameters of 412 ft and shell heights exceeding 72 ft.

As with the smaller bolted storage tanks, API standards have been developed and improved over the years to ensure the tanks meet the safety and operating needs of the petroleum industry. The tenth edition of API Spec. 12D, Field Welded Tanks for Storage of Production Liquids provides standard sizes with nominal capacities from 500 to 10,000 bbl for the production sector.

When larger tanks are required, the industry can refer to the tenth edition of API Standard 650, Welded Steel Tanks for Oil Storage for material, design, fabrication, erection, and testing requirements. The standard covers open-top or fixed-roof storage tanks that generally operate at atmospheric pressures. Design pressures above atmospheric and design temperatures exceeding 200°F may be permitted when additional requirements are met. Table 2 shows the capacity of welded storage tanks as a function of diameter and height.

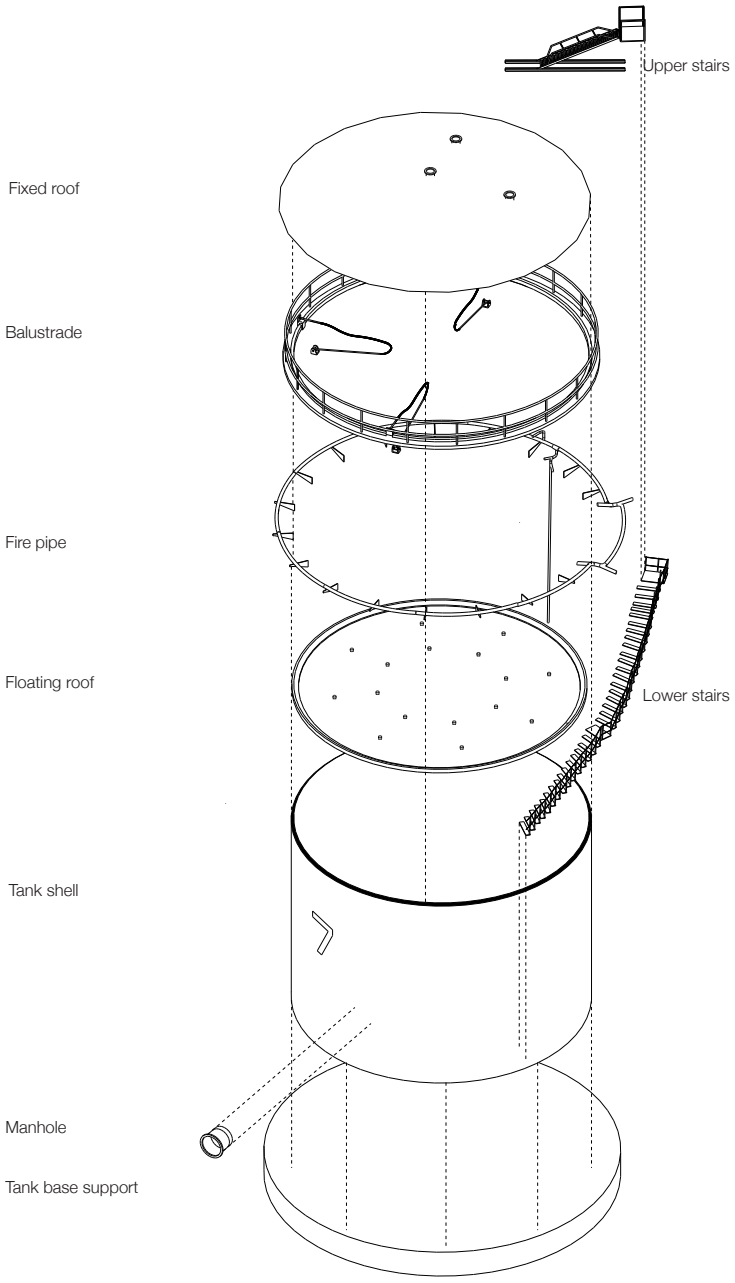


Silo Sections

Current Storage Options

The petroleum industry has experienced significant changes in the types of products used to feed the refineries around the world. The increased use of petroleum products has prompted the industry to turn to other sources for supply. Changes in product, physical, and chemical properties impose new challenges to the storage tank industry. Environmental and safety requirements continue to be a significant factor in the selection and design of the storage tanks used by the petroleum industry.

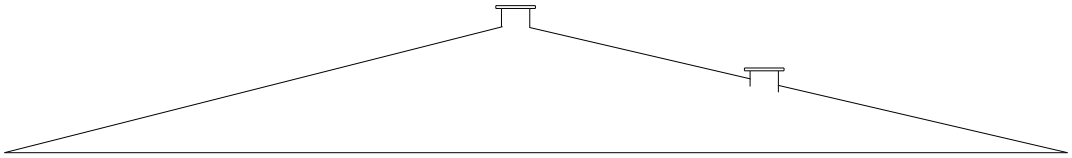
The general types of atmospheric storage tanks (AST) in use may be open top tanks (OTT), fixed-roof tanks (FRT), external floating-roof tanks (EFRT), or internal floating-roof tanks (IFRT). Depending on the product, a closed floating-roof tank (CFRT) may even be selected. The above ground storage tank has evolved with time.
The evolution of hydrocarbon vapors is dependent on the product's physical characteristics, the operating pressure of upstream equipment, tank storage conditions, and tank operations. In production operations, the fluid entering a tank often comes from a higher-pressure source (separator, treater, or other production vessel). As the fluid enters the tank, a portion of the fluid will "flash" to vapor. Depending on tank design, vapors may be directed through pressure vent valves directly to a vent or lighted flare. Alternatively, a vapor recovery compressor (or blower) may be installed to direct vapors vented from storage to downstream compressors for sales or injection. Vacuum relief valves are needed to keep a vacuum from occurring because of tank breathing and pumping operations. If a vacuum develops, the tank roof will collapse. Typically, both pressure and vacuum relief are combined in a single pressure-vacuum relief valve

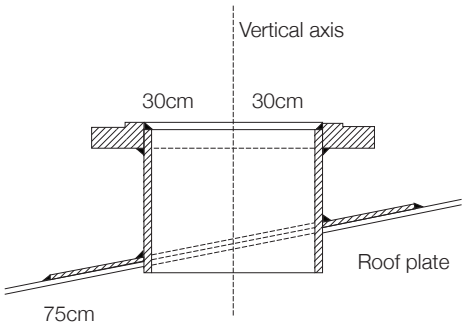


Exploded Silo Axonometric View

Shells

-Oil and oil products are most commonly stored in cylindrical steel tanks at atmospheric pressure or at low pressure.
-The two design standards applied most widely to the design of welded cylindrical tanks are BS2654 and API 650.
-Tanks are usually manufactured from plain carbon steel plate.
-It is readily weldable.
-A tank is designed for the most severe combination of the various possible loadings.
-For petroleum storage tanks, steel bottom plates are specified, laid and fully supported on a prepared foundation.
-Vertical cylindrical tanks carry the hydrostatic pressure by simple hoop tension.
-The cylindrical shell has to carry both its own weight and the weight of the supported roof by axial stresses. -Wind loading on the tank influences the axial stress.
-For open tanks, primary wind girders are required to maintain the roundness of the tank when it is subject to wind load.
-Secondary wind girders are needed in tall tanks.
Roofs may be fixed or floating.
-A cover to the contents of a fixed roof tank may be provided to reduce evaporation or ingress of contaminants.
-Manholes are provided for access and nozzles allow inlet, outlet and drainage, and venting of the space under the roof.





Roof Elevation Slope

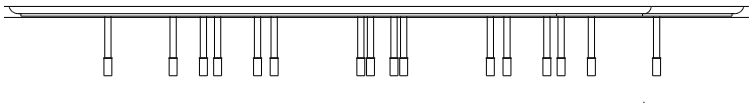
Section Roof Nozzle Vent

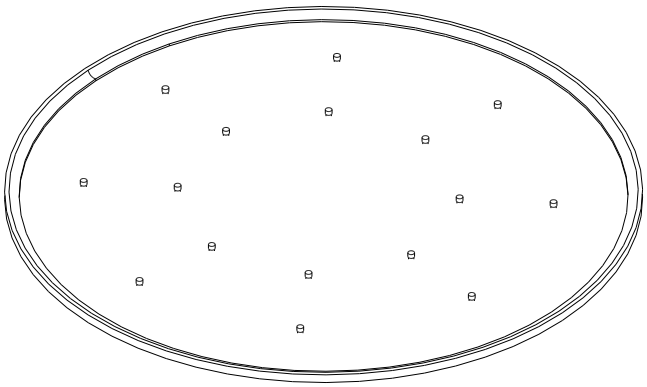
Fixed Roof

For access and cleaning out, nozzles are required through the shell roof and bottom for inlet, outlet, and drainage pipes, and for vents in the roof. They are normally made by welding a cylindrical section of plate into a circular hole in the structural plate. For small nozzles, no reinforcement is necessary, the extra material is considered sufficient. Larger holes must be reinforced in the same way as manholes. A manhole through a roof should be at least 500 mm diameter. Stiffening arrangements around the hole in the roof plate, and the type of cover, depend on the design of the roof. Access to the roof manhole must be provided by ladders, with suitable handrails and walkways on the roof.

