

AN ECO SYNERGIST HUB IN ROTTERDAM:

Reuse and Regeneration of neglected urban fragments into ecological hotspots

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1. INTRODUCTION

1.1 ABSTRACT

This paper focuses on the regeneration and reuse of remnant waste structures, lands in Rotterdam into future ecological hotspots to foster biodiversity, improve the quality of people and species' lives.

Due to a phenomena of pressing urbanization undergoing in the city, the majority of the old industrial, harbour areas or structures are demolished and replaced by new ones with different functions and forms so that the memory of the past urban structures gets erased.

Some lands instead are used and then abandoned or even never used and left uncultivated. These, usually covered by wild vegetation, can host a high range of biodiversity, especially in not polluted soils.

So what is the future of the Wastescapes in the city of Rotterdam?

The reuse and regeneration of abandoned spaces in the city can offer great potential for urban biodiversity and also for the improvement of socialization. For example, a wasted space can also be converted into a community garden where people can meet up and explore nature.

The sense of belonging to a place is fundamental and it can be discovered again via urban landscape design.

Any space can represent a point of integration and be perceived with its own identity. Citizens should be led to understand that a space can represent a place of sensorial and mental experience.

At large scale, the transformation of four critical industrial areas along the River Maas into new ecological hotspots leads to the increase of urban vegetation (biodiversity), the depollution of the soil, water and air.

At medium scale, a Southern area of intervention is chosen : Waalhaven and surroundings. This represents a crucial crossing point where the contrast between city and harbour/industry is much stronger and more evident .

At small scale, the district of Oud Charlois is chosen as an experimental area to intervene and test the success or failure of the intervention.

The design framework applied to the project site represents a resilient, efficient, sustainable, circular system that can adequately show the potential of Wastescapes in the city in urban, social and ecological terms.

This consists in the selection of particular zones of intervention where various design eco-components are applied according to duration, scale, site issue.

This "Toolbox" represents a set of flexible urban elements capable of promoting biodiversity, addressing climate change and easing urban fragmentations.

In particular, the quality of people and species' life is improved by some processes of phytoremediation of polluted soils which, combined with plant gradients, can lead to the improvement and enjoyment of the urban environment (water, soil, air).

KEYWORDS : Wastescapes, Circularity, Reuse, Regeneration, Sustainability

1.2 PROBLEM STATEMENT

Due to an economic process of “urban pressure” undergoing in the city, the majority of the old industrial, harbour areas or buildings are demolished and replaced by new structures with different functions and forms so that the memory of the past urban structures gets erased.

Some lands instead are used and then abandoned or even never used and left uncultivated. These, usually covered by wild vegetation, can host a high range of biodiversity, especially in not polluted soils.

1.3 RESEARCH QUESTION

Main Research Question :

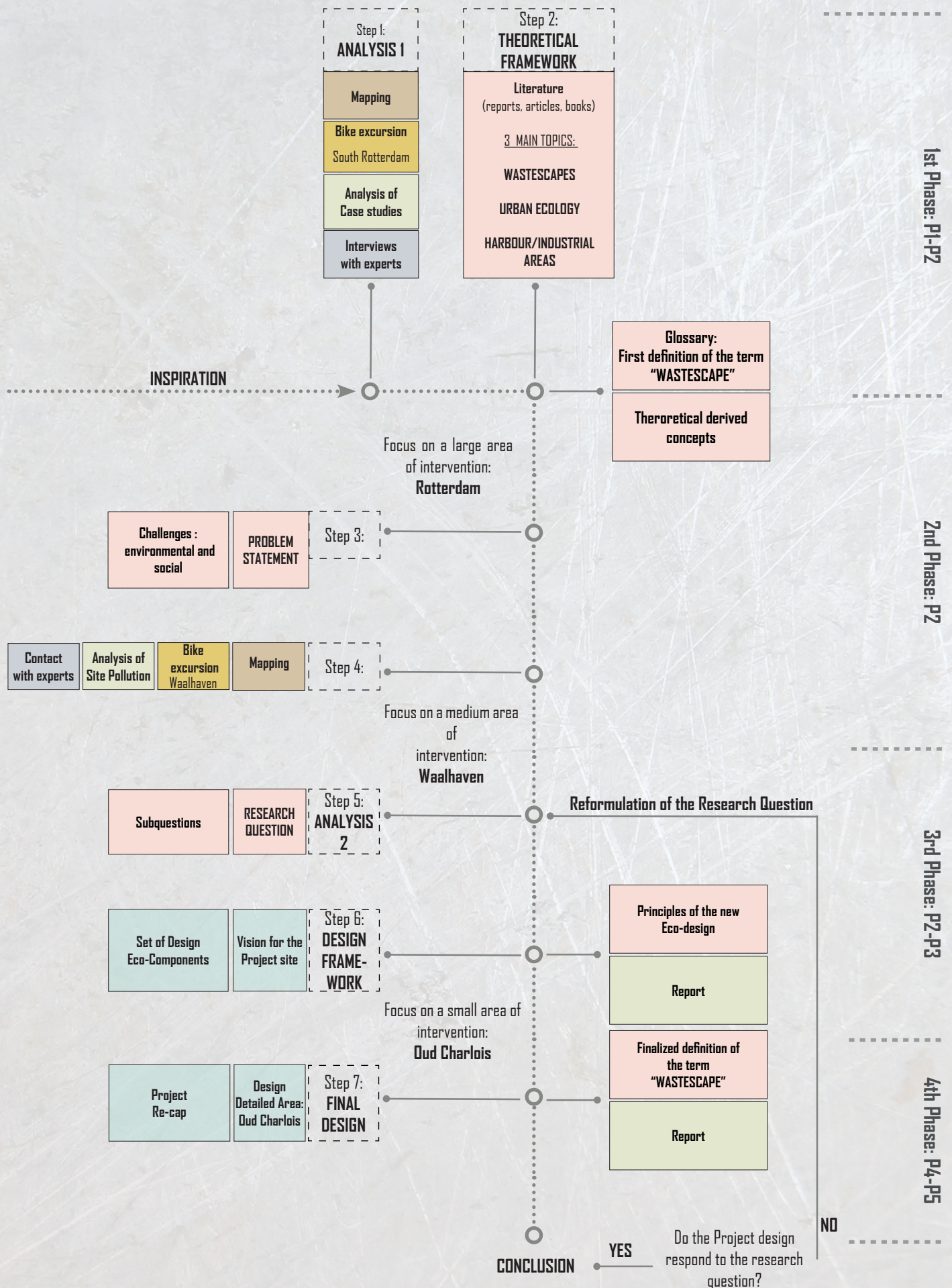
What spatial framework can guide the transition of Wastescapes in Rotterdam into ecological valuable spaces which can foster biodiversity, and improve the quality of people and species' life aspects on small, large scale (district/region)?

Sub-questions :

- Which exact kind of Wastescapes can be considered within the design framework?
- What particular reuse of “Wastescapes” can represent the best, efficient, sustainable and flexible eco-solutions against climate change, urban fragmentation and loss of biodiversity?
- Which green design solution can help to overcome the urban and social fragmentations of the southern districts of the city?
- How can the wastescapes and the existing green areas be combined in order to create new ecological corridors at large scale?
- Which is the best ecological way to depollute the Brown-fields improving the quality of the soil, increasing the biodiversity in the city?
- How can certain techniques of Phytoremediation be applied on certain gradients in order to tackle environmental and social issues in the project area?

2. RESEARCH METHOD

2.1 METHODOLOGY STRUCTURE



3. THEORETICAL STUDIES

3.1 WASTESCAPES

WASTESCAPE: AN ONGOING DEFINITION

Until now the definition of 'Wastescapes' remains quite broad, complex to define.

Depending on the context, the term is associated with various elements things such as polluted (unused) lands (Brownfields), neglected areas or abandoned structures (buildings, infrastructures...). These are spaces **'in between'**, **'suspended'** waiting for a new function, aspect, identity to assume. Usually, they can be of rural or industrial nature.

A 'Wastescape' can be considered as a **'discard'** resulted from an intensive, fast, increasing process of metabolic growth undergoing in a city, without any control or systematic regularization. Generally, Wasted areas can be generated by 'peripheral landscapes', which are traceable at the edge of a city, between the rural landscape and the urban one. The conformation of those landscapes appears quite fragmentary, sometimes asymmetric, spread and disconnected.

Moreover, the overlapping of many elements and functions causes the generation of anonymous, neglected areas where also many urban and rural issues arise. Due to these qualities, they have been defined as **'hybrid geographies'** (Amenta 2019).

DEFINITIONS GIVEN BY AUTHORS

Over time some authors have tried to give their own definition of the term 'Wastescape'.

For example, Kevin Lynch in his essay "Wasting Away" (1990), regards that Waste, identified as **form of decay and decline**, is strictly connected to people's life and growth. It is an essential, intrinsic part of human living in the city.

Nevertheless, people do not give a proper importance and recognition to this kind of space in the society. In fact, wasted places are invisible, useless, 'worthless' to citizens. Structures as buildings are defined as 'derelicts', while transport infrastructures are left abandoned and neglected.

Despite that, he also recognizes how urban wasted areas are really significant for wild species (Flora/Fauna) which can be hosted and thrive peacefully.

Michael Southworth, in between Kevin Lynch's thinking and Gilles Clément's one, indicates wasted areas those abandoned ones which are located in the city, but also on the border of that in various sizes and shapes.

The "Third Landscape" - Gilles Clément

Gilles Clément in his book "Manifeste du Tiers Paysage" (2004), indicates the **empty, residual, wild places** as "The Third Landscape" which are very necessary for the cities of today.

Those represent a set of fragmentary, **"undecided"** spaces, lacking of a function and specific destination. Usually, located at the border of woods, streets or rivers, they constitute an important, protected territory of refuge for biological diversity, also thanks to their dense vegetation.

Clément describes three main components of The Third Landscape: Primary sets, Reserves and Residues. In particular, a Residue (Délaissé) is defined as **'a product of a rational organization of the territory'**.



Figure 1. Le Jardin du Tiers Paysage.

Retrieved from <http://www.jazzi.it/2017/07/18/gilles-clement-met-tere-mostra-giardino/>

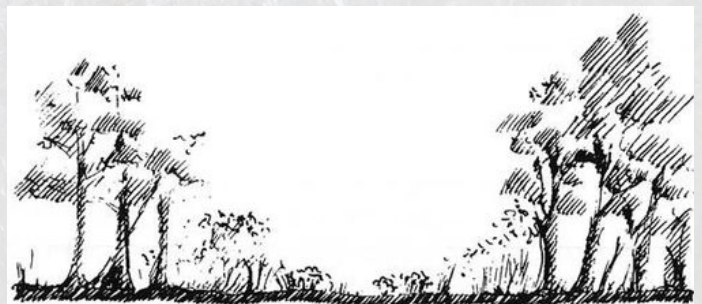


Figure 2. Section of vegetation gradient.

Retrieved from <https://www.pinterest.fr/pin/385831893052136319/>

HISTORY OF THE TERM 'WASTELAND'

Over the years the term 'Wasteland' has often taken on different meanings, usages, representations, depending on the time and place. It was above all possible to observe this change thanks to the study of cartographic maps and historical writings.

The first findings regarding the meaning of Wasteland can be traced in the script "The Great Charter of Forest" inserted in "the Magna Carta" of 1225. Here, Wasteland is described as "ravaged, injured unpopulated or wild in legal use, piece of land not in any individual's occupation, but lying in common" (Gidwany, 2012; Linebaugh, 2009). Therefore, a wasted land is mostly seen as a non-arable land, which presents a many different kinds of ecologies, linked "by their wilderness, by their resistance to domestication, and by the absence of conventional signs of urbanization" (Di Palma, 2014).

Wastelands seem to have a double meaning of spaces which are "useless" but, at the same time, spaces "not properly used". Moreover, they are strongly exploited due to the necessity of fuel, raw materials and food reserves. So, their productivity determines their spatial value.

In the 1500 Wastelands are considered as spaces with no value, therefore they are represented on the maps as white areas with no particular specifications.

In 1700, they seem divided into three important groups: mountain, forest and swamp.

By looking at the Ferraris Carte of Belgium (1706) and the Kriegscarte of the northeast of Italy (1798-1806), it is possible to notice how the Wastelands are considered as heathland and swamp lands with the possibility of human domestication and cultivation. This does not seem to happen instead in the following century, where Wasted lands appear as unproductive areas, covered with sand or forests, rich of savage plants and stones. (Di Palma, 2014)

In 1900, the ecological changes in the '70s and the industrial issues in the '80s lead some experts to re-evaluate the importance of the 'Wasteland'. New concepts and terms are introduced and juxtaposed to that: for example, there are 'terrain vague' by De Sola Morales in 1996, 'Third Landscape' by Clément in 2004 or 'Drosscape' by Berger in 2006.

In 2011, C. Michael Hall states that "**Wasteland is not a waste!**" reclaiming the importance of Wastelands as a place with strong, multiple potential (ecological, social, urban).

The "Drosscape" - Alan Berger

In his reading 'Stim & Dross' (1995), Lars Lerup looks more into the element of 'Drosscape', defined as 'natural component of every urban system' (Amenta 2019).

Subsequently Alan Berger in his book "Drosscape" (2006), introduces the term "waste" to indicate the process of urbanization which extends horizontally, especially in the US. By this using term, he also refers to the remaining urban products generated by the 'combination of natural and man-made processes'. These products are interstitial wasted spaces with no identity or function.

Although Drosscapes are considered as a subset belonging to the broader category of Wastescapes, the two groups could be also considered as separated elements. In fact, the origin of the term Drosscape is linked to the production of spatial 'left overs' (empty spaces) produced by the increasing industrialization happening in the US since the 19th century. Therefore, it refers to a precise geographical and historical context which cannot be applied to another term as 'Wastescapes' whose origin is less defined and precise.



Figure 3. "C-mine" Cultural Square, Genk, Belgium

Retrieved from <https://www.publicspace.org/works/-/project/h091-c-mine-cultural-square>

WASTELANDS AND WILDERNESS

Berger, together with Southworth, state that Wastelands are strictly connected with the growth of a city, in particular horizontally ('urban sprawl'). This process of production of Waste happens naturally, therefore there should not be considered as a negative fact. In fact, according to Berger (2006), Wastelands are '**indicators of healthy urban growth**'.

According to Lynch in 1972, The relationship between Wasteland and the Urban Wilderness has often been frequently dealt in many studies.

Haid regards in 2011 that Wastelands represent an expression of in-between Wilderness, characterized by a natural development of savage vegetation.

Usually, due to its Wilderness, a wasted space is negatively judged as valueless and unprofitable. On the contrary, it is very worthwhile and beneficial due to its capacity of hosting a high range of biodiversity, so that many habitats can let plenty of species thrive peacefully.

Indeed, this aspect is quite essential to the ecological sustainability of a city.

The appreciation of the beauty and environmental potential of wild, abandoned spaces should be more important for urban biodiversity rather than for the potential profitability of a land.

Unfortunately, the aesthetic of nature is often based on homogeneity of shapes and vegetation rather than on the diversity or asymmetry.

In 1969 Barr claims that a land which is apparently '**ugly**' and '**unattractive**' is defined a '**derelict**'.

Subsequently, in 1990, Lynch regards that the evaluation of a land as a derelict, is directly connected with the market economy. In fact, he affirms: 'If it pays, it isn't derelict. If it doesn't pay, due to any human devilmint, and once did pay, then it is derelict'.



Figure 4. Chausseestraße, Berlin, Germany

Retrieved from Gandy, M. (2013). *Marginalia: Aesthetics, Ecology, and Urban Wastelands*. *Annals of the Association of American Geographers*.

WASTELANDS AND BIODIVERSITY

Biodiversity in cities is a fairly relevant topic that should be taken into more consideration in the scientific and ecological field.

Through the study of some experts (Walters, 1970; Pysek, 1989), it has been noticed that in urban areas there is a higher concentration of plants than in rural ones, in particular with regards to non-native species.

Furthermore, there has been observed that there is a significant direct proportion between the quantity of vascular plants typologies and the urban population density, but inverse with respect to the surface of the city.

According to Klotz's (1990) and Pysek's (1993) researches, in towns with less than 100,000 inhabitants, it is possible to register from 530 to 560 species circa of ferns and flowering plants, while in cities with 100,000 to 200,000 inhabitants, between 650 and 730 species can be mapped.

In bigger cities with 250,000 to 400,000 people, from 900 to 1,000 species are registered, while in cities whose population is more than one million, the number of species often reaches 1,300.

The high variety of species in a city can be justified due to some factors related to urban spaces:

- The presence of a heterogeneity of habitats.
- The strategic position of welcoming and introducing new species through commercial, transport and tourist links.
- The connection with the adjacent areas.

Certainly, all the cities are different in size, features and undergo dissimilar changes. Therefore, the density of biodiversity is not equally divided across the cityscape. It usually occurs that many buildings become the main hosts of plant species formation than other places.

On the other hand, various plants that are too much concentrated in one place cause an increase of temperature in comparison to much larger areas (Godefroid and Koedam, 2007).

Future challenges as increase of urbanization, population or climate change can be mitigated by fostering urban biodiversity and expanding the availability of natural resources within cities.

Urban flora is also efficient at decreasing the urban heat island impact by "cooling" cities. Moreover, it may also be used to absorb carbon dioxide.

WASTELANDS AND URBAN VEGETATION

Wastelands, neglected and degraded areas, are usually covered by spontaneous and uncultivated vegetation, with a high rate of biodiversity.

These spaces also present many stages of succession of vegetation which are certainly helpful for the development of biodiversity (Mahey and Rink, 2010).

In particular, it is possible to define four different phases:

1. Young wasteland with pioneer plants (<3 years period)
2. Older wasteland with pioneer ruderal plants (3-10 years)
3. Old wasteland with ruderal herbaceous plants (10-50 years)
4. Wasteland with casual woodlands (> 50 year)

The factors which influence the stages of vegetation and the related diversity of species are : the weather, the concentration and the kind of land use (past and actual). Also the type of soil and its degree of permeability, the site and the expansion of urban wasteland are quite important to consider.

In a research conducted in Berlin (Zerbe, 2003), it was discovered that the transition region between the city center and the suburbs, where urban land use is connected with open green spaces such as parks, urban forests, and wastelands, has a wide range of land use patterns and a large number of species.

The ecosystems that were less intensively maintained had the highest number of species reported. Land use patterns with modest frequencies or intensities of interference, on the other hand, had a favorable impact on habitat diversity and total species diversity. As a result, a crucial point is then raised: wastefield species diversity can only be sustained by disturbing vegetation succession which can demands an action of stepping in (Witting, 2010).

The severity and extent of physical disturbances are likely to be influenced by the city's economic situation (Berger, 2006).

Plant succession also continues without interruption in more economically deprived areas, where a percentage of the urban center and/or suburbs has been deserted for extended periods of time, and achieves a more "stable," multi-layered structure than it does in more affluent cities (Muratet 2007; Del Tredici, 2010; Mahey and Rink, 2010). Moreover, the volume and maturity of natural vegetation in cities is inversely proportional to their economic prosperity.

'Improving biodiversity in urban environments will improve the quality of life and education of city dwellers, thus facilitating biodiversity conservation in natural ecosystems.' (Savard, 2000). Wild ecologies will offer both greenspace for play and a means of regulating urban temperatures, which is particularly relevant regarding the climate change concerns. Many city dwellers, on the other hand, perceive the existence of natural flora in their community like a conspicuous representation of abandonment and deterioration, also if they might observe the same kind of vegetation (e.g. wildflowers) emerging in a countryside area (Del Tredici, 2010).

Pyle (2003) states that urban communities are becoming profoundly isolated from nature and increasingly '**biophobic**'. To face this problem, Wilby and Perry (2006) affirm: 'Clearly, education and "**re-connecting people with nature**" are of primary importance if the biodiversity of urban landscapes is to be preserved'. This is even perhaps more important in the case of wastelands, which already have a negative reputation because of their environmental impact.

To a few people, wastelands represent a terrifying environment. The central issue for the growth and conservation of urban ecosystems is that 'wastelands are frequently viewed by the inhabitants as a symbol of degradation and deterioration, and wild random nature is frequently treated as a signal that the city is not being managed properly' (Dettmar 2005). Lynch (1972) expressed similar fears, claiming that "the wasteland provides a frightening impression of death and decay." However, economic development and external transition would often necessitate slow migration of people and gradual departure'. So wasteland is then viewed as a symbol of economic development and transformation.

According to Dunnett (2002), the efficiency and preservation of green open areas can be considered as one of the key indices of a district quality by local residents.

The natural and visual qualities of wasteland ecosystems must also be reconsidered by city dwellers. Wastelands have significant environmental qualities, make a significant contribution to urban environmental systems, and help lower the city's environmental impact. They also satisfy meanings of sustainable ecosystems as they are site-adapted and they require limited monitoring. Moreover, they are socially-environmentally useful and advantageous (Kühn, 2006; Del Tredici, 2010).

WASTELANDS AND URBAN PORTS

Reclamation and renewal efforts must take into account the ecological value of wasteland's spontaneous ecosystems and partake in planning strategies that interact with 'wasted' nature.

According to Del Tredici (2010), "design techniques that combine the ecological utility, visual aspect, and leisure capacity of natural urban forest or of some other wasteland plant life are prevalent to thrive than those that rely solely on ecology."

This assumes that people represents an essential component of the city environment, and their needs must be included in planning processes. The diligent control of ecological plant community processes is able to improve the visual appeal of urban areas and the incorporation of ingenious landscape features promotes their citizens' use, increasing popular backing for their conservation (Del Tredici, 2010; Kowarik, 2005).



Figure 5. Building complex in the Zhongzheng district of Keelung city in northeastern Taiwan

Retrieved from <http://desertedplaces.blogspot.com/2013/05/abandoned-building-complex-in-taiwan.html>

In the early years of 1900, the majority of harbours experienced several shifts as consequences of the industrial revolution. Since then, many of them have often developed in a linear way, depending on unrenewable resources.

In fact, ports continue to develop without any limit and produce relevant volumes of waste and wastescapes (lands in a condition of squander, emptiness).

This linear expansion mode is driven by the idea of the continuous consumption of intact, huge, accessible lands whose availability is regarded as always present. On the contrary, land is not an infinite reserve but limited. As a result, the insufficiency of lands damages the urban and suburban areas.

Furthermore, in recent years, due to an increase of density of population and a poor land management, several disordered aggregations have started emerging in the cities near the main infrastructures. Consequently, these have led to the formation of fragmentations (Wasted areas) in large (region) or small scale (district), and further issues as contamination and traffic jam, significantly affecting people's quality of life. The consequence of this dysfunctional plan is the overlay of harbour infrastructures on land systems without any connection, integration between them or with any other closer territorial element.

The intermediate lands that are situated between the city and the harbour (historic industrial zones) are considered as "suspended spaces" waiting for a new aspect and function.

Generally, it is possible to identify these spaces on the outskirts of infrastructures as contaminated, impoverished lands (Brownfields) with no function or use.

As soil is a natural limited source (Zanotto and Amenta, 2017), it is important to consider new methods and approaches for the restoration of wastescapes in order to reach a perfect circular system of growth. In fact, these dispersed fragments of land have a strong potential in the circular process of urban renewal which consists in a re-use of them into means to achieve a better standard of living for the inhabitants of a city and to re-establish a connection among the port, the city and the region around.

The conversion of wastescapes into regenerative spaces can also be considered in a larger plan of the creation of new regional eco-links, significant for species and the environment.

As Antoine Lavoisier said in 1772: **"Nothing is lost, nothing is created, everything is transformed"**. Therefore, any wasted space can continuously transform itself over time into a new one with different qualities and shapes.

CONCLUSION

The reading of multiple texts concerning the topic of "Wastescapes", in historical, social and ecological terms, has led to a personal definition of the word :

A **WASTESCAPE** is :

- A space of potential social and environmental **regeneration**. It can help to overcome the divisions between people and to enhance the quality of species' life. Its appearance and function are continuously **changeable** according to different times and places.
- A '**Non-place**' (Augé 1992) of Passage, but never of Arrival where there is no local identity to recognize. Its nature is invisible and apparently worthless to citizens.
- A place where nature, with its **wild** and **disordered** aspect, takes on a charm of its own, **mysterious, ambiguous** due to its indefinite form and function.
- A space lacking of own **identity**, recognizable social, spatial and cultural features from a community. This is the result of the strong pressure on the city to continually change its tissue, according to the economic needs of the society.



Figure 6. Aerial photo Theemwegtracé - Botlek

Retrieved from <https://www.portofrotterdam.com/en/news/pressroom/photo-gallery>

3.2 URBAN ECOLOGY

ECOLOGICAL URBANISM

Anne Spirn in his book "The Granite Garden: Urban Nature and Human Design" of 1984 expresses some principles regarding the right ecological approach to take towards the design of a city.

The author affirms that cities belong to the natural world, they are habitats and ecosystems, active and interdependent.

The city, its outskirts and the closer countryside need to be considered as one unique system in progress integrated, not separated, with the nature, so also any single green area or building with a bigger system.

She also regards that urban nature should be seen as a garden to be nurtured and appreciated, not to abandon or neglect.

Nowadays, this does not happen as nature is considered as a "place" or a "thing". The idea that nature is a place (e.g. 'countryside') or a thing (eg. 'mountain, river') is due to the inability to consider the city as something belonging to nature. This, on the other hand, is a "thought", not a "place" or "object" (Cronon 1996, Spirn 1997).

Individuals and families, humans and other animals, live in cities. These must provide environments which can satisfy the living, social necessities of the species that live there: procreation and development, activity and trade, connectivity, studying, playing, working... etc.

Many nonhuman animals, from bacteria to plants, insects, fish, birds, and mammals depend on cities for their survival (Sukopp 1990, Burger 1999). A few species are native, while others are quite common in cities; ones are beneficial to healthiness and well-being of human beings, others are harmful instead (Adams 2005).

Unfortunately, urbanization continues to decrease biodiversity, which has important negative consequences (McKinney 2008, Shochat 2010). The existence of fauna in a city is quite related to human health, so improving biodiversity is important not only for plants and animals.

According to Spirn, any ecosystem should be understood and preserved at any scale.

One of this is the city which is made up of further minor **ecosystems**: wetlands and river corridors, parks, homes, and communities. There are habitats belonging to ecosystems: for example, a pond ecosystem resides within the broader ecosystem of its drainage basin; a house is an ecosystem which is part of a community. Because of this interdependence, improvements in one environment may have significant consequences in others (Pickett 2004).

The several habitats are connected by the area they share as well as the networks by which resources and materials move (Wu and Loucks 1995, Cadenasso and Pickett 2007).

Such kind of ecosystem represents an open structure in which some products (energy, material, knowledge) are imported, converted, and used before being exported as wastes and commodities (Wolman 1965, Brunner 2007).

Any building and park needs to be built to use the least amount of resources, produce the least amount of waste, and perform multiple functions wherever possible.

The inefficient utilization of energy produces further pollution and increases degradation. The urban environment includes all of the processes that occur inside and across the region, including cultural, natural processes, inhabitants, and flows of water, air, nutrients, and pollutants (Machlis 1997; Pickett et al. 1997).

Flows of resources and pollution to and from residential areas often cause or intensify environmental, social issues in impoverished districts (Spirn 2005). Here, local action alone is destined to fail in these and other ways.

To prevent this, Spirn affirms that designers must define the structures to which the location of their project is linked and monitor the movements of energy or materials (e.g. waste). It is their duty to discuss the scope and effect of their interventions on the local environments to which they are connected.

Moreover, Hough declares in "Principles for Regional Design" (1990), following Jane Jacobs' thinking, that designers, together with people, should firstly intervene on site at one scale, also small as of of a district, where the success is sure, easier then move to a bigger scale (region), starting "**a process of environmental change**", where different stakeholders can participate and cooperate for a common purpose.



Figure 7. Converting an industrial building as Maassilo into an Eco-structure (own image)

URBAN DESIGN

Any urban planning initiative aims to improve the habitat of the city for people and other animals. Every species has unique requirements, and the most successful ways to improve their survival or gain dominance is always through the creation and maintenance of their ecosystem (Adams 2005, McDonnell 2009).

Urban design can definitely help with that as it can be implemented in order to foster and enhance the experience of the environmental factors that support life (Koh 1982, Howett 1987, Spirn 1988b and 1998, Gobster 2007, Beatley 2011).

Integrating free space of a city into a green base system has the potential to go beyond the leisure appeal of parks and to be a vital position in terms of sustainability, biodiversity. Parks and plazas, waterways and highway passageways should all be part of a cohesive scheme to enhance the quality of the environment, lessen the effect of natural disasters and provide a broad population of plants and animals (Spirn 1984 and 1988, Wenk 2002, Benedict and MacMahon 2006, Ahern 2007, Dreiseitl 2009).

The design of an urban ecosystem should include not just the form, shape, and materials, but also the methods by which it would be constructed and preserved through the years.

The city, as well as any home, green area, and infrastructure system, needs to be built like a bounded ecological system, importing and using less resources, producing less wastes, or at least recycling them as much as possible. (Lyle 1994, Wines 2000, Fromont 2003).

There are many ways of preserving an ecosystem, including preservation and regeneration.

The aim of preservation is to keep it in its present condition and protect it from human exploitation (Muir), while the one of restoration is to bring back a degraded environment to its previous, stable state. Unlike the other three methods, the aim of regeneration is to change the state of an ecosystem by introducing a new component: a home, a green area or a community.

Urban design represents a way of proposal projected towards the future, which is made more difficult given the fact that the landscape in a city is continuously evolving in unforeseen manners. Therefore, understanding a place's current and potential future requires a deep comprehension of how it has evolved over time.

A location's environmental past gives insight into how natural and societal forces interact over time, as well as how planners have intervened (Cronon 1991, White 1996, Klinge 2007). Here, history represents an essential basis for designers to understand the former background of a place.

Landscapes change over time, unexpectedly, in order to face natural forces and shifting human goals. Their hidden structure varies many times, according to certain conditions. However, under that a more permanent system lays with distinct cycles to which all species within the ecosystem adapt.

A urban configuration which can expose, react to the underneath form of a landscape is likely to be more resistant, resilient, and durable. This is quite relevant for the design of infrastructures that can serve the community, either at small, medium or large scale.

Nowadays most people reside in towns, and urban design is a great mean for refitting, especially to face unexpected events. For urban planners, a **resilient design** is fundamental if they are willing to create public spaces and build communities (Pickett et al. 2004, Vale and Campanella 2005).

CONCLUSION

The reading of texts concerning the topic of Urban Ecology (Theory and Design) has led to the formulation of the following concepts:

- Any urban ecosystem is important and has to be protected. The designers should understand that a city environment can be peculiar also for the special organism that live within it.

- The **reuse** and **regeneration** of abandoned places can be helpful for human beings, flora and fauna. It fosters an **improvement of urban biodiversity and communication between people and species** or just people themselves. For example, a wasted space can also be converted into a community garden where people can meet up and explore nature where many species thrive.

4. DESIGN PROJECT

4.1 ROTTERDAM

INTRODUCTION

The Rotterdam urban green system is made up of a network of waterways, parks, dikes and canals that are connected by paths, water storages, and other synergies.

The **Maas river** represents the region's main ecosystem. The Schie, the Rotte channels and the Ringvaart canal represent the main river ribbons located along the Northern coast. All of them form a radial network from the city's outskirts to Rotterdam's city center. On a smaller size, the three major ribbons are connected by some green networks (canals), called '**Singels**'.

The green system is built on half circles (from east to west), located on the past dike systems of the sea clay polders near the Maas and the Zuiderpark, rather than radial (from north to south) structures (Tillie 2016).

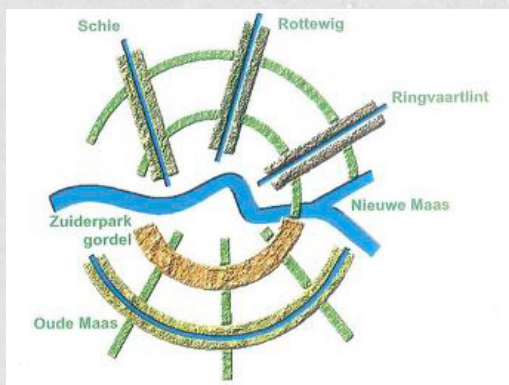


Figure 8. Scheme of the blue/green structure of Rotterdam (image of Nico Tillie). Retrieved from Tillie, N. "From Urban Green Structure to Tidal River in Rotterdam: Testing Grounds for Urban Ecology" (2020), p. 5

In the Northern river side, the main dyke is far nearer to the sea than in the Southern one. The main dyke links a number of old rivers and streams on the Northern shore, like the Rotte and the Schie. These rivers, streams are now controlled waterways or act as rain-water harvesting bodies in the polder's water network. Excess water is drained into the Maas river through these canals.

Another urban issue is related to **water storage** which now is quite needed. In fact, in the last ten years rainfall levels have increased, leading to a renovation of the current water system. In particular, the Southern districts, in comparison to the Northern ones, present a scarcity of water supply, together with poor housing conditions and urban fragmentations (Tillie, 201; Greef 2005b).

Moreover, many urban areas are present beyond the principal green structure of Rotterdam but their quality is still lacking. On the other hand, many '**greening schemes**' have been established for the city centre (Tillie, 2012; 2018b). Green roofs, facades, streets, squares, gardens, and playground are all well-known design solutions that can deal with future issues as densification of people and buildings.

In the city of Rotterdam, **tidal movements** have dominated and influenced the landscape for years. Many tidal river habitats, as well as their scenic and leisure qualities, have vanished with the port enlargement and the construction of dikes and rainstorm walls.

