

GROWING SOCIETY

report

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ABSTRACT

In this thesis report, research and landscape architecture design are integrated to formulate guiding principles to combat environmental and social issues in urban areas through the case-study of Lombardijen, a neighbourhood in the south of Rotterdam.

In the recently published 'Intergovernmental Panel on Climate Change' climate report, the overall expectancies of climate change is expected to increase world-wide, with temperature rise as main pillar to cause intensifying weather conditions, sea level rise, draught, ocean acidification and flooding.

These negative consequences of climate change are found to have an often amplifying effect on already existing inequalities based on asymmetries in power, showing great inequality in the levels of preparedness and ability to deal with climate change effects.

In the city of Rotterdam problems with flooding, draught and biodiversity loss, as well as problems with social inequality, a lack of social cohesion and a high demand for new houses put pressure on existing spatial structures. The neighbourhood of Lombardijen, in particular, is one of the cities post-war extensions based on garden-city principles. A once loved neighbourhood is now suffering from poor housing quality, lack of social integration due to fast changing demographics, large underused green spaces due to a lack of programming, poor ecological value due to monotonous vegetation and problems with water management. With the added demand for densification and the development of new houses, a new strategy needs to be made to bring the neighbourhood towards a holistic future.

Through the application of agroecology principles, possibilities are created for the improvement of environmental and social issues. Agroecology is an approach for the design and management of food and its production, as defined by Food and Agriculture Organisation of the United Nations. It integrates ecological and social concepts, and seeks an optimization between plants, animals, humans and the environment through the diversification of landscapes, efficiency in the use of resources and the formation of strong community links that ensure possibilities for collaboration.

By introducing the model of an agroecological farm, the neighbourhood of Lombardijen gets the opportunity to receive direct valuation of its public space and communal infrastructure. Farmers hired by the municipality take on the responsibility to care for the public spaces in collaboration with the inhabitants of the neighbourhood. The integration of food production benefits self-sufficiency, social cohesion and mobility for humans, as well as biodiversity through the ecological principles of agroecology. Also water management (through habitat creation), alternative food production and spatial quality are improved due to programming, activity and feelings of ownership.

The design of the neighbourhood and the overall strategy is based on the hierarchical structure of the original design of Lombardijen garden city.

The application of agroecology and the elaboration of the aforementioned model shows the possibilities for the improvement of social and environmental issues through public spaces design.

keywords: agroecology, Rotterdam, social cohesion, public space, urban ecology, urban food production

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1. INTRODUCTION

1. INTRODUCTION

1.1 I want to save the world....

In the recently published climate report by the Intergovernmental Panel on Climate Change, the overall expectancies of environmental changes due to climate change caused by human behaviour have been strongly altered, showing an even grimmer future (IPCC, 2021). Climate change is expected to increase worldwide, with temperature rise (see figure 1) as main pillar to cause intensifying weather conditions, sea level rise, draught, ocean acidification and flooding (IPCC, 2021; Nath et al., 2021).

All these negative consequences of climate change are found to have an often amplifying effect on already existing inequalities based on asymmetries in power, showing great inequality in the levels of preparedness and ability to deal with climate change effects (see figure 2). With the rising effects of climate change these inequalities are expected to rise further, which decreases social mobility and increased social instability (United Nations, 2021).

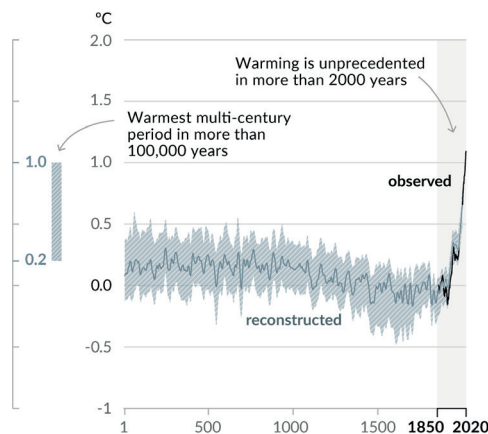


figure1: change in global surface temperature (decadal average) as reconstructed (1-2000) and observed (1850-2020)

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The United Nations 2020 World Cities Report also shows growing levels of exclusion and inequality becoming trends in urbanised areas, particularly stating that for more than two-thirds of the global urban population income inequality has increased since 1980 (2020). With cities and the world population in rapid growth, by 2050 68% of the world population is expected to be living in urban areas (United Nations, 2018). These large changes and changes in societal structures "(...) accelerated by economic structural transformations, shifting age structures in societies, rural-to-urban migration, and rising inequality in income and resource distribution – will exert additional pressures on social cohesion in developed as well as in developing countries" according to Christoph Sommer in his paper for the German Development Institute called Social cohesion and economic development: Unpacking the relationship (Sommer, 2019, p3).

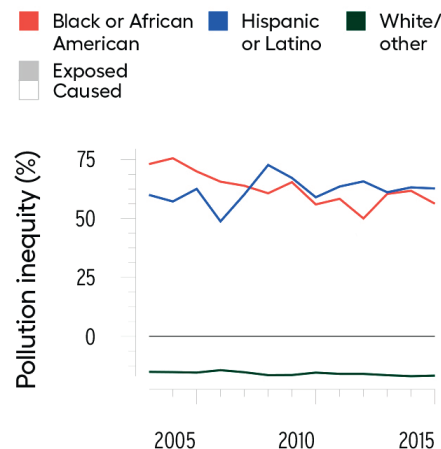


figure2: pollution inequity

Growing up in an urban environment during this tumultuous time, dealing with climate change, biodiversity loss, pandemics, housing crises, financial crises and refugee crises, I want to push the boundaries of what is believed possible in cities to help combat these issues. Discovering the personal wish for a holistic system that is neither cultural nor natural, but one that is thriving in its interconnectedness. Therefore, the bridge and connection between the environmental and the social issues that we face in the world today will be investigated in this graduation project Growing Society.

Growing Society is part of the cross domain design and research lab Urban Ecology and Ecocities (UECL). The lab sits within the chair of Urbanism at the faculty of Architecture and the Built Environment of the Delft Technical University and has a focus on the improvement of quality of life and environmental performance through the lens of urban ecology. Urban Ecology is defined by Richard Forman in his book Urban Ecology: Science of Cities (2014) as "the whole of interactions of organisms, built structures, and the physical environment, where people are concentrated" (Tillie, 2021). The lab focuses on translating ecocity principles and ecological issues into spatial designs and planning through understanding and intervening at systemic level by urban ecosystem restoration and eco components (TU Delft: Chair of Landscape Architecture, 2020; Tillie, 2021).

The goal is to deal with ecological issues and biodiversity, which lie at the heart of a large range of related environmental issues. For example, by compensating biodiversity loss through the integration of more urban green spaces and therefore also benefiting issues like the urban heat island effect, reduction of air pollution and water conservation. Therefore, the goal of tackling ecological issues can be widened to environmental issues which can in general be addressed by interventions towards the limitation of biodiversity loss.

The practice of landscape architecture within this lab specifically gives components of working through scale and time, following natural and cultural processes and systems as well as looking specifically at the spatial experience of the location.

1.2 Case-study

The lab uses Rotterdam as its study location, reacting to the problems within this specific urban territory. Rotterdam as a case study guides the lab's research to actualise global issues into local context. This local context allows further spatial definitions and physical problems that give frame to research through design. The population of the city of Rotterdam is estimated to grow almost 15% between 2018 and 2035 (CBS, 2019), while at the same time having to deal with the effects of climate change. The city will experience a rise in temperature, draught and extreme weather conditions that can lead to floods, see the flooded Koopgoot in the centre of Rotterdam on figure 3 (Gemeente Rotterdam, 2019-a). Furthermore, the National Monitor of Sustainable Municipalities denotes the city to be on the bottom in the ranking based on ecology and social and economic participation (2018). To tackle these is-



figure3: flooding after heavy rainfall in the Koopgoot, Rotterdam

ues, the municipality of Rotterdam has produced "A healthy and green Rotterdam for everyone": their vision for the public space for the period 2019 to 2029. In this vision they set the aim to focus on making the city more green, sustainable, inclusive and with a focus on slow traffic (2019-c). An example of how this can be achieved in the city can be seen on the roof of the Schieblock, see figure 4 of the DakAkker.

Especially the ecological improvements that the city wants to make are researched through the UECL of the TU Delft, offering examples and research into specific areas and topics.

1.3 Problem detection

Through the UECL, I was able to explore the integration of natural systems within the cultural and human environment. Specifically in an urban context: my own context growing up.

Through working on this topic, developing as a landscape architecture student, developing as a human, my wish to save the world became more and more prominent. Our world faces many uncertainties, dealing with the consequences of the changing human-nature relationship. Seeing these problems in our day to day and the relation to our human actions, I not only want



figure4: nature and culture integration on the rooftop DakAkker, Rotterdam

to improve environmental and ecological systems but pushing the idea of what an ecosystem is and our role as human in it. In itself we, as humans, have placed ourselves outside of nature. Differentiating between cultural and natural, between cities and landscapes, placing ourselves outside the global ecosystem. Coming to a time in which we should strive for a balance between human and nature, reintegrating ourselves in the ecosystem. The 10 elements of agroecology will be covered in more detail in chapter 3: Agroecology.

1.4 Agroecology

In my quest to find an answers for tackling environmental and social issues, I was able to find a lecture series called "A Just Transition" organised by Pakhuis de Zwijger (see figure 5). Pakhuis de Zwijger is an independent platform for creation and innovation based in Amsterdam focus on the future of cities and urban environments. With its lecture series "A Just Transition" it explored the social implications of our transition towards a sustainable future, the third lecture called "Feeding the world with agroecology" specifically looked at social and environmental alternatives for our current food system. In the lecture dr. Pablo Tittonell, professor on Resilient Landscapes at the Groningen



figure5: dr. Pablo Tittonell at the Seminar "A Just Transition #3: Feeding the world through agroecology"

Institute of Evolutionary Life Sciences and principal research scientist in Argentina's National Council for Science and Technology, presented his vision of the future of agriculture through agroecology (Pakhuis de Zwijger, 2020).

For me this posed an answer to my questions for the betterment of environmental and social issues and I started a research into agroecology and the urban application of the concept. With agroecology I see potential for improving soil conditions, environmental, social and economic resilience, resource cycles and information exchange.

Agroecology is an approach for the design and management of food and its production, as defined by Food and Agriculture Organisation of the United Nations. It integrates ecological and social concepts, and seeks an optimization between plants, animals, humans and the environment.

Three major themes within agroecology are food security, responsible governance and environmental awareness, highlighting both social and environmental issues and possibilities.

In 2018 the FAO published ten elements for transforming food and agricultural systems to achieve their Sustainable Development Goals, amongst others: diversity, synergies, resilience, co-creation and sharing of knowledge, culture and food traditions, human and social values, recycling and efficiency, responsible governance, and circular and solidarity economy.

Diversity in agricultural crops and business models generates resilience and self-dependency. This is supported by recycling and efficiency which limits dependency on external resource providers. Knowledge on these preferable operations can be shared amongst farmers, to establish as well a recycling and efficiency in immaterial resources. This all operates under a blanket of responsible governance that facilitates healthy processes and supports both social as well environmental circumstances through policies.

1.5 Problem statement

Having established a number of problems the world is facing, there is a need for rebalancing. Finding a healthy relationship between humans and nature, a reintegration into the global ecosystem. Evidence shows that opportunities for social integration, healthy living and environmental betterment in urban locations can be found in the application of Agroecology, which seeks ecological and social improvements through fair food production (Altieri & Nicholls, 2018; FAO, 2018). In this way, steps can be taken to reintegrate in the global ecosystem, becoming once again part of the overall food pyramid.

There is need for changes in our built environment to accommodate this reintegration, as a landscape architect, dealing with public space, natural systems and human experience, there is a possibility to impact and guide this change through the bridging nature of the landscape architectural profession.