Venting has to be provided to cater for movement of the contents into and out of the tank and for temperature change of the air in the tank. Venting can be provided by pressure relief valves or by open vents.

For storage of petroleum products, emergency pressure relief has to be provided to cater for heating due to an external fire. Pressure relief can be achieved either by additional emergency venting or by designing the roof to shell joint as frangible





Elevation

Axonometric view

Floating Roof

A floating roof is sometimes provided instead of a fixed roof. The shell is then effectively open at the top and is designed accordingly.

During service, a floating roof is completely supported on the liquid and must therefore be sufficiently buoyant; buoyancy is achieved by providing liquid-tight compartments in one of two forms of roof - pontoon type and double deck type.

A pontoon roof has an annular compartment, divided by bulkheads, and a central single skin diaphragm. The central diaphragm may need to be stiffened by radial beams.

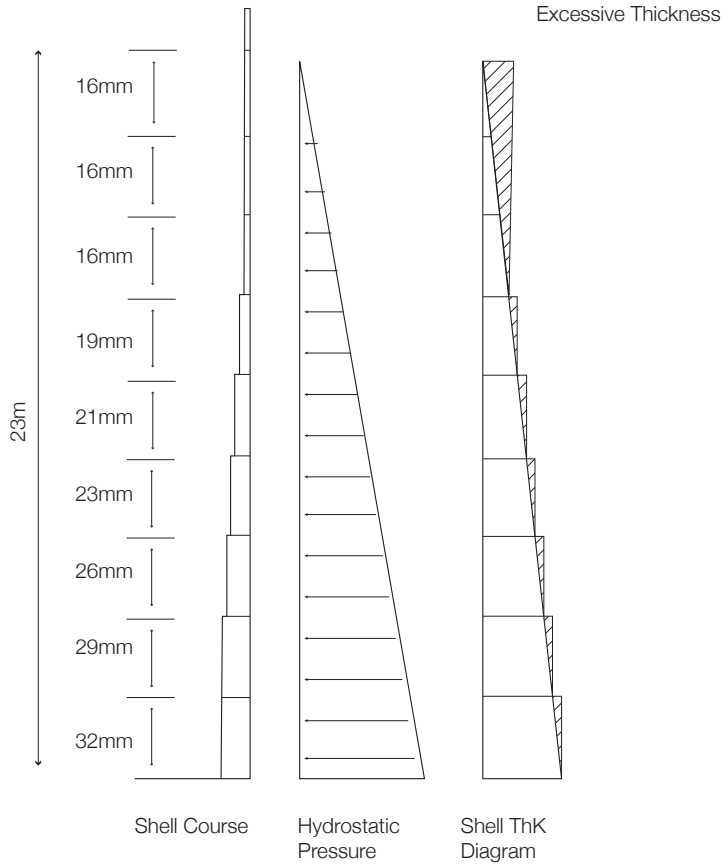
A double deck roof is effectively a complete set of compartments over the whole diameter of the tank; two circular skins are joined to circumferential plates and bulkheads to form a disk or piston.

Both types of roof must remain buoyant even if some compartments are punctured (typically two compartments). The central deck of a pontoon roof should also be presumed to be punctured for this design condition.

Because the roof is open to the environment, it catches rain, which must be drained off. Drainage is achieved by a system on the roof which connects to flexible pipework inside the tank and thence through the shell or bottom plates to a discharge. The design is required to ensure that the roof continues to float in the event of a block in the drainage system which results in a surcharge of water on the roof (usually 250 mm of water).
When the tank is emptied, the roof cannot normally be allowed to fall to the bottom of the tank, because there is internal pipework; the roof is therefore fitted with legs which keep it clear of the bottom. At this stage the roof must be able to carry a superimposed load (1,2 kN/m2) plus any accumulated rainwater.

For maintenance of the drainage system and for access to nozzles through the roof for various purposes, maintenance personnel need access from the top of the shell to the roof whatever the level of contents in the tank. Access is usually achieved by a movable ladder or stairway, pinned to the shell and resting on the roof. For maintenance of the tank when it is empty, an access manhole must be provided through the roof.
Where a cover to the contents is provided inside a fixed roof tank, to reduce evaporation or ingress of contaminants (e.g. water or sand), a much lighter cover or screen can be provided.

Such a cover is likely to be manufactured from lighter materials than steel, though a shallow steel pan can sometimes be provided. The cover does not need to be provided with access ladders, nor to be designed for surcharge. It does have to be designed to be supported at low level when the tank is empty and to carry a small live load in that condition.



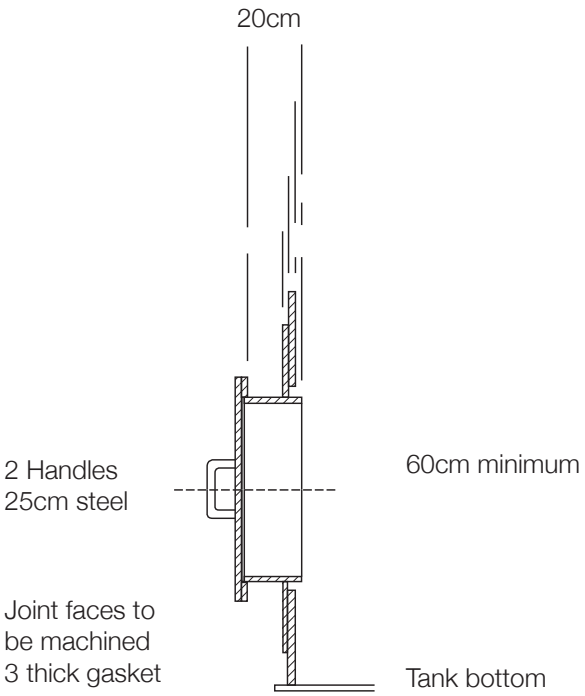
Diagrammatical Sketch of Shell Wall with Design Thickness

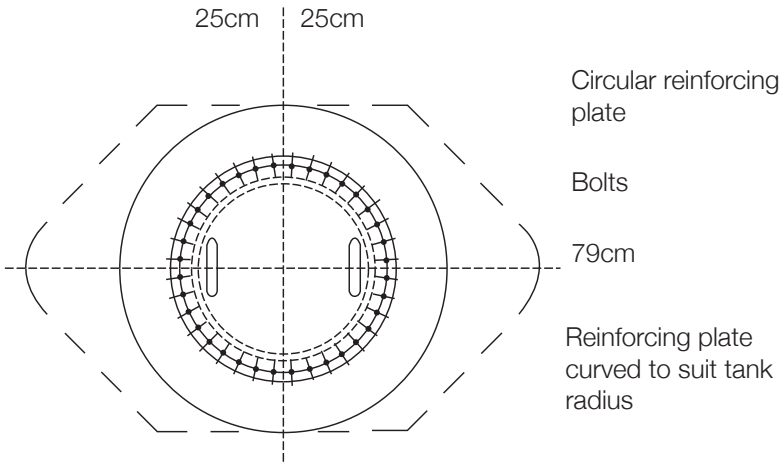
Tank Shell Section

Tank Shell

Vertical cylinder tanks carry the hydrostatic pressures by simple hoop tension. No circumferential stiffening is needed for this action. The circumferential tension in the shell will vary directly, in a vertical direction, according to the head of fluid at any given level. For a uniform shell thickness, the calculation of stresses is therefore straightforward.
The cylindrical shell has to carry its weight, and the weight of the roof which it supports, as an axial stress. In addition, wind loading on the tank contributes tensile axial stress on one side of the tank and compressive stress on the other.

A thin-walled cylinder under a sufficient axial load will of course buckle locally, or wrinkle. In practice, imperfect shells buckle at a much lower stress; an allowable stress level of as little as a tenth of the above might be more appropriate. However, in normal service the axial stresses in shells suitable to carry the circumferential loads for the size of tank used for oil and water storage are much smaller than even this level of stress.