Nowadays, the majority of fresh/brackish water bodies is located in the National Park De Biesbosch and in the Oude Maas.

The Nieuwe Maas (or Meuse) represents a passageway for boats and the largest green structure of the city.

The Rotterdam delta formed by the Rhine and Meuse rivers in Rotterdam, is one of the few tidal non-river systems available to fish migration.

As many river gates are blocked off by dams or tidal flow walls, the development of valuable green spaces for residents is necessary along the river.

A planned larger surface near the Maas river with tidal parks is going to fulfill many goals. In fact, it can provide leisure benefit to people while also improving the ecological qualities of the tidal river.

A tidal park in the city represents a physical intervention that employs various possibilities and achieves several targets. In fact, it has the potential to carry nature much near the city, especially in points of the city the access to the river is obstructed.

By smoothing the river banks, new environments can be offered and enjoyed by people (tourists, citizens) and species (biodiversity). Such ecological interventions will be also aimed at give some continuity of the river water from east to west, essential for fish migration or other species' one.

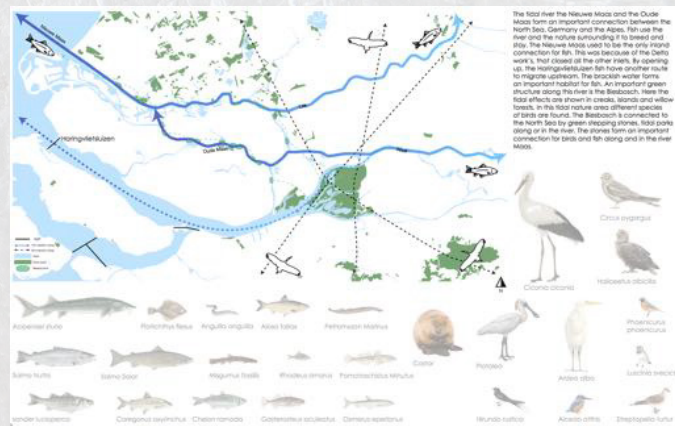


Figure 9. Eco-connections, for species, between the Nieuwe Maas, the Oude Maas, the North Sea and the surrounding areas (image of E. Kannekens). Retrieved from Tillie, N. "From Urban Green Structure to Tidal River in Rotterdam: Testing Grounds for Urban Ecology" (2020), p. 11

HARBOUR SITUATION IN THE CITY

Rotterdam is located at the crossroads of two significant economic points: the Randstad and the Rhine-Scheldt delta region. Regarding the geographical setting, the Southern side of the city is mostly used for organizational and mechanical activities, while the Northern zone is thought for public facilities and corporate operations (City of Rotterdam, 2007).

In the past, the lands located in the middle between the harbour and Rotterdam have undergone a process of abandonment, followed by another one of construction.

The River Maas and the related harbour operations have often identified as elements of **spatial division** and **class difference** between the two sides of the city.

Furthermore, since 1950 phenomena as '**containerization**' and innovation of technology has caused a significant change regarding the harbour.

In fact, as containers demanded larger areas and more profound depth of water, the major and local authorities decided to start further developments of the port over the boundaries of Rotterdam. Such decision led to the fracture and the gradual detachment of the harbour and the city, while several broad zones remained empty and exploitable for construction.

Since 1970, a few organizations in Rotterdam have put many efforts to minimize the spatial, social fragmentations among people and to enhance a better enjoyment of the city.

Nowadays, such urban zones are well incorporated into the urban pattern. For example, the Southern district Kop van Zuid is quite significant as it represents the first area of intervention and regeneration of the river waterfront. Such intermediation allowed the district to maintain a connection with the center of the city and Rotterdam a fresh new aspect.



Figure 10. The development of the Port of Rotterdam through time
Retrieved from <https://i.redd.it/ntdu9su3arr1l.png>

Rotterdam has applied the **circular economy** idea into a city-scale development approach. The ultimate target is for green energies to fuel 100 percent of the area by 2050. To achieve this goal, economic cycles must be ended, any ecosystem has to be protected and the land exploitation must be limited only to the necessary.

The city of Rotterdam has recognized the significance of **transitioning from a linear to a circular growth** paradigm and the relative benefits. Other strategies for energy transfer and other circular economy concepts must still be implemented next.

The structure of interactions between constructed, unbuilt, and natural ecosystems needs to be revised, also taking into account the inhabitants.

Harbours represent areas where diverse fluxes of input and waste collide. In order for ports to transition to a circular model, the recycling mechanism should apply to physical wastes.

Diversely, such system is also referred to a broader strategy that includes both the physical and landscape aspects of recycled wastescapes. This is in reference to the achievement of new territories, which are quite significant for a port's attractiveness.

The disposal of space also enables harbours to evolve, renew themselves, and react to global changes. Current economic forces are compelling ports, towns, and regions to work together.

As a result, combined partnerships are proposed as a means of optimizing land use while simultaneously avoiding the occupation of new fields. These techniques increase a port's efficiency and functionality in an indirect way.

In the case of Rotterdam, the port authority plans a cooperation with the city as the best way to boost the port's productivity after years of isolation. This type of partnership allows for the development of **sustainable growth policies** that do not jeopardize the region or the local area. Then, the port will become a driving factor in the territorial renewal at any scale. This would allow to become a fundamental element for geographical, social and territorial combination. Harbour and city councils have settled close **stakeholder relationships**, establishing **circularity** and the **recycle** of the port-city encounters as a territorial strategic plan. This is intended to improve the relationship between the port and the territory on a small and wide scale, as well as in terms of facilities and community. (Amenta, L., and P. de Martino, 2018).

ROTTERDAM ANALYSIS : REGIONAL > CITY > DISTRICT

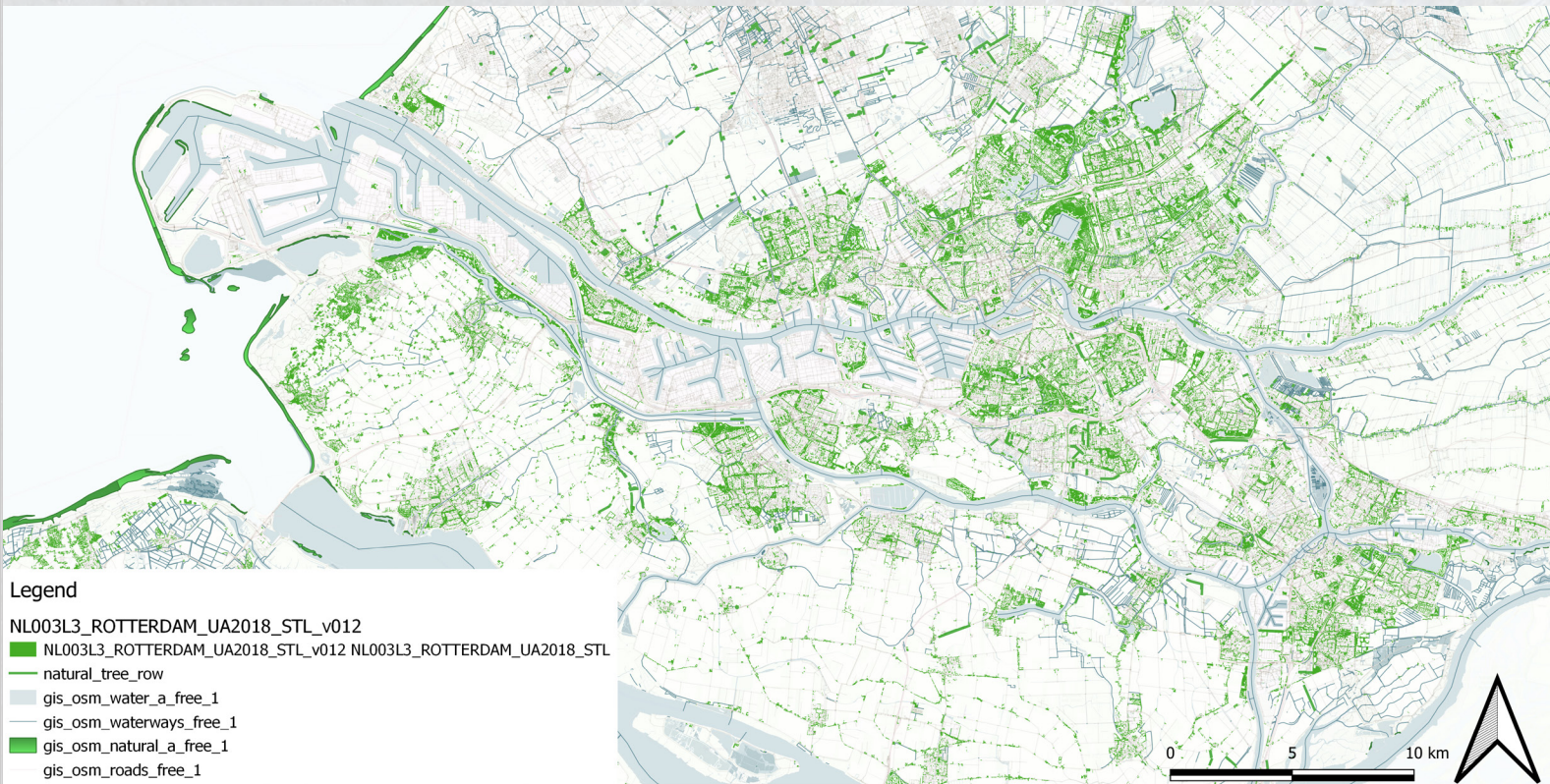


Figure 11. GREEN (RURAL/URBAN) AND BLUE AREAS

-The map shows the blue and green structures of the areas in and around the city of Rotterdam.

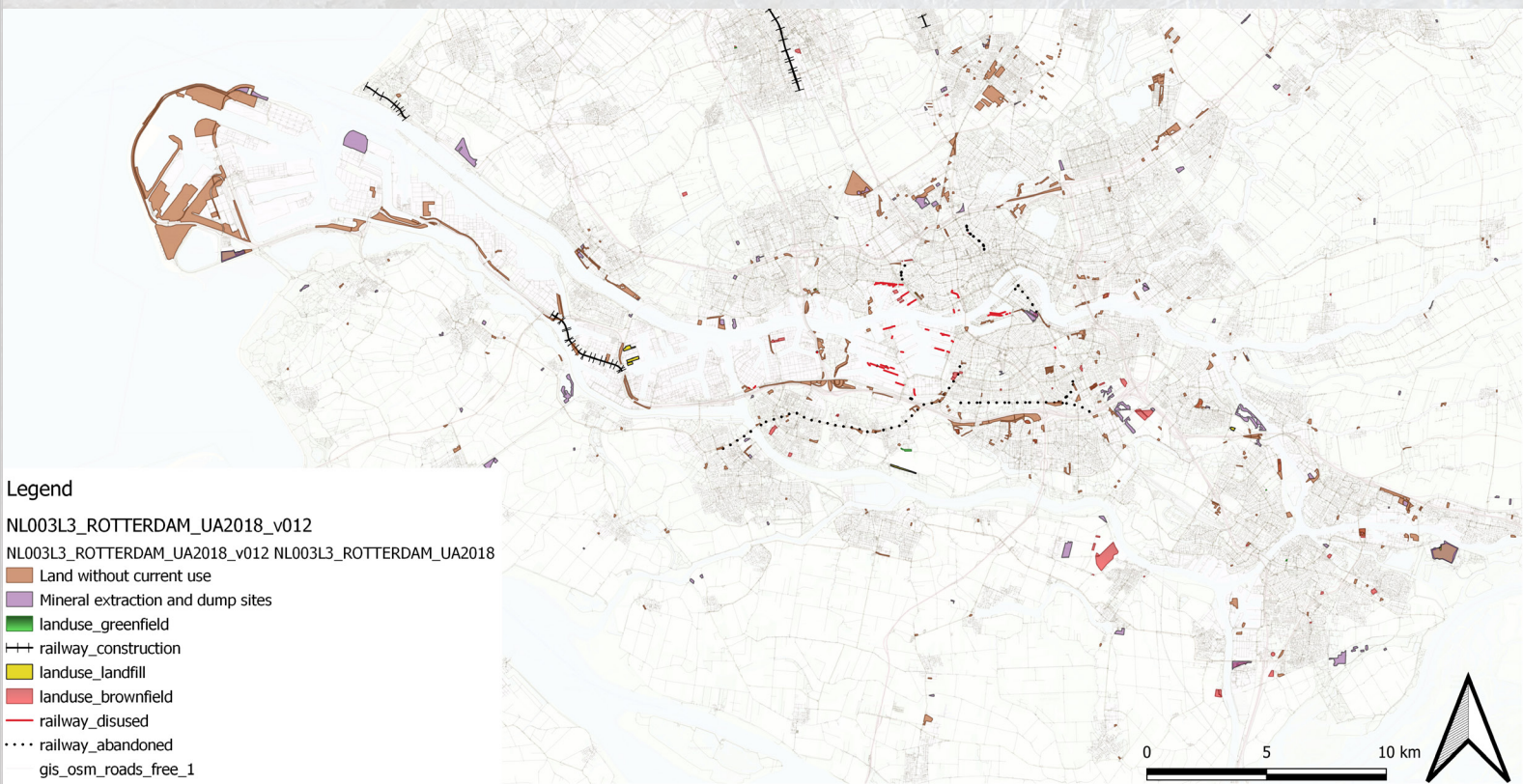
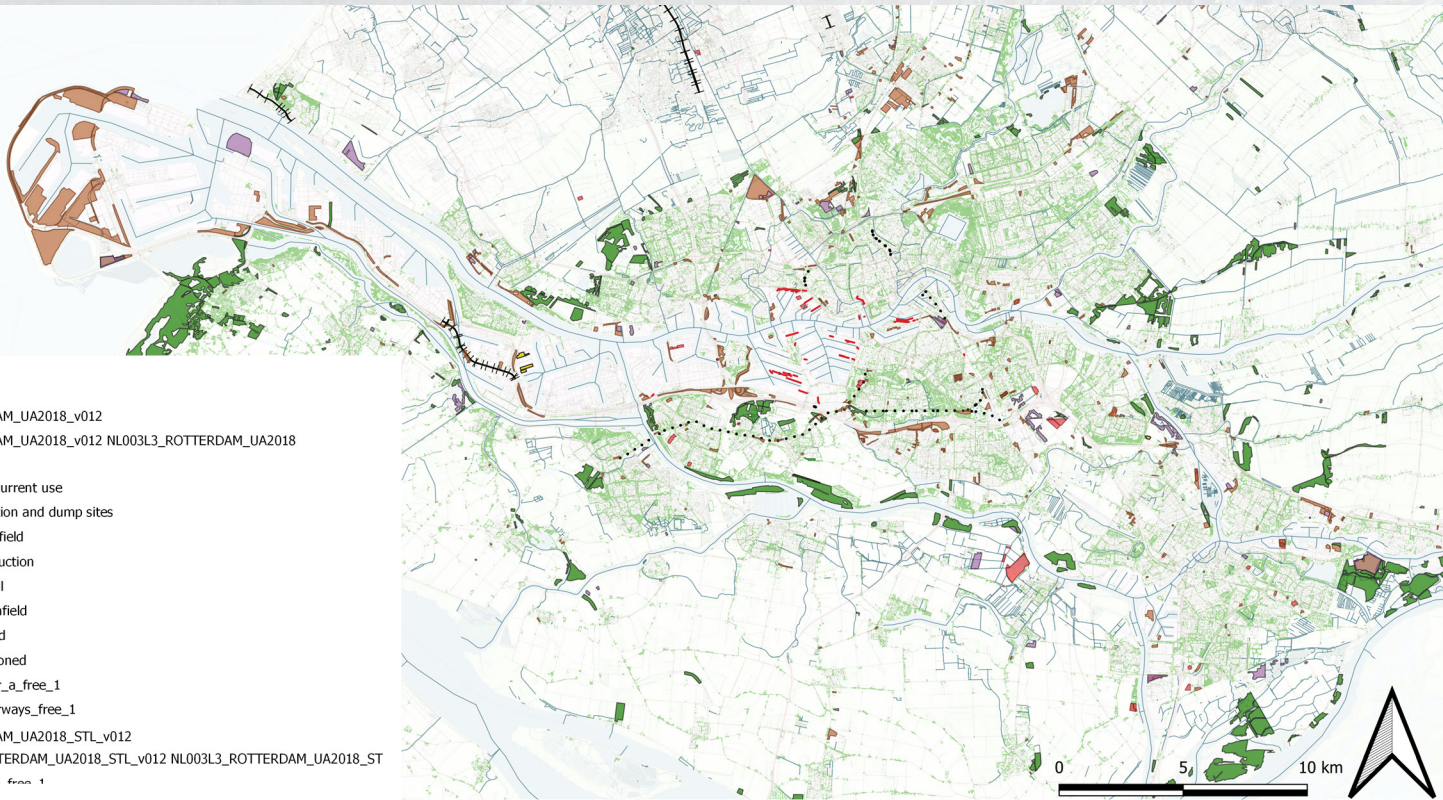


Figure 12. BROWNFIELDS, DUMPSITES AND UNUSED LANDS

- The map shows the abandoned (polluted), disused territories, landfills in and around the city of Rotterdam.

ROTTERDAM ANALYSIS : REGIONAL > CITY > DISTRICT

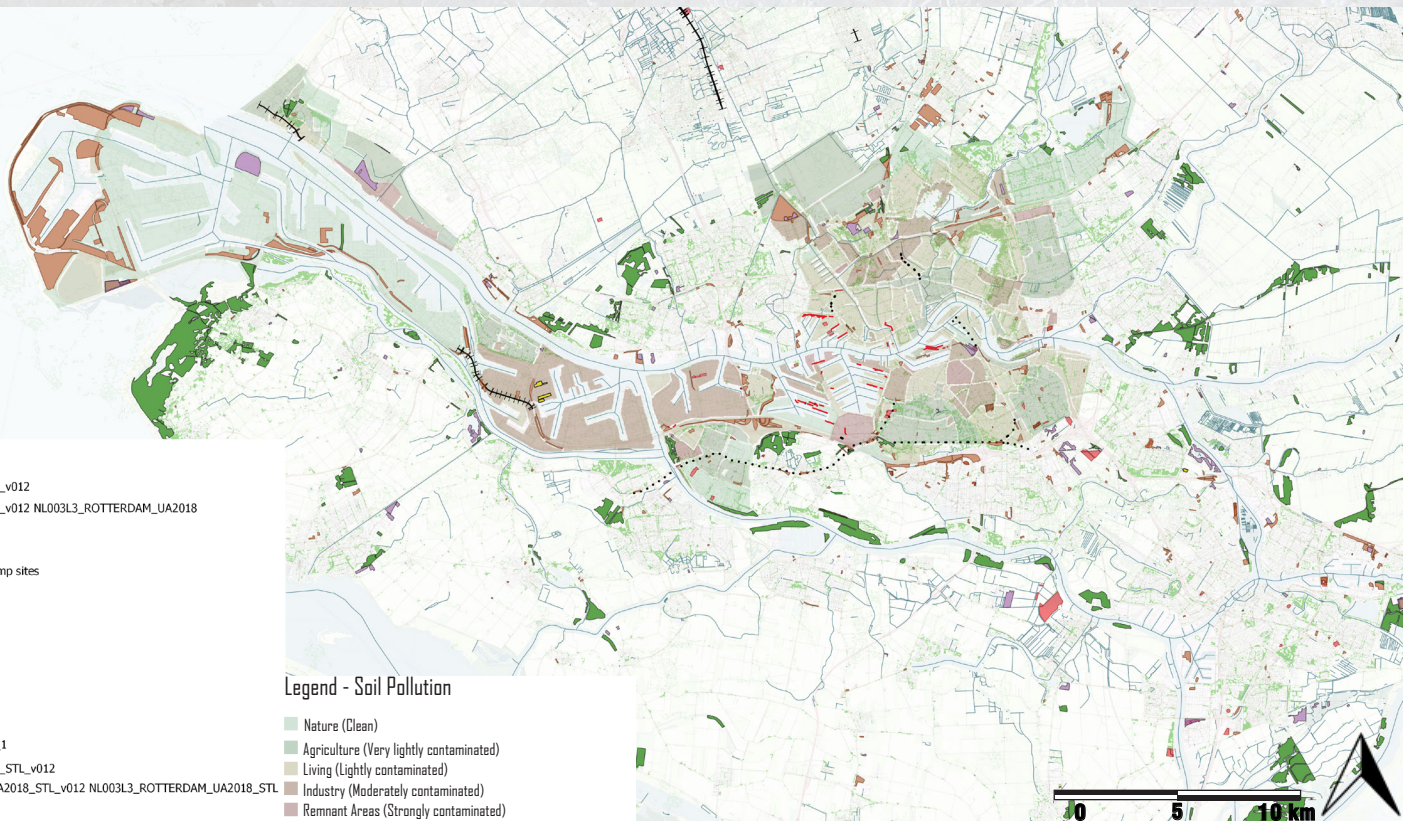


Legend

- IL003L3_ROTTERDAM_UA2018_v012
- IL003L3_ROTTERDAM_UA2018_v012 NL003L3_ROTTERDAM_UA2018
- Forests
- Land without current use
- Mineral extraction and dump sites
- landuse_greenfield
- ++ railway_construction
- landuse_landfill
- landuse_brownfield
- - - railway_disused
- ... railway_abandoned
- gis_osm_water_a_free_1
- gis_osm_waterways_free_1
- IL003L3_ROTTERDAM_UA2018_STL_v012
- NL003L3_ROTTERDAM_UA2018_STL_v012 NL003L3_ROTTERDAM_UA2018_STL
- gis_osm_roads_free_1

Figure 13. ABANDONED SPACES AND GREEN AREAS

- The map shows a combination of wasted areas and vegetation in and around the city of Rotterdam.



Legend

- NL003L3_ROTTERDAM_UA2018_v012
- NL003L3_ROTTERDAM_UA2018_v012 NL003L3_ROTTERDAM_UA2018
- Forests
- Land without current use
- Mineral extraction and dump sites
- landuse_greenfield
- ++ railway_construction
- landuse_landfill
- landuse_brownfield
- - - railway_disused
- ... railway_abandoned
- gis_osm_water_a_free_1
- gis_osm_waterways_free_1
- NL003L3_ROTTERDAM_UA2018_STL_v012
- NL003L3_ROTTERDAM_UA2018_STL_v012 NL003L3_ROTTERDAM_UA2018_STL
- gis_osm_roads_free_1

Legend - Soil Pollution

- Nature (Clean)
- Agriculture (Very lightly contaminated)
- Living (Lightly contaminated)
- Industry (Moderately contaminated)
- Remnant Areas (Strongly contaminated)

Figure 14. ABANDONED SPACES, GREEN AREAS AND SOIL POLLUTION

- The map shows a combination of wasted areas, vegetation, soil pollution in and around the city of Rotterdam.

ROTTERDAM ANALYSIS : REGIONAL > CITY > DISTRICT



Figure 15. GREEN AREAS AND SOIL POLLUTION

- Soil quality in / around the city of Rotterdam varies considerably. Some areas have a high rate of pollution, while others a lower one.



Figure 16. POTENTIAL GREEN CONNECTIONS ("GREEN SEWING CORRIDORS") THROUGH INDUSTRIAL AREAS

- From the analysis of the green areas around the city, potential ecological corridors can be created or other existing ones to be strengthened.
 - The two main ones are the central vertical one for bird migration, while the horizontal one along the Maas river is important for fish migration.

ROTTERDAM ANALYSIS : REGIONAL > CITY > DISTRICT



Figure 17. INDIVIDUATION OF FOUR CRITICAL POINTS

- Because of the existence of central industrial zones, four important points along the Maas river show a discontinuity of green areas between North and South. The presence of such industrial areas also hinders the accessibility to the river from the city.

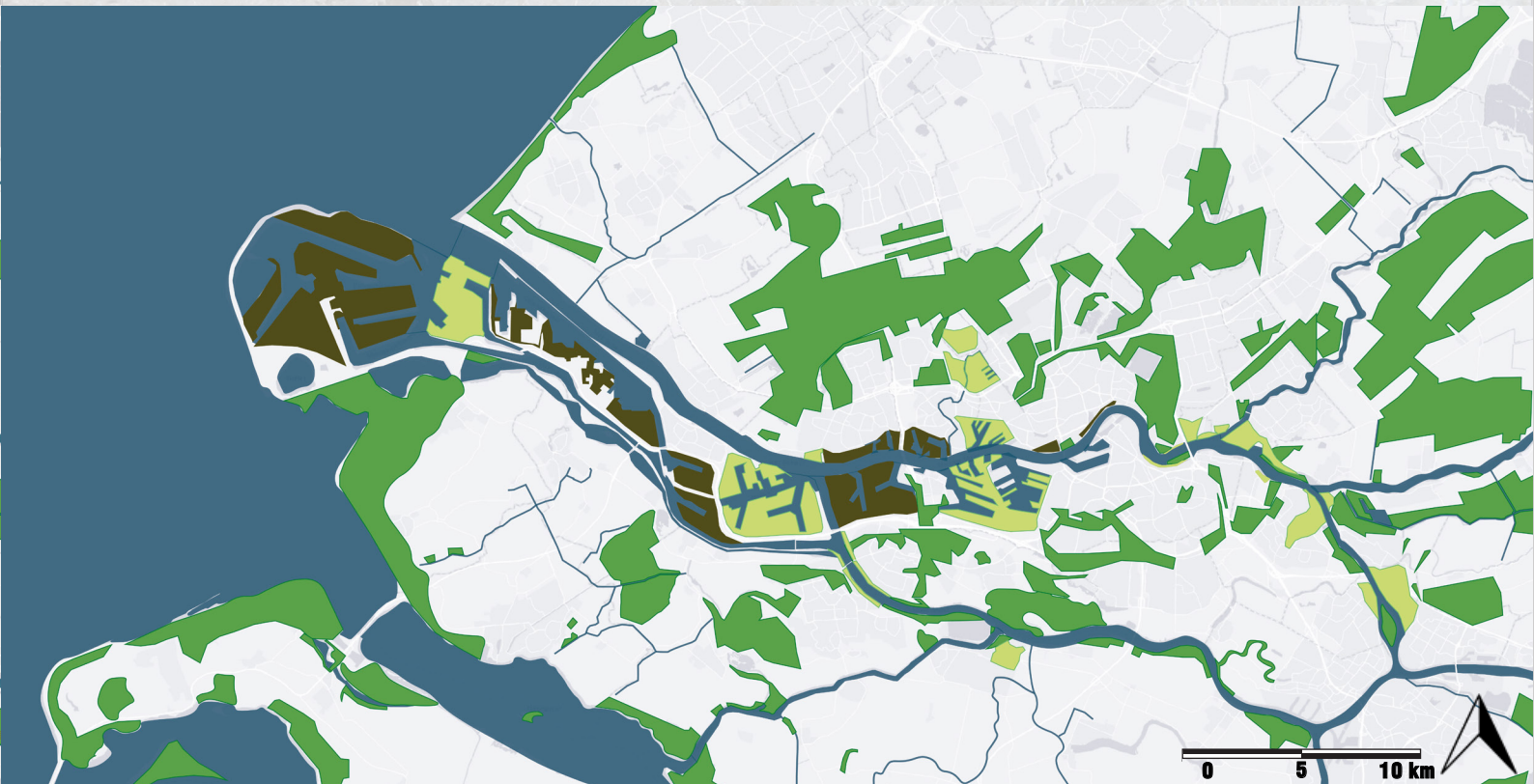


Figure 18. INDUSTRIAL AREAS CONVERTED INTO NEW ECO-HOTSPOTS

- The transformation of industrial critical areas into new ecological hotspots leads to the increase of urban vegetation (biodiversity), the depollution of the soil, water and air.

ROTTERDAM ANALYSIS : REGIONAL > CITY > DISTRICT



Figure 19. SELECTION OF A CRITICAL AREA OF INTEREST. LARGE SCALE.

- The chosen area of intervention represents a crucial crossing point where the contrast between city and harbour/industry is much stronger and more evident.



Figure 20. AREA OF INTERVENTION: WAALHAVEN AND SURROUNDINGS. MEDIUM SCALE.

- The area is going to host a future increase of population, building densification and green urbanization.

ROTTERDAM ANALYSIS : REGIONAL>CITY>DISTRICT



Figure 21. AREA OF INTERVENTION: WAALHAVEN AND SURROUNDINGS. CONNECTIONS.

- The presence of a Vertical/Horizontal Green Connection in the area fosters the mobility along the water and the improvement of relation between North and South.

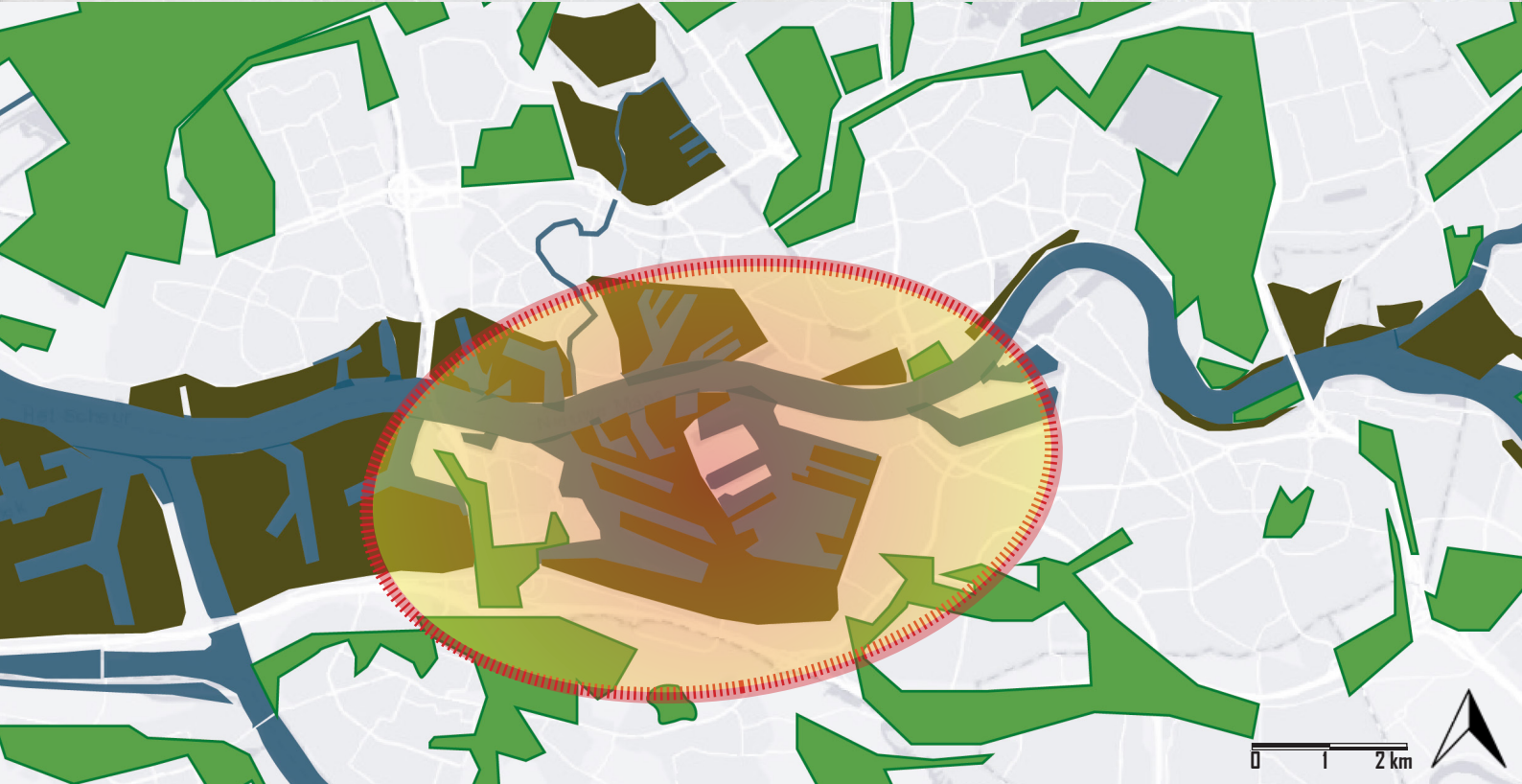
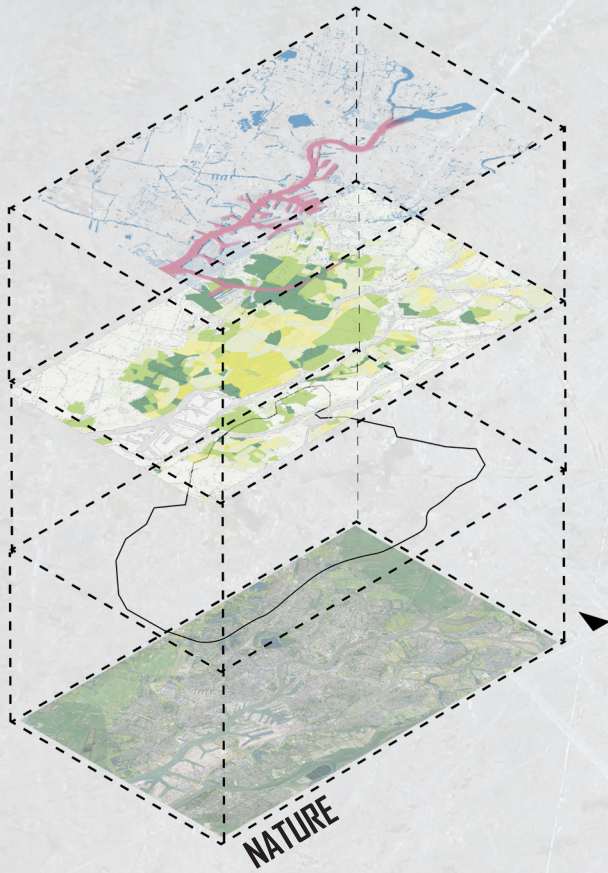


Figure 22. AREA OF INTERVENTION: WAALHAVEN AND SURROUNDINGS. SMALL SCALE.