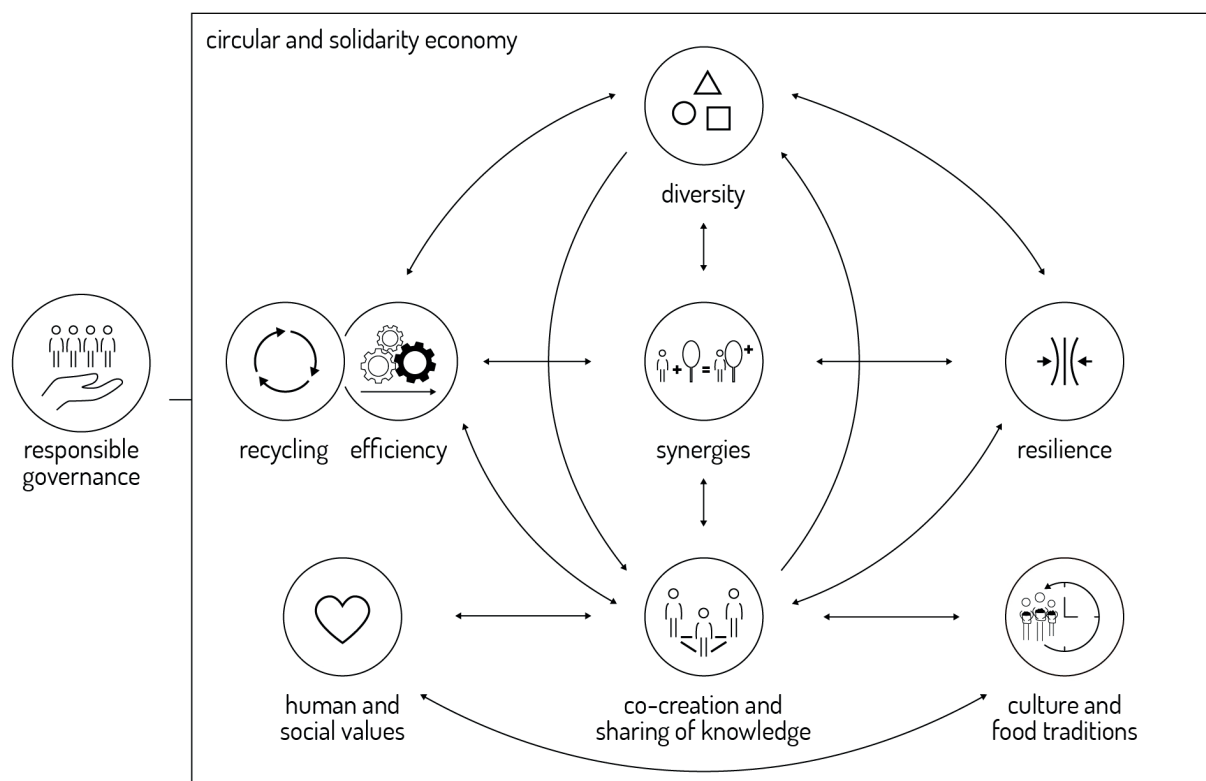


figure6: 10 elements of Agroecology

1.6 Research Question

‘How can a landscape architect tackle environmental and social issues using agroecology in public space design?’

1.7 Methodology

To answer this research question I use three perspectives. Through a case studies, desk analysis and site visitations I look at the environmental and social issues in a spatial context, agroecology is researched in detail on theory, practice and organisation through literature research, a masterclass and reference projects. Public space design is looked at

from theoretical level from literature research. These sources of knowledge establish goals, input and criteria for experiments following into the design and the implementation of the project. Out of the design, recommendations are then condensed to form a base for reapplication and reflected in the conclusion. This structure is visualised below in figure 7.

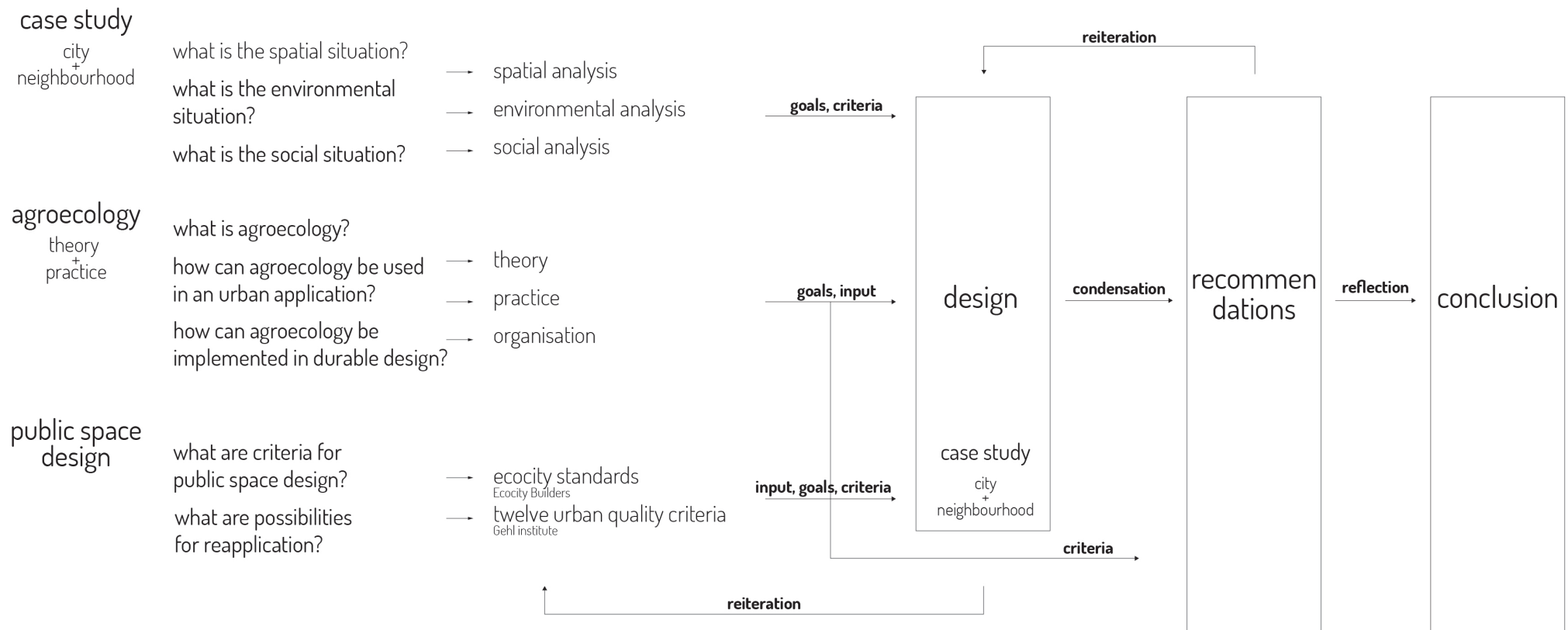


figure7: research design

2. CASE-STUDY

2. CASE-STUDY

First, to give background on the case study, the storyline of Rotterdam will be explained. Afterwards, a spatial, social and environmental analysis is done, and future developments of Rotterdam will be touched upon. Second, I will zoom in on Lombardijen, the case study and design area, and discuss its storyline and the analysis into the current condition. This will serve as a base for design experiments.

2.1 Rotterdam storyline

The Rotterdam area is situated in the Rijn-Maas estuary, around the rivers connection with the North Sea. This location and its development has great influence on the current social, spatial and environmental identity of the city.

2.1.1 Rotterdam pre-historic development

The Rotterdam area was a complete tidal landscape, where the tide and the flow of the rivers created valleys by erosion and sedimentation at the meeting point between tidal salt water and river fresh water (Palmboom, 1987) (figure 8). On the northern parts main mass was formed due to protection from the sea by beach walls and low dune formation. Also, there was peat formation through the establishment of tidal swamp forest areas. The created masses formed a



figure8: pre-historic development

system of land-plates and streams affected by tidal influences.

The area encompassed peat bogs, estuarine, wetland habitats and spontaneous free play of species was present.

2.1.2 First human interventions

When urbanisation started, flooding events were affecting the land, threatening urban settlements, in other parts of what is now the Netherlands, that have been established on sand ridges.

During this time, Urban and human influence is slowly expanding in periods of relative stable land conditions. Humans started using natural process to claim the land and peat areas where drained by the use of ditches to create arable land.

Due to the drainage of this peat the land started to subside causing many floods. People had to build river dykes and coastal dykes for protection against water surges from the sea and the Maas river. Due to the protection offered by the dykes, the farmers were able to use the land permanently. Around this time the windmill was introduced as a mechanical intervention that could drain the land much quicker. The first peat polders where constructed and are characterised by long ditches in the landscape (see figure 9).

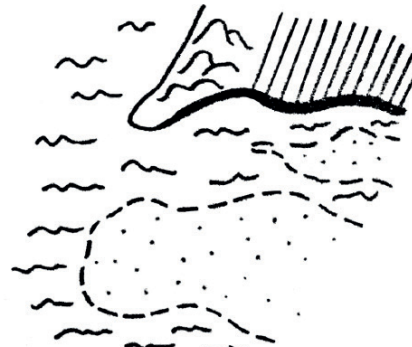


figure9: first human interventions

2.1.3 City development

Within these peat polder the beginning of the urbanisation of the city was marked by the construction of a dam in the 13th century on the transition between the small river Rotte and the river Maas. This dam stopped tidal water from continuing up the small river (Palmboom, 1987).

The loss of tidal influence landscapes along this small river affected the influx and outflux of species. The construction of the dams resulted into a change in salinity of the river and also blocked the direct connection between the rivers and the sea, but therefore making it safe for human habitation.

The dam marked a spot for trades people, sailors and fishermen to settle forming a growing development and the extension of the ports till the 19th century. The extension combined with the canalisation of the river Maas towards the North Sea and industrialisation of the German Ruhr-area, increased the possibilities for use for international trade, both towards the sea and inland. This allowed the harbour and therefore the city to grow fast and big. New workers that moved away from the countryside in the Netherlands and Belgium to work in the harbours were housed in mostly cheap and small houses making for very dense residential urban neighbourhoods (Romein, n.d.).

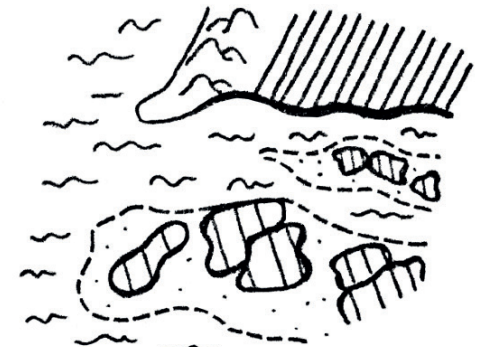


figure10: city development

In the areas around the growing city, the peat in the polders on the north side gradually subsided due to the drainage needed to use the land, and over time due to the harvesting of peat polders to generate fuel from turf. The turf allowed for steady heating for the growing urban areas in the South of Holland but left large lakes, unable to be further drained to reclaim. This made for the landscapes current look of large open meadows with a dense pattern of ditches and dispersed lakes, threatened by development of housing and in the green revolution by the development of greenhouses.

2.1.4 South bank urbanisation

On the south side of the river Maas the development was moving much slower, the lack of protection from the sea by dunes caused the land to be very vulnerable. Large floods wiped out many settlements on the south, leaving only larger strongholds like the city of Dordrecht (Palmboom, 1987).

This land was finally polderised in an island-like structure, spreading from one point through the clay landscape (figure 11). These clay polders were deeper than the peat polders, but needed less ditches and had less difficulty with drainage (Palmboom, 1987).

The sea clay polders created large fertile areas with



figure11: south bank urbanisation

many minerals placed by years of tidal influence. This valuable arable land is protected by large dams that needed to protect the people from extreme flooding, but also the land from salinisation. This created a landscape that is a (often not so amicable) combination of open tidal areas and sea-clay polders with an agricultural function, industrial and residential areas.

Only in the second half of the 19th century the harbour was extended on the south bank of the river (figure 12), bringing dense and chaotic housing for the fast increasing group of harbour workers.

2.1.5 Rotterdam in the 20th century

The south developed steadily up until the second world war, after which the housing shortage and the want for cheap housing put pressure on these urban extension (Tillie et al., 2016). A vision for Rotterdam was made which combined modern Europe characteristics and the industrial city, including "large boulevards (Coolingsingel), representative buildings, passages, urban streets and squares, plenty of space for entertainment and culture, and an orientation to the world" (Tillie et al., 2016).

During the second world war development took a standstill, with bombardments destroying large parts of the inner city resulting in the build of solely emer-

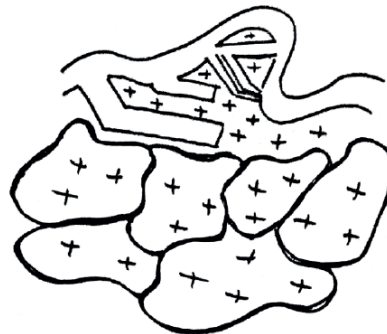


figure12: Rotterdam in the 20th century

gency housing. After the war, the city was rebuilt with the main priority to restore and later on extend the harbour. The harbours were extended towards the west, making Rotterdam the number one port in the world from 1962 (Tillie et al., 2016).

Plans for the rebuilding of the inner city resulted in a low density landscape following modernist town planning and strict spatial separation of function, making it an area with mainly shops, department stores, offices and some cultural venues (Romein, n.d.)

The post-war housing crisis also asked for the expansion of the city and the building of many new houses. These neighbourhoods were based on the modernist garden city design principles and designed with a wish to integrate the former natural character of the areas they were expanding into. During this time, the pré-war densely built residential areas deteriorated immensely, calling for a large scale urban renewal programme that was started in 1974 and took around 20 years (Romein, n.d.).

When the port was booming and the economy was strong, guest workers from Italy, Spain, Turkey and Morocco were attracted to work in the harbours. These groups settled in the south of the city in the newer and older working class neighbourhoods.