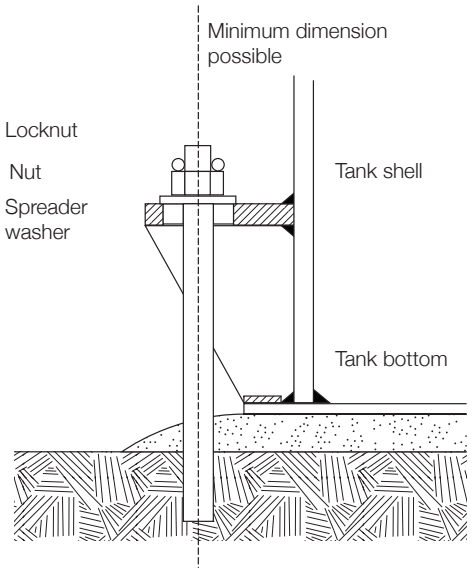
Section

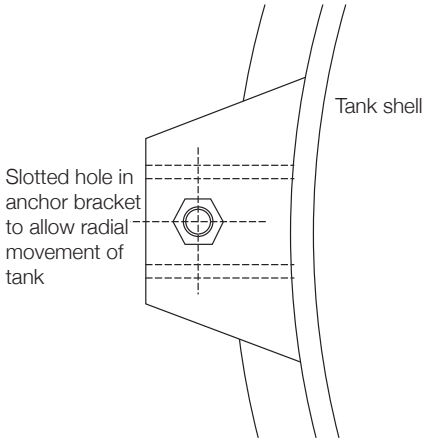
Elevation

Manhole on Tank Shell

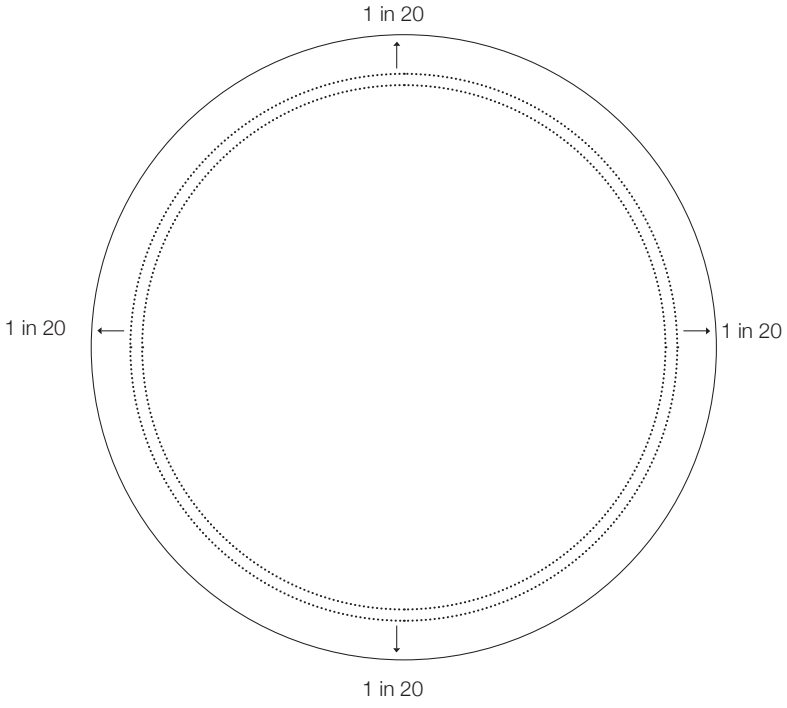
Access is required inside fixed roof tanks for maintenance and inspection purposes. Such access can be provided through the roof or through the shell wall. Manholes through the roof have the advantage that they are always accessible, even when the tank is full. Access through the shell wall is more convenient for cleaning out. A manhole through the shell wall should be at least 600 mm diameter and is normally positioned just above the bottom of the tank. Clearly, the cutting of an opening in the shell interferes with the structural action of the shell. The loss of section of shell plate is compensated by providing additional cross-section area equal to 75% of that lost. The area must be provided within a circular region around the hole, though the actual reinforcement should extend beyond that region.

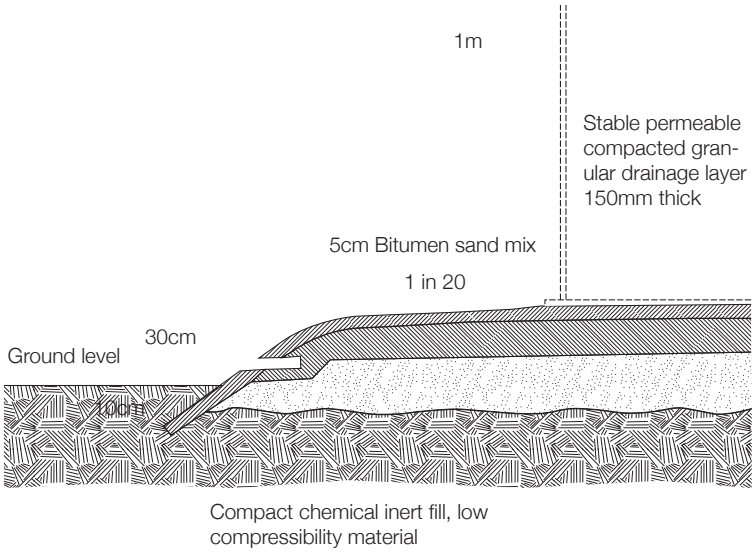
Tank Base


Minimum dimension possible
Locknut
Nut
Spreader washer
Tank shell
Tank bottom


Tank shell
Slotted hole in anchor bracket to allow radial movement of tank

Tank Base


1 in 20
1 in 20
1 in 20
1 in 20


1m
Stable permeable compacted granular drainage layer 150mm thick
5cm Bitumen sand mix
1 in 20
30cm
Ground level
10cm
Compact chemical inert fill, low compressibility material

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BS EN 10025, 1990, Hot Rolled Products of Non-alloy Structural Steels and their Technical Delivery Conditions, British Standards Institution, London.

Young, W. C., Roark's Formulas for Stress and Strain, McGraw Hill, 1989.

BS 449: Part 2: 1969, Specification for the Use of Structural Steel in Building, British Standards Institution, London.

Borders

The Saint Elizabeth's Day Flood, Master of the St Elizabeth Panels, c. 1490

Mood Collage Pernis and High Dikes, c. 1500-1800

Mood Collage Pernis with High Dikes and a higher Oil Infrastructure, c. 1930 - present

Edge Development

On the night of 19 November 1421 – the feast day of Saint Elizabeth – much of Holland was flooded. The Dordrecht region was badly hit: 23 villages were submerged and 2,000 people died. The survivors later had an altarpiece made. The outer panels depict the disaster, with the breach of the dike on the right and the undamaged town of Dordrecht on the left.

In the fourteenth century, the combined effects of soil subsidence and rising sea levels meant, in many parts of the Low Countries, that sea level and ground level converged to the same height. This was the period that saw the first large-scale building of dikes.

In the period between 1500 and 1800, the Netherlands became ever more prosperous and witnessed rapid population growth, although the graph displays peaks and troughs. The acme of the Golden Age was in the first half of the seventeenth century. Large-scale hydraulic engineering works such as land reclamation, polders and large scale peat extraction were organized by collectives, with interested parties joining forces for the purpose.

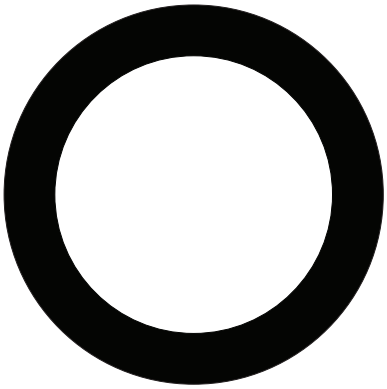
Shell refinery went into production in 1936. The terrain measures 500 ha and 6 meters above water level. In 1949, the petrochemical plants came into operation, where raw materials for PVC were produced, as well as Teepol.

The products are: gas oil, diesel oil, petrol, kerosene, lubricants, LPG and fuel oil. The chemical plants produce polyols and solvents such as alcohols , acetone and glycol ether .

Among the newer plants, in addition to a desulphurisation plant , is a gasification plant which converts the heavy petroleum residues into syngas and has a capacity of 1650 tons / day of heavy residues. Most of this syngas is converted to 285 tons / day of pure hydrogen . This is used in the so-called hydrocracker , in which 9,000 tons / day of heavy petroleum fractions are converted into lighter fractions. The rest of the syngas is used in a thermal power plant .