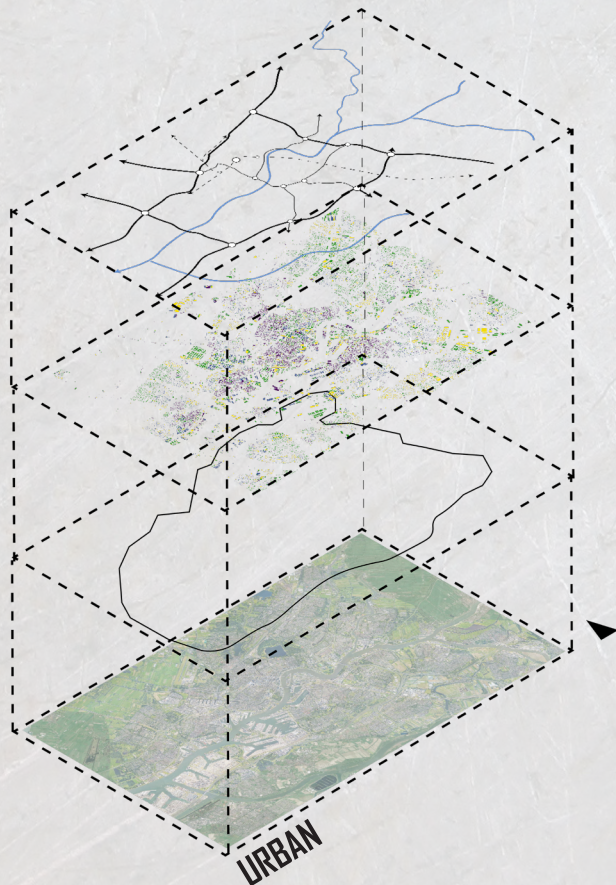
- Current Plan of Urban Intervention and reconnection between the city and the port: "Plan StadsHaven".

ROTTERDAM ANALYSIS : NATURAL /URBAN/ ENVIRONMENTAL LAYERS



- BLUE STRUCTURE
 - Water salinity**
 - Salt water
 - Fresh (Sweet) water
- GREEN STRUCTURE
 - Parks
 - Recreational areas, tidal parks
- CONTOUR AREA
- BASE MAP

Figure 23. Natural Layers



- MOBILITY
 - Highway
 - Main Road
 - Railway
 - River
- BUILDINGS (BY CONSTRUCTION YEAR)
 - 1100 - 1945
 - 1945 - 1970
 - 1970 - 2000
 - 2000 - 2021
- CONTOUR AREA
- BASE MAP

Figure 24. Urban Layers

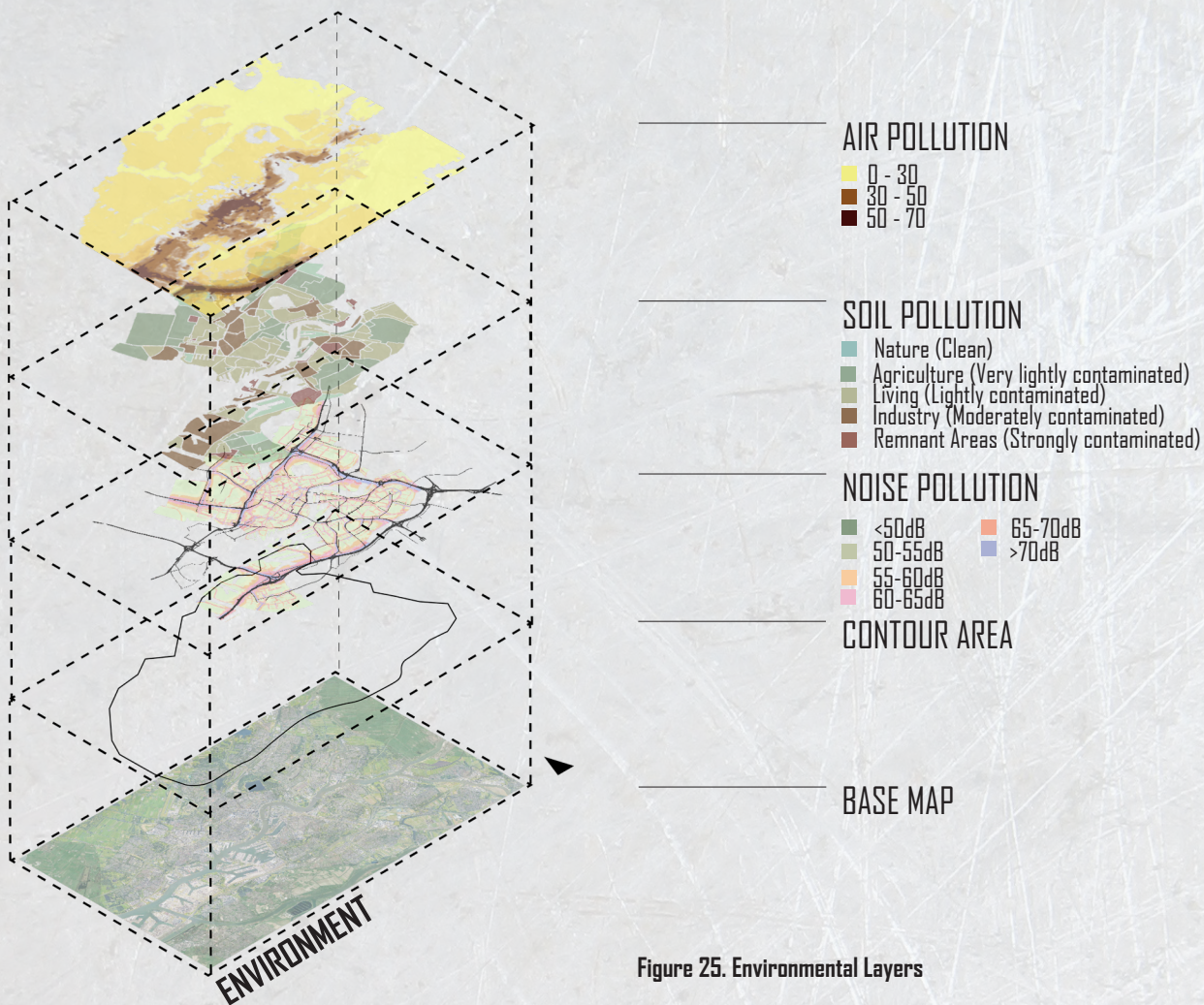


Figure 25. Environmental Layers

CONCLUSION

The analysis of the city of Rotterdam and its surrounding region under multiple aspects (natural, urban, environmental) led to the formulation of the following statements:

- The highest levels of pollution can be observed along the main communication routes such as the Maas (Water) river or the highways (Air, Noise) that connect the city vertically and horizontally to the surrounding areas.
- The quality of the urban space varies according to the location. Near the port, vegetation is scarce and urban agglomerations appear fragmented, isolated from others. In the inner-city, the green areas appear more dense and aggregated, as well as the built areas.
- The relationship between the density of industrial and building areas is inversely proportional: in fact, in the city center there are fewer industrial areas, and vice versa.
- Due to a strong urbanization, the presence of historical port structures is almost nil. In fact, most of them have been replaced by other, more advanced and modern structures.

4.2 WAALHAVEN

INTRODUCTION



Figure 26. Satellite image of Waalhaven. Retrieved from Google Earth

The city of Rotterdam has **various types of landscape**, in particular, it is possible to identify 5 (Figure 27):

- Sea Clay Landscape (Green)
- Peat Meadow Landscape (Purple)
- Onshore Polders (Light Yellow)
- Lands outside the dike (Orange)
- Dunes (Strong Yellow)

Besides the dunes, there are three different zones to take into account: the seashore barriers close to the Westland, the peat meadow area of Midden-Delfland, the Krimpenerwaard and Alblasserwaard, and the sea clay zone of Voorne-Putten and IJsselmonde.

The seashore barrier zone presents a layer of sand, with sparse dunes everywhere. It is quite risen up in comparison to the peat meadow polders.

The peat meadow landscape is quite low and has a peat substrate which is partially soaked with clay layers (e.g. Midden-Delfland).

The sea clay zone consists of matter choked up with silt by the sea. A few former ring polders have been also mixed up with peat underground.

The project area of Waalhaven mainly belongs to the category of the **landscape outside the dikes** of the city, but also includes a limited part of the Sea Clay landscape and Peat Meadow one.

In the landscape outside the dikes, the level of the soil is risen up in order to protect the inner built areas from the possible river overflowing.

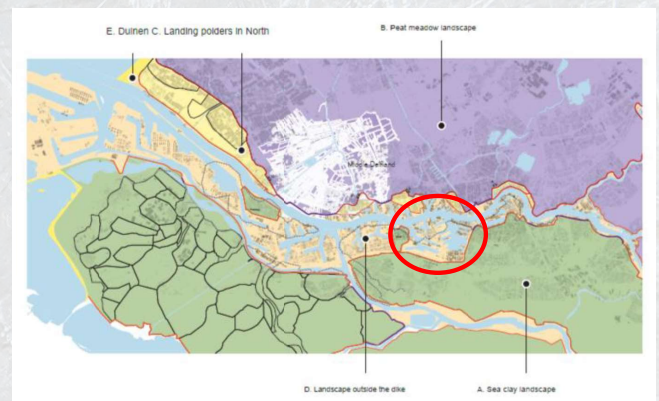


Figure 27. Typologies of landscape in Rotterdam according to the subsoil.

Retrieved from Landschappelijk Raamwerk - De Rivier als Getijdenpark 2016



Figure 28. Map showing the areas (red) out of the dikes in Rotterdam.

Retrieved from Landschappelijk Raamwerk - De Rivier als Getijdenpark 2016

NORTH AND SOUTH SIDES: DIFFERENT FEATURES

1. North: Peat Meadow Landscape

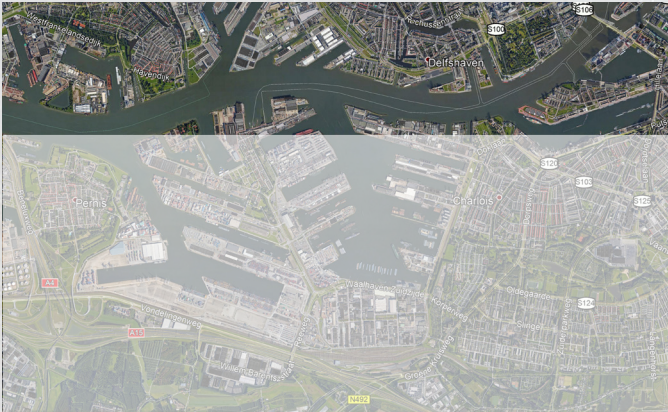


Figure 29. Satellite image of Northern River Side. Retrieved from Google Earth

2. Center: Landscape - Out of the dikes (Sand/Clay)

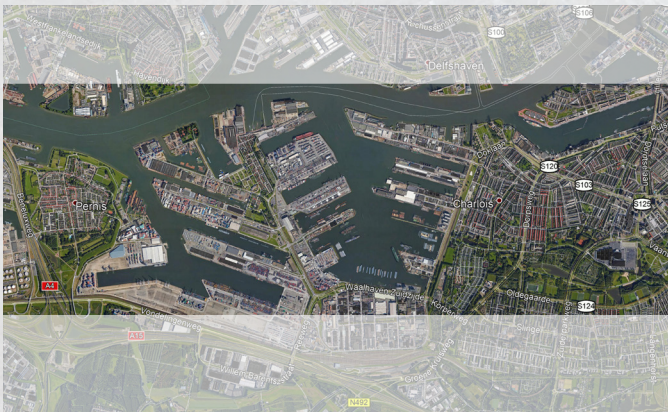


Figure 30. Satellite image of Central River Side. Retrieved from Google Earth

3. South: Sea Clay Landscape

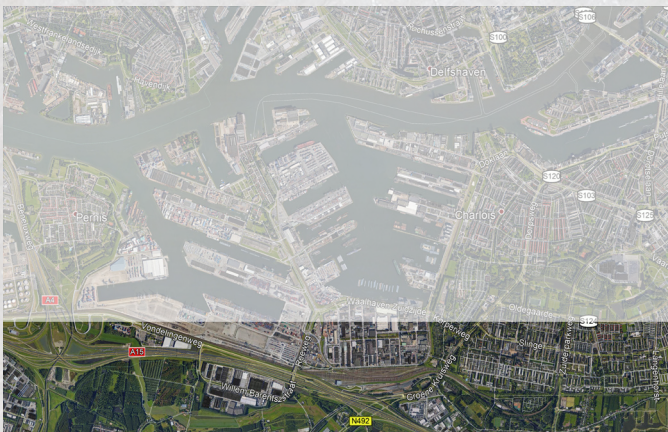


Figure 31. Satellite image of Southern River Side. Retrieved from Google Earth



Figure 32. Type Section of Southern River Side. Retrieved from Landschapelijk Raamwerk - De Rivier als Getijdenpark 2016

Main Features of the Peat Meadow Landscape:

- Ditches that lie in long fans in the landscape.
- Buildings are spread along ribbons in the landscape. Woods and groves have been created on the edges of the polder-Randstad green structure. The pattern of ditches continues up to the river.
- The dike is not a boundary between inner and outer dike, but a thin line under which the polder landscape runs.
- Large parts urbanized.



Figure 33. Type Section of Central River Side. Retrieved from Landschapelijk Raamwerk - De Rivier als Getijdenpark 2016

Main Features of the Landscape - Out of the dikes:

- Construction of harbors and industrial areas in the area outside the dykes.
- About 70% paved with stone embankments and quays.
- Ground level of the banks is about 4 meters above sea level- Due to accretion and port activities.
- Mostly urbanized.



Figure 34. Type Section of Southern River Side. Retrieved from Landschapelijk Raamwerk - De Rivier als Getijdenpark 2016

Main Features of the Sea Clay Landscape:

- Ring-shaped polders.
- Dikes are often planted with trees such as ash, poplars and willow trees.
- Zones of the ring dikes outside the dikes grew- accretion.
- The dike forms the boundary between the inner and outer dike.
- Largely urbanized areas.

TIDAL NATURE IN THE CITY

The environmental factors for tidal nature differ from place to place. The various types of environment offer access to a broad range of ecosystems. The tidal area and, thus, the waves are much larger near the water, causing a different impact on subsidence. The salt water eventually shifts in brackish water on the western river bank near the shore. Further east, this transforms into a freshwater coastal plain.



■ Salt water
■ Fresh (Sweet) water

Figure 35. The map shows the Quality of the Maas river water.

Gradients with various plants develop in multiple environments based on the water salinity rates and the tidal grades. The result is the formation of a **gradient-rich habitats, protected zones** for fish and birds to thrive. Species reside in this kind of tidal areas according to their proximity and accessibility. Therefore, the range of species as bugs, fishes, and birds continuously differs.

The tidal parks are located in the Maas river alluvial plains so the tides can be seen there. Nevertheless, since the tidal river runs across a lowland region of peat/lakebed/ sea clay polders underneath the water level, spatial interaction between city environments and the Maas river is usually hard to achieve. In most situations, there must be **visual communication** with the water and/or the tidal river green areas in order for it to be expected to be integrated into the metropolitan system. Apart from that, each site requires a **unique connection** in order to respond to the 'genius loci' of the location.

A tidal park provides conditions to regenerate, improve natural assets along the river where high/low tides are successful and tidal habitats have decreased due to urban growth. A **gradual landscape** can be formed, allowing for the increase of various ecosystems. The results is the enhancement of the river's value longitudinally along the water as a migration path for fishes, birds, and other species

which seek for nutrient-rich sites or places to nest (Gemeente Rotterdam, 2018).

The tidal parks should be regarded as an action of improvement in Rotterdam's green life and work conditions. The need for accessible green is particularly strong in the centre of the city, where new increases of density are taking place.

The correct environments should promote the growth of tidal nature, allowing various gradients and ecosystems to evolve.

For example, in the case of a tidal channel, where varying water changes affect the flood zones, urban design can incentivize gradients from wet to dry.

Spring tides represent also other phenomena to take into account, besides high and low tides. When spring tides occur, the contrast between high and low water is the more visible and biggest. In that case, the high and low water levels are more than their usual ones.

Small interventions can mean the difference between a submerged environment and another which is not, resulting in a multitude of different ecosystems. Typologies of design strategies can be raising hills or reducing, reinforcing barriers and breakwaters. Material deposition is visible inside river curves, while corrosion is quite evident outside river ones.

For example, the Maashaven Tidal Park is a big scale plan. It represents a chance to develop an urban park of leisure value for the Southern river side's nearby suburban areas. In detail, the project constitutes a recreational open space with some parks and green areas along the water.



Figure 36. Personal vision of the Maashaven Tidal Park: the area results regenerated by the introduction of vegetation, also aimed at the depletion of water, soil and air at the site.

TYOLOGIES AND FEATURES OF THE RIVER BANKS

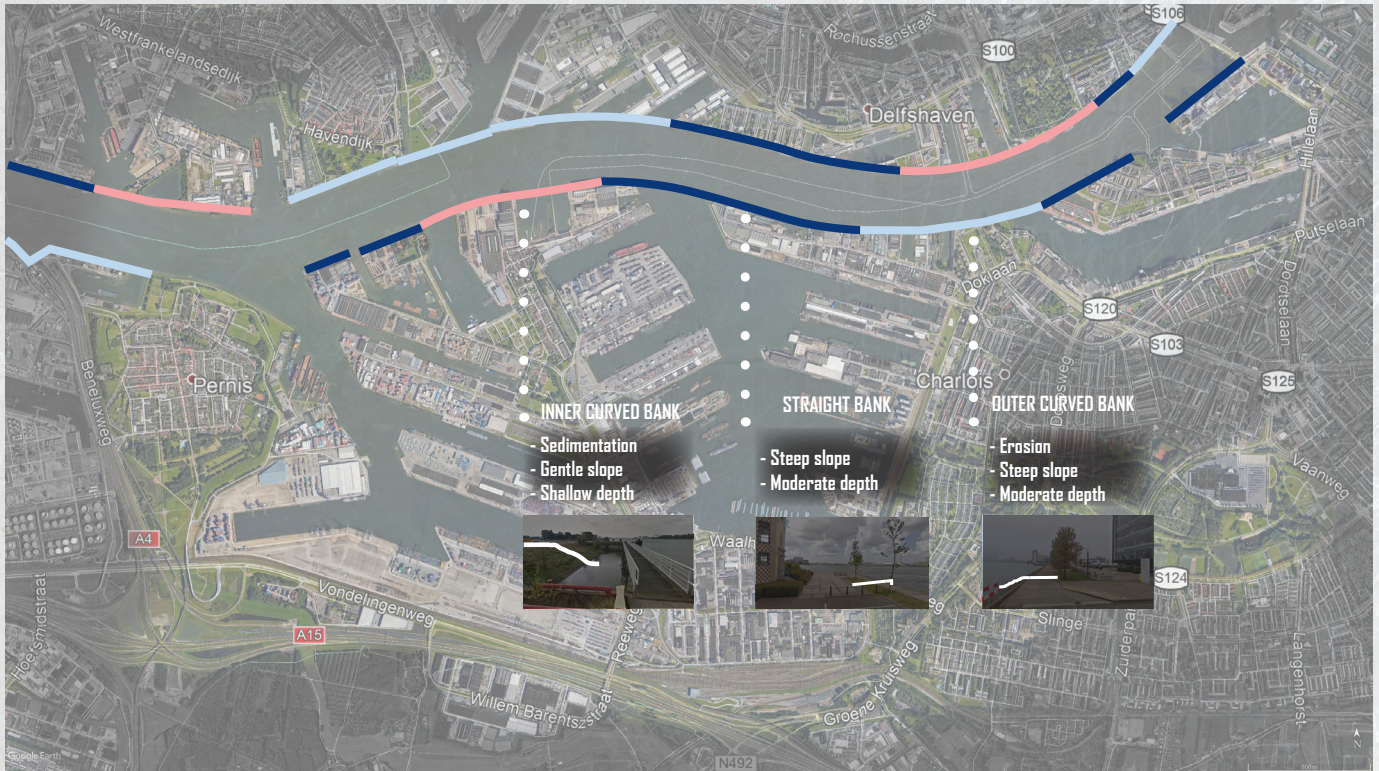


Figure 37. Three Different typologies of river banks along the Maas river: Inner curved, Straight, Outer curved.

The Northern and Southern banks along the river Maas differ under many aspects.

In particular, it is possible to identify three main typologies with their own features : Inner curved, Straight, Outer curved.

In the first type, clear signs of sedimentation appear, on a gentle slope. The depth of the bank is quite shallow.

In the second case, the bank is very slope and squared. The shape is barely nature-like. Its depth is quite moderate.

In the third typology, the embankment presents signs of erosion on a steep slope. Its depth is moderate.

In Rotterdam the river banks can be design elements where it is possible to create vegetation gradients in order to link the dike and the river, reinforcing their stability (Gemeente Rotterdam 2018).

As the harbours are situated in the middle of the river and the city, the dike is placed much more downstream upon the Southern river edge. In most cases, the dike is slowed down from the sea. This is aimed to create easily accessible, one-of-a-kind locations near the river or in harbour inlets.

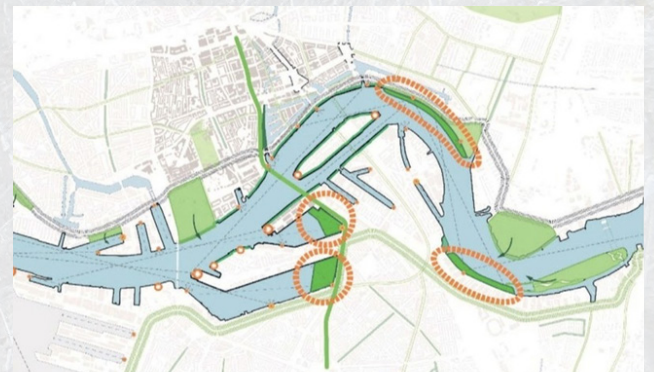


Figure 38. Creation of future green river banks along the Maas river Retrieved from Visie Openbare Ruimte 2019 - 2029 Rotterdam



Figure 39. Vision of green river banks along the Maas river Retrieved from Visie Openbare Ruimte 2019 - 2029 Rotterdam

THE DEVELOPMENT OF WAALHAVEN AREA THROUGH TIME

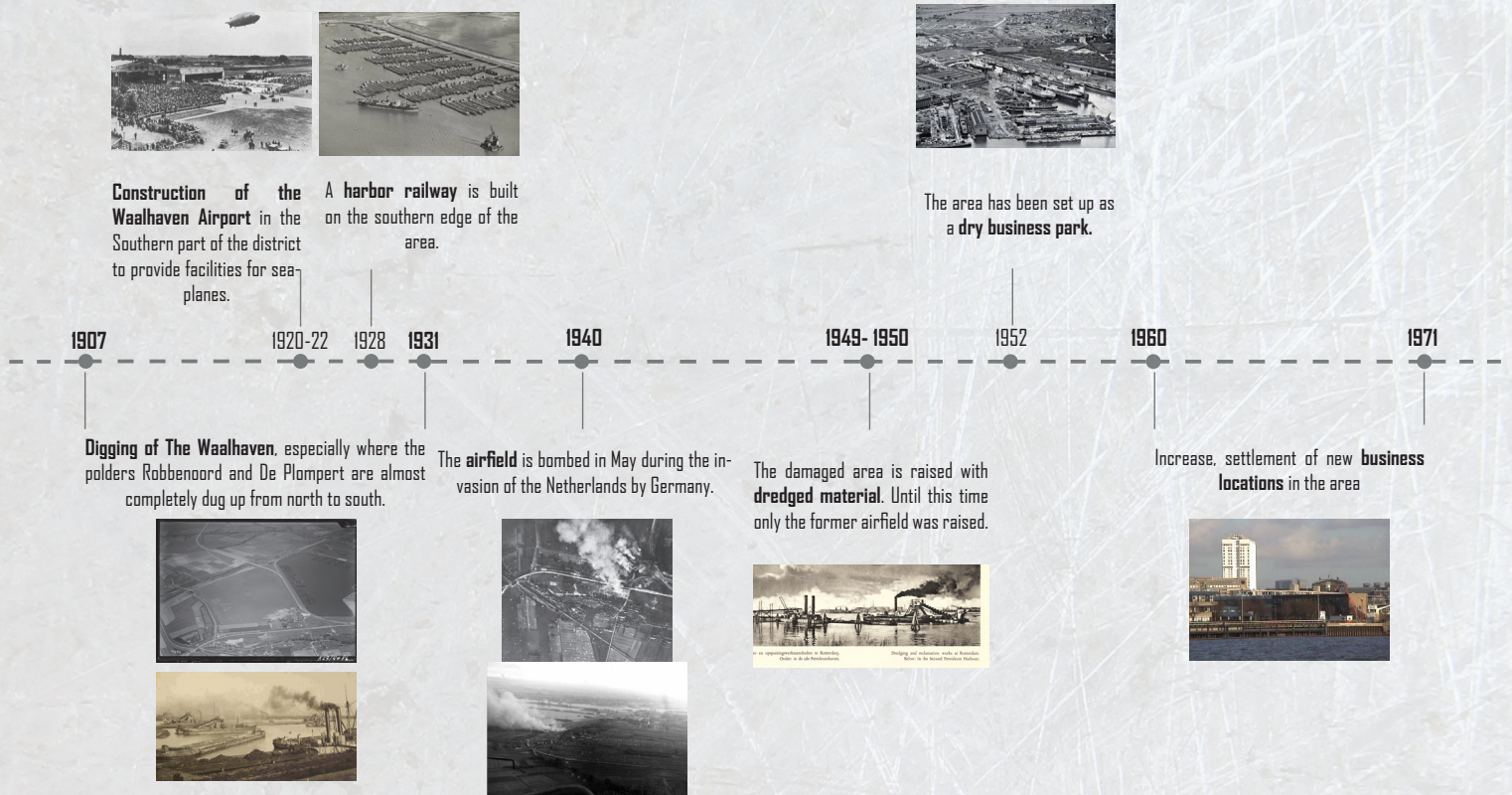


Figure 40. Historical Images of Waalhaven and surroundings.

Retrieved from: https://nl.wikipedia.org/wiki/Vliegveld_Waalhaven
<https://www.heijplaat.com/2020/05/28/waalhaven/>
<https://www.dredgepoint.org/dredging-database/equipment/historical-works-netherlands-part-2>

The Waalhaven was excavated from 1907 to 1931, with the polders Robbenoord and De Plompert nearly entirely excavated from north to south.

The Waalhaven Airport was built between 1920 and 1922. This is the southern portion of the Waalhaven, which was extensively dug out to provide accommodation for float planes and flying boats.

The Kool airplane building company, which constructs light air cargo planes, was founded at the airbase. In 1928, the port railroad was built on the area's Southern outskirts. Its airbase was destroyed during Germany's invasion of the Netherlands in May 1940. Then the allies attacked the airbase.

There were attempts to rebuild the airbase after the war, but due to extensive war destructions and insufficient land for landing, the project fell into disrepair.

In the period between 1949 and 1950, dredged matter was used to lift the field. From the analysis of some historic maps, just the old airbase has been elevated in the first stage of increasing (till 1950). The area has been designated as a 'dry business park' since the mid-Fifties. The majority of business areas were created, particularly towards the end of the Sixties.

The property is situated in an old polder field. First, soil was raised that had been released during the digging of the Waalhaven, and then the airport was built by 1922.

TRACES OF THE PAST IN WAALHAVEN AREA

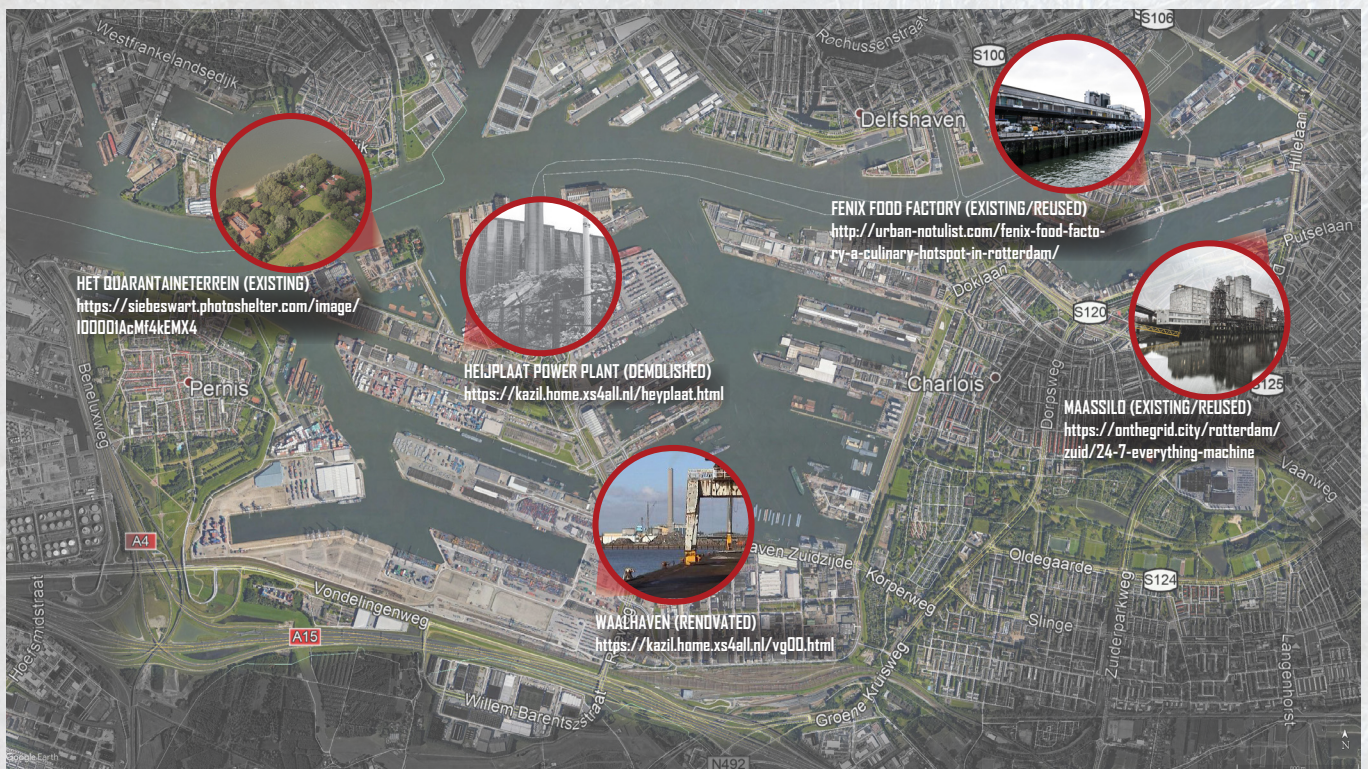


Figure 41. Historic structures (demolished / replaced / unused) in Waalhaven area

From an analysis of the historical structures at the site, a diversity of periods and conditions can be observed. Some have been demolished (e.g. Heijplaat Power Plant), others replaced (e.g. Waalhaven South) or still existing and reused (e.g. Maassilo; Fenix Food Factory).

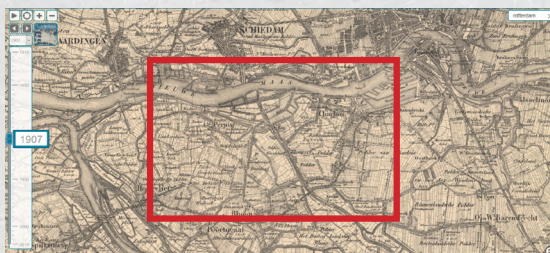
A GRADUAL FRACTURE OVER TIME BETWEEN THE PORT AND THE CITY



1815



1900



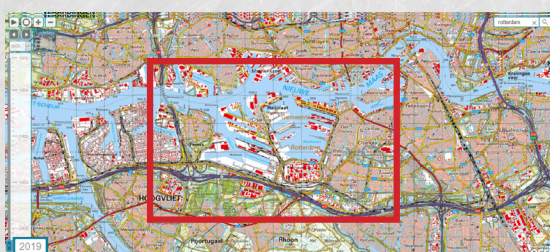
1907



1950



2000



2019

Starting in 1950, there were two very decisive phenomena for the port of Rotterdam: **Containerization** and the **Technological Revolution**.

As the containers required more and more space to occupy and the ships deeper water to moor, the construction of port extensions outside the city center was established. Therefore, the port and the city began to gradually separate and vast lands were left deserted awaiting new urban uses.

Figure 42. Historical images of Waalhaven area.
Retrieved from <https://www.topotijdreis.nl/>

PLAN “STADHAVENS”: A WAY OF RECONNECTING THE PORT AND THE CITY

Throughout the time, the harbour has gradually distanced itself from the rest of the city. At the moment it is searching for a way of interaction with the city. The harbour and local officials have collaborated on a project known as the “Stadshavens plan”.

This initiative, which began in 2002, is an indication of how the direction to port-city interactions is evolving (Daamen and Vries, 2013). The plan is part of a second phase of waterfront revitalization. The initiative is about more than just getting the port back to the urban area; it also regards the cooperation of the harbour and city officials in exchanging thoughts and shared goals (Aarts, Daamen, Huijs and Vries, 2012).