In the 1980s the strength of the Rotterdam port



figure13: Rotterdam towards the future

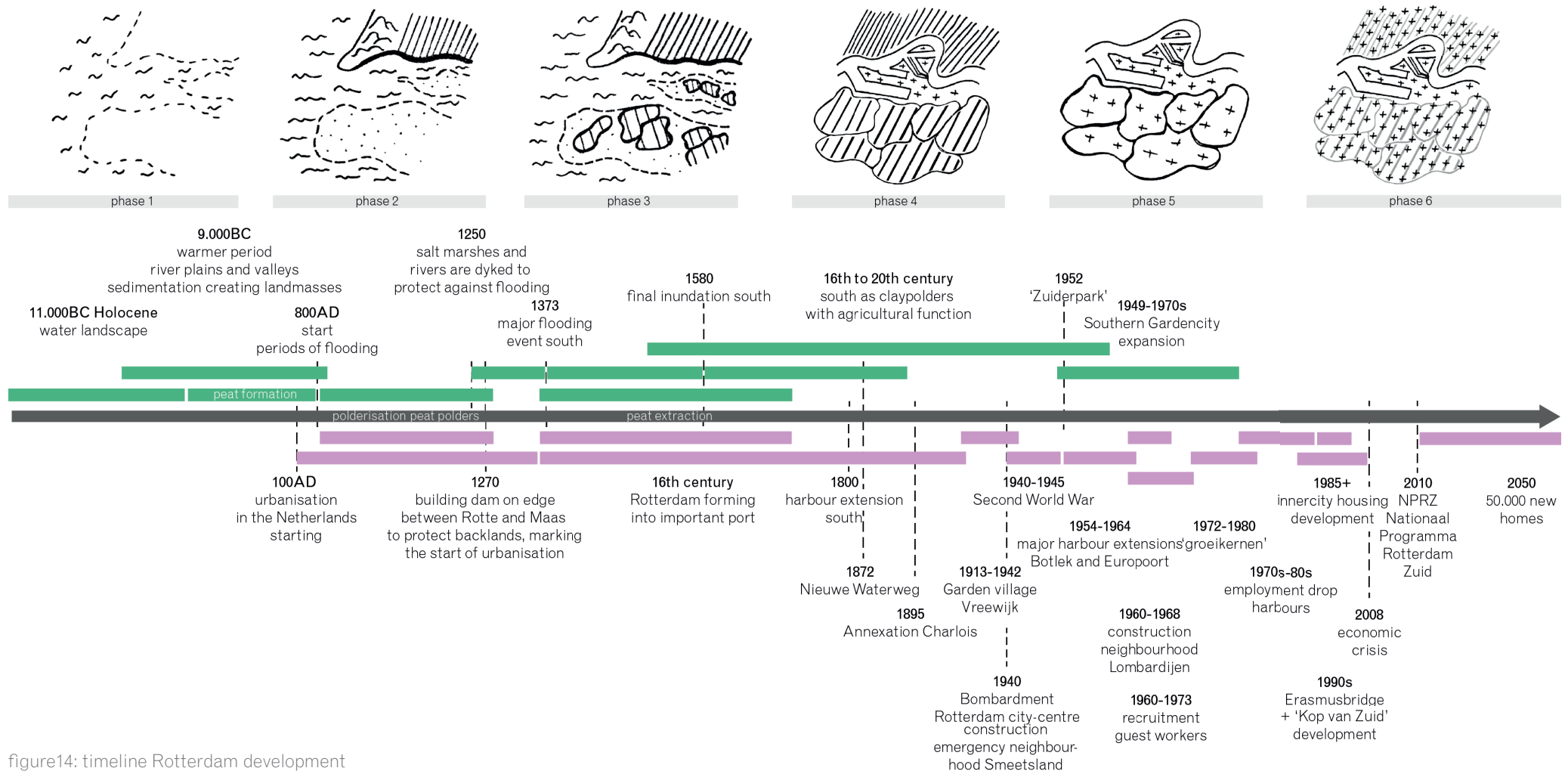


figure14: timeline Rotterdam development

started to shift, an oil crisis marked the end of prosperity. At the same time the port moved westward to facilitate bigger sea vessels with larger harbours and larger facilities. These large facilities were operated through automated processes and the use of containers, which resulted in a drop of employment opportunities (Tillie et al., 2016).

Another development was the appointment of the so called 'groekernen', small towns around Rotterdam were appointed as space for the city region to

grow through satellite cities. This loss of economic prosperity, the loss of job opportunities and attractive satellite cities for richer inhabitants left the south of Rotterdam with growing social problems, poverty, housing in poor conditions and social segregation (Tillie et al., 2016).

There is a shift since 1980 from the quantitative expansion of housing to the qualitative improvement of the city (Romein, n.d.). Rotterdam is working towards a (literally) heightened profile with high-profile pro-

jects of modern high-rise buildings and extending the residential programme of the city centre.

Part of the quality lift is the 2005 Groenplan for the improvement of the green structure of the city and with that raising its attractiveness. The plan describes the green-blue structure of Rotterdam to be shaped around a radial structure on the north side of the Maas, this structure is based on the Schie, Rotte rivers and the Ringvaart canal that form the major ribbons going from the outside of the city towards the

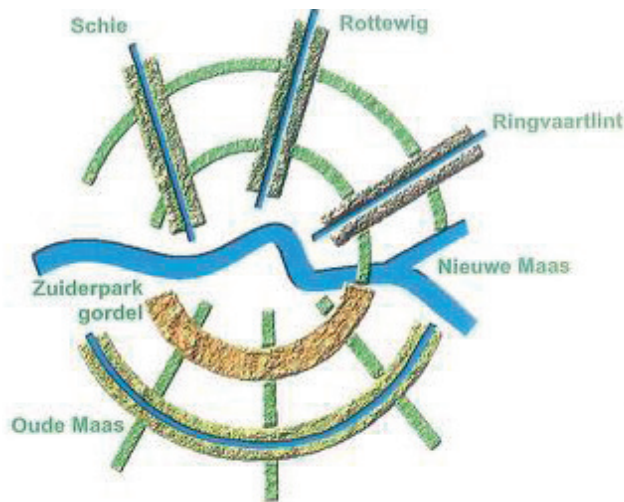


figure15: fundamental urban green structure in Rotterdam based on natural systems supplemented by cultural layers

centre in a north-south direction. On a smaller scale these ribbons are connected through the 'Singels'.

On the south side the green structure is based on half rings in the east-west direction, these rings follow the old dyke structures of the sea clay polders and are located along the old Maas and the Zuiderpark (see figure 15) (Tillie, 2019).

There is still an important task in connecting the half-rings on the south side to form a strong structure (De Greef, et al., 2005). Possibilities to do this can be seen along large infrastructural lines like the highways and train tracks (see figure 22 on page 20).

Despite these efforts for qualitative improvements, the south side of the city can't escape its problems. In 2010 national politics interferes, asking for a large scale analysis of the areas problematic. The rapport is published in 2011 and is called '*Kwaliteitssprong Zuid: ontwikkeling vanuit Kracht*' (Quality Leap on the south: development from strength). Major problems are identified and a national programme is deemed needed

to solve the 'un-dutchlike' socio-economic problems resulting in the Nationaal Programma Rotterdam Zuid (NPRZ, 2017).

FIVE PERSPECTIVES

THAT GIVE DIRECTION TO THE CITY WE WANT TO BE



figure16: five perspectives of the Rotterdam Vision for Public Space 2019-2029

2.1.6 Rotterdam towards the future

With Rotterdam moving towards the future, the municipality has established 5 perspectives that give direction, namely circular, health, inclusive, productive and compact (figure 16). Compact due to the plans of the municipality to add 50.000 houses in the coming decades to combat a housing crisis. They aspire to mainly actualise these houses by densifying and developing around infrastructure and in former port areas.

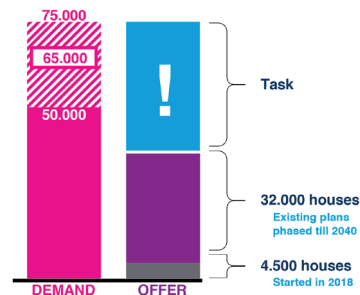


figure17: development exploration requirements

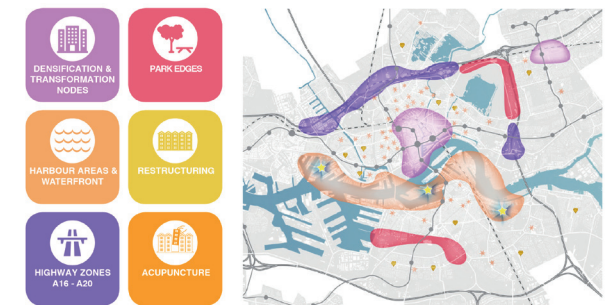


figure18: development exploration strategies

There is a focus on a rising demand for houses for middle to high income households, social risers and young professionals. Besides the large building assignment there is a task for the improvement of the quality of the existing housing stock. This is mostly immediate for the regions connected to the Nationaal Programma Rotterdam Zuid.

The goal is to improve the balance between different social classes on a neighbourhood scale to improve opportunities for personal development within neighbourhoods.

On a city scale, the new developments will adhere to 20% social housing, 30% middle range housing, 30% higher range housing and 20% top range housing. This is meant to improve the balance.

More specifically, the focus needs to be on the middle and higher range to alleviate problems for smaller households, recent graduates, elderly and others that are only just above the social housing range.

The municipality also wishes to improve public space, focusing on meeting spaces, relaxation and sport, green spaces, shops, community facilities and good transport links (Gemeente Rotterdam, 2019-b).



figure19: Green structure constricted by development

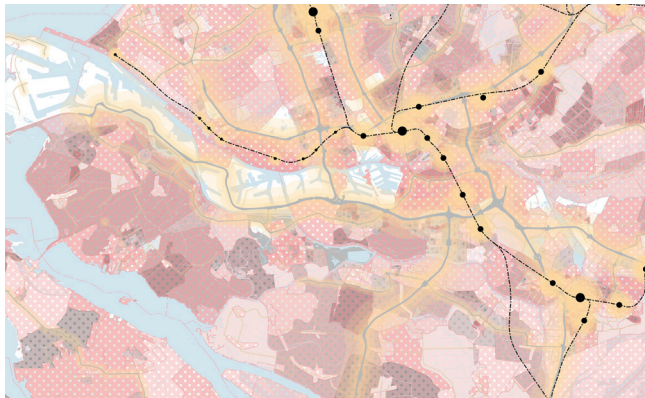


figure20: percentage high income vs. WOZ-waarde houses and high connectivity throughout the region

2.2 Rotterdam analysis

2.2.1 Rotterdam spatial analysis

The city is based around the river Maas, of which both sides holding a part of the urban environment.

There is a strong contrast between the two sides: a dense urban fabric in the north and patched structures in the south coming from the steady inundation from the former marshlands in the north.

Other differences can be seen articulated in the Groenplan of Rotterdam, with the north along radial lines and the south on tangent lines, the opposites are missing on both sides (figure 34).

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figure21: stepping stones

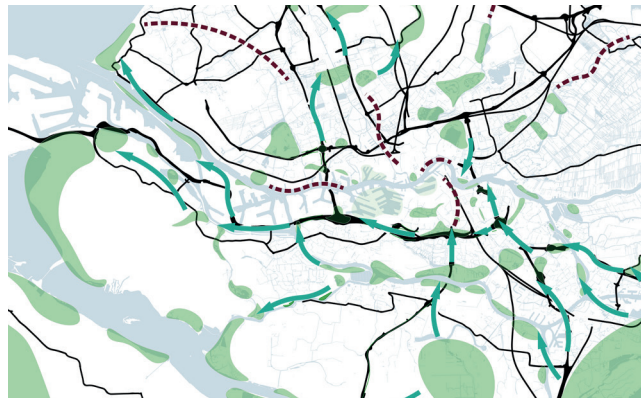


figure22: eco-corridors along infrastructure

2.2.2 Rotterdam environmental analysis

The area is varied in ecotopes in clay and peat polders, outer dyke areas, the river delta and highly urbanised zones. Among these ecotopes there forms a structure of stepping stones, connected through corridors around water and infrastructure (see figure 21 and 22). Within the cities there is little valuable green spaces and you see holes in the structure (figure 19 and 22), this causes a lack of biodiversity. Furthermore, the lack of green spaces is cause for urban heat island effect (figure 23).

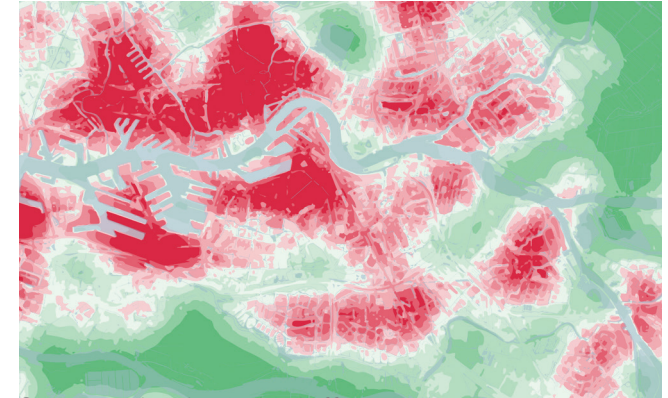


figure23: urban heat island effect



figure24: 2005 Groenplan Rotterdam in context with missing links

2.2.3 Rotterdam social analysis

When looking at the social analysis, you can again see a strong division between the north and south, with the south hosting the most social houses and the north as main desired living area, there is class segregation (see figure 20). On top of this, social housing is under threat due to plans by the government to transform these houses into a higher segment to generate a wider distribution of typologies. Finally you see a lack of social cohesion by this segregation and the lack of investment made in their living environment by the inhabitants.