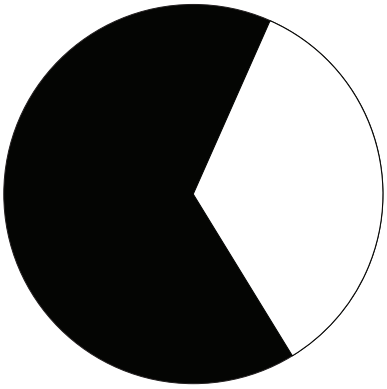
Built Up Area

63.5 km2



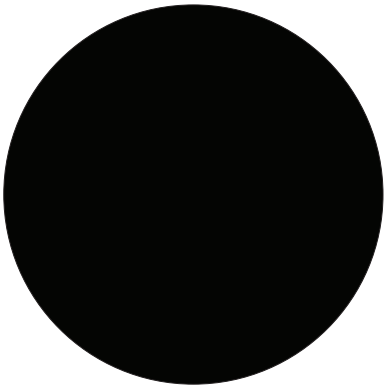
Port of Rotterdam

105.6 km2



Rotterdam

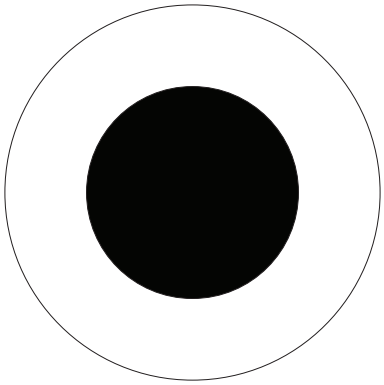
325.8 km2



Areas of Silos to Port and to Rotterdam

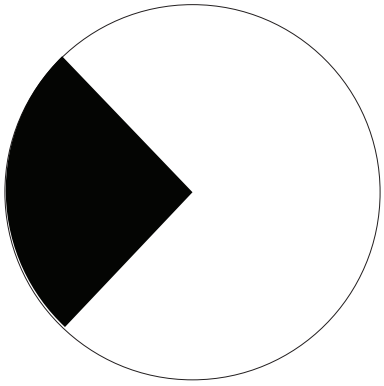
Site Silos to Silo Quadrant

36%



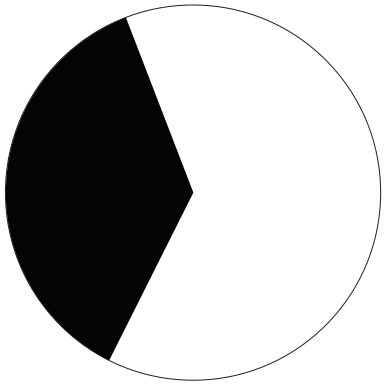
Silos to Petro Chemical

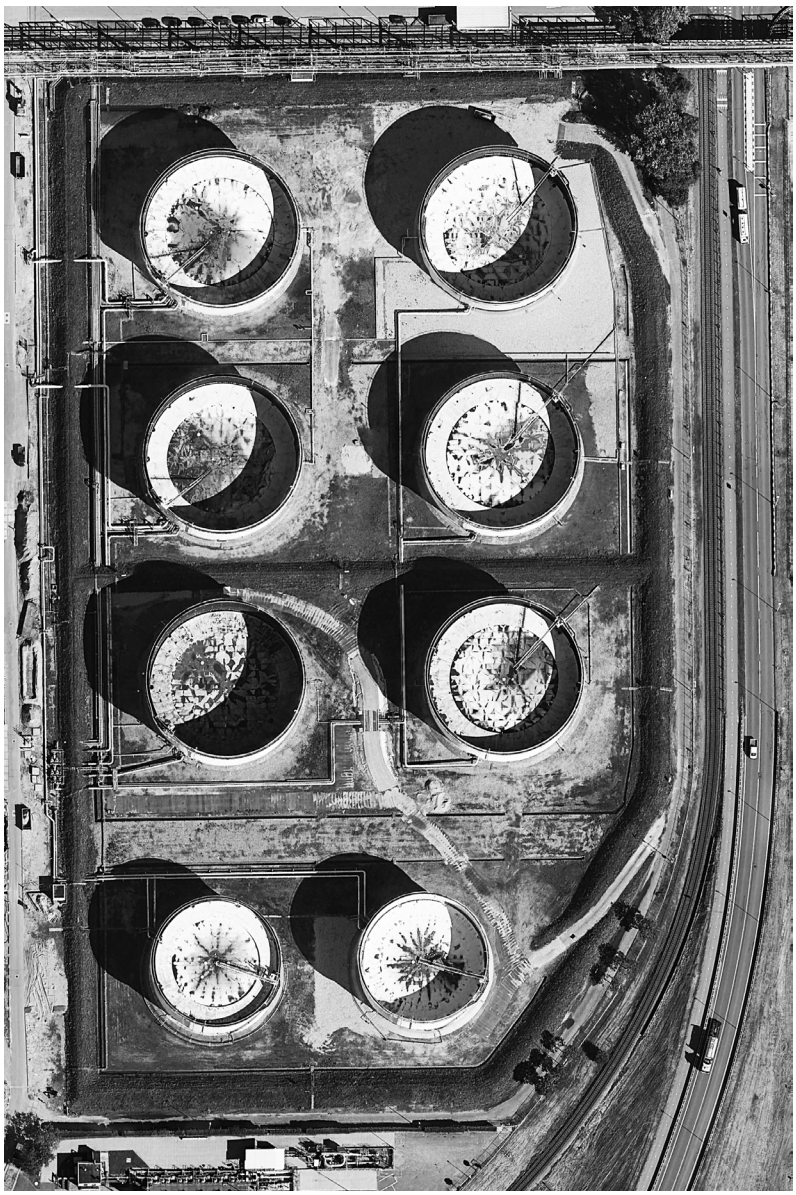
25.4 km2



Petro Chemical to Port

63.4 km2

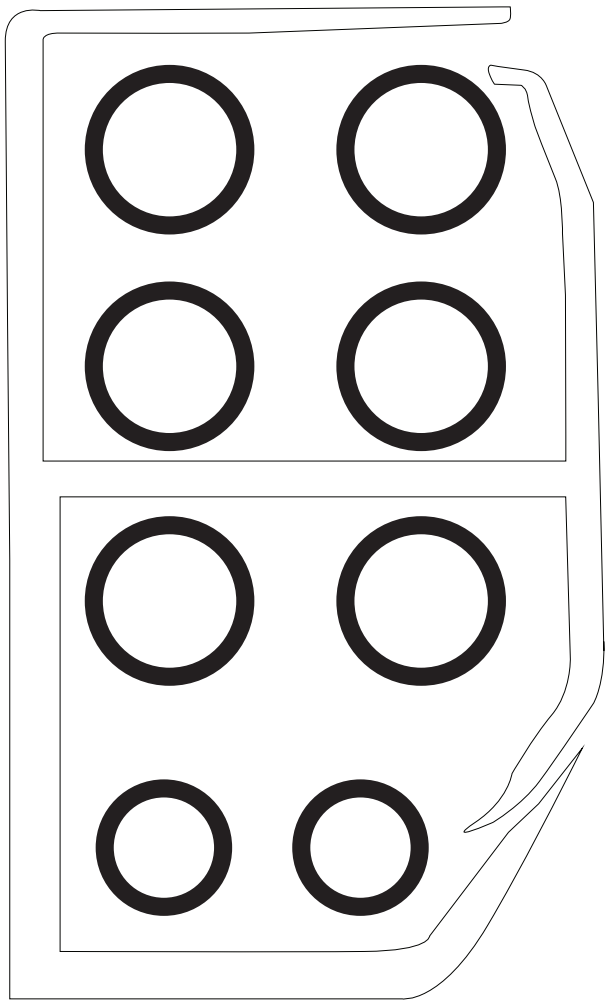




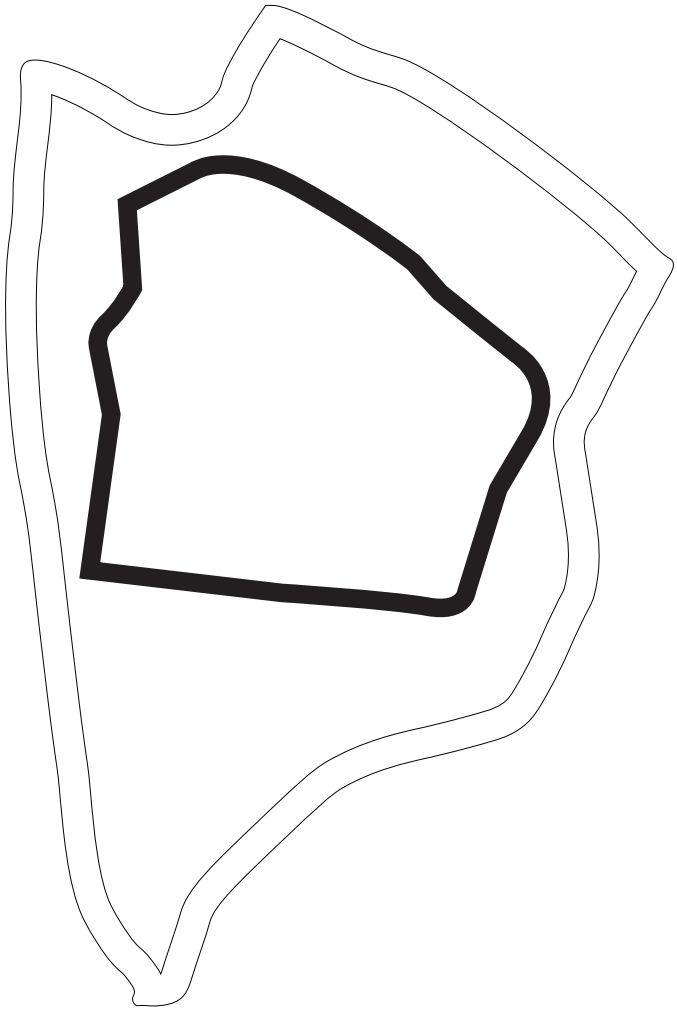
Sample Silo Quarter Pernis, Rotterdam

Site Comparison

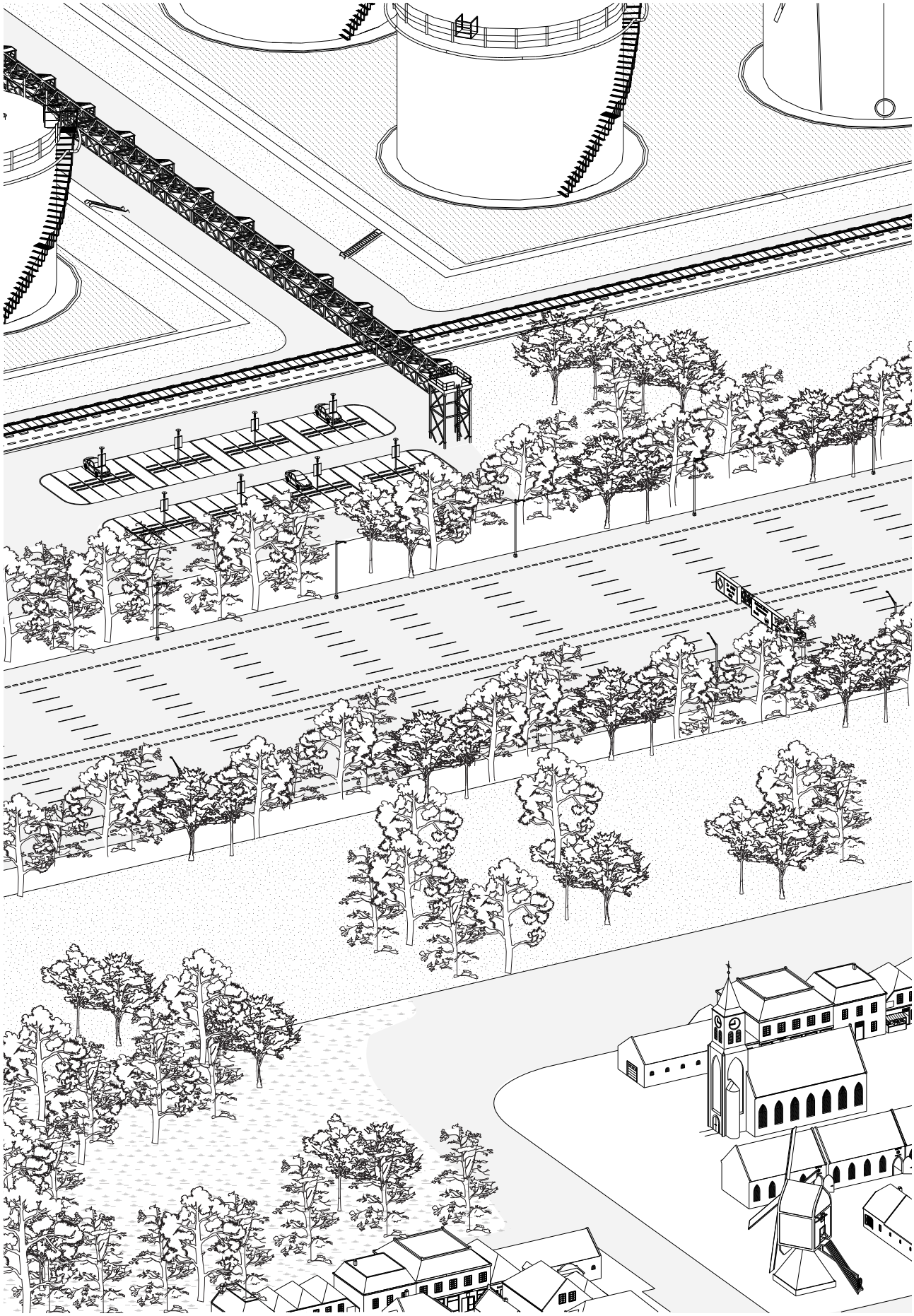
Pernis Town, Rotterdam



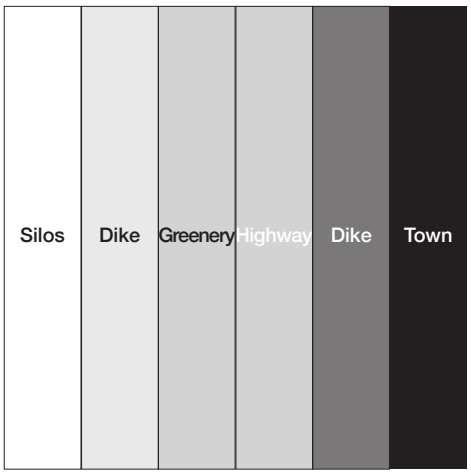
Silos & Dike



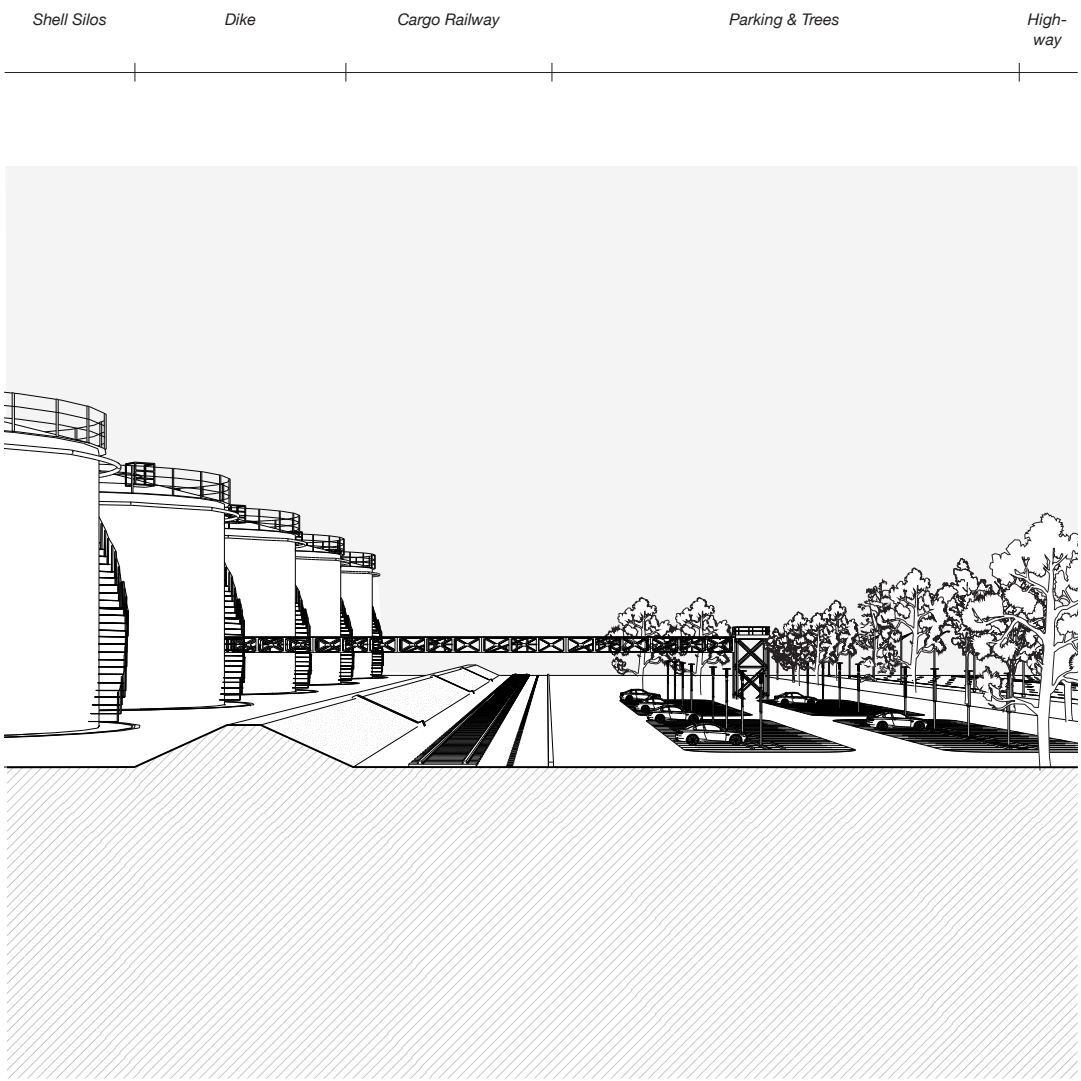