Stadshavens Rotterdam spans 1600 hectares, and the plan aims to make this region the most revolutionary and artistic global center. Companies would connect the harbour (logistics and shipping sector) with the nearby residential and education systems.

Stadshavens is an area in current development for short-term (2015), medium-term (2025), and long-term (2040) initiatives (City of Rotterdam, 2007). This approach describes two major paths for reform. The first choice is for the port to become a future power hub. To achieve that, a significant transition in the energy paradigm must be implemented.

Sustainability is a shared factor that joins the city and the port. The second path envisions a few harbour sites being transformed into commercial areas, including more harbour-linked industrial sectors. Old manufacturing sites would then be repurposed to house new roles and entrepreneurial ventures.

Stadshavens, along with the old dockyard RDM represents the location selected by the municipality and the port authorities to establish a ‘cluster of information and invention services’.

When both of these tactics are integrated, the resulting solution reflects the port’s reintegration into Rotterdam as a one unique system (City of Rotterdam, 2007).

The plan “Stadshavens Rotterdam” addresses four urban smaller sites, each with its own identity and growth forces.

The Waalhaven and Eemhaven areas are going to be a major hub for food (fruits, vegetables), and tank transportation. This location favours the city’s sustainability by encouraging more extensive use of space while also including transit that relies more on both inland and rail links.

Rijnhaven and Maashaven are the zones nearest to the center of Rotterdam in addition to the other areas of the plan.

Eventually, Merwehaven and Vierhaven are expected to be built over the next 30 years. These will become a creative neighborhood where both dwellings, businesses in the energy and resources fields cooperate.

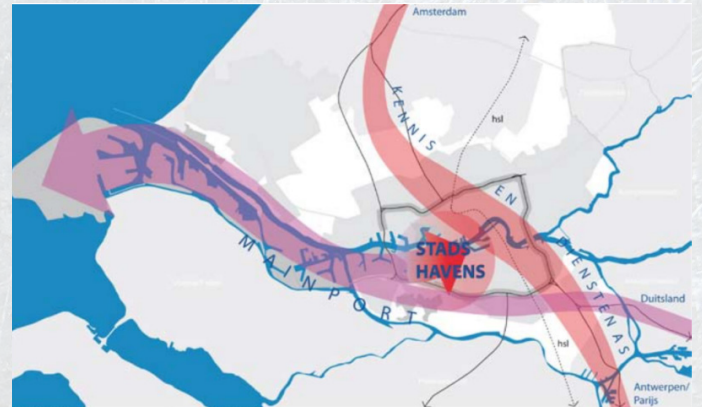


Figure 43. Plan Stadshavens, contextualized on a regional scale. Retrieved from Municipality of Rotterdam, Rotterdam STRUCTURAL VISION on “Plan Stadshavens”. <https://www.cob.nl/wp-content/uploads/2018/01/Structuurvisie-StadshavensRotterdam.pdf>

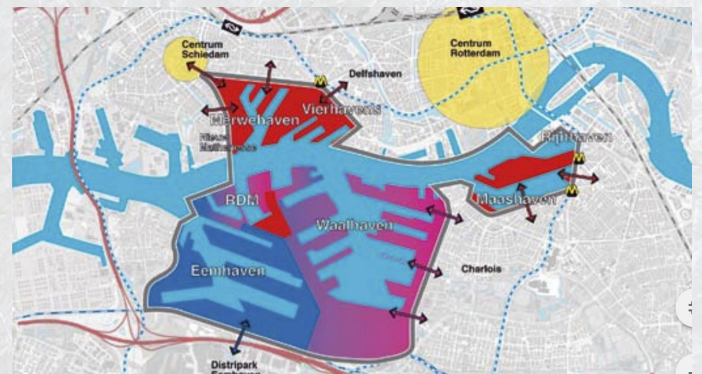


Figure 44. Plan Stadshavens and its links to the surrounding urban areas. Retrieved from <https://www.rotterdam.nl/wonen-leven/stadsvisie/>



Figure 45. Sub-areas belonging to Plan Stadshavens. Retrieved from Municipality of Rotterdam, Rotterdam STRUCTURAL VISION on “Plan Stadshavens”. <https://www.cob.nl/wp-content/uploads/2018/01/Structuurvisie-StadshavensRotterdam.pdf>

FUTURE BUILDING DENSIFICATION AND GREEN URBANIZATION IN ROTTERDAM

Rotterdam is getting denser and popular, 50,000 new houses or more will be needed in the next twenty years. They will be built in open and green areas within the ring road.

On the **East side**, along the A16 to Feyenoord City, 22,000 homes are planned separately. This is mainly at the expense of sports fields, allotments and business parks.

On the **South side** of the Maas, in the future Feyenoord City, another 10,000 homes will be built up.

On the **West side** of the city a neighborhood around the Van Nelle factory and the Schiegevangenis is planned with as many as 5000 homes, including a new metro station 'Spangen'. This is also mainly at the expense of sports fields and allotments.

Regarding **urban mobility**, the car will be less central and there will be more space for cyclists, pedestrians and green spaces. The aim will also be a design that is adaptable to meet the mobility transfer and modifications through the next years. The possibility to cross the avenues will be increased and adapted to any age by constructing further cross links. There will be a search for design innovations and new modes of transportation beside Rotterdam's avenues and roads. (Visie openbare ruimte 2019-2029 Rotterdam).

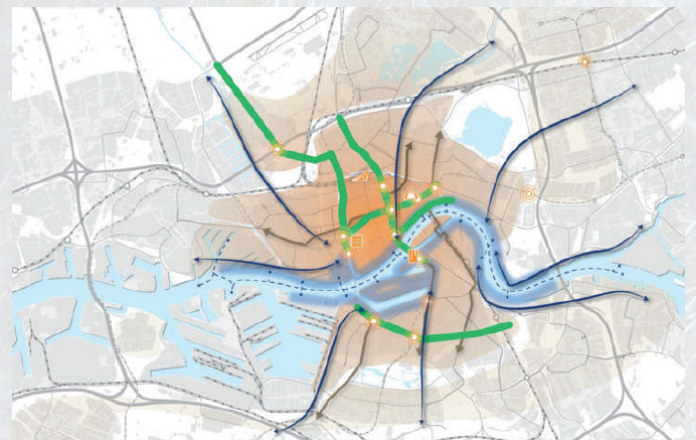


Figure 46. Future Urban Traffic Plan. Improvement of connection between Northern and Southern sides of the city.
Retrieved from Visie openbare ruimte 2019-2029 Rotterdam

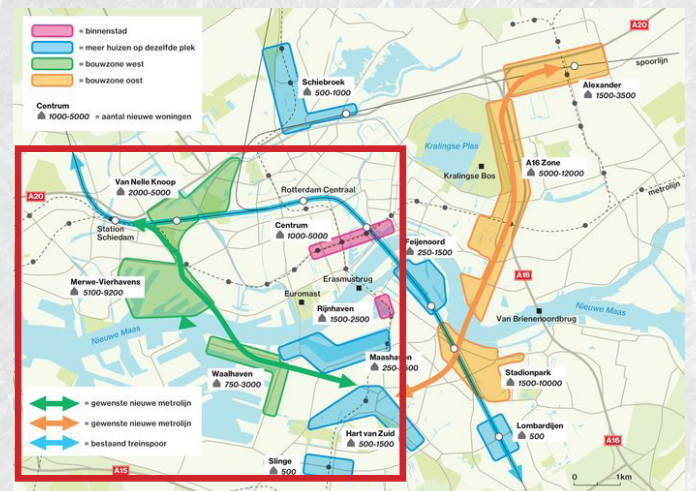


Figure 47. Increase of population in the South of Rotterdam by 2040.
Retrieved from <https://www.ad.nl/rotterdam/hier-gaat-rotterdam-de-komende-jaren-tienduizenden-huizen-bouwen~a990df97/>

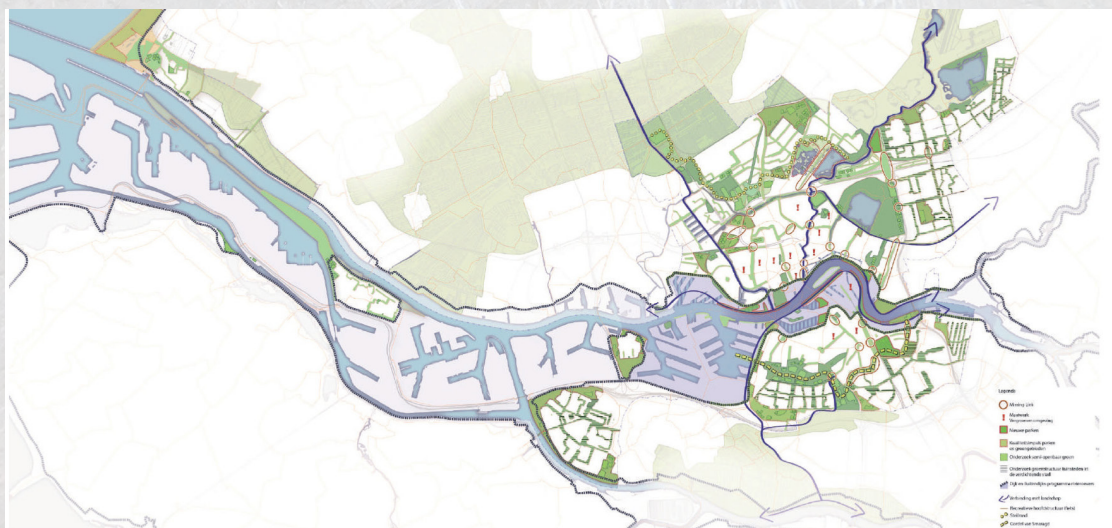


Figure 48. Plan of Future Green Urbanization in Rotterdam.
Retrieved from Visie openbare ruimte 2019-2029 Rotterdam

DENSITY OF GREEN PER NEIGHBOURHOOD

In the Waalhaven area the Density of green per neighbourhood varies: 50% for Parks (dark green) and 10-20% for Low - scarce vegetation (light green).

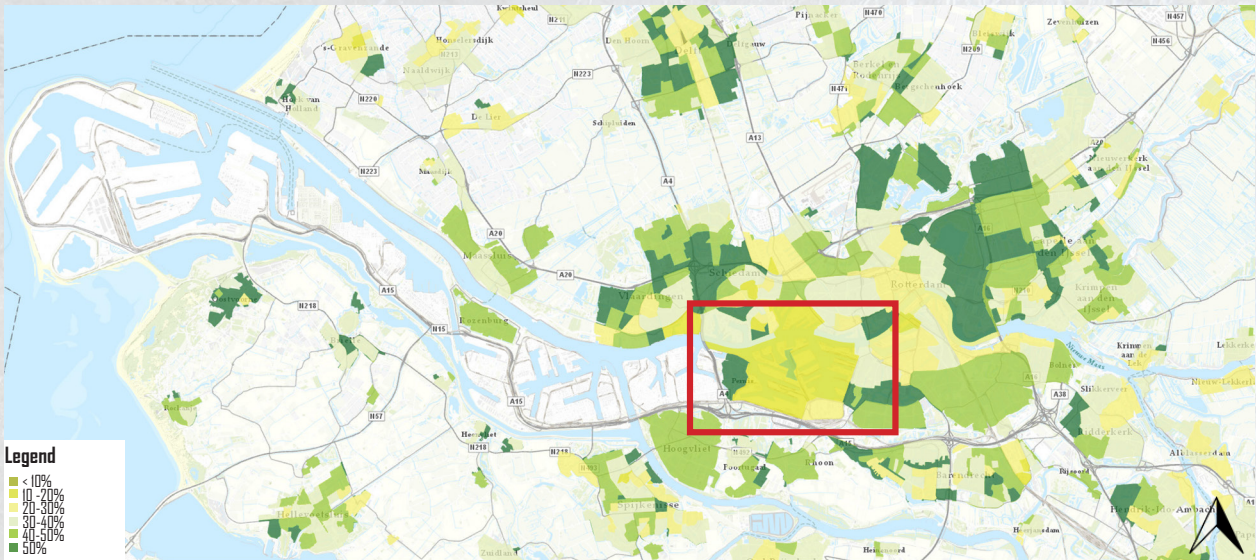


Figure 49. Green per Neighbourhood in Rotterdam.

Retrieved from ArcGIS-Klimaateffectatlas - Hitte <https://arcgis.com/DvGraD>

VALUABLE GREEN AREAS IN WAALHAVEN AREA

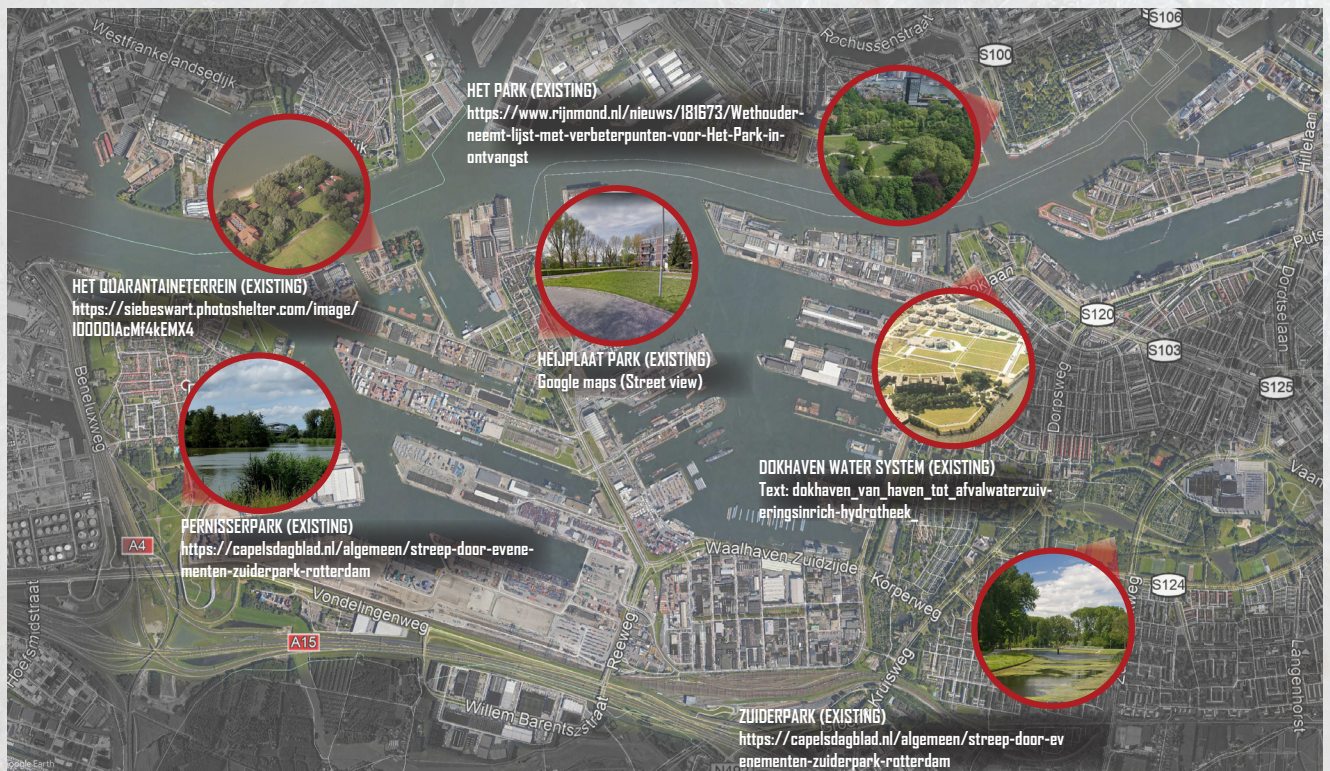


Figure 50. Current green sites whose historical and ecological value is significant in Waalhaven area.

The value of these areas is given by three factors:

- **ECOLOGICAL POTENTIAL** in a highly urbanized area
- **STRATEGIC LOCATION** between the water and the urban areas
- **RELATION, INTEGRATION** with historical structures in the area

WAALHAVEN AREA ANALYSIS : NATURAL /URBAN/ ENVIRONMENTAL LAYERS

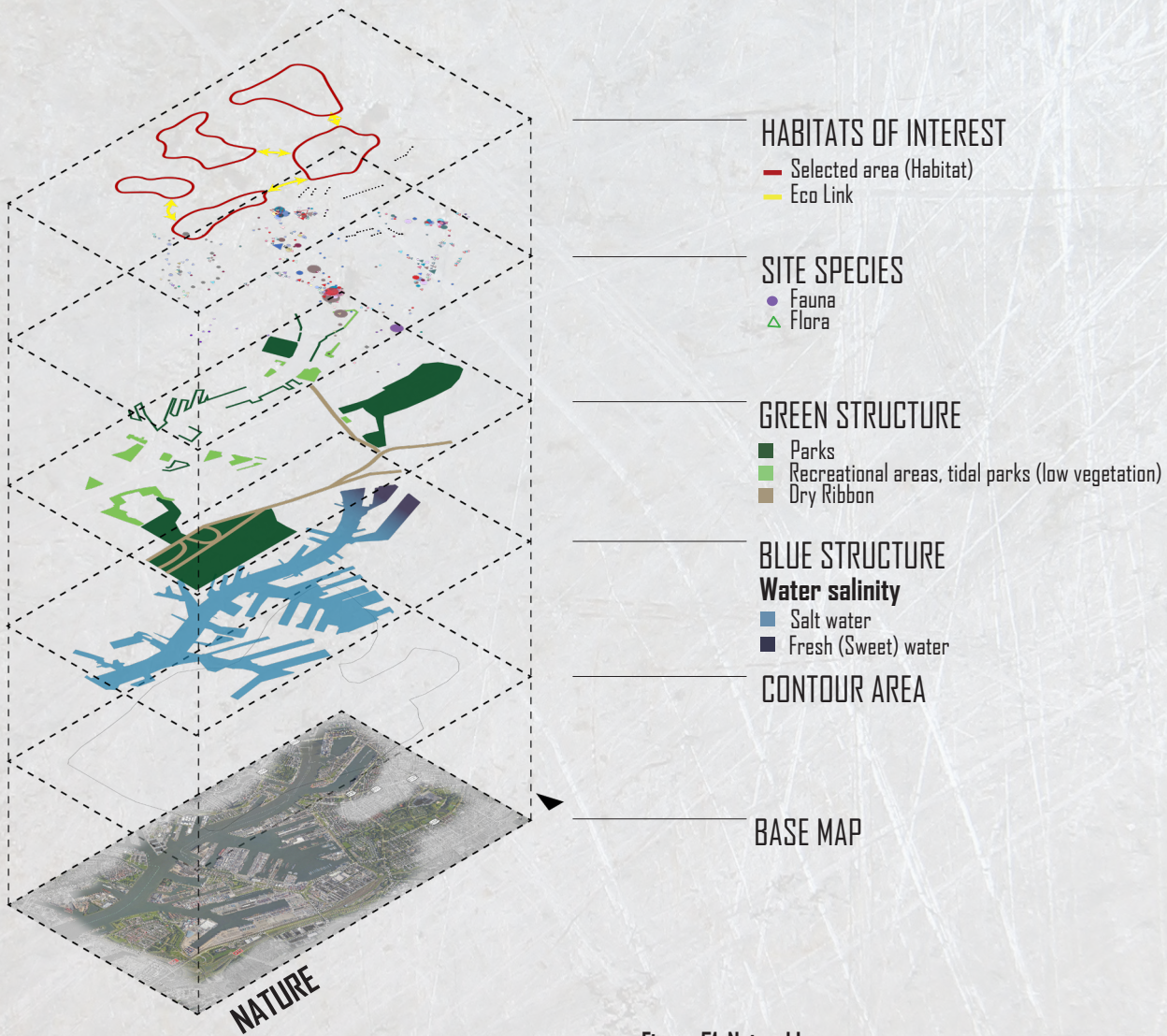
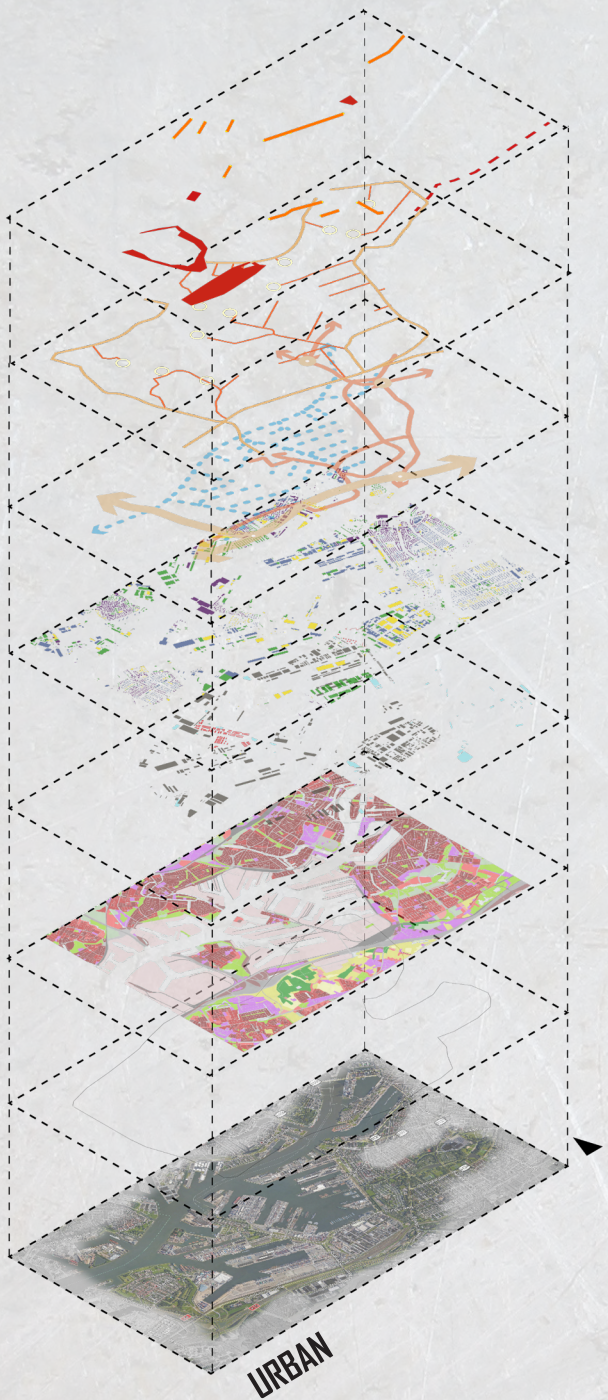


Figure 51. Natural Layers



WASTESCAPES (LANDS, BUILDINGS, INFRASTRUCTURES)

- Disused Railway
- Abandoned Railway
- Land with no Use

ACCESSIBILITY AND VIEWPOINTS

- Paths
- Viewpoints
- Highway

MOBILITY

- Primary Highway
- Secondary Highway
- Waterway

BUILDINGS (BY CONSTRUCTION YEAR)

- 1100 - 1945
- 1945 - 1970
- 1970 - 2000
- 2000 - 2021

BUILDINGS (TYPOLOGIES)

- Port industries
- Residential buildings

LAND USE

Artificial areas, buildings, infrastructures

- | | |
|--------------------------------------------------------------------------------|--------------------------------------------------------|
| ■ Continuous urban fabric | ■ Railways |
| ■ Discontinuous various density urban fabric | ■ Fast transit roads |
| ■ Isolated structures | ■ Other roads |
| ■ Industrial/commercial/public units | ■ Port areas |

CONTOUR AREA

BASE MAP

Figure 52. Urban Layers

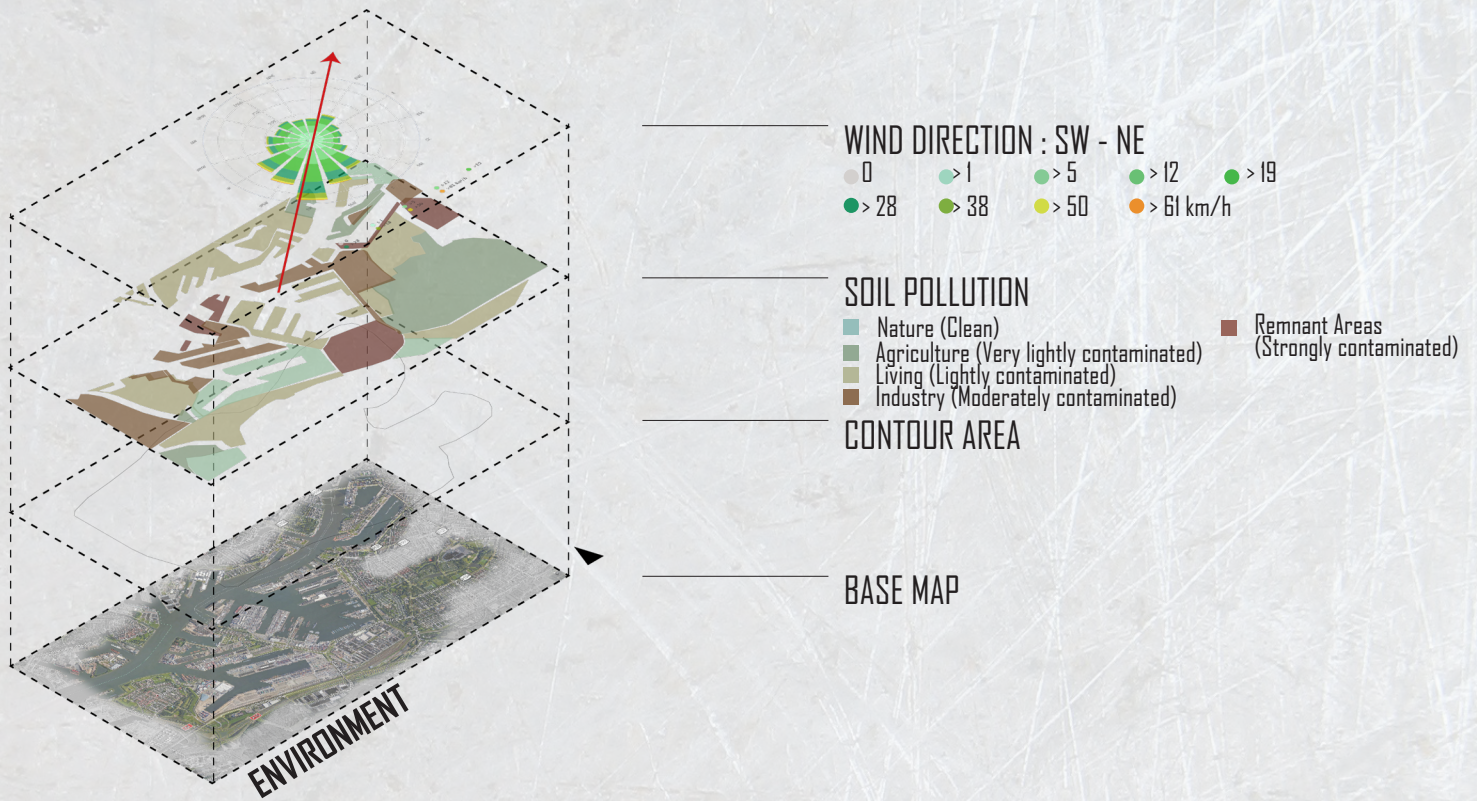


Figure 53. Environmental Layers

CONCLUSION

The analysis of the Waalhaven area under multiple aspects (natural, urban, environmental) led to the formulation of the following statements:

- The quality of the urban space varies according to the land use. Near the port, Vegetation and Biodiversity appear fragmented, concentrated in some punctual areas. Some of them are easily accessible, others not.
- The most urbanized areas in and around Waalhaven present high concentrations of mapped species. This is because of the presence of built structures which can represent a shelter for nature to thrive.
- Due to a strong urbanization, the presence of historical port structures is almost nil. In fact, most of them have been replaced by other, more advanced and modern structures.
- The application of a strategy of reuse of structures and abandoned lands can lead to the establishment of a circular system consisting of connected elements of Water, Vegetation and Buildings. Each of them can be essential to the improvement of the others. To achieve this goal, urban planning of the designers, the commitment of the city, its inhabitants and the port authority are strongly necessary.

WASTESCAPES AROUND WAALHAVEN AREA

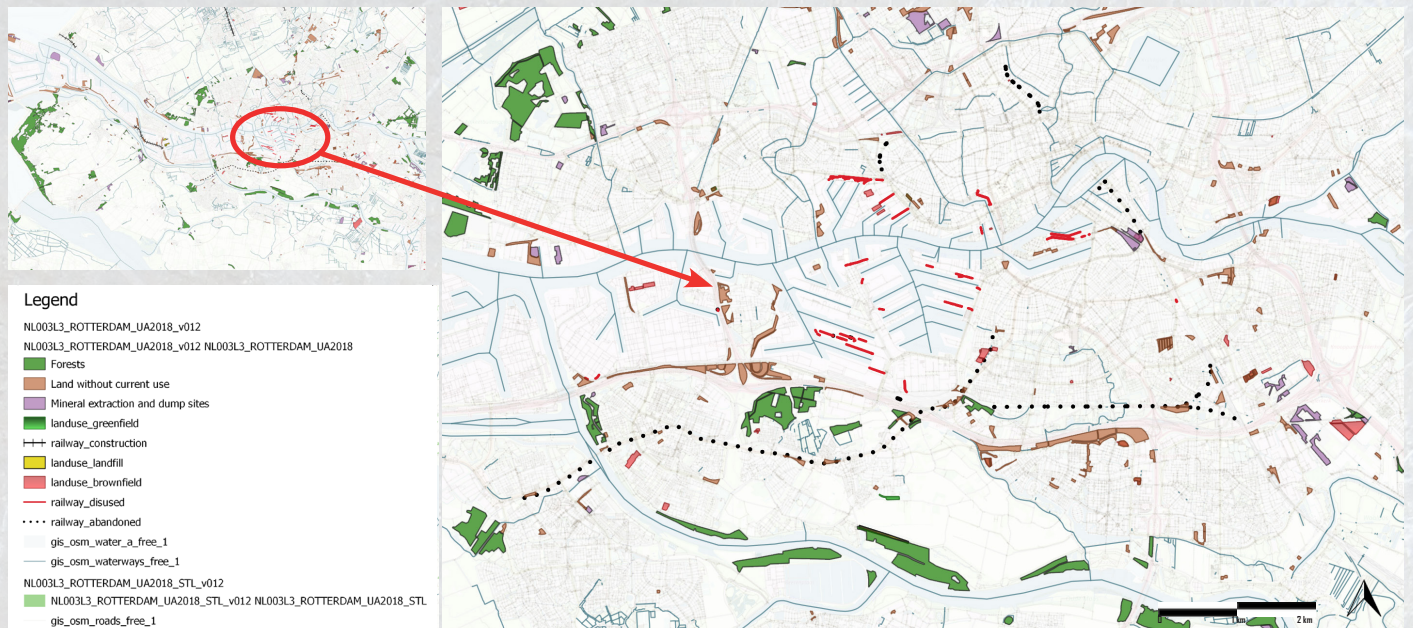


Figure 54. Map showing wasted areas and infrastructures around the area of Waalhaven.

WASTESCAPES IN WAALHAVEN AREA

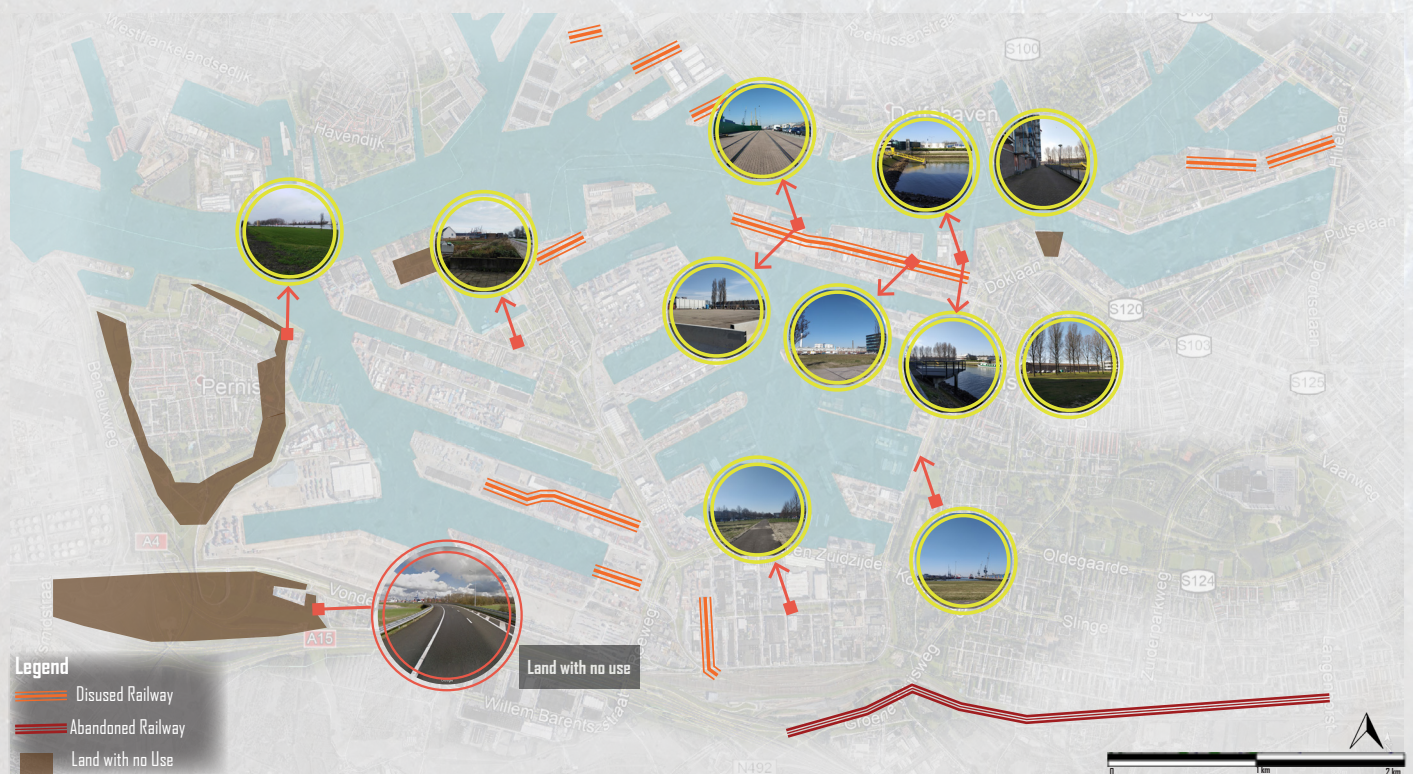


Figure 55. Map showing wasted areas and infrastructures in the area of Waalhaven.