2.3 Neighbourhood zoom-in

There are large differences between the north and southbank in their development through time, resulting in large spatial and social differences. With the main social issues and great possibilities in large public spaces mainly focused on the south side of the Maas, the project will focus more towards this area. Specifically the neighbourhood of Lombardijen, which is nestled strongly within the infrastructural network (see figure 25).

2.4 Lombardijen storyline

Lombardijen is a neighbourhood in the south of Rotterdam and houses around 14.000 inhabitants in around 7500 houses. The neighbourhood was constructed after the second world war as part of a strong reaction to a housing crisis. The neighbourhood is part of the larger district of IJsselmonde.

2.4.1 Land formation

The location of Lombardijen lays on the south side of the river Maas and as previously mentioned, this area was much later developed. Locked in between

the different riverarms and creeks, the landscape on the south was much more vulnerable to the tidal and river influences. Throughout the early middle-ages in periods of calmness small steps towards consolidation were made, but during a disastrous weather event in 1373, the entire polder was flooded.

For the next 150 years the sea and rivers had free reign over the area, depositing clay and sand on the former peat-landscape and giving its still existing soil-composition of dense clay, deep in the ground. In the end, the polderisation was done in small pieces, spread throughout the area from higher soil patches



figure26: Lombardijen 1850



figure28: Lombardijen 1938



figure25: Lombardijen in Rotterdam



figure27: Lombardijen 1900

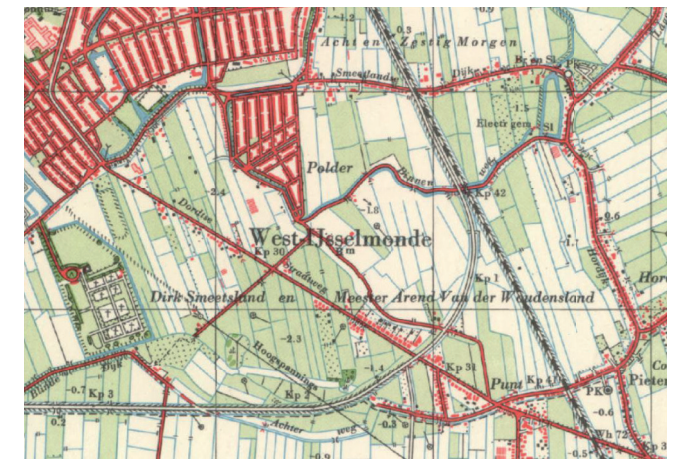


figure29: Lombardijen 1958

and remnants of the old poldersystem, finally completing the consolidation in 1580.

Three hundred years later the harbours were extended on the south, marking the start of the urbanisation of the area (Palmboom, 1987).

2.4.2 Agricultural polder landscape

Lombardijen is part of the IJsselmonde polder, one of the bowl-shaped polders that formed from the spreading pieces of consolidation. In this time the clay-polder had an agricultural function with cattle and cereals (Stichting Oude Kern Rijsoord, 2001). The polder is crossed by the Dordrechtsestraatweg and later by the traintracks connecting Rotterdam with Dordrecht (see figures 27 and 28). This connection with the city of Rotterdam gave the polders on the south side of the Maas a great importance for supplying the growing city with food.



figure30: southern garden-city plan

2.4.3 Urbanisation of Rotterdam South

In reaction to the growing need for workers for the port of Rotterdam, the city annexed the municipality of Charlois in 1895. Building in this area the neighbourhoods Afrikaanderwijk, Bloemhof, Tarwewijk, Carnissebuurt and Charlois, which were dense neighbourhoods with monotone streets and bad quality houses. The neighbourhoods were not a success and attracted only the newcomers to the city that were desperate for housing.

Just before the second world war the last pre-war neighbourhood, Vreewijk, was built just north of what is now Lombardijen. This neighbourhood followed the idea of garden villages which marked the start of modernist planning in the city and the adoption of garden city principles. Garden villages are were urban neighbourhoods with green and rural characters. This development made the edge of the city leaving Lombardijen still on the outside of the city as agricul-

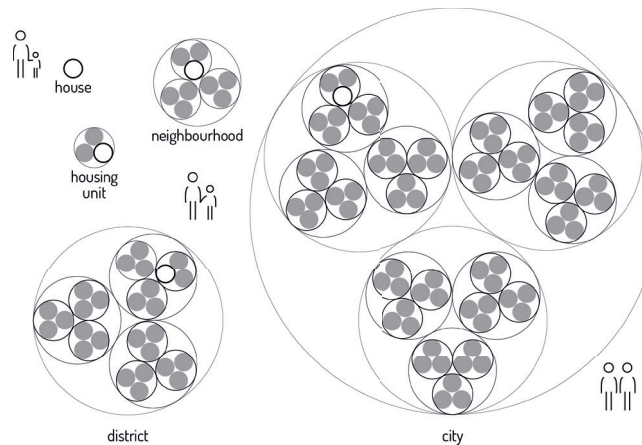


figure31: 'wijkgedachte'

tural area, see figure 26. Changing this somewhat by the emergency housing units placed on the north of the area in 1940 after large bombardments destroyed much of the city-centre of Rotterdam, see figure 29 (Zweerink & Hage, 2005).

2.4.4 Post-war extensions

Even though the second world war halted any physical development, planning was already in process to the city with the growing ambitions for the port of Rotterdam.

Mindful of the ever expanding city and the infringement of the green spaces around the city, plans were made to extend, in a similar fashion of the garden village Vreewijk, with the aim to integrate the urban and rural characters of the areas. Now fully designing with the modernist garden city principles originating from English urban planner Ebenezer Howard.

Many plans were made throughout the years, moving



figure32: the composition of Lombardijen with different sub-neighbourhoods

from the idea to create seamless transitions between the old and the new towards independent neighbourhoods that broke from the dense industrial pre-war environments and wanted to offer reprieve to the working classes, offering complete functional separation.

With this, plans for three neighbourhoods were made, the neighbourhoods of Pendrecht, Zuidwijk and Lombardijen. Only later in the development the municipality realised the need for even further development and started making plans for a large neighbourhood on the other side of the train-tracks called IJsselmonde. See figure 30 for the entire plan for the southern garden cities of Rotterdam.

The 'wijkgedachte' is the idea to create a physical and spatial hierarchy between housing units, to optimize the connections and relationship between inhabitants. The hierarchy forms around a layered structure from the house, to the neighbourhood, to the city and is used to provide a sheltered and protected relaxed living space (figure 31). In Lombardijen specifically the idea of a social training territory was added, meaning the use of the hierarchical structure to level the different interactions and therefore creating a training space for life.

There was a special focus for the future adults, the children, that had specific spaces for play and learning within the structure, reaching from playing areas in the communal gardens for the smallest and areas for the older children further away (Zweerink & Hage, 2005).

2.4.6 Concentric design

In comparison with Pendrecht and Zuidwijk, which were designed at the same time, the neighbourhood of Lombardijen has a lower building density and on average larger housing units. The design was made by designer Peter van Drimmelen and is based on a clear concentric structure with the infrastructure and

green structure as main guiding features (figure 32).

In the centre of the neighbourhood there is a central park area with all overarching functions. Around this, seven sub-neighbourhoods are separated by large green spaces with dense vegetation with a wild character to give contrast with the green spaces within the neighbourhood that are designed as community gardens. These community gardens have open and park-like vegetation, keeping open spaces for connections and view lines (see figure 38).

The infrastructure give clear structure through one ring around the central park and one circular line connecting almost all neighbourhoods more on the outside.

All the neighbourhoods have their own central neighbourhood parks and facilities, coming together in the central park area in which all the overarching functions are housed.

2.4.7 Changing demographic

Section 2.1.5 explains more on the general changes the city of Rotterdam went through during the second part of the 20th century, in Lombardijen this had great effect. The satellite city program pulled people away from the city, while cheap labourers were brought in to take on low paying jobs.

The large amount of cheap housing with no opportunity for growth within the neighbourhood caused a gradual run off of people and a lack of integration with new comers and between groups of different cultures.

Over the years the Lombardijen grew to be suffering from the heightened mobility lessening the need for neighbourhood based functions and the lack of use of communal green spaces due to outdated programme and the isolation of these spaces because of problems with routing and access. The ballooned use of cars and the needs for parking put pressure on the public space.

2.5 Lombardijen future

2.5.1 Densification

Densification and changing housing compositions As stated before, Rotterdam has plans to build 42.000 new homes by 2030 and 50.000 new homes by 2040. In their vision they want to focus on six principles for development: densification and transformation at nodes, park edges, harbour areas and the waterfront, transformation and redevelopment of existing built up areas, infrastructural zones near the A16 and A20 highways and through unpunctual interventions to maintain spatial qualities in specific areas (figure 33). The city being in need for both high-density urban living environments and quiet green urban living environments for families.

For these new housing project, the municipality of Rotterdam aims to reach a balance in living forms. A large portion of the current housing market is social housing, the municipality wants to strive for 20% social housing units, 30% middle-range units, 30% higher-range units and 20% top-range units. To get to

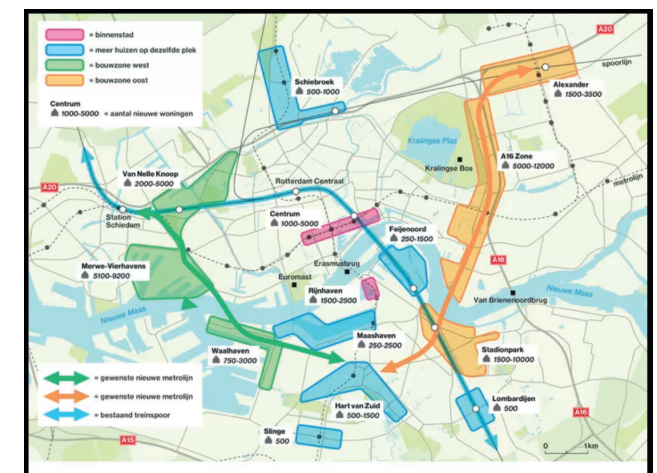


figure33: exploration development approach

this balance there is a city-wide task to focus on the middle and top range units with a specific focus on smaller households like starters and elderly and on families just above modal incomes (circa € 38.035 to € 55.000 per year (1-1-2019)) (see figure 34 and 35).

Specifically for Lombardijen, it will entail densification along the railway and near the train station planned for the period between 2025 and 2040. Station Lombardijen will be part of an important new development in railway intensity. The municipality strives for metro-quality connections on the Oude Lijn, the railway between Leiden and Dordrecht. This improvement in mobility gives chances for new inhabitants that want to be well connected on a local and regional level.

Through a scenario-plan by the municipality into the location of development and densification there are an expected 500 new houses to be built for 2040 in the neighbourhood of Lombardijen. As a mixed green urban district there should a focus on adding houses at the top of the middle-range housing units and a small

addition of low middle-range housing units.

2.5.2 Public green space

The national government has given municipalities a guideline number of 75 m2 of green space per home in their Spatial Planning Memorandum for new-build locations (Rijksoverheid, n.d.). Looking at Lombardijen and the amount of green space, the neighbourhood is scoring well.

Considering the total surface of the neighbourhood to be 262,5 ha and the total public green space to be 94 ha, the 7340 households each have 129 m2 of public green space to their disposal. With plans of the municipality to add 500 new houses to the neighbourhood by 2040 the new amount of households will be 7840, making it 121 m2 per household.

However, from the municipal plans for the Meerjaren Investeringsprogramma Buitenruimte 2006-2020 (Multi-year Investment Program Outdoor Space 2006-2020), Rotterdam wants to reduce the amount of public green space in garden city neighbourhoods

by 20%, due to undervaluation by inhabitants and the municipality being unwilling to pay the high maintenance costs (Lobée, 2006). Due to the fact that this specific plan hasn't been made public, there is now knowledge on the actualisation of these wishes. It does however show an absolute undervaluation of the public green space in garden city neighbourhoods and the resulting unwillingness by the municipality to pay its high maintenance costs.

This reduction of 20% would result in the total public green space of 76 ha and making it 96 m2 per household, which would still be well above the minimum of 75 m2 green space, but doesn't consider the role of the neighbourhood within the city as many other neighbourhoods do not have access to large amounts of green spaces near their homes. But based on these plans, objectively there would be an overhead of around 16 ha of green space in the neighbourhood of Lombardijen, which originally was 36 ha.