Town & Dike



Silos Town Edge

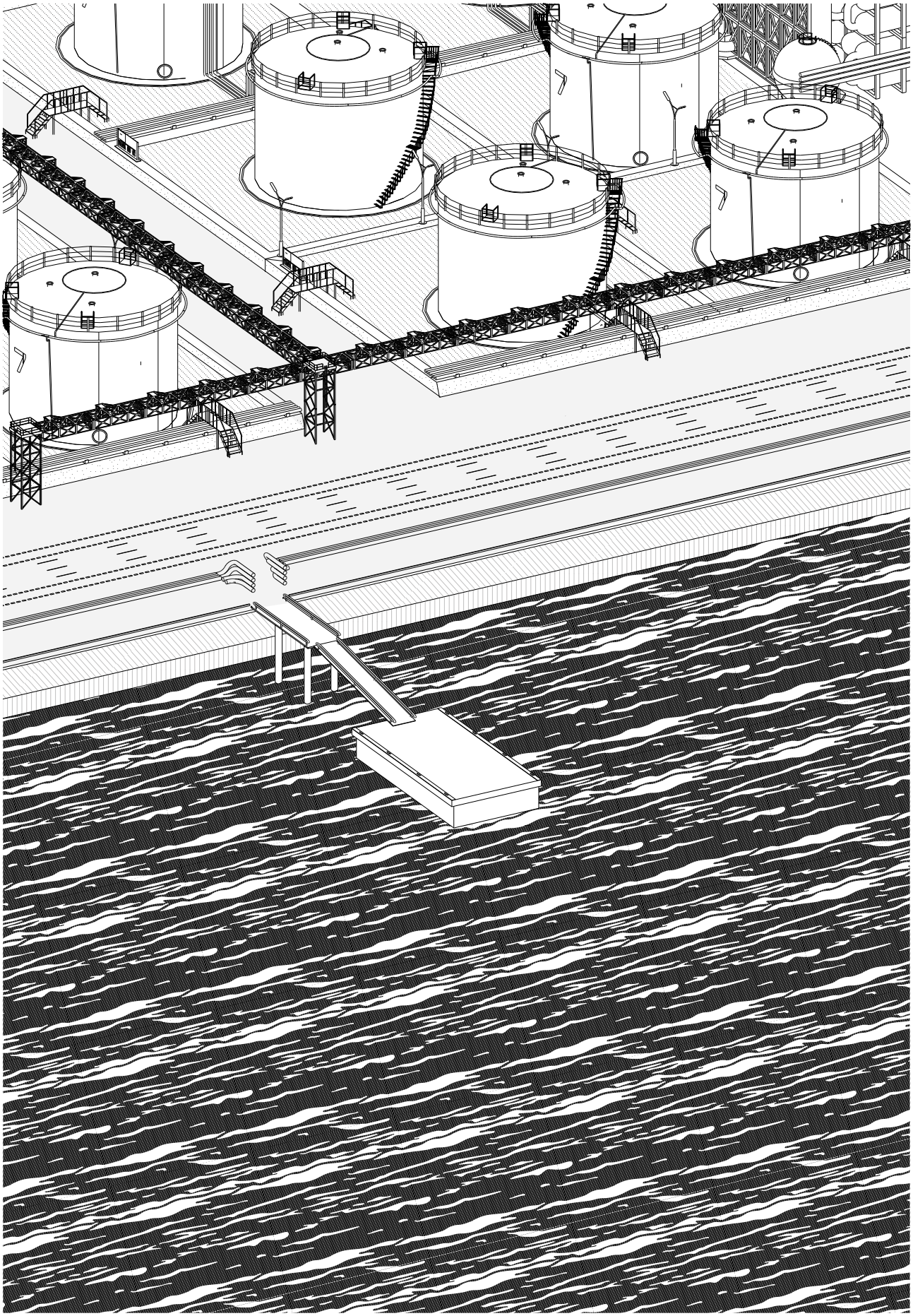


Gradient Clear Cut

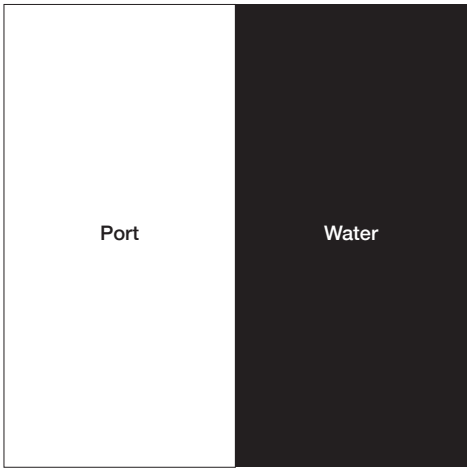


Shell Territory Land Entrance 6m Above Sea Level

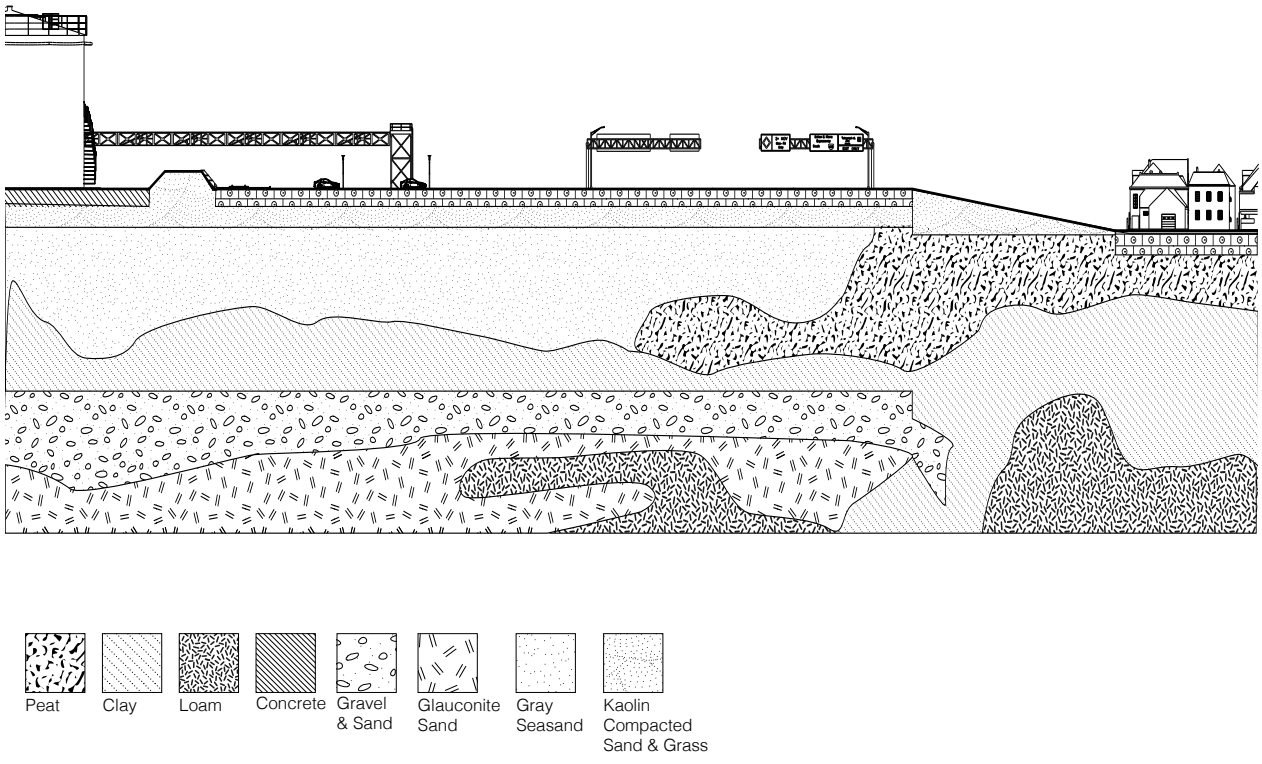
Diked Pernis Town 2m Below Sea Level



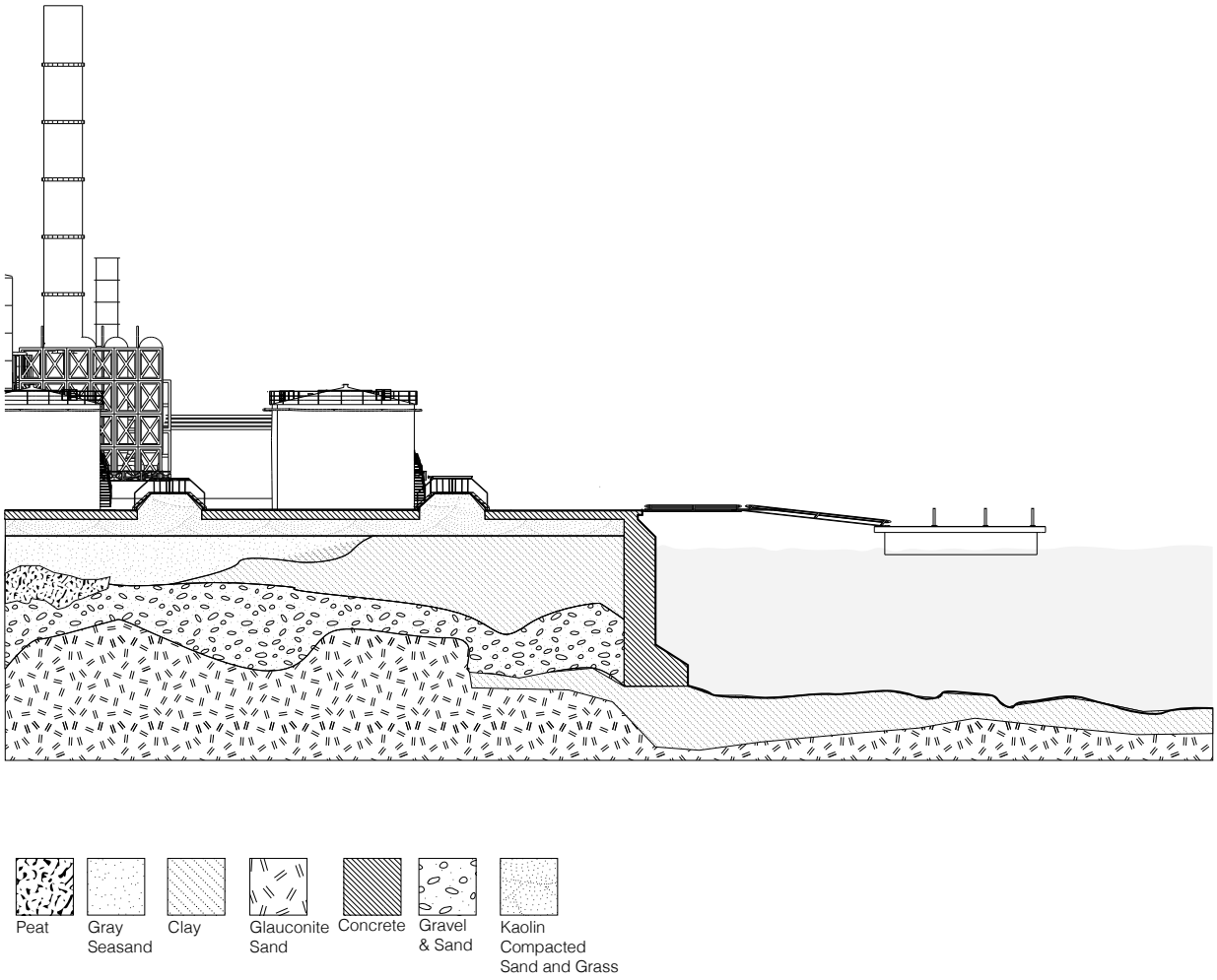
Silos Water Edge



Clear Cut



Site Edge Section, Pernis Town and Shell Territory



Site Edge Section, Shell Territory and Nieuwe Maas River

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Shell Pernis Refinery, https://www.shell.nl/over-ons/shell-pernis-refinery.html.

Nature

Composition & Meaning of Nature

The minute details of silhouette, trellis, cube and axis prevent the eye from resting on any central focus. Each part of the picture