The selection of these areas is given by these criteria :

- **EMPTYNESS** of people and carried out activities
- **LOW, NEGLECTED VEGETATION**
- **NO RELATION, INTEGRATION** with the surrounding spaces, buildings
- **DISUSE** either if new or old spaces, structures (railway, water taxi stop)

SELECTION OF WASTESCAPE SITE CONDITIONS

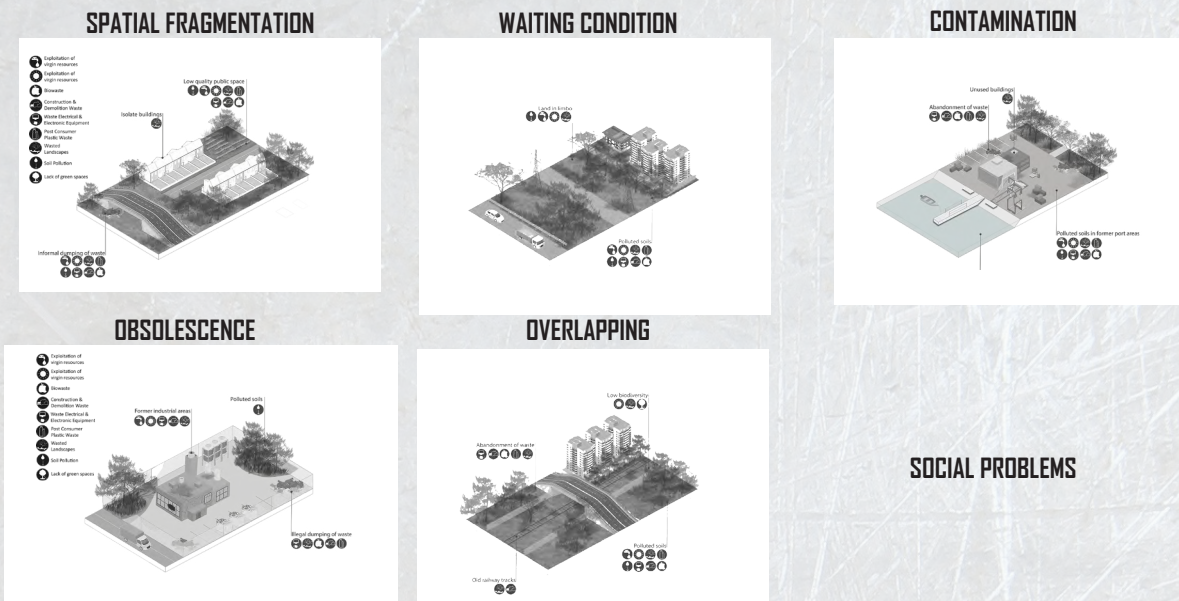


Figure 56. Selected cases of Wastescape Site conditions, recognizable in Waalhaven area.

Retrieved from Amenta, L., (2019), Beyond WASTESCAPES: Opportunities for sustainable urban and territorial regenerations.

In the project area it is possible to identify six types of wastescapes conditions: Spatial Fragmentation, Waiting Condition, Contamination, Obsolescence, Overlapping and Social Problems. All these site conditions can be identified via the observation of the lands, buildings, infrastructures.

SPATIAL QUALITY IN WAALHAVEN AREA

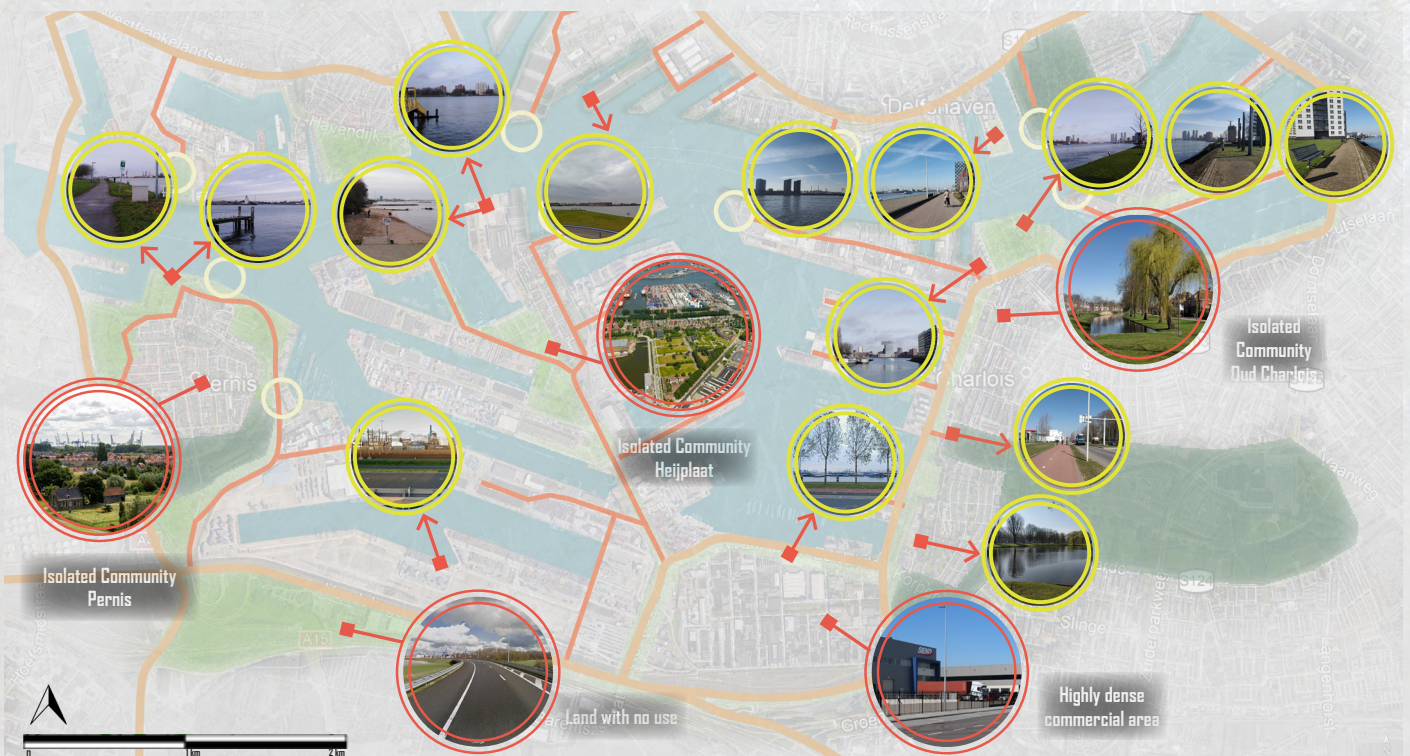


Figure 57. Analysis of the Spatial Quality in the Waalhaven area via site visits by bike

In waalhaven area, 5 main significant areas can be identified where the quality of green and residential spaces is various. In fact, these areas are isolated, disconnected from the others due to infrastructures such as highways or port facilities.

The waterfront appears accessible in some sections and obstructed in others, thus determining a different quality of the port space.

WASTESCAPES AND SOIL POLLUTION AROUND WAALHAVEN AREA

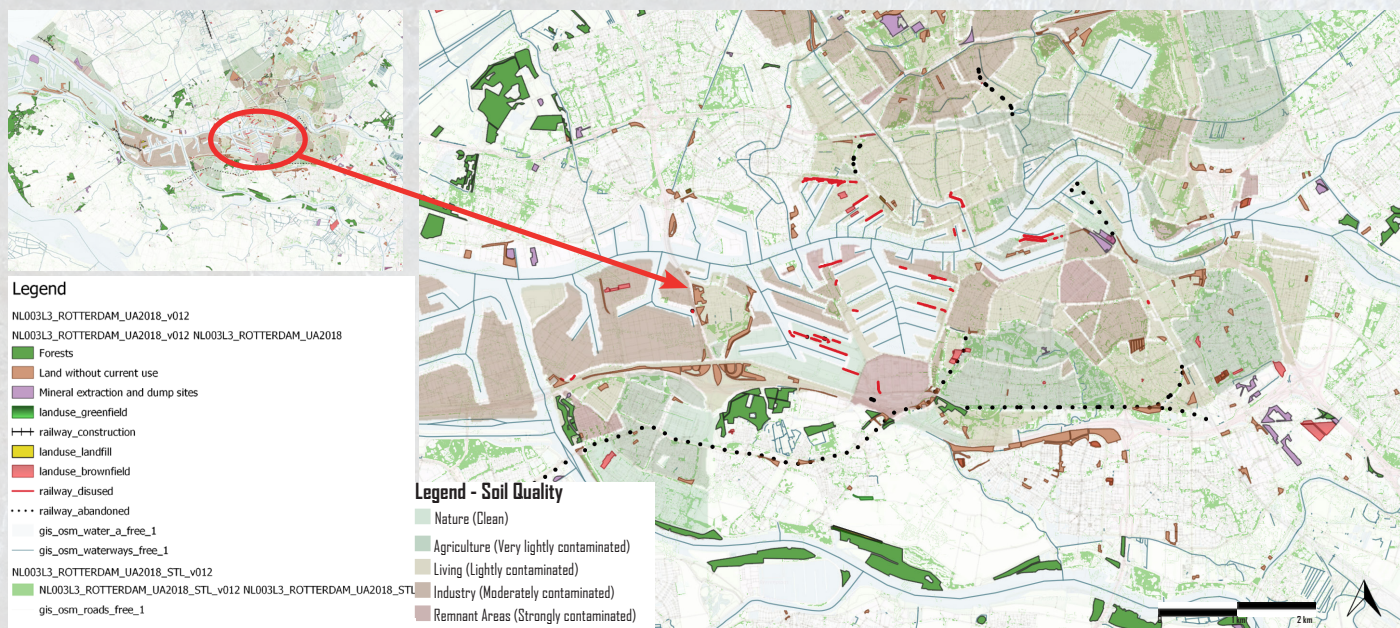


Figure 58. Map showing wasted areas, infrastructures and soil pollution around the area of Waalhaven.

SOIL POLLUTION IN WAALHAVEN AREA



Figure 59. Map showing Soil Pollutants in Waalhaven area. The most frequent ones are Zn, Ba. In second place, Cu and Mineral Oils.

In 1949-1950 and 1952-1971: the contaminated dredge in Waalhaven area was used to increase the level of the area with maintenance dredging from the city ports and 1st, 2nd Petroleumhaven.

The quality of the dredging was class I, II, III and IV (slightly to heavily contaminated). The dredged material now is in development into a business park covered with a layer of sand of unknown origin. The upper 0,5-1m of soil is undefined but it mostly presents the same contaminants (OIL and HEAVY METALS as Cu/Pb/Zn etc).

BIODIVERSITY IN WAALHAVEN AREA



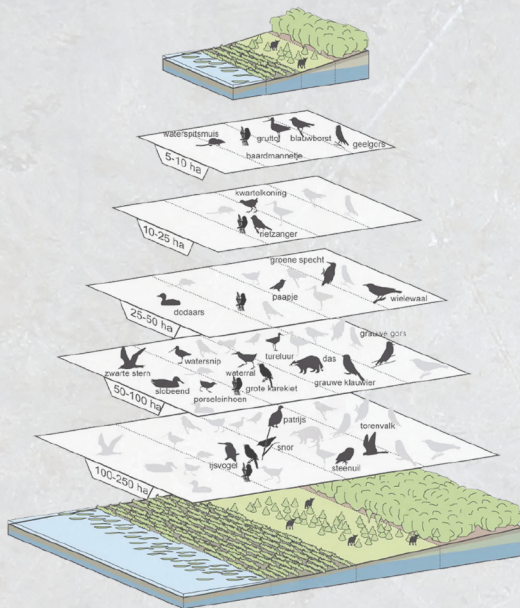
Figure 60. Map showing mapped species (Flora/Fauna) in the area of Waalhaven.



Figure 61. Map showing selected Red List species (Fauna) in the area of Waalhaven

After the mapping of various species (Flora/Fauna) in the Waalhaven area, an individuation of areas of interest has been done. Subsequently, there has been a selection of species which were included in the Red list of species to be protected and safeguarded.

SPECIES AND THEIR RELATED HABITAT



Depending on a particular habitat, there are specific species that belong to it. The **EXTENT** of the ecosystem is also relevant since if an area is large, it can accommodate more species rather than if it were small.

The type of plants, soil and environmental conditions of a space are also other factors that affect the attractiveness of some species in a place.

In particular, a vegetation gradient is a structure that allows to accommodate multiple species as needed, thanks to the variability of the **HEIGHT** of the vegetation. In fact, some prefer poorly lit and dense spaces such as forests (e.g. bats), while others prefer open and bright spaces (e.g. rabbits).

Figure 62. Axonometric scheme which shows the relationship between an habitat and the species that live in it. Retrieved from Jansen, Sjeff. "Introduction on Ecology". 10 March 2021, Online Lecture.

TYPOLOGIES OF GRADIENT

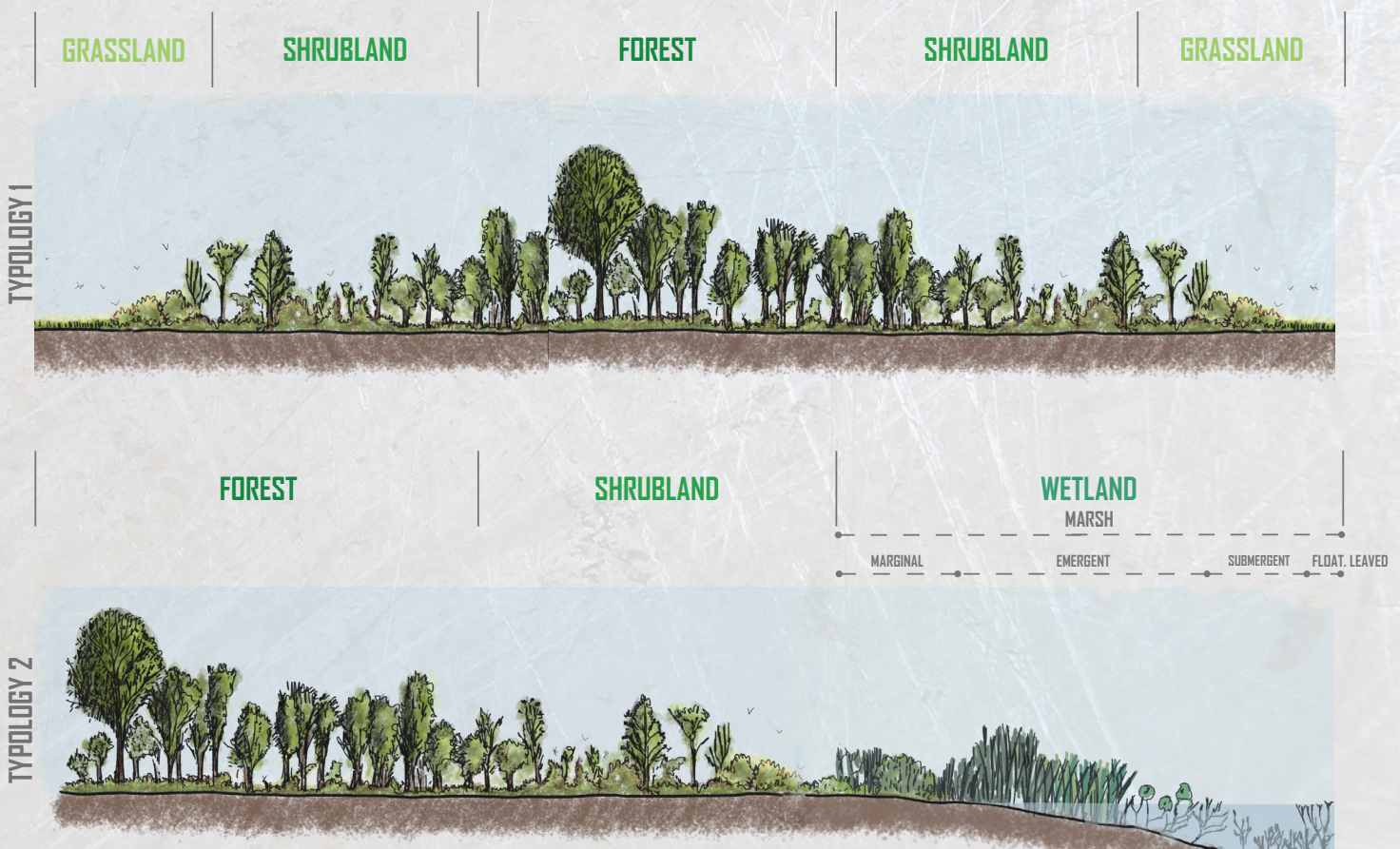


Figure 63. Sections of two different typologies of gradient, according to the disposition and the height of vegetation : 1) CLIMAX and 2) DESCENT.

SELECTED SPECIES (FLORA/FAUNA) IN WAALHAVEN AREA

Legend

FLORA - Plants against pollution, tolerant to wind, idoneous for sandy/loamy soils

Forest:

- 1. Quercus Robur
- 2. Salix Nigra
- 3. Populus x canescens

Shrubland:

- 4. Taxus baccata
- 5. Crataegus monogyna
- 6. Berberis vulgaris
- 7. Amelanchier rotundifolia
- 8. Rosa canina
- 9. Salix nigra

Grassland:

- 10. Helianthus rigidus
- 11. Brassica Juncea
- 12. Typha angustifolia
- 13. Phragmites australis
- 14. Lythrum salicaria
- 15. Hypericum calycinum
- 16. Phalaris arundinacea
- 17. Chrysopogon zizanioides

Wetland:

- (Underwater plants)
- 18. Ranunculus aquatilis
- 19. Hottonia Palustris
- 20. Callitriche palustris
- 21. Elodea canadensis

(Plants with floating leaves)

- 22. Eichhornia crassipes
- 23. Patamogeton natans
- 24. Polygonum amphibium
- 25. Phragmites australis

(Floating plants)

- 26. Stratiotes aloides
- 27. Ceratophyllum demersum

FAUNA - Target species (endangered)

- 29. Rabbit - *Oryctolagus cuniculus*
- 30. EU Eel - *Anguilla anguilla*
- 31. Bone - *Platichthys flesus*
- 32. Carp - *Cyprinus carpio*
- 33. Common Coot - *Fulica atra*
- 34. Meadow Pipit - *Anthus pratensis*
- 35. Bumble bee - *Bombus*
- 36. Redwing - *Turdus iliacus*
- 37. Noctule bat - *Nyctalus noctula*



Figure 64. Scheme of Selected species (Flora/Fauna) in Waalhaven area, divided according the different grades of possible habitats. Moreover, the selected vegetation have also properties of environmental purification.

TYPOLOGIES OF GRADIENT WITH SOME SELECTED SPECIES

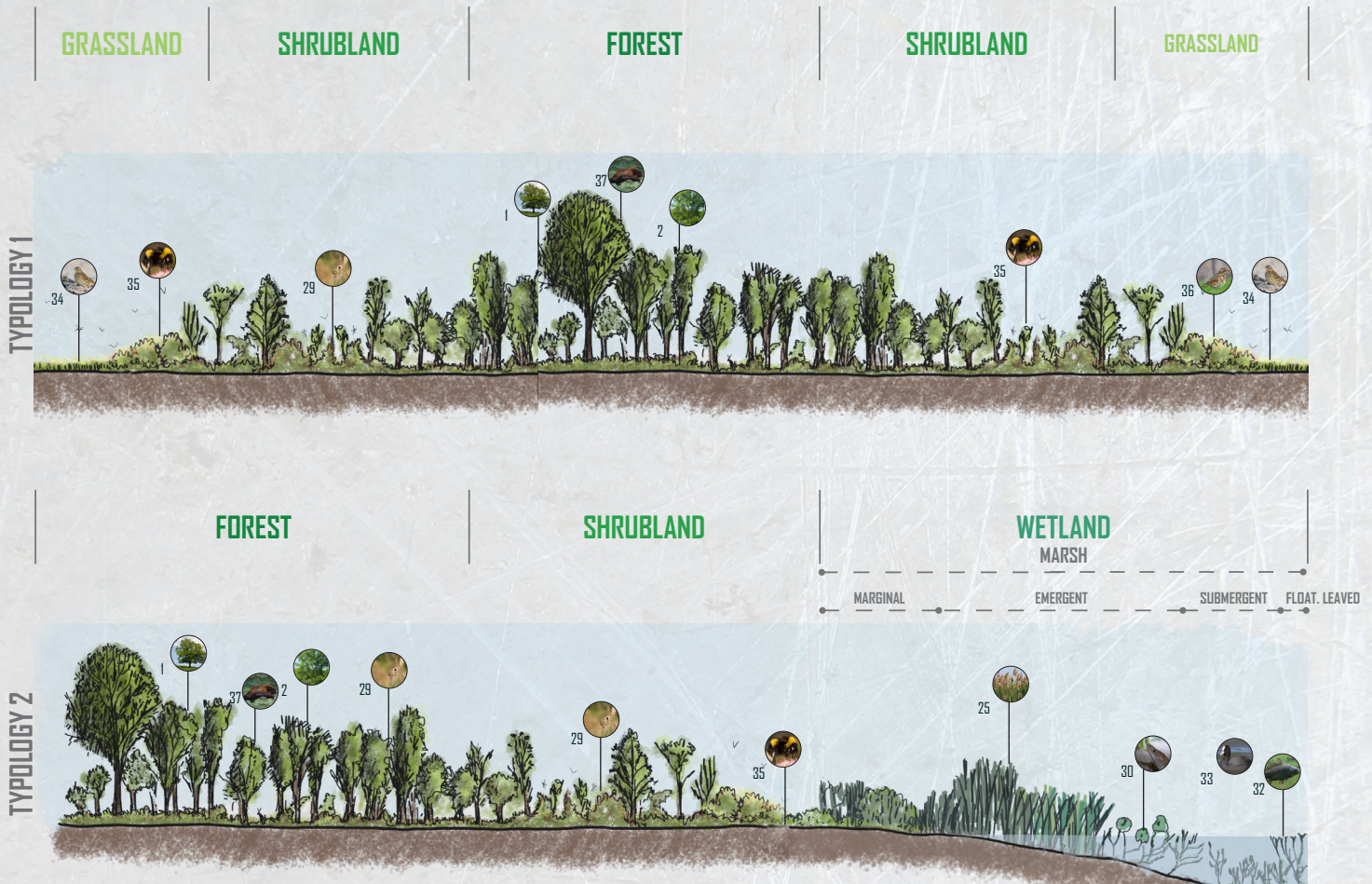
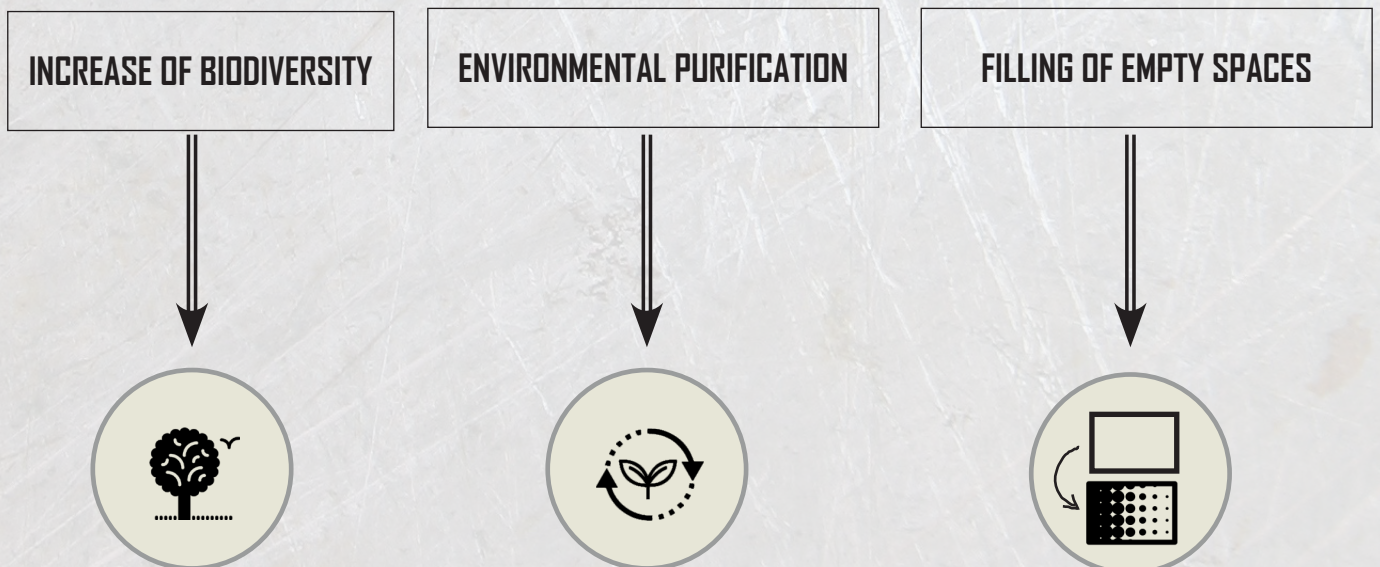


Figure 65. Sections of two different typologies of gradient: 1) CLIMAX and 2) DESCENT, showing the possible selected thriving species.

POTENTIAL OF A VEGETATION GRADIENT IN A CITY



DESIGN

DESIGN FRAMEWORK

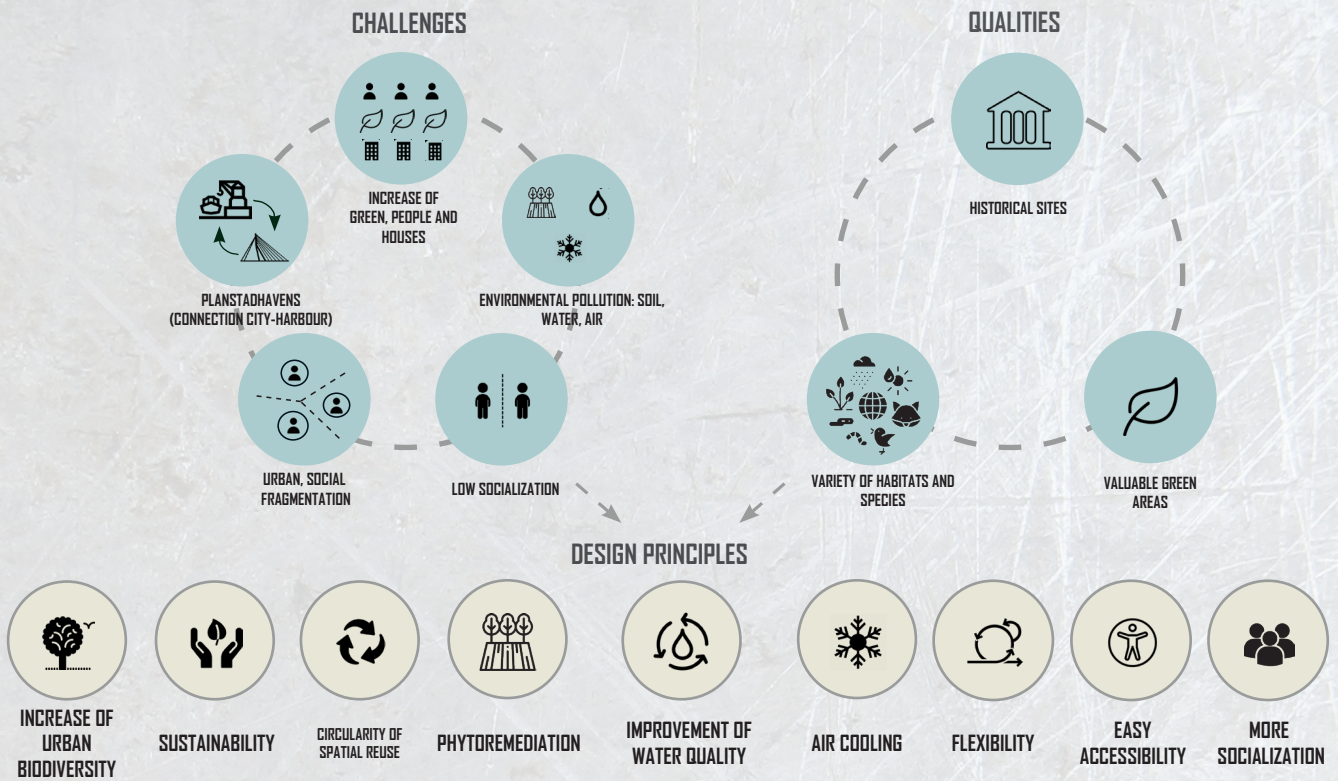


Figure 66. Diagram illustrating the factors (challenges and qualities) that led to the formation of Design principles for the site intervention.

CONCEPT MASTERPLAN - WAALHAVEN AREA



Figure 67. Design concept prior to the definitive plan: connection of separate areas by vegetation (trees, parks) with improvement of spatial accessibility .

SOIL MAP WITH SITE INTERVENTIONS BY DESIGN ECO-COMPONENTS

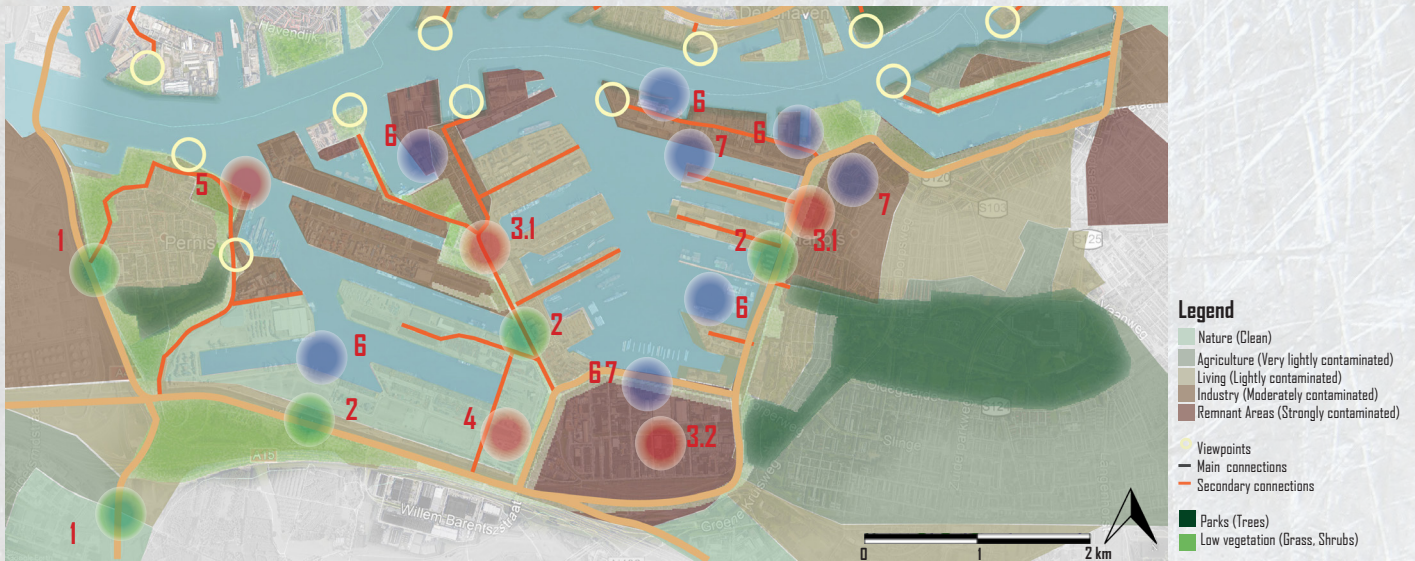
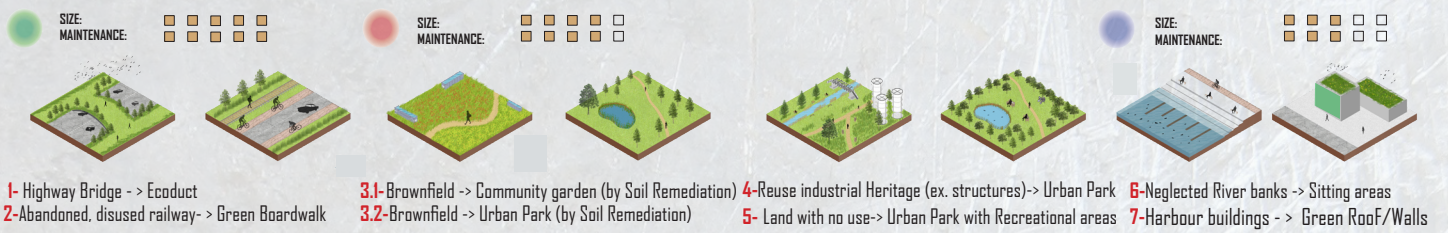


Figure 68. Soil Map illustrating the site interventions by the introduction of the design eco-components, divided per size and maintenance requirements.