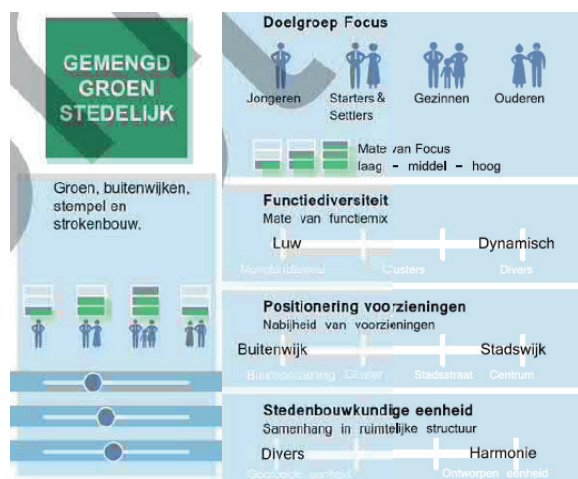


figure34: target audience

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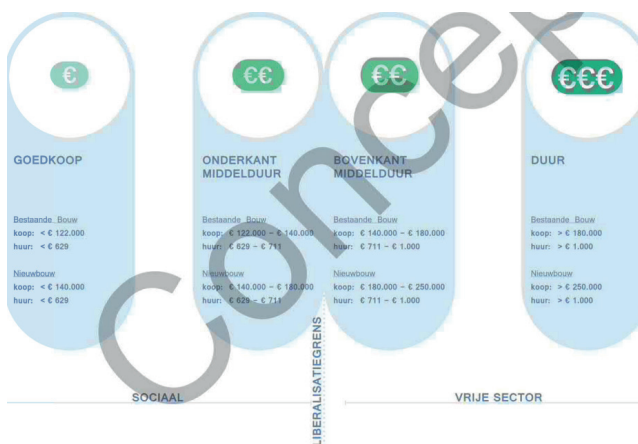


figure35: focusmarket

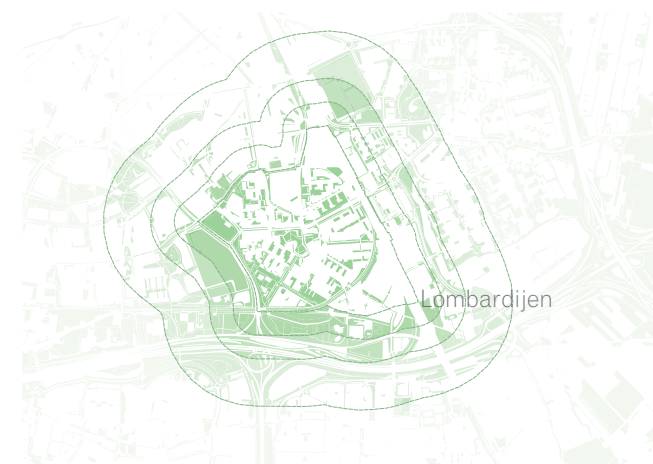


figure36: public green space Lombardijen

2.6 Lombardijen analysis

2.6.1 Spatial analysis

The design of Lombardijen is based on the 'wijkgedachte'. It includes large green spaces and open building structures. There is a great variation in housing typologies, such as row houses, free standing villas, open building blocks and apartment blocks (see figure 37). Remarkable in Lombardijen are the closed façades, the backsides of houses and closed garden fences along public spaces.

2.6.2 Environmental analysis

As mentioned earlier, Lombardijen has a great amount of green space. However, there is little variation in these green spaces, namely, mainly lawns and some wooded areas are present. Urban habitats are created through buildings and gardens. Yet, the water structure needs to be refined to allow for more ecological impact.

2.6.3 Social analysis

Figure 39 shows the neighbourhood profile with the physical, safety and social index of Lombardijen, this index is based on a range of factors and created by the municipality of Rotterdam. For the physical index the municipality look at houses, public space, facilities and the environment. The safety index encompasses numbers on theft, violence, burglary, vandalism and nuisance. Lastly, the social index is based on information on self-sustainability, co-reliance, participation and connectedness.

On average the numbers in Lombardijen are around average, but with a discrepancy between the objective and subjective measurements with often objectively higher scores than subjectively.

Looking at figure 40 a representation of the index development of Lombardijen between 2018 and 2020 can be seen, showing a negative balance in terms of safety and social. There is only a small improvement in the physical index.

The neighbourhood consists mostly of housing/build-

ing function is most often housing, resulting in very little jobs in the area. Over half of the houses is owned by a housing cooperation and there is a large run through, as people do not live/stay long in the neighbourhood. The population varies widely in terms of cultural background, but is not varied in social class.

The development question present is not easy, as there are many factors that need to be combined, but are not easy to be combined. These are: the varying cultural backgrounds, little activity in and use of the public green spaces.

Looking at the social status of Lombardijen in comparison with Rotterdam, a few interesting differences are brought forward. Lombardijen houses a relatively large percentage of inhabitants aged 65 and older (see figure 41), which are mainly housed in larger complexes and towers for the elderly with in built care facilities. Recent numbers from the Adults and Elderly Healthmonitor show that 61% of elderly are suffering from moderate to severe loneliness in the district of IJsselmonde (Gezondheidsmonitor Volwassenen en

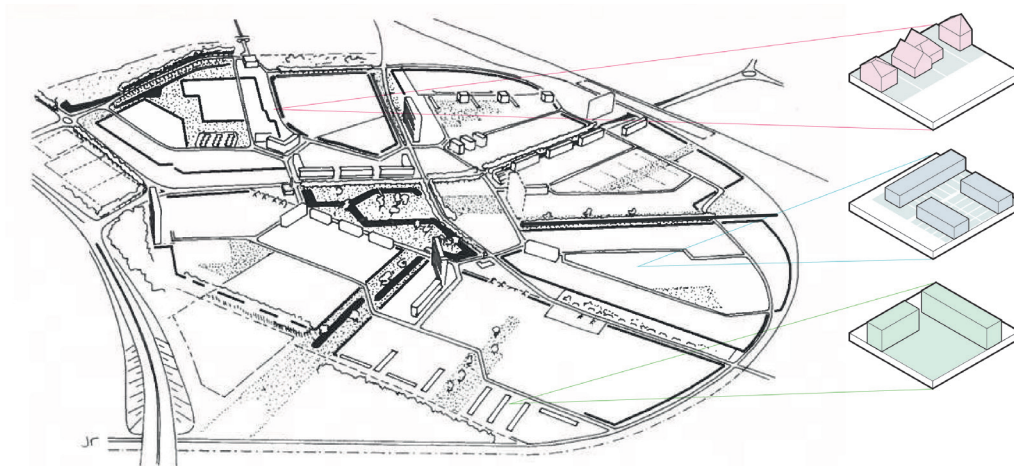


figure37: spatial configuration

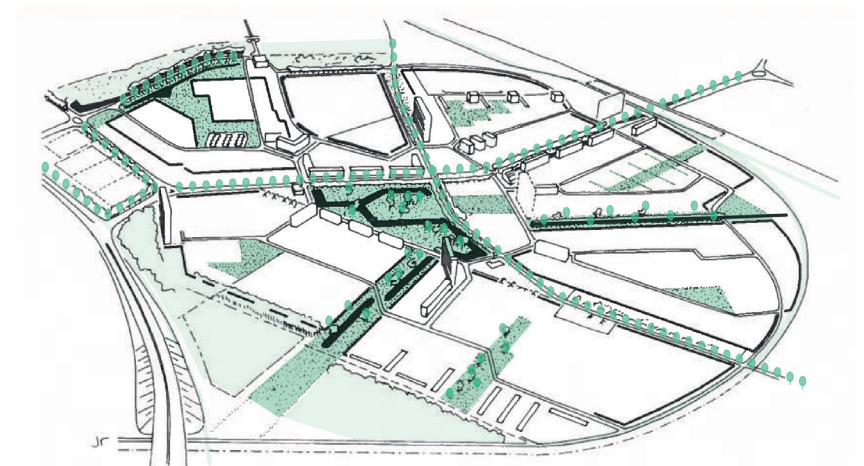


figure38: green structure

Ouderen, 2020). This shows a need for the inclusion of this group and the importance of social cohesion to prevent these situations.

Another topic for discussion is the current housing stock. Almost 50% of the houses are social housing, which is slightly higher than the average in the whole city. This shows opportunity for larger scale redevelopment, but also in combination with the lack of diversity in the quality and price range of the houses a danger of large run-through of inhabitants as well as a very limited vertical social structure. This is supported by the current numbers of the households (see figure 42), which show more than half of the inhabitants have a low income, these numbers and the comparison with the whole of Rotterdam indicate financial segregation.

Considering the plans of the municipality to re-

range housing value ratios, there will be a large need for the replacement of the low value houses (see figure 45) for the higher value, both threatening the ability for current inhabitants to stay in their neighbourhood as well as giving opportunity for personal growth within the neighbourhood.

Finally an important number to highlight is the delegation of persons of a non-western migration background stands out (see figure 43). In general Rotterdam is a highly multicultural city, benefiting from a rich variety of cultural influences. However, without proper opportunities for interaction, these differences in culture and background can have a negative effect on social cohesion.

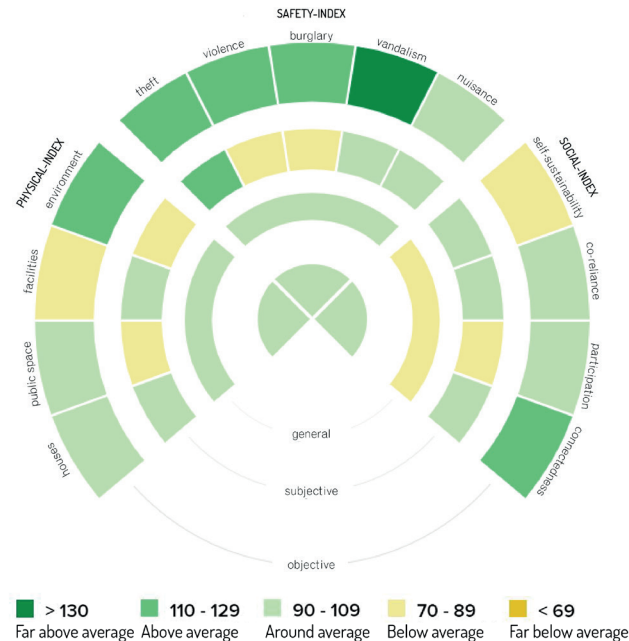


figure39: the physical, safety and social index of Lombardijen

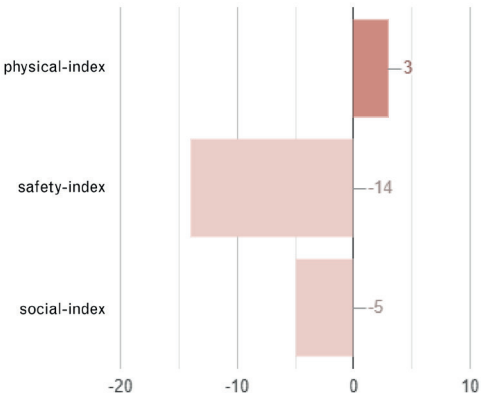


figure40: representation of the index development of Lombardijen between 2018 and 2020

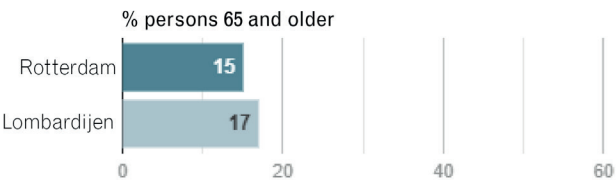


figure41: percentage of elderly inhabitants

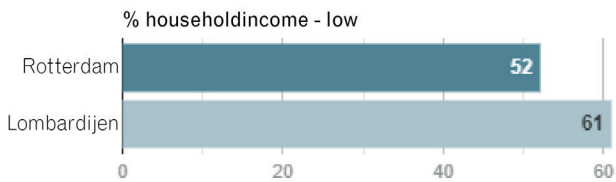


figure42: percentage of low income households

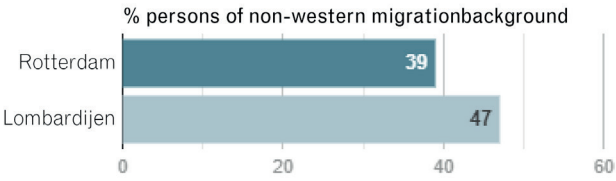


figure43: percentage of inhabitants with a non-western migration background

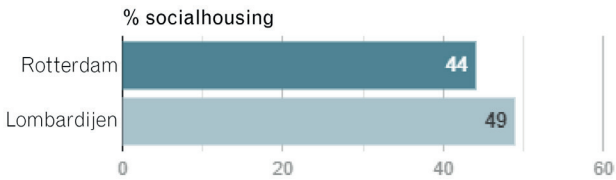


figure44: percentage social housing units

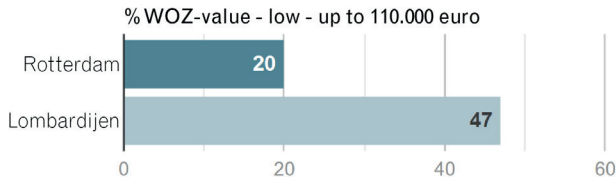


figure45: percentage low real estate value

2.6.4 Built environment

A large part of the current housing units are in need of modernisation. Figure 46 shows the diagnosis of development urgency of Lombardijen. Opportunities for high density development, in line with municipal planning, can be found around the public transport station. On the south east side of the neighbourhoods there is need for transformation, and giving the possibilities, it could be suitable for single family houses with higher density. Also, the sub-centres are in much need for development as they are in disrepair and in need for new functions. These parts of Lombardijen are depicted in figures 47 through 51.