is given equal status, no part subordinated to any other. Disproportionate forms, abrupt changes of colour, backdrops brought into the foreground, all contribute to the complexity of the overall effect. These airless jungle scenes seem to hide more secrets than they reveal. Behind the green lurks bottomless black; blossoms of paradise reflect and veil the cruelty of the jungle. Rousseau's intuitive discovery of his own method of representing absolute space, a multiplicity of viewpoints in a single plane, ran parallel to the early Cubism.

In the jungle series of Rousseau, the predilection for violence suggests hidden turbulence in the artist's character: from a psychological viewpoint Rousseau is not the noble savage inhabiting a tranquil golden age in harmony with nature; rather he is the hard primitive. Camouflaged by the Belle Epoque he lived in out his individual battle against everyday civilisation.

The wild animal is transposed from the menagerie to freedom. Domesticated tropical landscapes become devouring jungles. Aggression, eroticism and terror are brought into the open. Behind every leaf is the artist in disguise, balancing on the edge between fear of death and hope of peace.

A tangled jungle of fantasy and truth reflecting on his own life and imagination of the in ordinary.

http://www.all-art.org/symbolism/rousseau07.htm

Henri Rousseau
Dream 1910

Genesis Nature Temptation

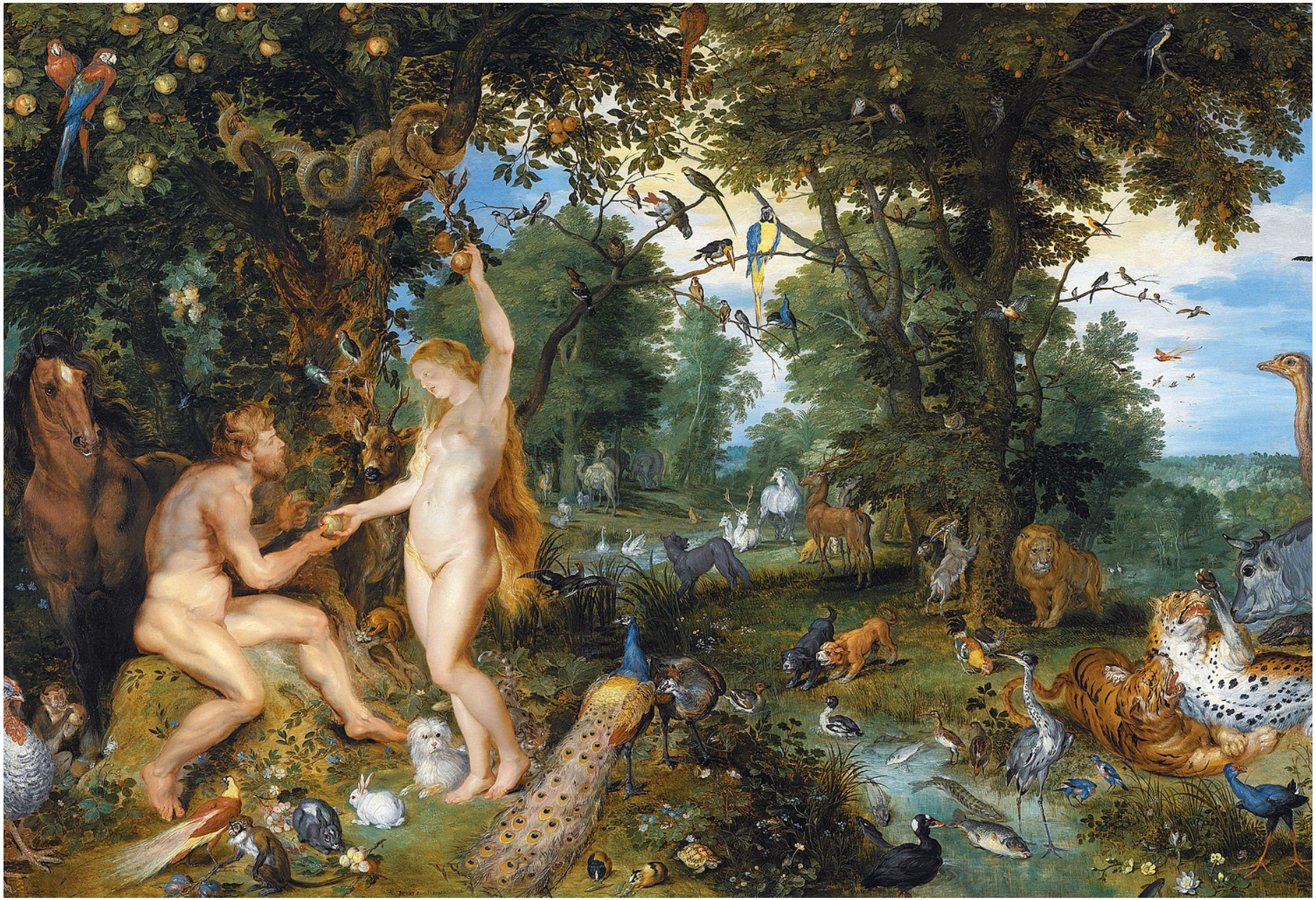
And God planted a garden Eastward, in Eden; and there he put the man whom he had formed.