DESIGN ECO-INTERVENTIONS ON SITE IN WAALHAVEN AREA

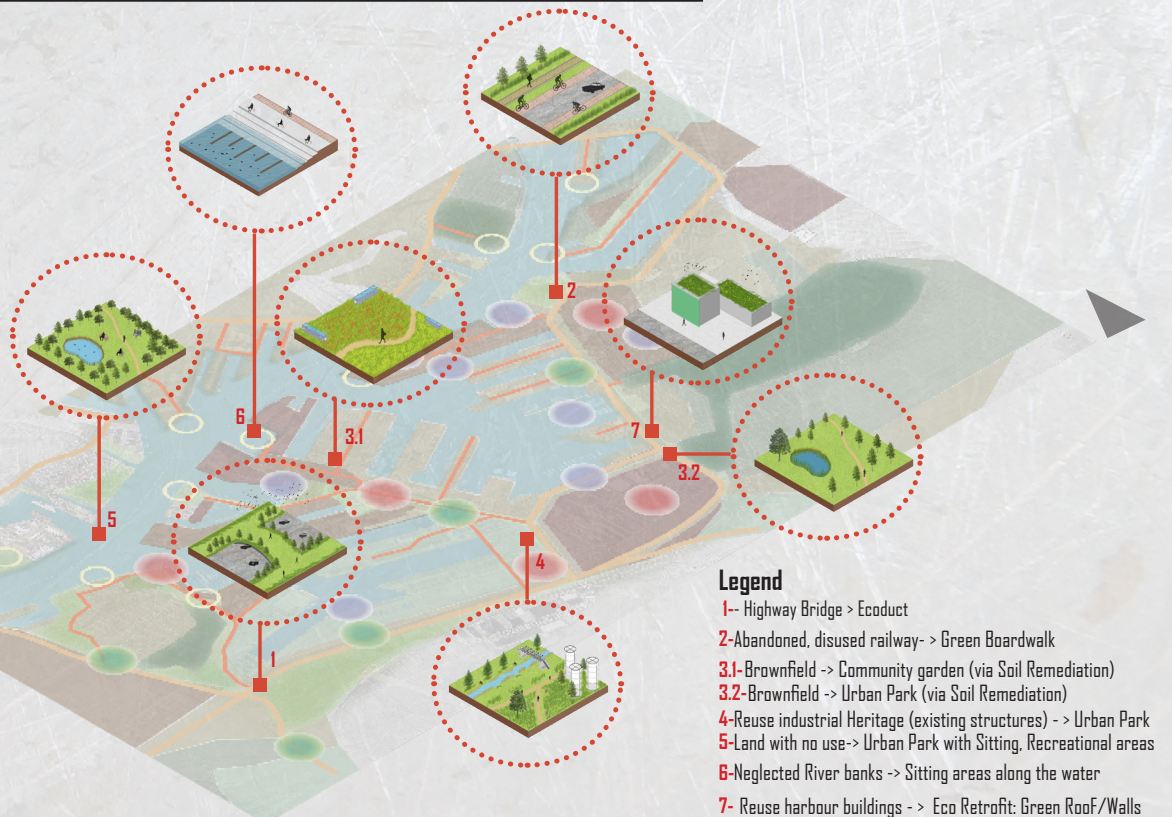


Figure 69. Axonometric drawing visually showing the site interventions on the chosen locations in Waalhaven area.

TIMEFRAME OF DESIGN ECO-INTERVENTIONS IN WAALHAVEN (TIME SPAN: 50 YEARS)

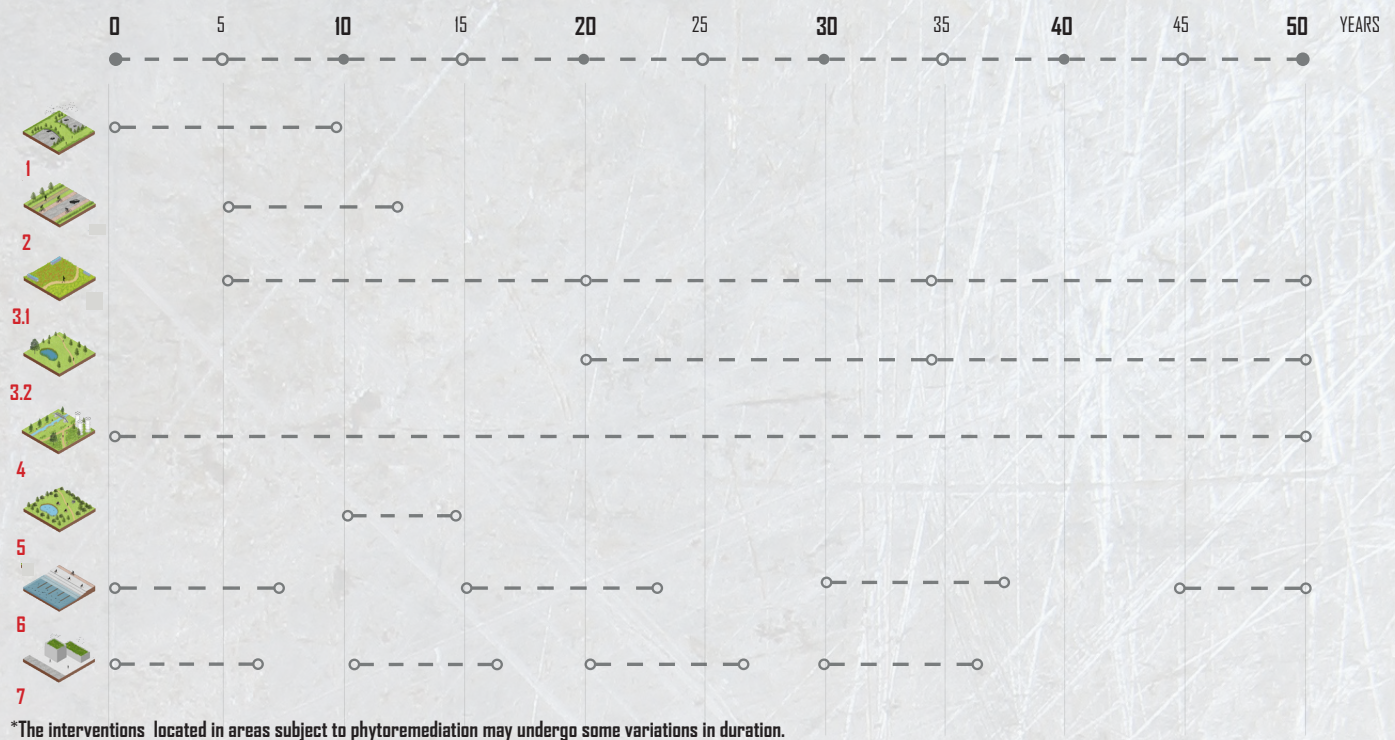


Figure 70. Diagram illustrating the duration of the Eco Site interventions. Some of them can be carried out in a long span, while others in a short one.

URBAN QUALITY CRITERIA FOR PUBLIC SPACE

QUALITY CRITERIA OF REFERENCE:

- **Protection:** against unpleasant sensory experiences and traffic
- **Comfort:** Opportunities to walk/cycle, stop/stay, sit, see and exercise
- **Enjoyment:** Aesthetic qualities, positive sensory experience and of the environment

Protection

- Protection against traffic & accidents — feeling safe**
 - Protection for pedestrians and cyclists
 - Eliminating fear of traffic
 - Safe crossings
- Protection against crime & violence — feeling secure**
 - Lively public realm
 - Allow for passive surveillance
 - Diversity of functions 24/7/365
 - Well lit / lighting in human scale
- Protection against unpleasant sensory experiences**
 - Wind/draft
 - Rain/snow
 - Cold/heat
 - Pollution
 - Dust, noise, glare

Comfort

- Opportunities to walk/cycle**
 - Room for walking
 - Interesting facades
 - No obstacles
 - Good surfaces
 - Accessibility for everyone
- Opportunities to stop & stay**
 - Attractive & functional edges
 - Defined spots for staying
 - Objects to lean against or stand next to
 - Facades with good details that invite staying
- Opportunities to sit**
 - Defined zones for sitting
 - Pleasant views, people watching
 - Good mix of public and cafe seating
 - Resting/waiting opportunities
- Opportunities to see**
 - Reasonable viewing distances
 - Unhindered views
 - Interesting views
 - Easy orientation
 - Lighting (when dark)
- Opportunities to talk & listen**
 - Low noise levels
 - Public seating arrangements conducive to communicating, 'talkscapes'
- Opportunities for play & exercise**
 - Allow for physical activity, exercise, play & street entertainment
 - Temporary activities (markets, festivals, exhibitions etc)
 - By day and night
 - In summer and winter

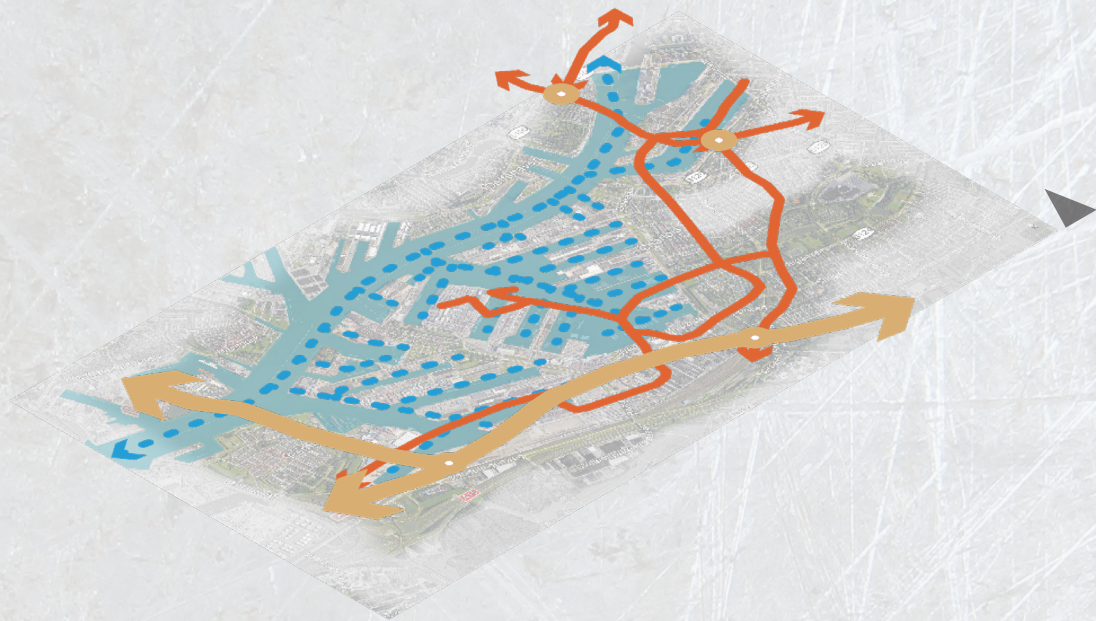
Enjoyment

- Dimensioned at human scale**
 - Dimensions of buildings & spaces in observance of the important human dimension in relation to senses, movements, size and behaviour
- Opportunities to enjoy the positive aspects of climate**
 - Sun/shade
 - Heat/coolness
 - Shelter from wind/breeze
- Aesthetic qualities + positive sensory experience**
 - Good design and detailing
 - Good materials
 - Fine views/vistas
 - Rich sensory experiences: trees, plants, water

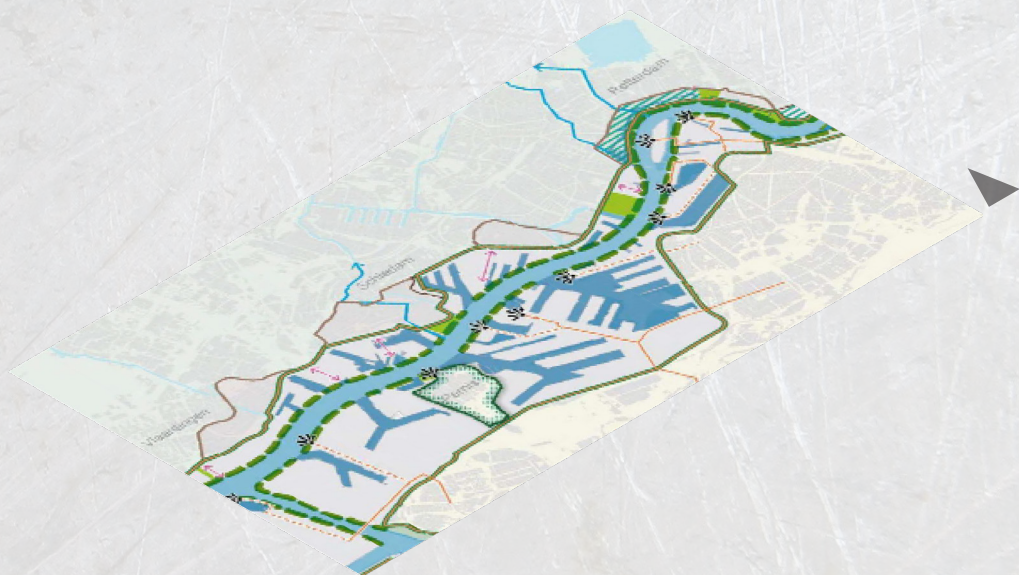
Figure 71. 12 Urban Quality Criteria by Gehl Architects

Retrieved from <https://gehlpeople.com/blog/young-people-designing-browns-villes-heart-1/attachment/quality-criteria-2018/>

MOBILITY, ACCESSIBILITY AND VIEWPOINTS - CURRENT SITUATION



- Legend - Mobility**
- Primary Highway
 - Secondary Highway
 - Waterway



Retrieved from Landschappelijk Raamwerk - De Rivier als Getijdenpark 2016

- Legend - Accessibility and Viewpoints**
- Paths
 - Viewpoints
 - Highway

Figure 72. In Waalhaven area, the mobility and the accessibility are quite difficult and complicated due to the presence of the harbour settlements.

MOBILITY, ACCESSIBILITY AND VIEWPOINTS - PROPOSAL



Figure 73. In the proposal, the mobility and the accessibility towards the water and other spots are facilitated and improved via the increase of new paths and viewpoints. The usage of cars is limited though.

MASTERPLAN (CURRENT SITUATION) - WAALHAVEN AREA



Figure 74. Masterplan of the actual area of intervention: Waalhaven and surroundings. Removal of obstructing industrial buildings.

MASTERPLAN (20 YEARS BY NOW) - WAALHAVEN AREA

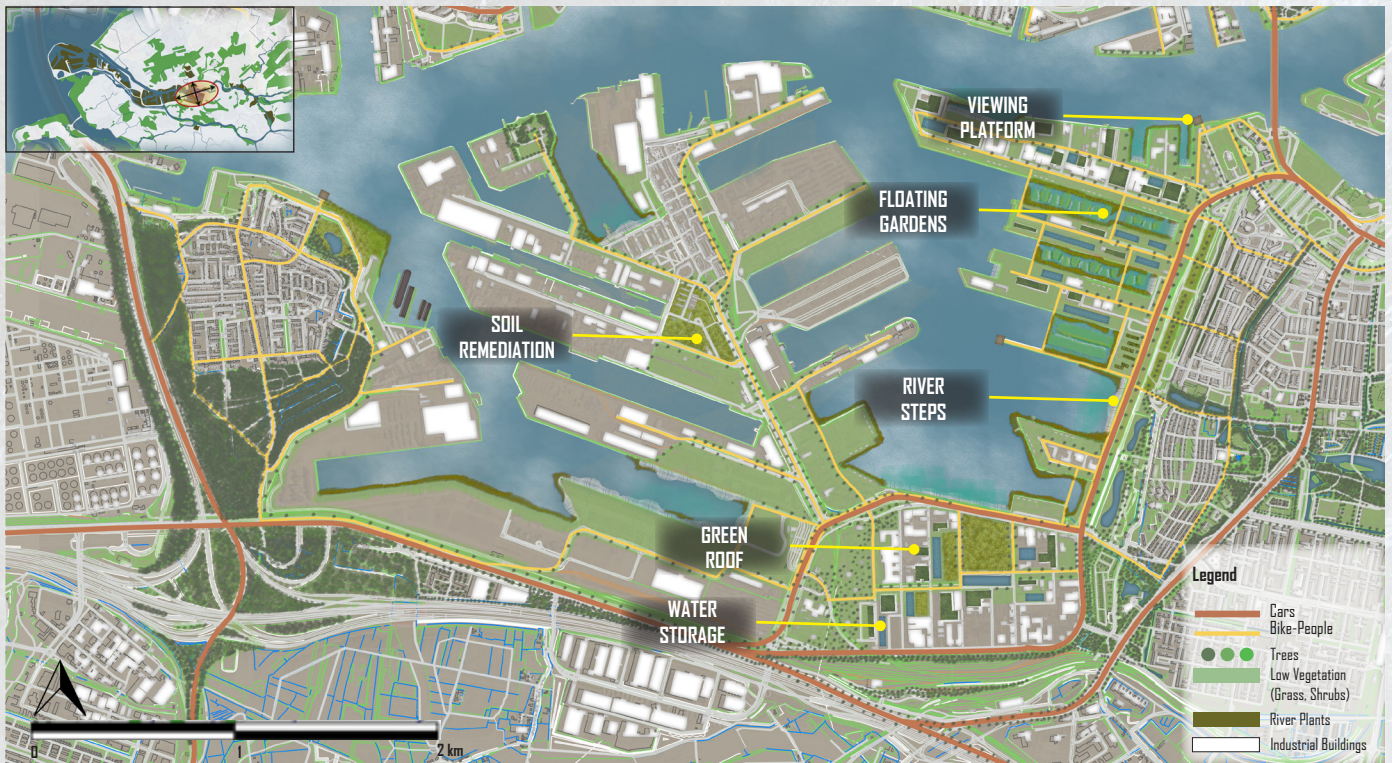


Figure 75. Masterplan of the area of intervention in 20 years: Waalhaven and surroundings.

The design proposal for the project area consists in the introduction of a resilient, efficient, sustainable system capable of adequately showing the potential of the Wastescapes in the city. These can be redefined as flexible urban elements capable of promoting biodiversity, addressing climate change, alleviating urban fragmentation and improving citizens' quality of life over time. To achieve this, it is necessary to apply a process of regeneration of the abandoned lands and structures present in the area, giving them a new ecological and social function.

In particular, the use of Eco-design components helps to better manage the urban planning of the area. Multiple short-term or long-term interventions, of varying extent, can be implemented at the same time or in different periods.

Two of them also include ecological experimentation, involving the combination of a phytoremediation process with a vegetative gradient. Both, based on gradual development times, can become interdependent and achieve possible environmental improvement results.

The increase of vegetation, especially trees on the Southern edge, can bring positive effects to the environment, the local wildlife and the citizens' life. In fact, a peri-urban forest is essential to face issues such as soil deterioration, consumption, pollution and it can also be a buffer against wind (from South-West) and noise disturbance.

Moreover, vegetation can attract further biodiversity to the area and it can help with human physical, mental well-being.

DESIGN GOALS FOR THE NEW ECO-DESIGN :

- **Improvement of accessibility** towards the water by the redesign of river banks, walkways along the waterfront.
- Reduction of spatial urban fragmentation by **improvement of green connections**.
- **Creation of more places to walk/sit/stand** along the water and enjoy the waterfront.
- **Improvement of the quality of local habitats and species' condition**.
- Reduction of the Soil Pollution in contaminated sites.
- **Reduction of unpleasant sensory experiences** (due to physical agents or urban design).

MASTERPLAN (20 YEARS BY NOW) WITH EXPERIMENTAL SITES

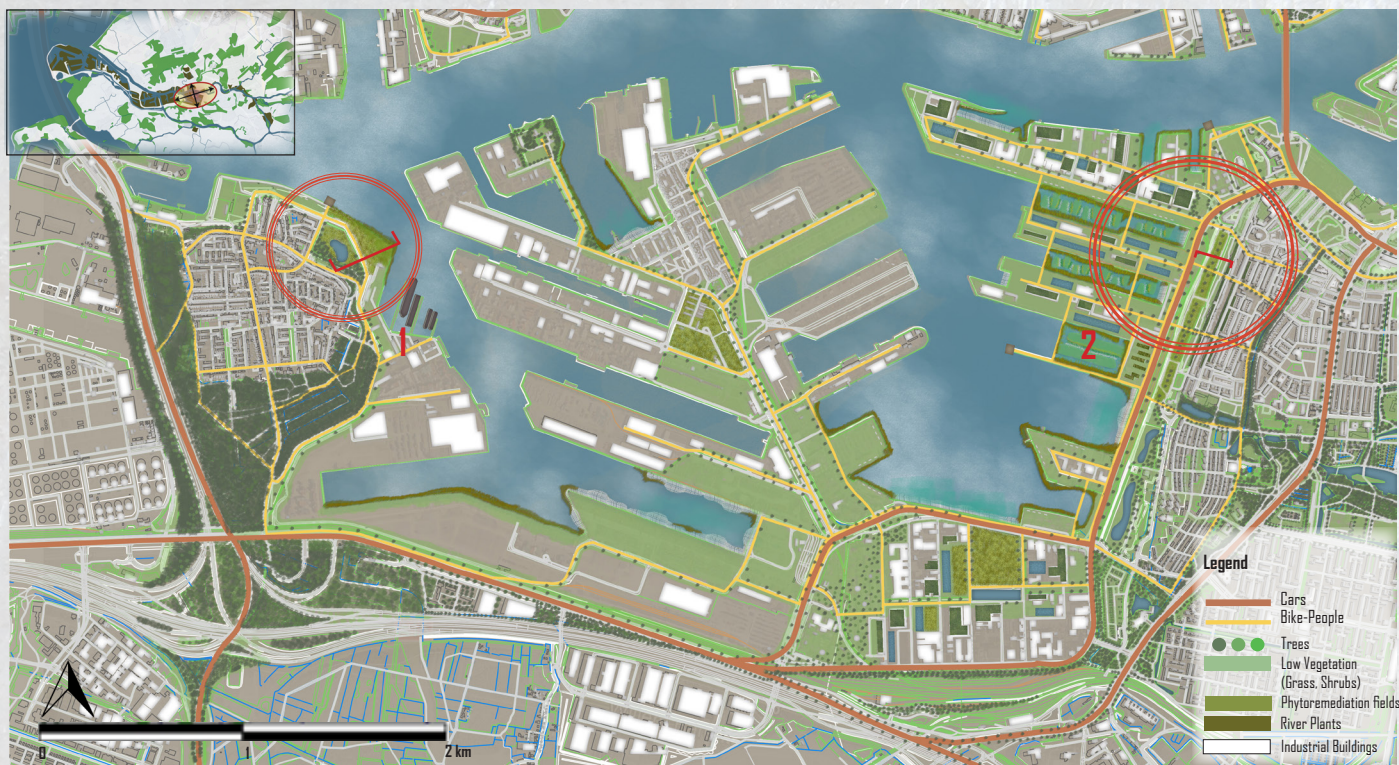


Figure 76. Masterplan of Waalhaven area showing the two chosen experimental areas of intervention.

SECTIONS OF INTERVENTIONS: COMBINATION: GRADIENT/PHYTOREMEDIATION (BY 20 YEARS)

- SITE 1: PERNIS DISTRICT

- How can certain techniques of Phytoremediation be applied on vegetation gradients in order to tackle environmental and social issues in the project area?

CHOSEN TECHNIQUES: according to the type of Pollutants and the related purifying Plants

- Phytoextraction

- Rhizofiltration

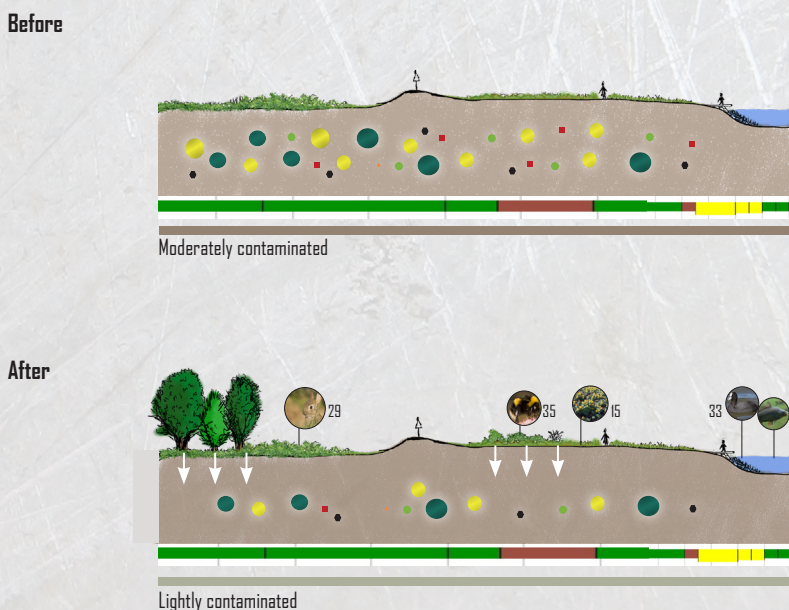
Legend-Soil Quality

- Clean
- Very lightly contaminated
- Lightly contaminated
- Moderately contaminated
- Strongly contaminated

Legend-Pollutants

- Cd
- Ba
- Cu
- Co
- Hg
- Pb
- Zn
- Ni
- PAH's
- Mineral Oil (various)
- As

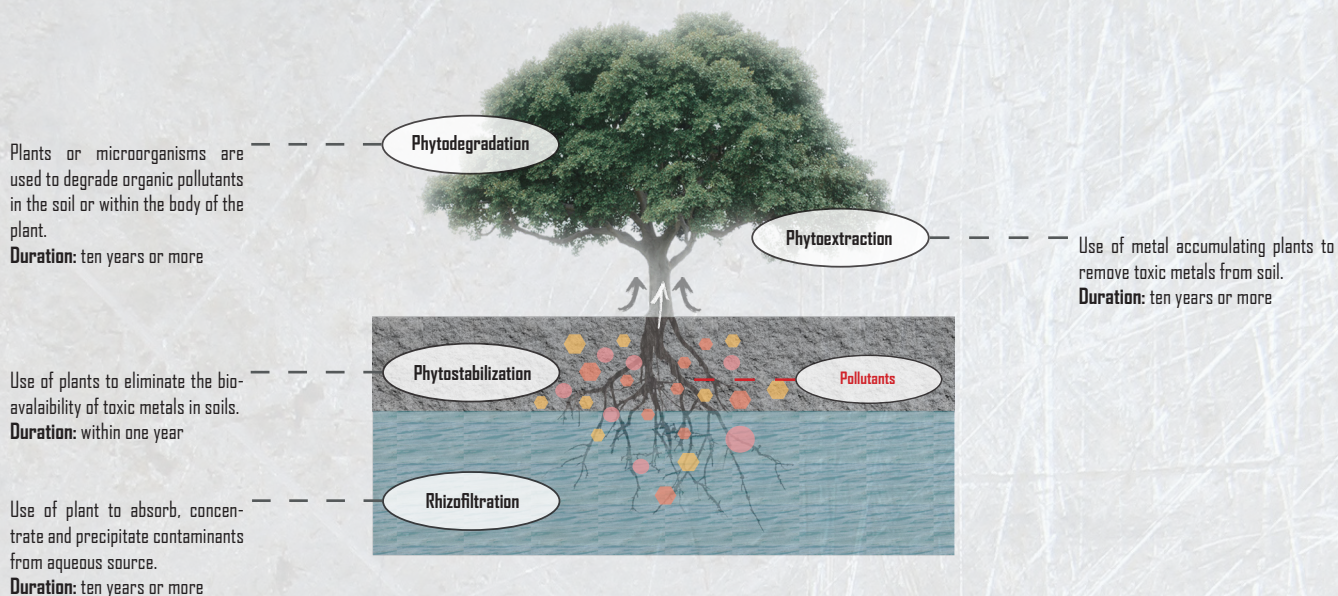
Clay Sand Peat



*To learn more about the name of the species, go to page 48.

Figure 77. Section related to the experimental site of Pernis district.

PHYTOREMEDIATION: SELECTED 5 TECHNIQUES TO TACKLE (SOIL/AIR/WATER) POLLUTION



Duration: It Depends on the remediation objective and therefore also the chosen phytotechnology process.

- **SHORT:** if phytostabilization is chosen. The remediation objective can then already be achieved within the year.
- **LONG:** in the case of phytoextraction of metal contaminated soils. In this case the remediation will often take several decades.

Figure 78. Scheme illustrating some of the main Phytoremediation process, Soil Pollutants in relation to vegetation.

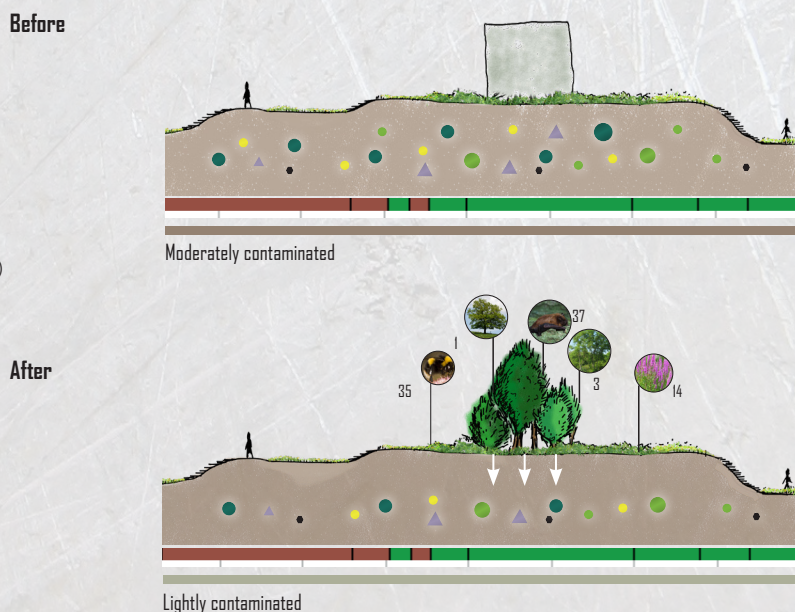
- SITE 2: OUD CHARLOIS DISTRICT

CHOSEN TECHNIQUES: according to the type of Pollutants and the related purifying Plants

- **Phytodegradation**

- **Phytostabilization**

- Legend-Soil Quality**
- Clean
 - Very lightly contaminated
 - Lightly contaminated
 - Moderately contaminated
 - Strongly contaminated
- Legend-Pollutants**
- Cd
 - Ba
 - Cu
 - Co
 - Hg
 - Pb
 - Zn
 - Ni
 - PAH's
 - Mineral Oil (various)
 - As
- Clay
Peat



*To learn more about the name of the species, go to page 48.

Figure 79. Section related to the experimental site of Oud Charlois district.

4.3 OUD CHARLOIS

ODD CHARLOIS AREA ANALYSIS

SPATIAL QUALITY

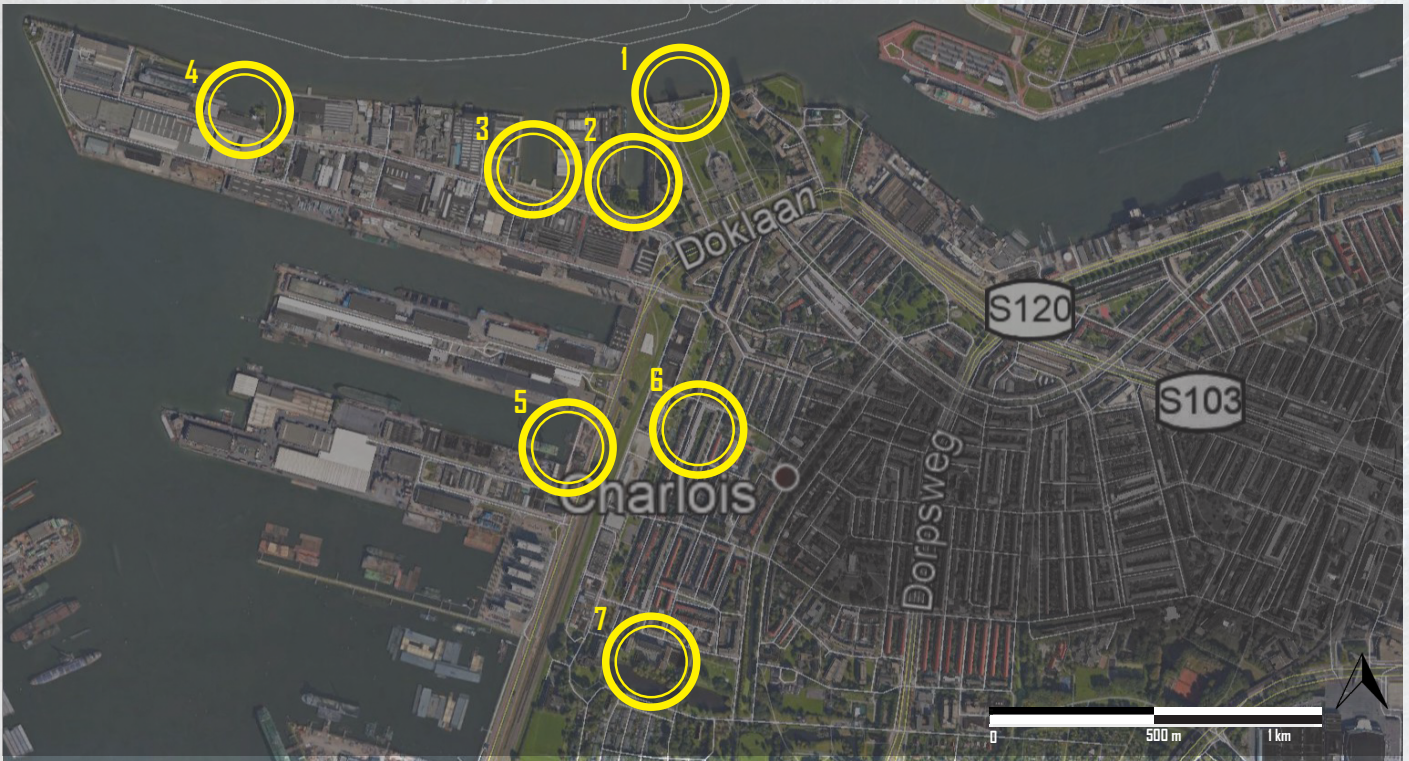


Figure 80. The map shows the points chosen for Oud Charlois' space analysis. It can be noticed that the focal points vary depending on where you are in the district.