figure46: development urgency diagnosis



figure49: Zenobuurt, back-sides of gardens on community park



figure50: Zenobuurt, inactive façades on the Zenostraat



figure47: Molièrebuurt, small poor quality housing units



figure48: Molièrebuurt, inactive façade



figure51: Zenobuurt, single-family homes

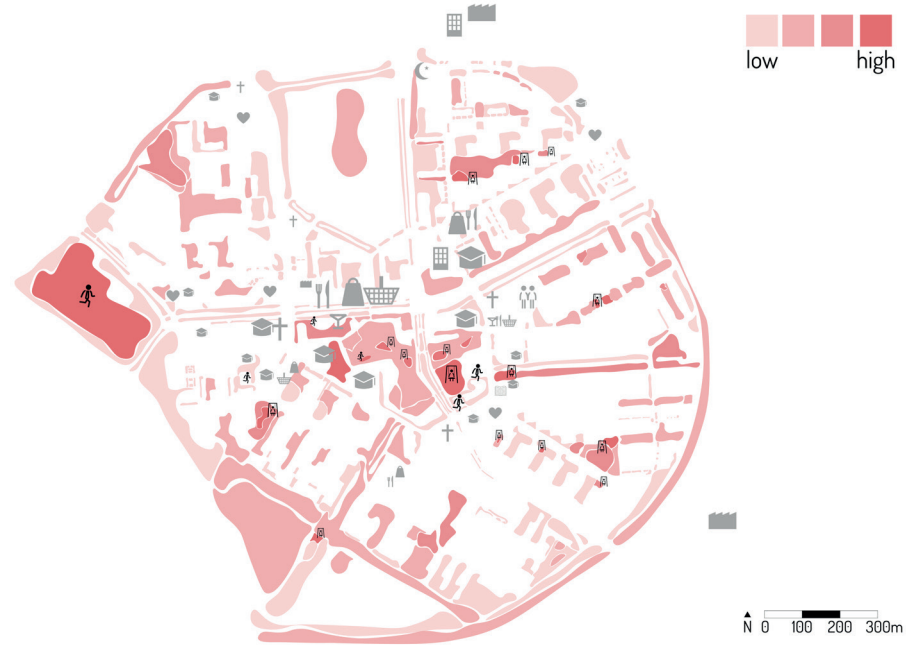


figure52: activity diagnosis, condensed around play functions



figure56: fly tipping and littering



figure57: Homerusbuurt, inactive square



figure53: Zenobuurt, underused communal garden



figure54: Homerusbuurt, inaccessible play facilities



figure55: Molièrebuurt, sub-centre facilities

2.6.5 Activity

Figure 52 shows the activity diagnosis of Lombardijen. Activity is centred around play facilities and larger recreational zones. The sub centres do not pull much activities and activation is needed within the smaller green spaces as shown by figure 53-57. Little care for the public space is shown by the litter problems (figure 56).

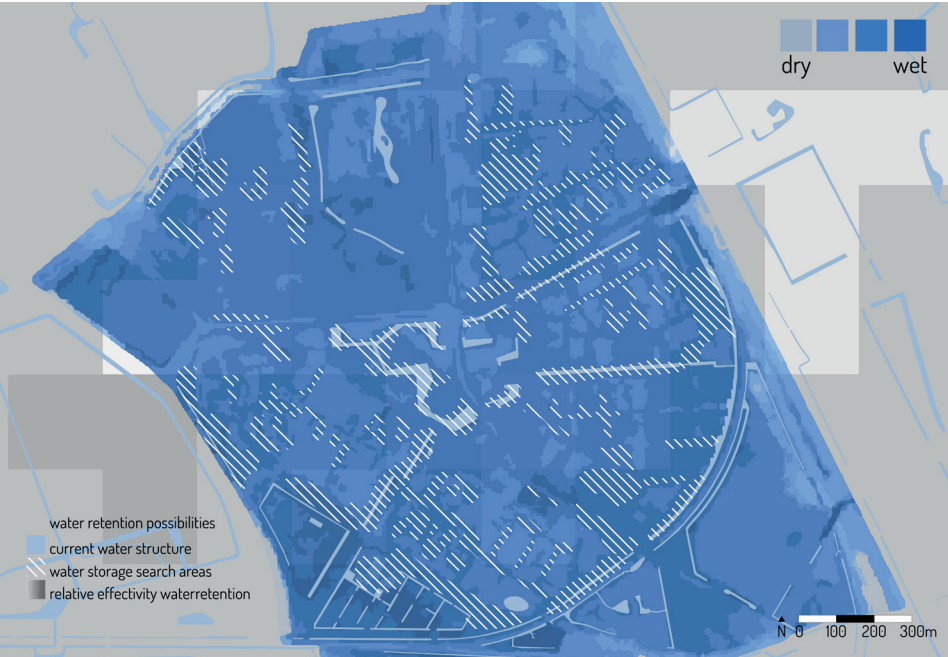


figure58: water storage diagnosis



figure59: Homerusbuurt, flooded play facilities



figure60: Karl Marxbuurt, flooded recreational area

2.6.6 Water

Figure 58 shows the diagnosis of water storage in Lombardijen. A distinction can be made between wet and dry areas. The wettest and lowest areas are shown in figure 58 with etched in the most promising areas for water storage, based on number on infiltration values, groundwater-levels and relief. Many of the sub-neighbourhoods are showing more potential for water storage than they are 'doing' now. Yet it needs to be taken into account that infiltration is barely possible due to the hard clay soil, problems with infiltration are shown in figures 59 and 60.



figure61: singel



figure62: Karl Marxbuurt, clay-polder landscape



figure63: Spinozaweg, tree lanes as linear green structure



figure64: small path hugged with rugged vegetation



figure65: Homerusbuurt, singel

2.6.7 Biodiversity

Figure 66 and 67 present the biodiversity quality diagnosis of Lombardijen. There is strong green structure present, but when looking at the ecology in the neighbourhood, the monotonous vegetation calls for improvement. Taking into account the current aims for species enrichment, the main opportunities can be found in the linear structures running from the centre to the outside of the neighbourhood.

Page 32 and 33 elaborate on the different species that are observed in the area or are already targeted within ecological development. All species have their own habitat and ecological elements within the urban structure and the current public space that they need for food, procreation and shelter.

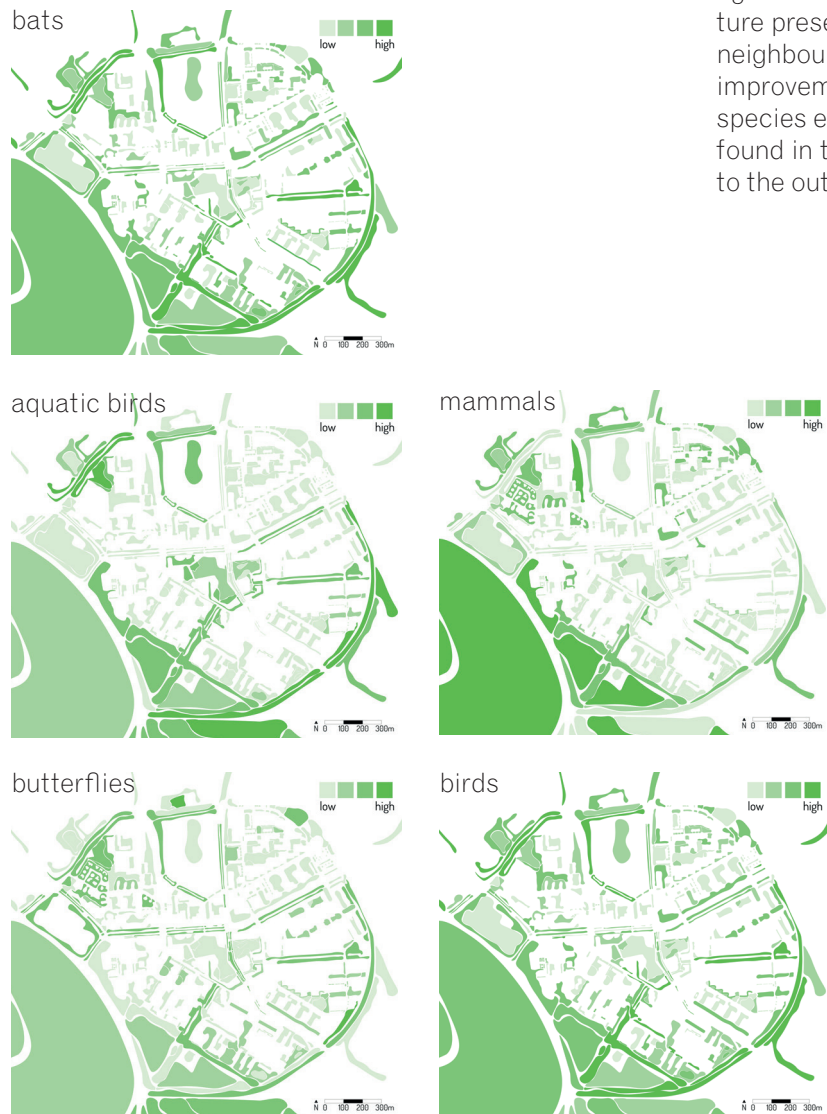


figure66: biodiversity quality diagnosis observed and target species



figure67: biodiversity quality diagnosis

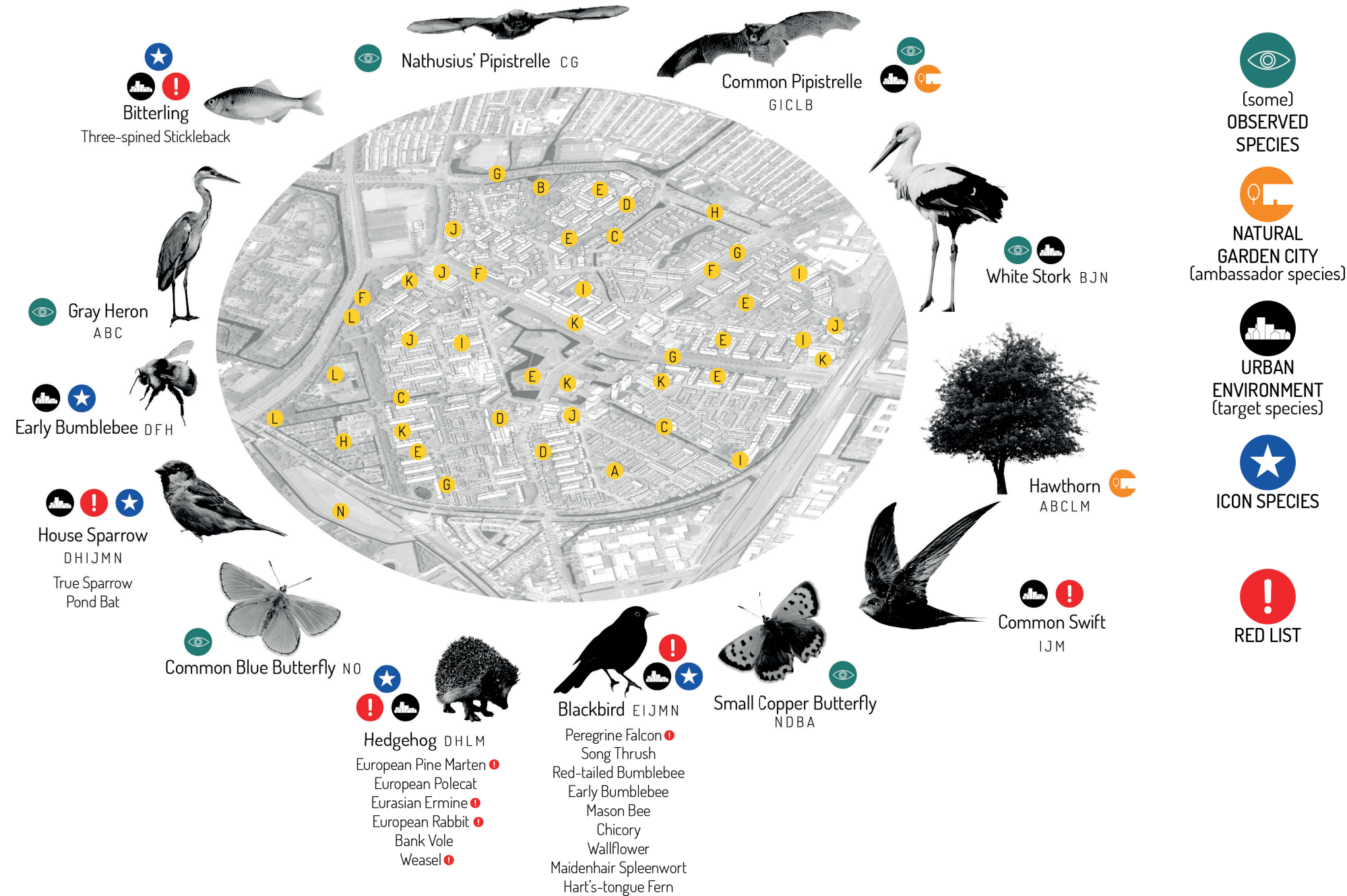
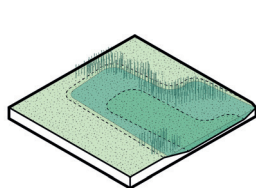
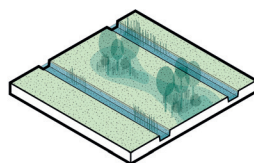


figure68: species around Lombardijen
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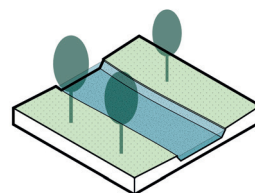
wet