And out of the ground made God to grow every tree that is pleasant to the sight, and good for food; the tree of life also in the midst of the garden,
and the tree of the knowledge of good and evil.

And God took the man, and put him into the garden of Eden to dress it and to keep it and commanded the man, saying, Of every tree of the garden thou mayest freely eat: but of the tree of the knowledge of good and evil, thou shalt not eat of it: for in the day that thou eatest thereof thou shalt surely die.

Genesis 2:8–14

Peter Paul Rubens
Original Sin, 1615 c.a



Artificial Photosynthesis

Artificial photosynthesis is a chemical process that biomimics the natural process of photosynthesis to convert sunlight, water, and carbon dioxide into carbohydrates and oxygen. The term artificial photosynthesis is commonly used to refer to any scheme for capturing and storing the energy from sunlight in the chemical bonds of a fuel (a solar fuel). Photocatalytic water splitting converts water into hydrogen and oxygen and is a major research topic of artificial photosynthesis. Light-driven carbon dioxide reduction is another process studied that replicates natural carbon fixation.

Research of this topic includes the design and assembly of devices for the direct production of solar fuels, photoelectrochemistry and its application in fuel cells, and the engineering of enzymes and photoautotrophic microorganisms for microbial biofuel and biohydrogen production from sunlight.

The photosynthetic reaction can be divided into two half-reactions of oxidation and reduction, both of which are essential to producing fuel. In plant photosynthesis, water molecules are photo-oxidized to release oxygen and protons. The second phase of plant photosynthesis (also known as the Calvin-Benson cycle) is a light-independent reaction that converts carbon dioxide into glucose (fuel). Researchers of artificial photosynthesis are developing photocatalysts that are able to perform both of these reactions. Furthermore, the protons resulting from water splitting can be used for hydrogen production. These catalysts must be able to react quickly and absorb a large percentage of the incident solar photons.

Whereas photovoltaics can provide energy directly from sunlight, the inefficiency of fuel production from photovoltaic electricity (indirect process) and the fact that sunshine is not constant throughout the day sets a limit to its use.[2][3] One way of using natural photosynthesis is for the production of a biofuel, which is an indirect process that suffers from low energy conversion efficiency (due to photosynthesis' own low efficiency in converting sunlight to biomass), the cost of harvesting and transporting the fuel, and conflicts due to the increasing need of land mass for food production.[4] The purpose of artificial photosynthesis is to produce a fuel from sunlight that can be stored conveniently and used when sunlight is not available, by using direct processes, that is, to produce a solar fuel. With the development of catalysts able to reproduce the major parts of photosynthesis, water and sunlight would ultimately be the only needed sources for clean energy production. The only by-product would be oxygen, and production of a solar fuel has the potential to be cheaper than gasoline.[5]

Artificial Photosynthesis

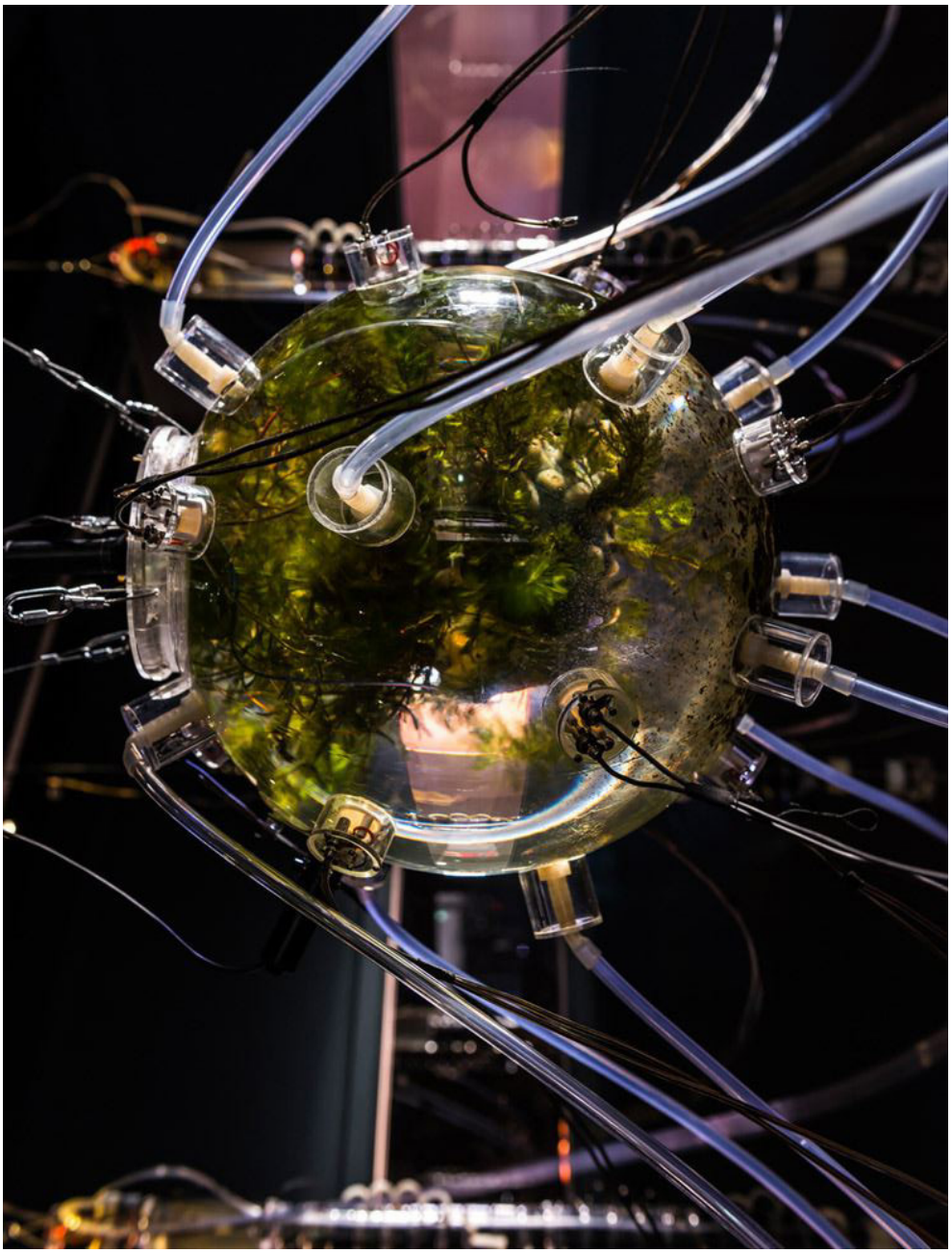
Living in extreme conditions requires creative adaptations. For certain species of bacteria that exist in oxygen-deprived environments, this means finding a way to breathe that doesn't involve oxygen. These hardy microbes, which can be found deep within mines, at the bottom of lakes, and even in the human gut, have evolved a unique form of breathing that involves excreting and pumping out electrons. In other words, these microbes can actually produce electricity.
Scientists and engineers are exploring ways to harness these microbial power plants to run fuel cells and purify sewage water, among other uses. But pinning down a microbe's electrical properties has been a challenge: The cells are much smaller than mammalian cells and extremely difficult to grow in laboratory conditions.

MIT engineers have developed a microfluidic technique that can quickly process small samples of bacteria and gauge a specific property that's highly correlated with bacteria's ability to produce electricity. They say that this property, known as polarizability, can be used to assess a bacteria's electrochemical activity in a safer, more efficient manner compared to current techniques.

Bacteria that produce electricity do so by generating electrons within their cells, then transferring those electrons across their cell membranes via tiny channels formed by surface proteins, in a process known as extracellular electron transfer, or EET.
Existing techniques for probing bacteria's electrochemical activity involve growing large batches of cells and measuring the activity of EET proteins — a meticulous, time-consuming process. Other techniques require rupturing a cell in order to purify and probe the proteins. Buie looked for a faster, less destructive method to assess bacteria's electrical function.

http://news.mit.edu/2019/identifying-electricity-producing-bacteria-0111

A microfluidic technique quickly sorts bacteria based on their capability to generate electricity.



Thank You