MAP OF SOIL POLLUTION AND QUALITY



Figure 81. The map shows the different grades of soil pollution in the area and the relative types of current pollutants.

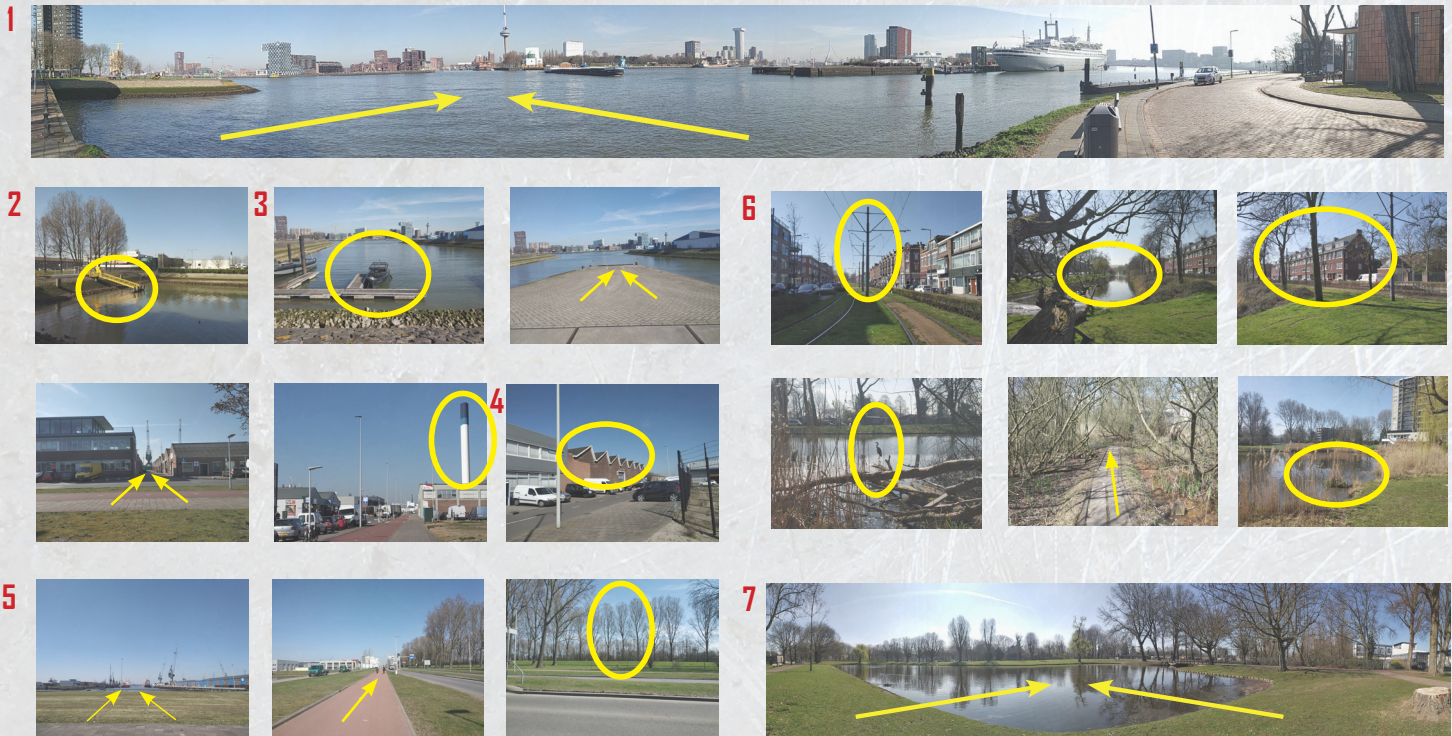


Figure 82. Site pictures illustrating some focal points, element of interest which can be found in Oud Charlois. There is a noticeable absence of specific points of reference (Landmarks) in the area.

CONCLUSION

The analysis of the **SPACE** of the Oud Charlois district led to the following observations:

- The quality of the public space is **heterogeneous**, in fact in the residential area (East) it is very controlled, while near the port it is quite poor.
- This is above all visible from the different presence and care of the vegetation in both areas. In a residential area, it is very dense and well-kept, while in the port area it is very scarce and neglected.
- There is a notable difference in visibility in the district: along the waterfront, the space is wide and open, while in the residential and commercial areas, it is limited.

Regarding the quality of the **SOIL POLLUTION** and relative **POLLUTANTS**:

- The area is on **average polluted**, not at very high levels.
- The most present pollutants, due to the concentration rate, are **Zn, Pb** and some **Mineral oils**.



Legend-Soil Quality

- Nature (Clean)
- Agriculture (Very lightly contaminated)
- Living (Lightly contaminated)
- Industry (Moderately contaminated)
- Remnant Areas (Strongly contaminated)

Legend-Pollutants

- Cd
- Ba
- Cu
- ▲ Co
- Hg
- Pb
- Zn
- Ni
- ▲ PAH's
- Mineral Oil (various)
- As

DESIGN

CURRENT SITUATION



- REMOVAL OF OBSTRUCTING BUILDINGS

Legend

- Bike - Cars - People
- Bike-Cars
- Parks (Trees)
- Low Vegetation (Grass, Shrubs)
- Removed Industrial Buildings
- Industrial Buildings
- Unused Spaces
- Views



0 100 m 200 m

Figure 83. Current condition of the Oud Charlois district.

ANALYSIS SCHEMES:

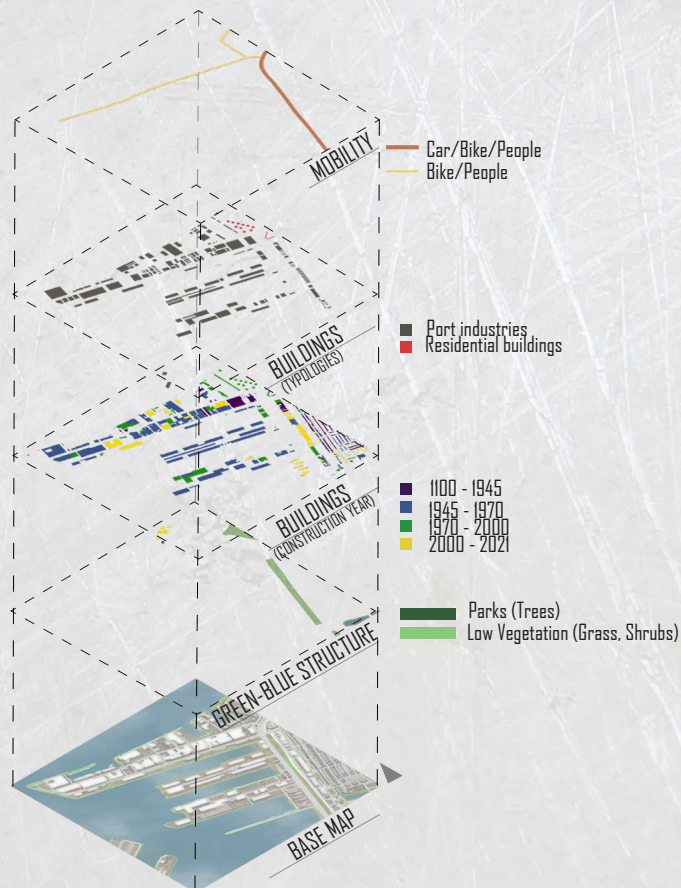


Figure 84. Axonometric diagram that shows the analysis of the current condition of the Oud Charlois district under some few aspects.

PROPOSAL (BY 20 YEARS)



- TRANSFORMATION OF REMAINING BUILDINGS INTO ECO-STRUCTURES

Legend

- Cars
- Bike-People
- ● ● Trees
- Low Vegetation (Grass, Shrubs)
- Phytoremediation fields
- River Plants
- Green Roof
- Water Storage
- Ind. /Res. Buildings
- Floating plants (pur.)
- ← Rainwater
- ← Purified water (Clean)
- ○ Inlet/Outlet

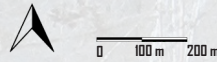


Figure 85. Condition of the district of Oud Charlois after the project intervention.

PROPOSAL SCHEMES:

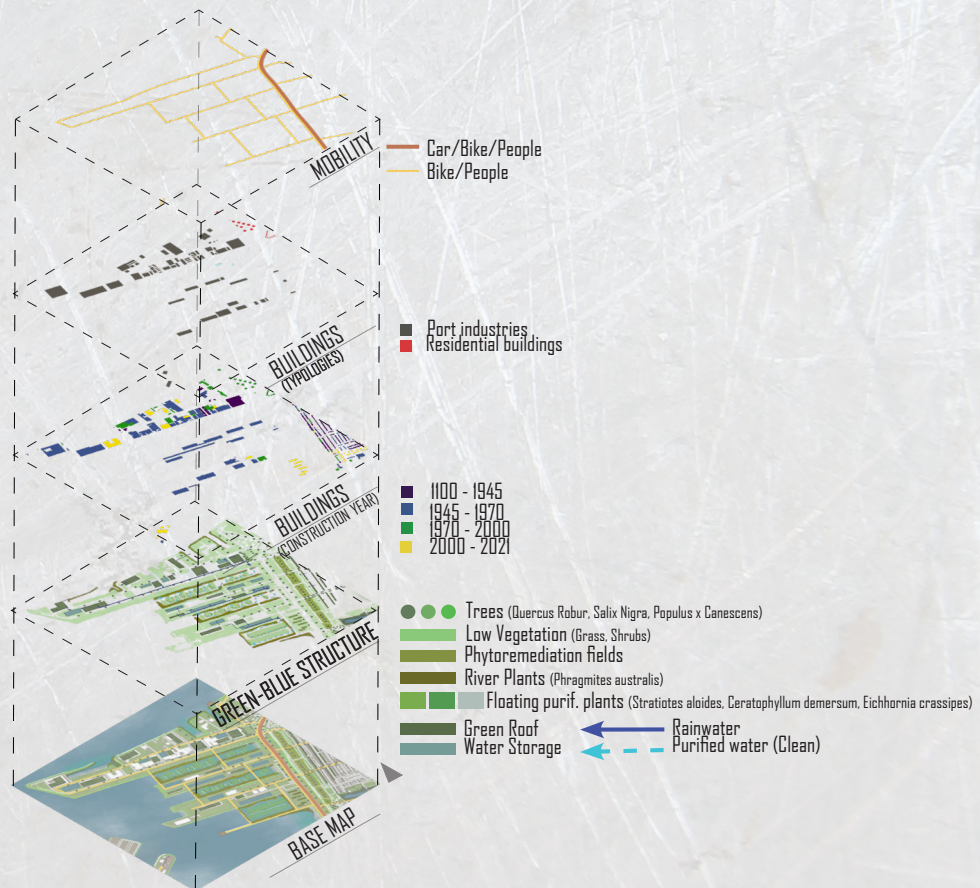


Figure 86. Axonometric diagram that shows the analysis of the condition of the district of Oud Charlois after the project intervention.

DESIGN ECO-INTERVENTIONS ON SITE IN OUD CHARLOIS

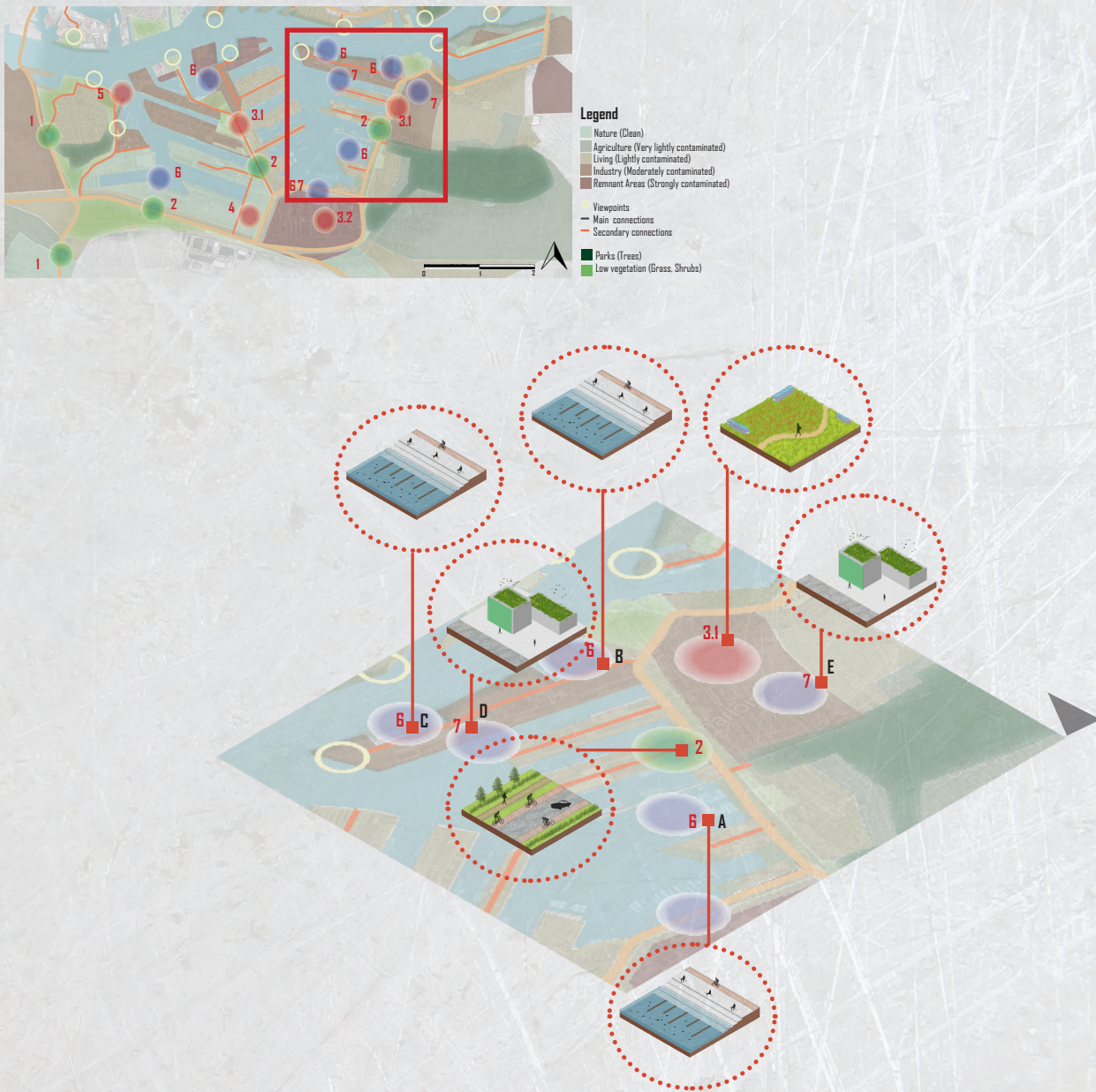

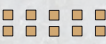


Figure 87. Axonometric drawing visually showing the site interventions on the chosen locations in Oud Charlois.


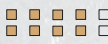
TIMEFRAME OF DESIGN ECO-INTERVENTIONS IN OUD CHARLOIS (TIME SPAN: 20 YEARS)

Legend

SIZE:  MAINTENANCE: 





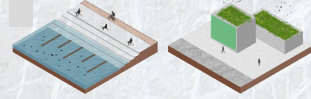
2- Abandoned, disused railway -> Green Boardwalk

SIZE:  MAINTENANCE: 



3.1- Brownfield -> Community garden (by Soil Remediation)

SIZE:  MAINTENANCE: 



6- Neglected River banks -> Sitting areas
7- Harbour buildings -> Green Roof/Walls



Figure 88. Diagram illustrating the duration of the Eco Site interventions in Oud Charlois. Some of them can be carried out in a long span, while others in a short one.

HUMAN ACTIVITIES ON SITE - OUD CHARLOIS

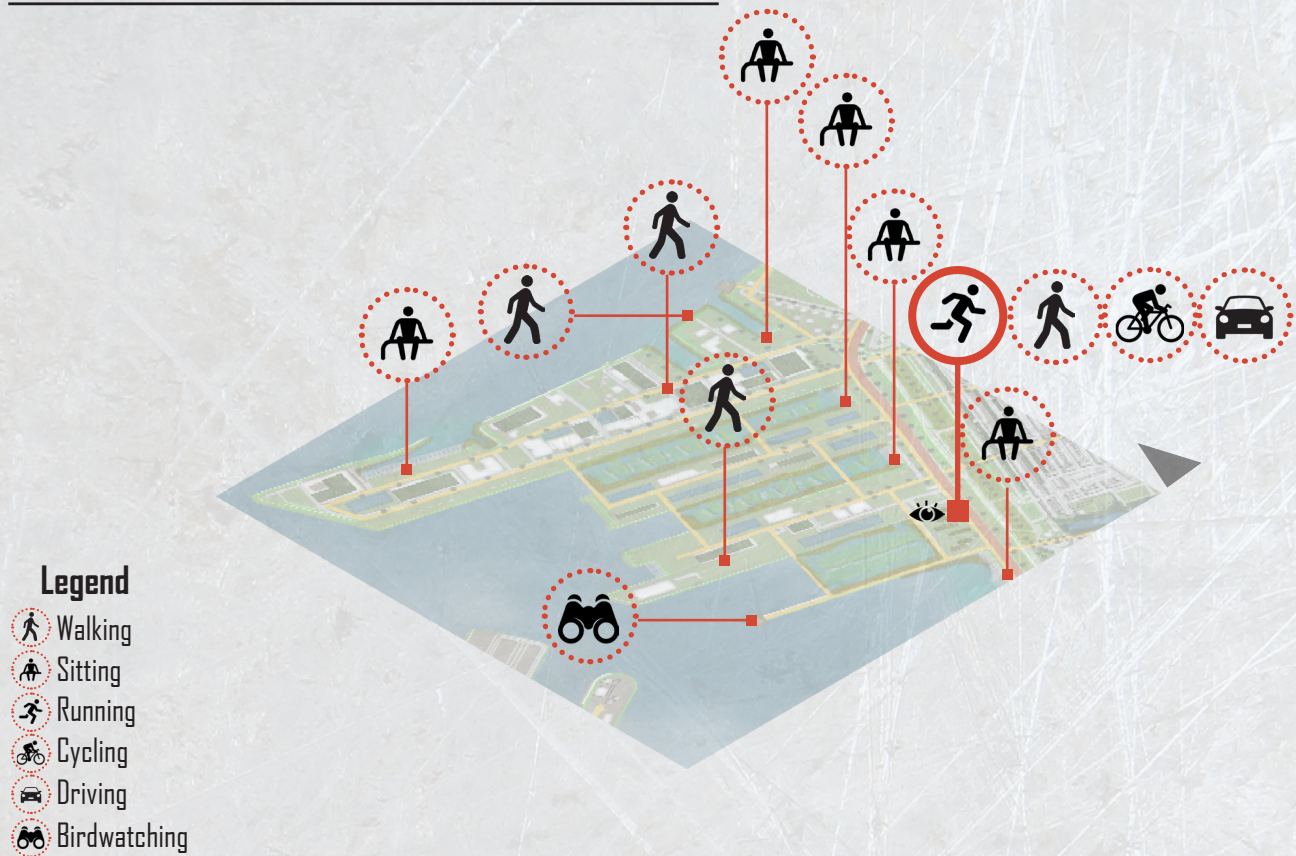


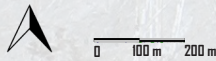
Figure 89. The design proposal in Oud Charlois allows the execution of different simultaneous human activities (walking, cycling, sitting etc..)

CURRENT SITUATION

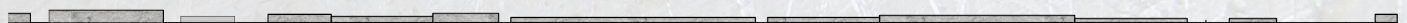


Legend

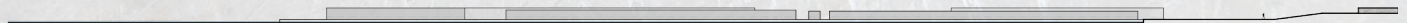
- Bike - Cars - People
- Bike-Cars
- Parks (Trees)
- Low Vegetation (Grass, Shrubs)
- Industrial Buildings



SECTION A-A'



SECTION B-B'



SECTION C-C'

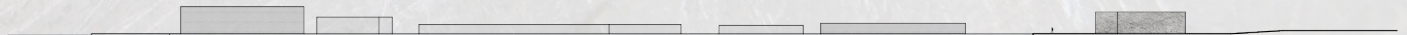
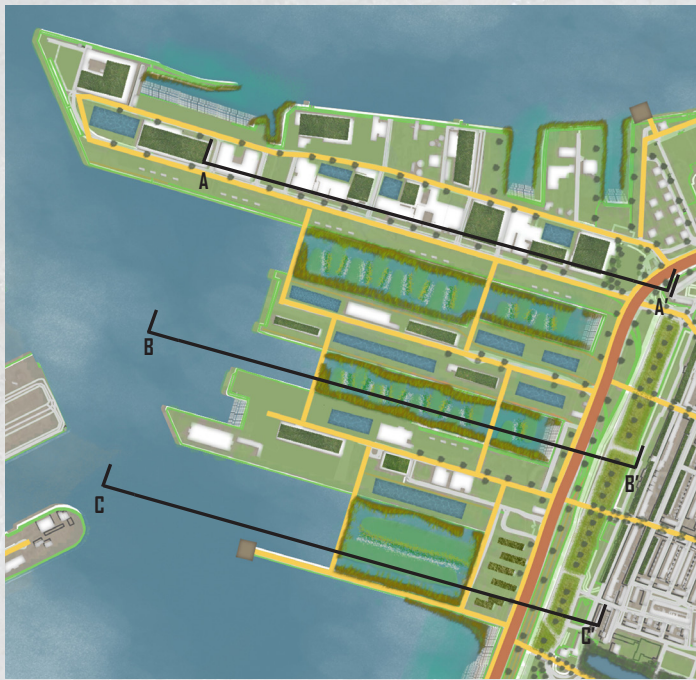



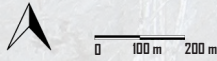
Figure 90. Sections related to the current condition of the Oud Charlois district.

PROPOSAL (BY 20 YEARS)



Legend

-  Cars
-  Bike-People
-  Trees
-  Low Vegetation (Grass, Shrubs)
-  Phytoremediation fields
-  River Plants
-  Floating plants (purifying)
-  Green Roof
-  Water Storage
-  Ind. /Res. Buildings



SECTION A-A'



SECTION B-B'

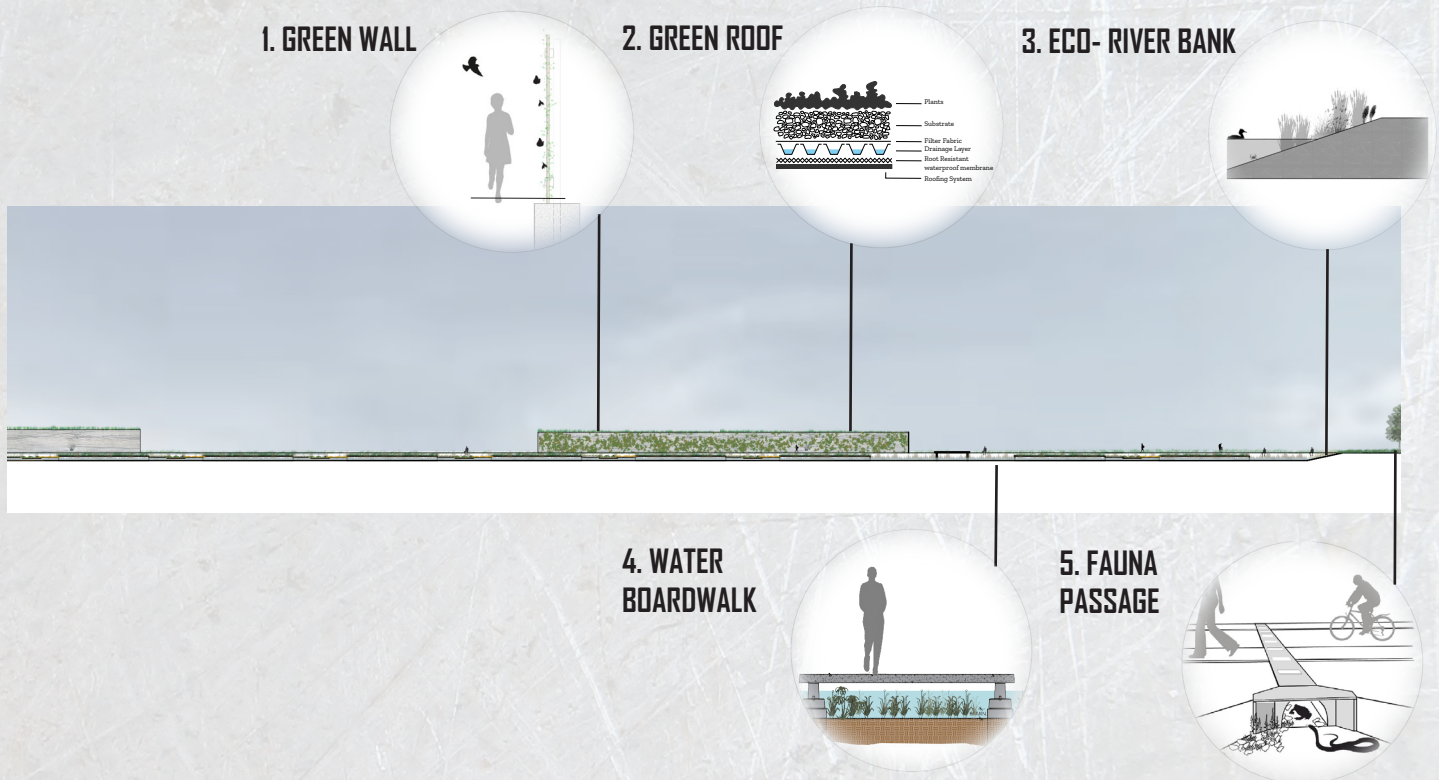


SECTION C-C'



Figure 91. Sections related to the condition of the district of Oud Charlois after the project intervention.

SECTION B-B': CONSTRUCTION DETAILS

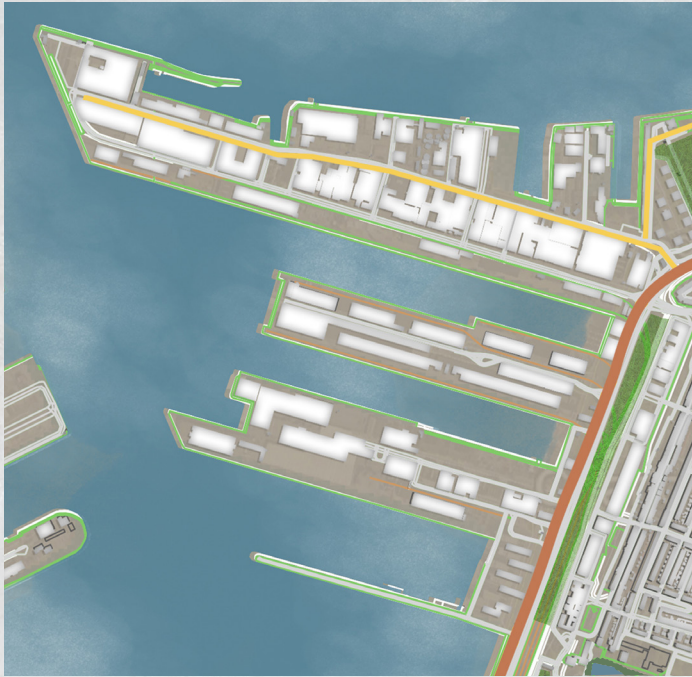


* Source images 3.5: "Twenty ideas for integrating biodiversity in urban planning and development", Gemeente Amsterdam
 4: <https://greatriversgreenway.org/design-guidelines/trail-design/boardwalk/>

Figure 92. The section chosen presents different design solutions on a different scale, to be applied in the Oud Charlois district.

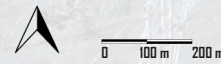
DEVELOPMENT OF THE PROJECT PROPOSAL THROUGHOUT TIME

CURRENT SITUATION



Legend

- Bike - Cars - People
- Bike-Cars
- Parks (Trees)
- Low Vegetation (Grass, Shrubs)
- Industrial Buildings

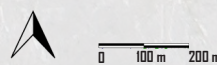


PROPOSAL (BY 20 YEARS)



Legend

- Cars
- Bike-People
- Trees
- Low Vegetation (Grass, Shrubs)
- Phytoremediation fields
- River Plants
- Green Roof
- Water Storage
- Floating plants (pur.)
- Rainwater
- Purified water (Clean)
- Inlet
- Outlet
- Ind. /Res. Buildings



DEVELOPMENTS: - Transformation Of Remaining Buildings Into Eco-Structures

- Creation of Phytoremediation areas

- Increase of Vegetation

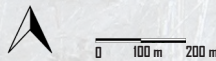
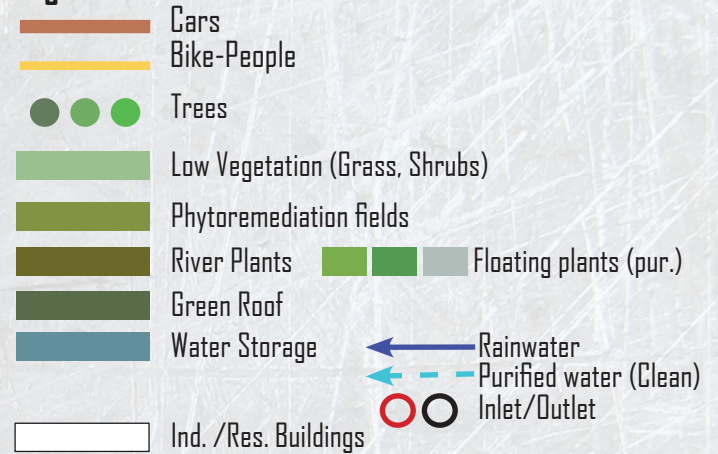
- Transformation of Green Roof/Wall Buildings into Water Storage areas or vice versa

Figure 93. The plans show the temporal development of the project proposal for Oud Charlois for the next twenty years.

PROPOSAL (BY 40 YEARS)



Legend

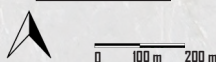
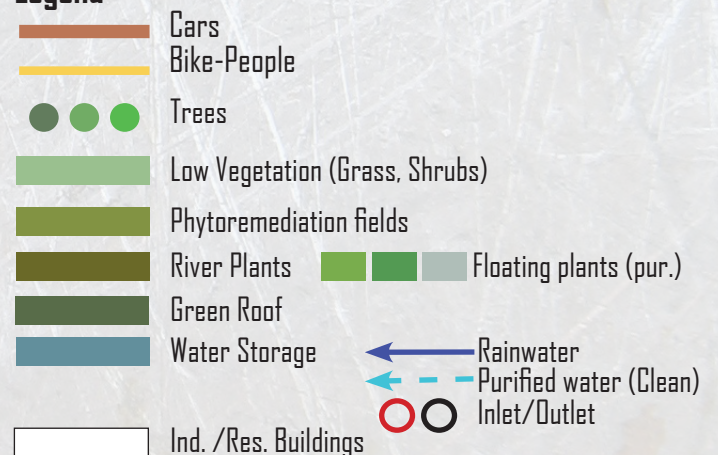


- DEVELOPMENTS:**
- Increase of Purifying plants (River Banks, Floating Gardens, Slope)
 - Increase of Green Roof Structures
 - Transformation of Green Roof/Wall Buildings into Water Storage areas or vice versa

PROPOSAL (BY 60 YEARS)



Legend



- DEVELOPMENTS:**
- Increase of Purifying plants (River Banks, Floating Gardens, Slope)
 - Increase of Green Roof Structures and Water Storage pools
 - Removal of a few buildings and conversion of other ones into Green Roof/Wall Structures

Figure 94. The plans show the temporal development of the project proposal for Oud Charlois for the next thirty and fourthy years

OLD CHARLOIS - BIRD VIEW (BY 20 YEARS)

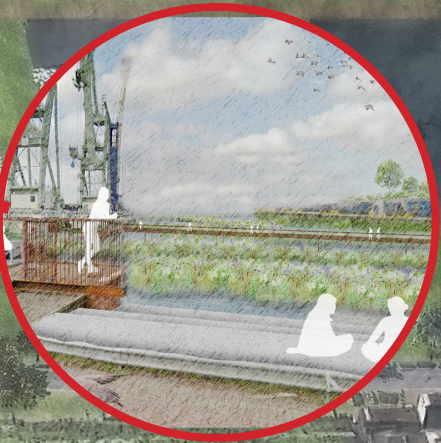
OLD CHARLOIS
Houses

Unused Railway > Boardwalk

Green



Figure 95. Axonometry and Eye-level views showing the Waalhaven area after the implementation of the ecological interventions by twenty years.