A. water retention field

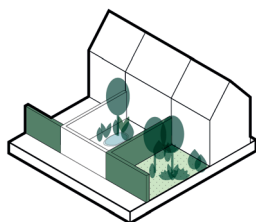


B. wetland polder

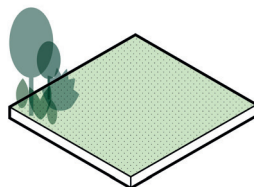


C. 'singel'

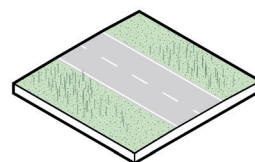
maintained



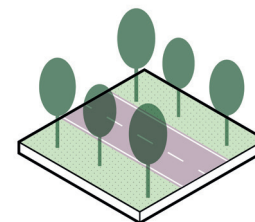
D. small scale gardens



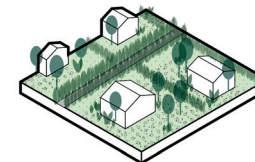
E. open lawn



F. road bank

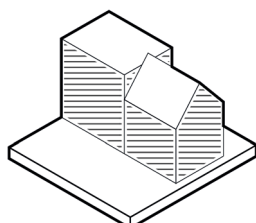


G. lane

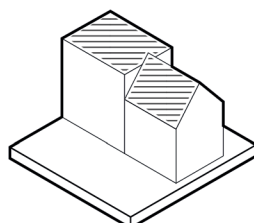


H. allotment

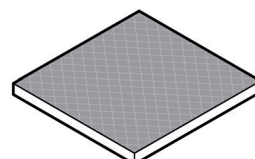
stony



I. façade

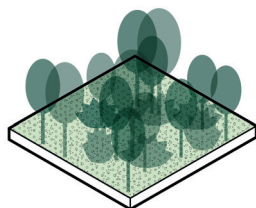


J. roof

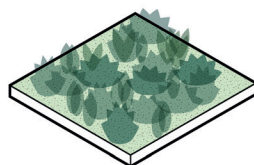


K. large paved areas

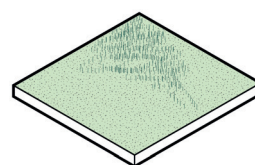
wild



L. forested



M. low shrubbed covering



N. meadow

figure69: ecological elements

3. AGROECOLOGY

3. AGROECOLOGY

In this chapter agroecology will be explained along its theory, practice and organisation, this information will serve as input for the design and organisational criteria that form the basis for the design of Lombardijen.

3.1 Theory

As stated in the introduction, agroecology is an approach for the design and management of food and its production. It integrates ecological and social concepts, and seeks an optimization between plants, animals, humans and the environment. In 2018 the FAO published ten elements for transforming food and agricultural systems to achieve their Sustainable Development

Goals (FAO,2018) (figure70).

3.1.1 Diversity

Diversification is an important part of agroecological transitions to ensure food security and nutrition while conserving, protecting and enhancing natural resources. By planning and managing diversity, agroecological approaches enhance the ability to support ecosystem services, including pollination and soil health, upon which agricultural production depends. Diversification can increase productivity and resource-use efficiency by optimizing biomass and water harvesting. Furthermore, through diversity farmers can create

diverse farms with a multitude of different crops, this contributes to resilient farms and allows for synergies between within farms, communities and ecosystems (FAO, 2018).

3.1.2 Co-creation and sharing of knowledge

Agroecology strives for stronger connections within communities and ecosystems, by bringing agriculture back to the local context farmers are dealing with local challenges which can be better responded to when communities work together to make innovations. In this process there is an exchange of knowledge, both from inside the community and outside of it to combine practical knowledge from producers and traders as well as global scientific knowledge (FAO, 2018).

3.1.3 Synergies

Within agroecology synergies are promoted within the overall organisation as well as the agricultural and ecological systems. Strong connections within communities and ecosystems emphasize partnerships, cooperation and responsible governance to manage trade-offs, involving a multitude of different actors at different scale. Through this links can be made between a wide spread of processes within the food system, production process and ecosystem services. On the other hand agroecology highlights diversity and diverse systems where ecological and biological processes like annual crops, perennial crops, animals, trees, soil, water and other agricultural components can interlink to improve yields, dietary diversity, weed control, soil structure and fertility, while also providing biodiversity and pest control (FAO, 2018).

3.1.4 Efficiency and recycling

Through a focus on synergies to heighten efficiency within the use of biomass, nutrients and water and working towards closing these cycles as well as by looking at reducing waste farms are less reliant of ex-

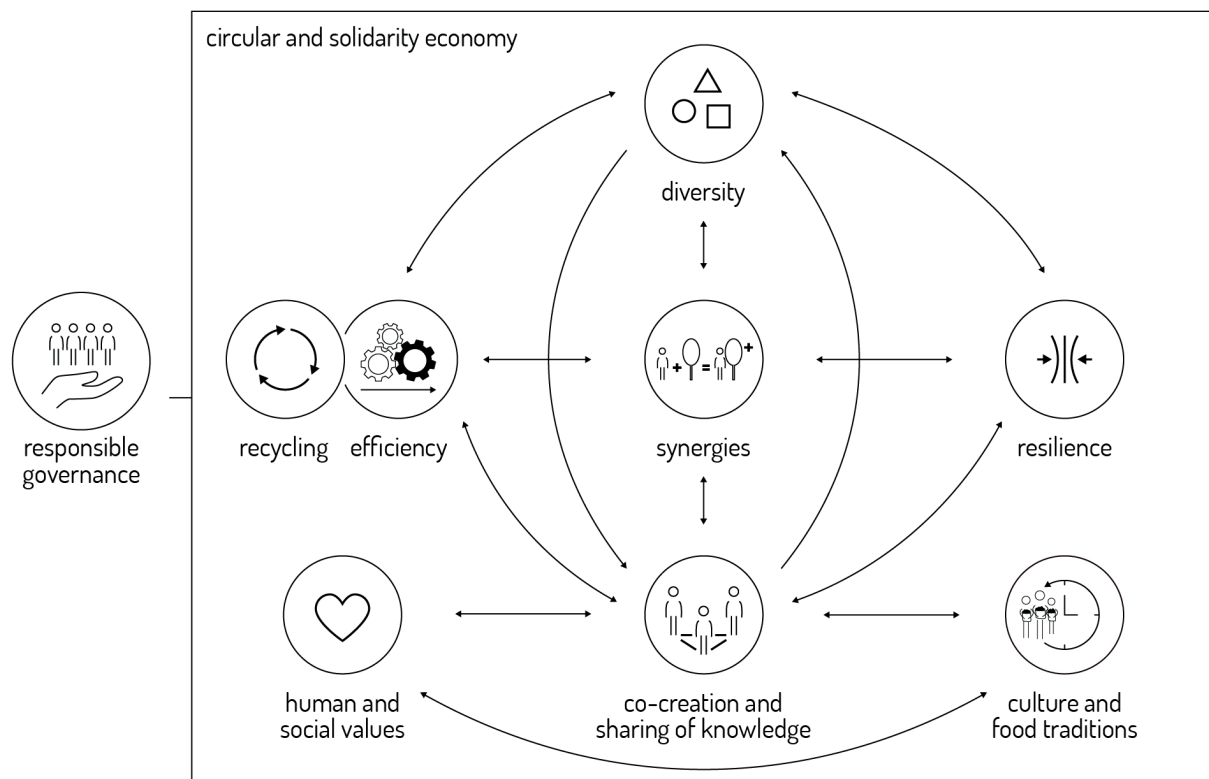


figure70: 10 elements of agroecology

ternal resources, this reduces economic and environmental costs but also reduces vulnerability to market and climate shocks (FAO, 2018).

3.1.5 Resilience

Through diversity as well as efficient use of processes and cycles, agroecological systems are more resilient and have a greater ability to recover from climate, economy and agriculture disturbances (FAO, 2018).

3.1.6 Human and social values

By building autonomous communities and resilient economies and ecological systems, agroecology empowers to overcome challenges and promote human and social values and rights (FAO, 2018).

3.1.7 Culture and food traditions

Current agriculture is often disconnected from its location, therefore creating dependant structures and contributing to coexistence of both hunger and obesity. Culture and food traditions can offer knowledge closely related to the contextual landscapes and food systems, therefore offering new and optimised input for the transition of agriculture (FAO, 2018).

3.1.8 Responsible governance

Agroecology needs transparent, accountable and inclusive governance systems to have a platform for farmers to transition towards agroecological concept and practices since it depends on equitable access to land and natural resources. Responsible governance can facilitate these transitions through incentivising long-term investments that are necessary to enhance soil, biodiversity and ecosystem services (FAO, 2018).

3.1.9 Circular and solidarity economy

Agroecology strives for circular and solidarity economies that reconnect producers and consumers to shorten food value chains and with that fight global

food waste, pollution through transportation, inefficiency in resources and it creates stronger local markets and resilient communities (FAO, 2018).

3.1.10 Key concepts

These elements can be broadly grouped into three topics: food security, responsible governance and environmental awareness. Food security through resilient communities, resilience provided by diversity, efficiency, recycling and synergies, optimising interactions within the food system. Responsible governance as well as organisation serve as a blanket over the entire process by facilitating agroecological transitions and by promoting strong connections and partnerships that allow for collaborations. Finally, through efficiency, recycling and diversification as well as creating links with culture and food tradition farmer are made aware of their environment and the greater system that they are a part of.

3.1.11 Urban agroecology

For the urban application of Agroecology, Miguel Altieri and Clara Nicholls, have set a collection of agroecological principles in 2019 for the design of biodiverse

and productive urban farms (see figure 71). Focusing on the optimisation of resources like organic matter, nutrients and natural resources. Enhancing functional biodiversity by creating appropriate habitats and using biological soil enhancement through providing the best soil conditions for plant growth, by managing organic matter and by enhancing soil biological activity. Providing conditions to diversify species and genetic resources at field and landscape scale and by enhancing beneficial interactions amongst agricultural biodiversity components to mimic ecological processes (Altieri & Nicholls, 2018).

3.2 Practice

3.2.1 Masterclass agroecology in practice

To gain better understanding on the practical implications of agroecology, great insights have been found through the masterclass Agroecology in Practice. The Agroecology in Practice Masterclass is organised by the Ommuurde Tuin, a community supported agricultural garden on the site of a former vegetable garden of King Willem II and tea garden of his wife Queen Emma, close to Wageningen. The garden is built on the agroecological principles with a strong

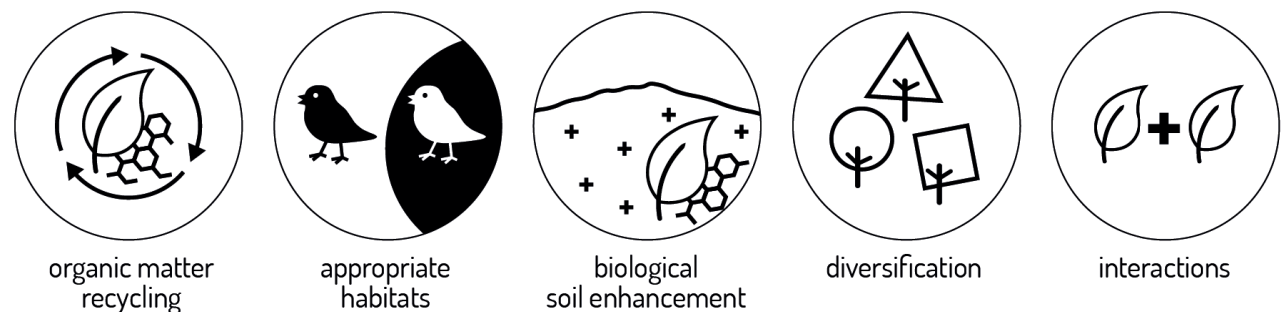


figure71: principles for urban agroecology

focus on soil life and healthy soil. The garden opened in 1999 and now operates on the basis of around 95 prescriptions for weekly food bags during twenty-five harvest-weeks, direct sales and organisation of events. The masterclass is organised in collaboration with the University of Wageningen.

The Ommuurde Tuin is community supported agriculture (CSA), a form of agriculture that is based on a shared profit and a shared risk for farmer and community. The Ommuurde Tuin operates on a basis of around 95 food bags, generated during each of the 25 harvest weeks and given to the shareholders. At the beginning of the season all shareholders pay the farmer, covering the main investment necessities. Other options of generating income from gardens like the Ommuurde Tuin based on CSA principles are Pick Your Own gardens, allowing shareholders to pick their own vegetables and therefore saving on the farmers labour costs, bulk harvesting, creating a stronger separation between stakeholders and the garden while maintaining lower labour costs, and combinations between them.

For the Ommuurde Tuin, the main principle of agroecology is its soil practices which is focused on feeding

the soil that feeds the plant rather than the traditional practice of feeding the plant.

3.2.2 Soil practices

These practices include building the soil through physical, chemical and biological structure, physical meaning the structure which influences permeability and rooting processes, the chemical structure providing nutrients and acidity and the biological structures that process and encompass life within the soil. These structures are supported by practices like crop-rotation for structure and nutrient spreading, weed and pest control through the attraction and introduction of natural enemies and minimal soil disruption.