Harbour Dock > Floating Gardens

Green Roof

Water Storage



Water taxi stop > Eco River Bank

EYE LEVEL VIEW - OUD CHARLOIS



Figure 96. Transformation of an abandoned railway section into a green walkway for people and species. Before.



Figure 97. Transformation of an abandoned railway section into a green walkway for people and species. After.

EYE LEVEL VIEW - OUD CHARLOIS



Figure 98. Transformation of a Water taxi stop into an Eco river bank. Before.



Figure 99. Transformation of a Water taxi stop into an Eco river bank. After.

EYE LEVEL VIEW - OUD CHARLOIS



Figure 100. Transformation of an harbor quay into a sitting area surrounded by vegetation and floating gardens. Before.



Figure 101. Transformation of an harbor quay into a sitting area surrounded by vegetation and floating gardens. After.

PROJECT RE-CAP

LARGE SCALE

MEDIUM SCALE



- INSPIRATION + SELECTION OF AN AREA OF INTERVENTION + FORMULATION OF PROBLEM STATEMENT AND RESEARCH QUESTION

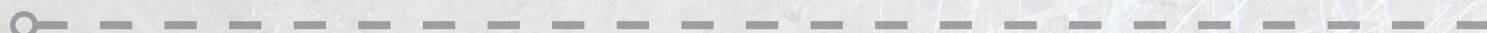


Figure 102. Development of the research project from the largest, territorial scale to the smallest and most detailed urban one.



Figure 103. Transformation of a port area (Wastescape), polluted in Oud Charlois into a more green and ecological one. Before.

MEDIUM SCALE

SMALL SCALE



- FORMULATION OF A CONCEPT AND OF A DESIGN FRAMERWORK

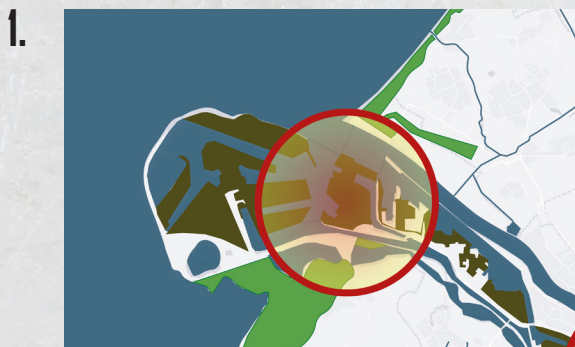


- PROJECT DEVELOPMENT + CONCLUSION



Figure 104. Transformation of a port area (Wastescape), polluted in Oud Charlois into a more green and ecological one. After.

FOUR CRITICAL AREAS - FEATURES



- Dunal Landscape
- Absence of Living areas
- Main Prevalence of Industrial settlements



- Urban Landscape
- Still Prevalence of Industrial areas
- Presence of a few Living areas



- Rural Landscape
- Balance of Living and Industrial Areas
- Minor presence of Industrial areas

Figure 105. Comparison of the features, problems, geographical conditions between the Waalhaven area and other three selected critical ones.

FOUR CRITICAL AREAS - COMPARISON

DESIGN ECO-COMPONENTS

	HIGHWAY BRIDGE -> ECODUCT	DISUSED RAILWAY -> GREEN BOARDWALK	BROWNFIELD -> COMMUNITY GARDEN	BROWNFIELD -> URBAN PARK	REUSE INDUSTRIAL HERITAGE -> URBAN PARK	LAND WITH NO USE -> URBAN PARK WITH RECREATIONAL AREAS	NEGLECTED RIVER BANKS -> SITTING AREAS	HARBOUR BUILDINGS -> GREEN ROOF/ WALLS
1. 				✓	✓	✓		
2. 	✓	✓	✓				✓	✓
3. 	✓						✓	✓

CONCLUSION

The comparison of the four critical areas identified in Rotterdam led to the formulation of the following statements::

- Different physical conditions and area extensions require some solutions instead of others. It is not possible to apply all the design solutions in any of the other 3 areas.
- The area number 2 can be a subsequent intervention area after that of Waalhaven, given the need for more design interventions.
- The areas 1 and 3 they seem to require fewer design interventions, perhaps others different from those introduced in Waalhaven.

Figure 106. Testing of the possible application of the design principles, eco-components of the Waalhaven area on other three selected critical ones.

4.4 PROJECT PATTERN SCHEME

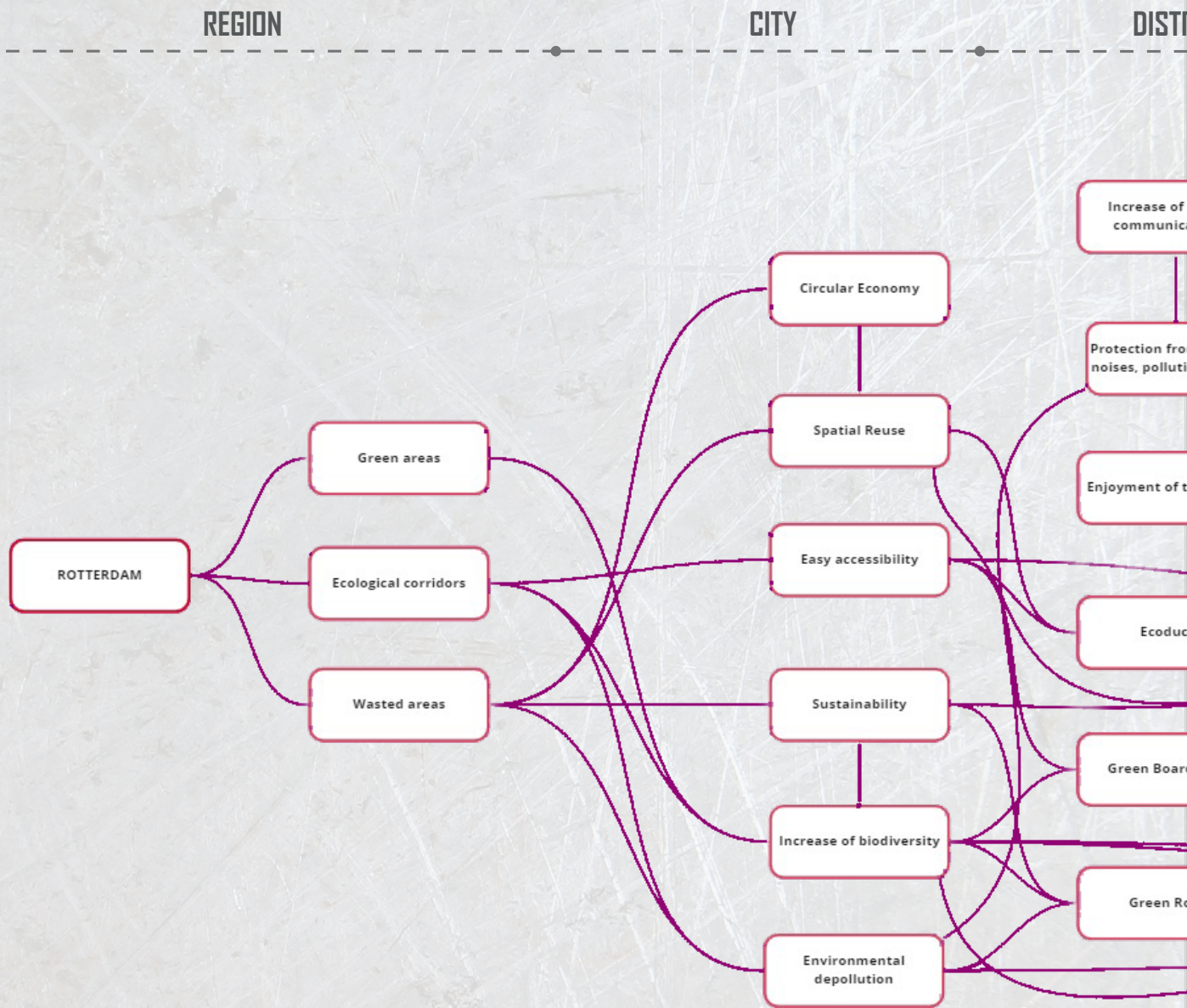
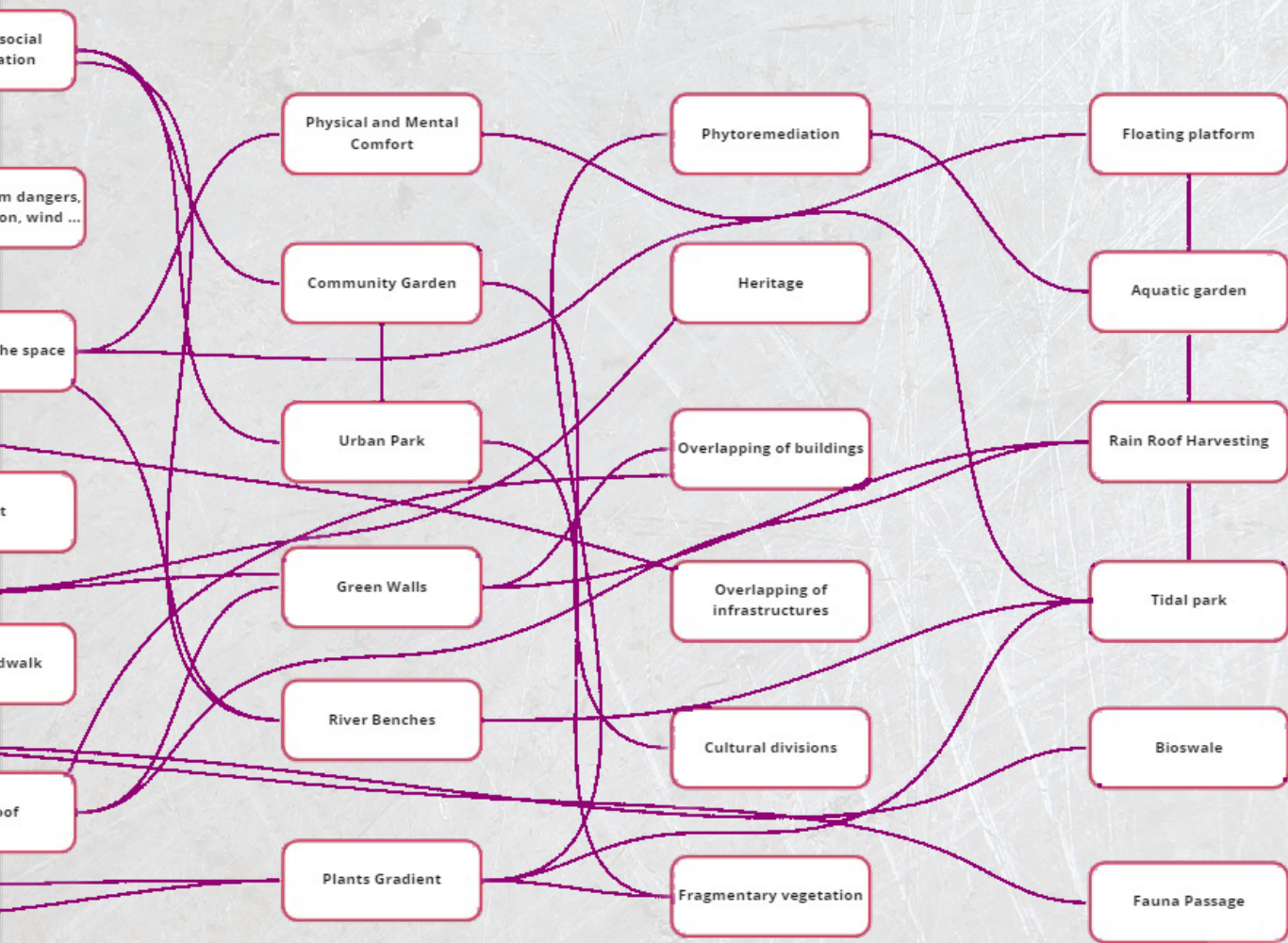


Figure 107. Pattern scheme that shows the different elements that belong to the research project and their relative connections. Each of them belongs to a large, medium or small scale (Region, City, District, Neighbourhood, Building).

RRICT

NEIGHBOURHOOD

BUILDING



5. REFLECTION

For my graduation project, I have decided to deepen the theme of abandoned spaces in the urban environment. This theme has always fascinated me. Many times it happened to me to observe structures or untouched lands, without use in my country, Italy, and I wondered what could be the causes of this phenomenon and if there were perhaps some benefits to be derived from them.

Often, due to economic, political or social problems, many of these spaces remain 'suspended', invisible to people who are rarely interested in their recovery, regeneration.

Also in Rotterdam I happened to see some examples of this space, especially near the port. Here, the majority of buildings or lands has been continuously demolished and substituted by other structures with new functions and forms so that the memory of previous urban structures is being lost. Instead, certain fields are used, then discarded, or never used at all and left untouched.

I have focused my research on the area of Waalhaven (and surroundings), regarding which I have formulated the following Research Question:

"What spatial framework can guide the transition of Wastespaces in Rotterdam into ecological valuable spaces which can foster biodiversity, and improve the quality of people and species' life aspects on small, large scale (district/region)?"

I have selected this area of interest as it currently represents one of the harbour zones where the concentration of abandoned lands, industrial buildings and spatial, social fragmentations is quite high and critical in the city.

To answer this question, I have carried out a continuous work of parallel research and design, structured in different phases and levels of analysis / detail. In particular, I have divided my work into three different scales of interest: large (Rotterdam), medium (Waalhaven) and small (Oud Charlois).

All three areas are linked by a single project idea, that is the experimental attempt to convert an industrial-port area into an ecological hub where different elements take part. The environmental success of a single part of the city can represent a turning point for even more similar critical areas, especially along the Maas River.

The used working approach worked satisfactorily, especially in the final phase of research where theory and research could best complement each other. This was given above all by the personal ability to select specific topics of interest and on the further assistance of my mentors. Their expertise and knowledge of the research topics represented an essential resource for carrying out the work.

Their feedback has always been very precise and detailed. This helped me to improve my work each time and to give me inputs to integrate it personally. Furthermore, the readings that they have recommended to me for my research have been very meaningful and helpful.

My research work has taught me a lot: to be an independent researcher and architect, sometimes critical of the surrounding space and, at the same time, curious about it. In this graduate work, I have had the opportunity and freedom to personally express my technical skills and ideas.

Developing a vision of a space, accompanied by the choice of personal themes of interest, has undoubtedly led to a good result of the work.

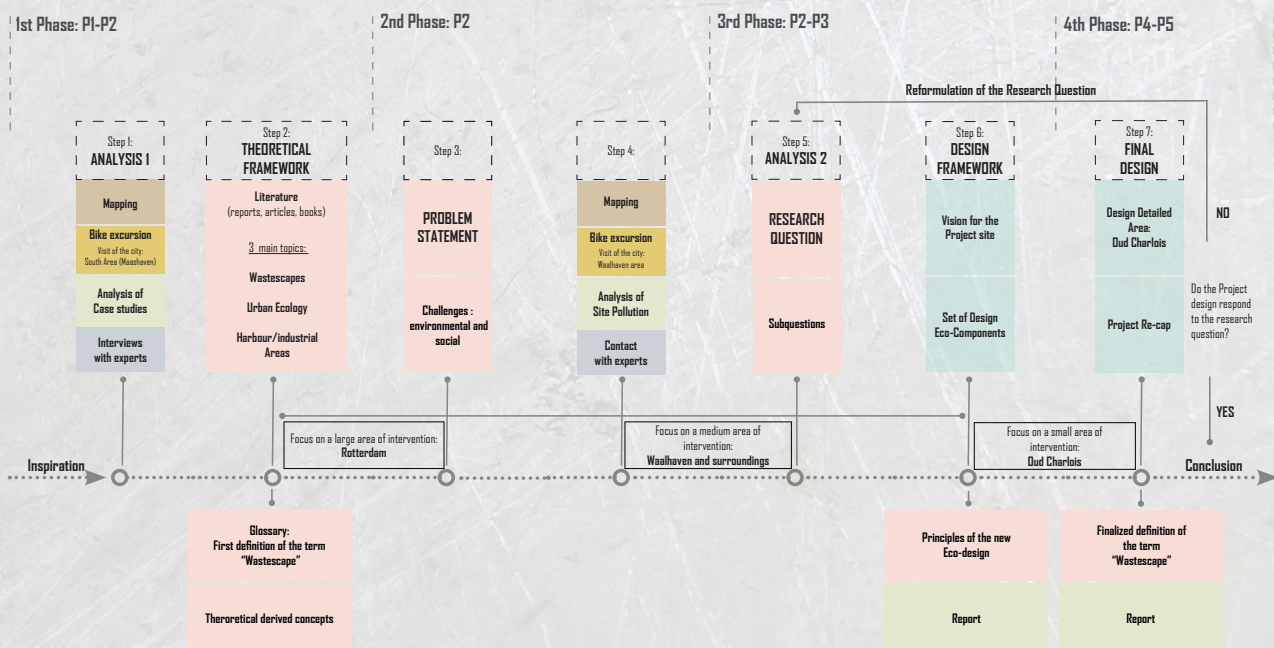


Figure 108. Research Plan.

- The relationship between research and design.

In the graduation project, the relationship between research and design was and always is complementary. The one represents the tool of verification and improvement of the other. There is no (theoretical) research that does not provide the basis for design, and there is no design that does not bring innovation, change and updating to research.

Thanks to the research, I was able to acquire and develop my own bases for the design of urban space. The research contributed to the formation of a design framework on which I regulated my event in a precise and efficient way.

- The relationship between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS).

The graduation project topic is linked to that of the studio as it represents a design example where the cooperation of urban planning and landscape architecture show how the quality of the environment, of the life of people and species can be improved by Urban Ecology.

In the project intervention, the regeneration of wasted spaces in Rotterdam leads to the creation of new Eco-hotspots which can become attractive meeting points for people to interact between each other and reconnect with nature.

The project work shows the application of various principles that belong to the master track of LA, such as the understanding of the spirit of a place (genius loci), the enhancement of its spatial qualities and environmental potential. The regeneration of wasted spaces by innovative, sustainable techniques requalifies the urban place, also influencing the citizens' perceptions towards it.

The intervention acts on the urban landscape together with other important factors: Scale, Time and Process. These, together with the Design, will determine the appearance, duration and physical extension of the urban redevelopment project.

The graduation work allows me to implement the knowledge, skills belonging to the master programme (Msc AUBS): for example, management of a project under different aspects (urban/landscape), capacity of tackling a problem with flexible design solutions, the usage of notions, practice to build up an efficient design proposal.

- Elaboration on research method and approach chosen by the student in relation to the graduation studio methodical line of inquiry, reflecting thereby upon the scientific relevance of the work.

The research method and methodology adopted were theoretical and practical. For the former we mean, textual analyzes of books, essays and articles on the topics of interest, while for the practical aspect some site visits were carried out, mapping of various kinds about Rotterdam and conversations with experts. In detail, the reading of texts on the theme of Wastescares and Urban Ecology represented a valid and important basis for my research, especially for the design choices.

The use of programs such as GIS for the mapping of natural and urban elements in /around Rotterdam has certainly helped to better define the quality of the information and the range of analysis for the research.

Occasional visits to the project site in different months of the year allowed the observation of very interesting seasonal changes, especially regarding the vegetation. All these research actions allowed me to establish a precise design framework, a fundamental guideline for the development of my project. Without it, my work would have been more disorganized and fragmented.

- Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results.

Furthermore, the graduation project represents an invitation to the citizens of Rotterdam to feel encouraged to start appreciating and giving importance to the abandoned spaces in the city.

The reuse and regeneration of wasted places can offer great potential for urban biodiversity and also for the improvement of socialization between people.

The sense of belonging to a place is also fundamental and it can be discovered again via urban landscape design. A space can represent a place of experience and a point of integration and be perceived with its own identity.

Therefore, through my intervention, I would like to introduce in Rotterdam a systematic, efficient, sustainable, circular design proposal that can adequately show the potential of Wastescares in the city. These can be redefined as flexible urban elements capable of promoting biodiversity, addressing climate change, improving citizens' quality of life over time. Moreover, on a large scale, the Eco-design intervention can then help to reduce the existing contrasts between the North-South sides of the city, on small one it can ease the urban fragmentations within the Southern districts.

- Discuss the ethical issues and dilemmas you may have encountered in doing the research, (if applicable) elaborating the design and potential applications of the results in practice.

Ethically, the presence of the port authority on the project site did not allow me to fully access some areas as they are 'private'. To compensate for this, I have tried to obtain the necessary information in another way (online, books).

Also in my design intervention, I took into consideration the presence of this authority and tried to find a mediation, integrating new design elements with pre-existing ones.

6. ACKNOWLEDGMENTS

During the development of this research project I have received great support and assistance for which I will always be grateful.

First of all, I would like to express my tremendous appreciation to my three supervisors, Dr.ir. Nico Tillie, Prof. Dr.ir. Arjan van Timmeren and Dr. Libera Amenta whose expertise and knowledge have helped me refine my work by pushing me to improve it time after time. Your feedback has always been very precise, analytical and honest, your availability of time and understanding always very kind and worthy.

I would like to thank as extra adviser, Cecilia Furlan, for providing me with very useful information for my work on the subject of today's Wastescapescapes and Drosscapescapes.

I would also like to thank external consultants:
Remco Pikaar (TAUW), Joris Boons (Port of Rotterdam), Rosario and members of
Ace. Gio. Ca. "Giardino degli Scalzi", Naples, Italy.

Also, I would like to thank my family, especially my mom for her time, support and helpfulness throughout my years of study. Without you, I could not have realized my dream of becoming an architect.

I would like to dedicate this work of mine to my beloved grandfather, my first fan who has always believed in me and shared with me my successes, challenges and school adventures. You will always be in my heart.

Then, I would like to thank all my friends in Delft, my childhood and high school friends in Milan who have always supported and encouraged me.

To conclude, if you are reading this text, remember to always believe in yourself and to always fight for your ideas and dreams even if sometimes others might let you down by asking you to give them up.
Follow your path with your head held high.

Francesca Mazza

7. REFERENCE LIST

LITERATURE (Reports, Articles, Books)

Wastescape:

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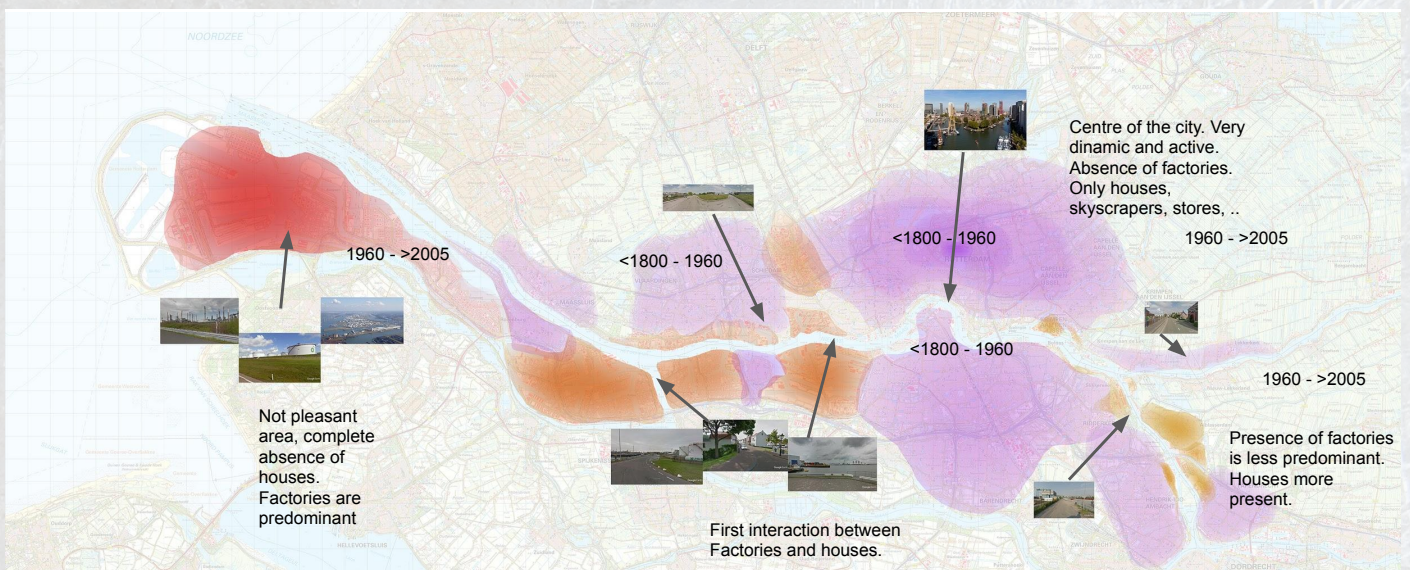
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8. APPENDIX

ANALYSIS OF SPATIAL QUALITY IN ROTTERDAM



- **Quality and Densification of Industrial areas** (Coloured Gradients: Red, Brown)
- **Residential areas** (Coloured Gradient: Purple)
- **Periods of Building Construction** (Data)

The large-scale analysis of the quality of urban space in the city of Rotterdam led to the following conclusions:

- The relationship between the density of industrial and building areas is inversely proportional: in fact, in the city center there are fewer industrial areas, and vice versa.
- The quality of the residential areas, especially the central ones of the city, is superior to that of the port areas.
- The architectural style also varies from area to area, more industrial and rough in the port areas, more sophisticated, modern / traditional in the city center.
- Given these factors mentioned above, each individual's experience and enjoyment varies from one urban space to another. For example, it can be enjoyable in central urban areas and unpleasant in peripheral ones.

Figure 109. Map showing the large-scale analysis of the quality and historical period of space in the Rotterdam areas.

EXAMPLES OF WASTESCAPES IN ITALY

During some visits in Milan and Naples, some wasted spaces/structures have been identified and analyzed. After that, a few principles have been extracted to be applied to the design of the research project.

FOOTBALL COURT IN SAN SIRO DISTRICT, MILAN > GREENFIELD (ABANDONED)



PARCO DELLO SPICCHIO, NAPLES - PUBLIC PARK IN CONTINUOUS CHANGE (UNDER RENOVATION)

BEFORE



LATER



NOW



Retrieved from <https://www.chometemporary.it/2013/06/06/riutilizziamo-italia-wwf-riqualificazione/>

GIARDINO DEGLI SCALZI, NAPLES - MEDIEVAL HORTUS > COMMUNITY GARDEN (STILL ACTIVE)



20TH CENTURY STABLES MONTEL, MILAN > THERMAL BATHS (PROJECT IN PROGRESS)



Retrieved from <https://blog.urbanfile.org/2020/10/11/milano-san-siro-al-via-la-riqualificazione-delle-scuderie-de-montel/>

Figure 110. Sites in Italy (Milan, Naples) which are examples of abandoned or regenerated spaces.

CONCLUSIONS

FOOTBALL COURT IN SAN SIRO DISTRICT, MILAN > GREENFIELD (ABANDONED)

The case of the abandoned soccer field in the Sansiro district highlights some interesting aspects regarding urban biodiversity. In fact, the lack of care and disinterest in the old sports field has allowed some species such as squirrels or crows to thrive in the area. The same can be said about plants.

Currently not many people stop to observe the green space but prefer only to pass by.

Through the analysis of this case, I understood how important a green space in a city is for people and species. Sometimes leaving a wild and uncultivated area can have many benefits for the environment.

PARCO DELLO SPICCHIO, NAPLES - PUBLIC PARK IN CONTINUOUS CHANGE (UNDER RENOVATION)

The park represents a space in continuous evolution. The appearance of this park has changed over the years. From an abandoned and neglected park, it was then regenerated by the citizens and reused for common activities.

Due to vandalism, it was later damaged. Its future use is currently unknown.

The history of this park shows how an urban space can always regenerate itself by continuously assuming new aspects and functions, according to the time and the citizens' behaviour.

Common green spaces must be enhanced, not neglecting or damaging them. Sometimes even bad urban management is responsible for the deterioration of a public green space.

GIARDINO DEGLI SCALZI, NAPLES - MEDIEVAL HORTUS > COMMUNITY GARDEN (STILL ACTIVE)

This medieval garden was born as a cloister of an adjacent church. Over time, the attention towards this green space has decreased as has the maintenance of it. A few years ago, a group of young volunteers decided to revive this historic space, converting it into a garden for the community.

The garden has multiple species of trees, a vegetable garden for the local community and represents a protected refuge for a colony of cats.

This recovery of urban space shows how it is possible to re-evaluate a wasted space and convert it into a new one with further benefits for species and people. Moreover, it is also important to remind citizens the historical value and importance of a space for a community.

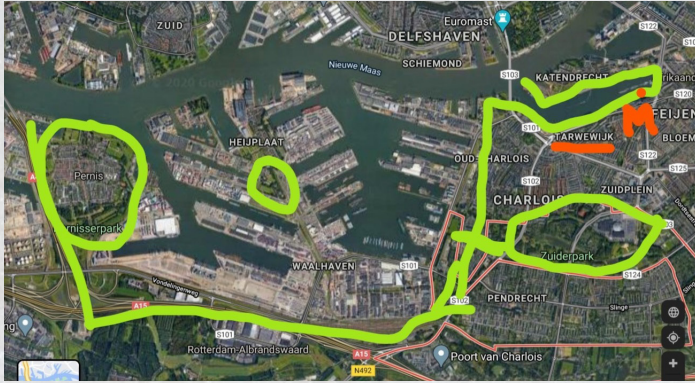
20TH CENTURY STABLES MONTEL, MILAN > THERMAL BATHS (PROJECT IN PROGRESS)

The conversion of some stables into a future spa space for the San Siro district represents an intervention aimed at the recovery, and not the demolition, of a historic structure.

In this case, the project seems more aimed at the well-being of citizens and less with other species. Undoubtedly, the current state of neglect is favorable to the development of biodiversity. However, there seems no sign of mediation with it.

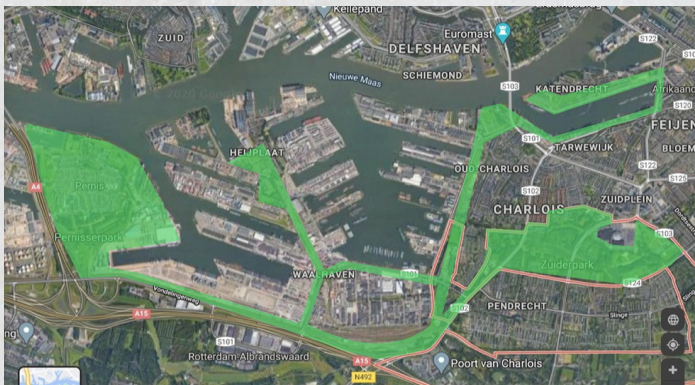
In a historical recovery project, be it a land or a building, it is important to find design solutions that can satisfy the needs of people and species. A coexistence between them is a necessary factor in the urban environment.

DEVELOPMENT OF A GREEN SYSTEM IN WAALHAVEN AREA



PHASE 1

In this phase, there is a first attempt to connect different areas of Waalhaven through vegetation, especially trees. Despite this, there are still some disconnections, for example with the district of Heijplaat.



PHASE 2

In this phase, there is an improvement of the green connections, which are more defined and clear. The type and quality of the vegetation, however, is still generic.



PHASE 3

In addition to the previous phase, a possible connection system has been designed between the various areas, reachable through pedestrian or cycle paths. Along these routes, it is possible to stop in some points ('nodes') and admire the surrounding landscape.



PHASE 4

In the current phase, the green system has a very articulated and defined structure. In the current phase, the green system has a very articulated and defined structure. The final goal is a balanced integration between port and residential structures and green spaces.

Figure III. Maps illustrate the gradual development of the green linking system of areas in Waalhaven.

REFERENCE DESIGN PROJECTS: WASTESCAPE- HISTORY - NATURE



Retrieved from <http://landezine.com/index.php/2013/02/schoneberger-sudgelände-park-by-odious/>

SCHÖNEBERGER SÜDGELÄNDE PARK - BERLIN, GERMANY (2009)

The project is very interesting as it concerns the recovery of an old railway converted into a path through wild nature. History and vegetation are combined together to offer the visitor a sensory and educational experience.



Retrieved from https://www.vogt-la.com/memorial_hannoverscher_bahnhof

MEMORIAL HANNOVERSCHER BAHNHOF - HAMBURG, GERMANY (2017)

The project concerns the recovery of the section of a historic Hannoverscher railway used for the deportation of people during WW2. Here, some railroad tracks have been removed, others not. The traces of those who have disappeared have been reused as a reference for the design of a new route that reminds people of the journey of many deportees to the camps.

The vegetation accompanies this path on its sides.



URBAN PARK AROUND A FORMER GASOMETER - NAPLES, ITALY (2020-...)

The project concerns the recovery of an abandoned urban area surrounding an old gasometer, now unused. The area will be converted into a green space for citizens, while maintaining the ancient gasometer as a historical urban element.

In the 14,000 square meters of park, over 1000 specimens of various native plants will be introduced into the new public space.

During the works there will also be an adaptation of the lighting of the Park with more eco-sustainable devices.

Retrieved from <https://www.napolidavivere.it/2020/12/17/un-nuovo-parco-urbano-al-vomero-riprendono-i-lavori-allex-gasometro/>

Figure 112. Reference projects for space design in the Waalhaven area.

TRANSFORMATION OF A WASTESCAPE - HEIJPLAAT



Figure 113. Transformation of an abandoned wasteland into a community garden with plants suitable for Phytoremediation.