The practice of crop rotation means that every year there is a spatial circulation of the different types of crops, specifically the different families to which the crops belong. Crop rotation prevents diseases like nematodes, fungi and (soil) insects by moving possible attractors away from sites that are suffering, this is also the rule for weed and their management since specific crops are more susceptible to specific weeds.

Another key feature is the levels of nutrients and

organic material. Certain crops have certain wishes for their environment and specific nutrients they will need. This will mean discrepancies within the fields, that by crop rotation is spread and will therefore be equalised. Finally it will provide soil structure and soil fertility, crops that give certain soil structures can then give them to the crops that need them.

Another way of improving soil conditions is by using green manure, which are crops that are sown with the main function to improve soil conditions. Depending on the type of crop green manure can provide

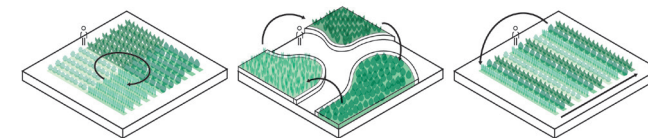


figure74: crop-rotation

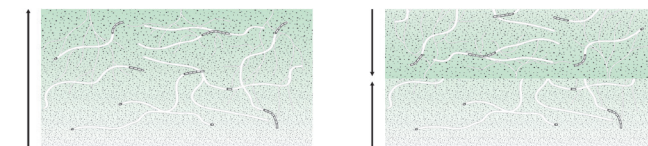


figure75: effects of soil disruption

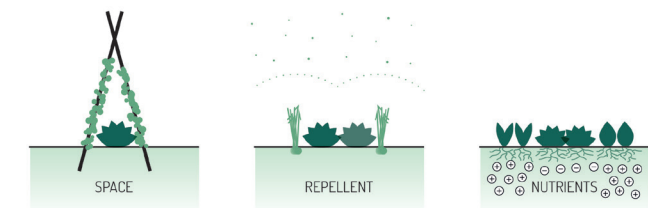


figure76: intercropping function

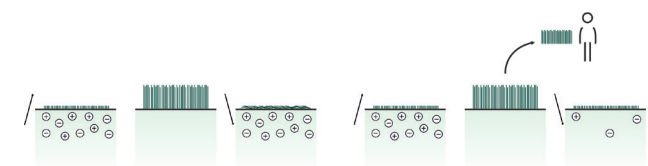


figure77: nutrient cycles



figure72: picture of the Ommuurde Tuin in June 2021



figure73: example of inter-cropping with a spatial function with climbing beans and lettuce heads

structure in the soil through rooting, embedding the soil with organic material through broken down plant particles, holding nutrients through wetter seasons preventing them from washing away and finally green manure can be good for biodiversity by providing food and shelter. An important thing to keep in mind while sowing green manure is to use a mixture of at least five different families for soil health, giving a multiplied effect. Examples of green manure can be found on figures 79 through 95, the different functions and benefits of the varieties are found in figure 142 in

appendix 9.1. The practice of green manure is shown in figure 78.

As mentioned above, the structure of the soil is very important, this will allow soil to better absorb moistures and gives better growing conditions for crops. One of the main dangers for soil structure and its disruption are by ploughing. This common practice in traditional agriculture destroys structures that are created by organisms in the soil and also kills these organisms by disrupting the different oxygen levels and moving the organisms through the depth of the

soil.

Finally, one of the most important soil practices is composting. Composting gives the opportunity to keep as much of the nutrients in the soil as possible. Figure 77 shows the natural nutrient cycle for soil, plants grow by taking nutrients from the ground, these nutrients will go back to the soil once the plant dies, by harvesting crops we take away nutrients that would otherwise stay in the cycle. Since humans do not give the opportunity for nutrients to re-enter the cycle, for example through excrements, it is important

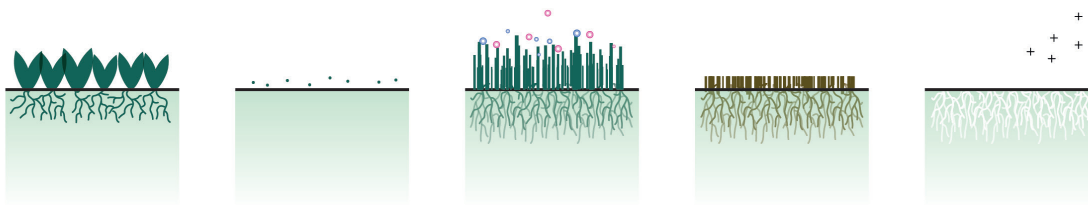


figure78: green manure



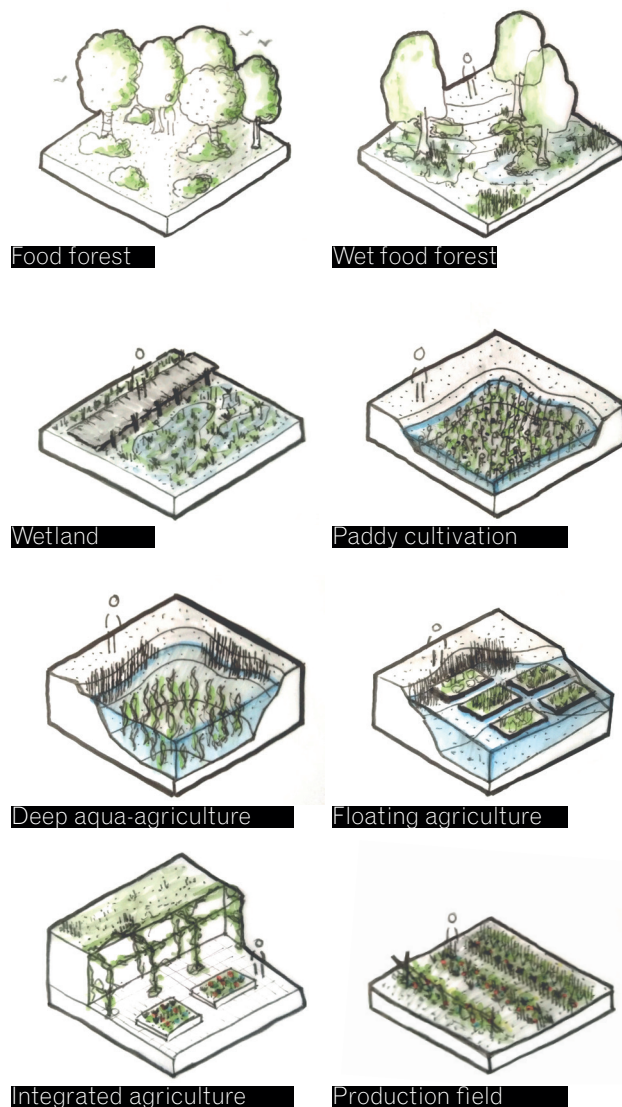


figure96: principles for ecological food production

to compost as much as possible from the crops to be able to give this back to the soil. This will help the crops grow and maximises nutrient exchange.

Intercropping is a technique that is used in agroecology and has spatial, chemical and biological components. The main idea is to combine specific crops to get certain benefits, spatially this can be done to be able to fit more crops in a planting bed, packing the plants in will also allow for less space for weeds to grow. Intercropping can also be done by using the differences in nutrients that the crops need to grow, making combinations between crops provides and takes away different nutrients which will benefit the crops in their growing process. Finally intercropping can give biological benefits due to the fact that certain crops can attract specific organisms that are natural enemies to common pests and that will therefore help protect crops against these pests.

In general attracting and introducing natural enemies will help provide a natural ecosystem that provides balance between different organisms.

3.2.4 Alternative agriculture

By use of alternative agriculture in different forms there is an opportunity to create a variety within the landscape, this landscape can then provide useful interactions.

Food forests can be seen as a form of agroecology, due to its use of natural processes and interactions that contribute to ecosystem services. The main principle of food forests is its use of vertical space, rather than just the horizontal space which is used in traditional agriculture. The forest is organised in different layers, the canopy layer with tall trees provide mostly nuts and fruits. The second layer is the low tree layer with trees up to five meters and concern mainly fruit trees. Underneath this you can find the shrub layer, which is the third layer. These shrubs can have a variety of berries, fruit, nuts and currants as well as

medicinal and flowering shrubs. The next layer is the herbaceous layer with herbs and flowering plants for pollinators. The fifth layer is the rhizosphere with root crops such as carrots and potatoes, around this is the surface layer with plants that spread to cover the soil and protects it and helps with weed management. Finally, the vertical layer, which are vines and climbers with fruit, berries or beans. Other layers like wetland layers and fungal layers can also be added (De Groot & Veen, 2017).

Furthermore, possible alternative forms of agriculture can be found in hydroponic and aquaponic systems. These water based forms of food production can be combined with other functions, offering multifunctional spaces through, for instance offering services like stormwater mitigation (Diehl et al., 2020). To illustrate the possible application forms of these principles a collection of diagrams in figure 96 present the spatial quality of these different habitats.

3.2.5 Biodiversity through agroecological processes

By taking care of the soil and the diversification of the landscape there is an overall improvement of the natural environment and providing better conditions for biodiversity. One specific theme that will lead the improvement in biodiversity in a specific directions are the target species associated with small scale farming. The main target species being a Little Owl, a red listed bird that is accompanied by a list of organisms including the Barn Swallow, Common House Martin, Common Linnet and Red Pimpernel (Van den Boogaard, 2019).

3.3 Organisation

Since agroecology is not only based on environmental components, but also social components, there is great importance to take note of how these developments are organised.

3.3.1 Community supported agriculture

An organisation form seen often in agroecological farms is CSA. CSA is community supported agriculture, which is based on the relationship between a group of people forming a community and the close contact with a specific farm. The model operates on the idea of yearly investments which allows farmers to invest in their farm at the beginning of the season after which throughout the year the community are able to reap the benefits, for instance through weekly food bags.

3.3.2 Agroecology as movement

Agroecology is not just a theory and practice but also a movement, specifically in the form of La Via Campesina. La Via Campesina is an international network of peasants, small and medium size farmer, landless people, rural women and youth, indigenous people, migrants and agricultural workers. This movement is in line with one of the ten principles of agroecology through their sharing of knowledge, in which they provide a platform to exchange experiences and information and for the interaction between peasant organisations on regional levels. Their main focus is on defending food sovereignty, working towards land and agrarian reforms, promoting agroecology, defending local seeds, promoting peasant rights and fighting against the criminalisation of peasants (La Via Campesina, 2020).

Within the Netherlands the agroecology movement can be found in the Toekomstboeren, which is an initiative that works towards sustainable and social agriculture and food production in the Netherlands (Toekomstboeren, 2021).

3.3.3 Practical examples of farms

Highlighting two practical examples of the organisational aspects of agroecological farms are two projects with different points of view. First is the

Ommuurde Tuin.

As previously mentioned the Ommuurde Tuin is an agroecological garden, the garden operates on the basis of community supported agriculture and had food bags as main output and closed relationship to their client. From the initiative of the garden, they have set up a structure through which they gather their income at the beginning of the year and give their supporters weekly food bags.

To ensure a fair wage for the workers, as well as provide affordable produce for costumers of the Ommuurde Tuin, they have set a 'Solidarity Payment'. Through this payment form, stakeholders determine their own prices but are made aware of the implications this has on hourly wages.

As an example of a possible outcome: *Shareholders set a gross salary for the farmers (e.g. 16 euro | hour, which is communicated as the minimum wage for the workers). For a medium food bag the workers spend one hour of labour, therefore making the yearly payment of 1 hour times the 16 euro | hour times the 25 weeks in a season equalling to 400 euros.* (De Ommuurde Tuin, 2018).

The process the Ommuurde Tuin uses is one of their



figure97: food bags from the Ommuurde Tuin

own initiatives, an example that flips this is the Herenboeren. Herenboeren is a way for communities to become self-sufficient on their own terms, they themselves are hiring a farmer that can farm their land to their wishes. The community operate in a group of around 200 families, participants buy into the project to provide a starting capital (Herenboeren, 2017). After this, yearly payments need to be made to cover running costs, they are not paying for the product they are receiving but for the overall production costs that will provide.

3.3.4 Community gardens

Many existing community projects and literature on the topic show possibilities through participation and activation for the social integration of urban inhabitants. As the paper *Mosaic governance for urban green infrastructure: Up-scaling active citizenship from a local government perspective* by Arjen Buijs et al. (p. 54, 2019) has shows that “active citizenship contributions to UGI creation and maintenance relate to the quantity but also quality of green spaces, including, for example, increases in biodiversity and pollinators, climate change adaptation and local food supply”. They also report additional benefits with the activation of communities, enhancing social cohesion and environmental awareness. Astrid Molenveld adds to this that community gardens are a way for residents to reclaim public space, something that in contradiction with a nanny state that provides such services. This can serve as an addition to the social basis of agroecology and to strengthen the opportunities of application in the urban environment.

Research into key factors into the durability and success of such initiatives through literature and case studies have resulted in a collection of valuable lessons.

An analysis by Molenveld et al. in *A qualitative comparative analysis of collaborative governance structures as applied in urban gardens* (2021) shows that key factors

for the durability for urban garden are found in financial independence, strong institutionalization and having a core group of volunteers. The need for a core group of volunteers is reiterated by a study by Rutger Henneman into the possibilities of creating a network of green (food) initiatives in the city of Rotterdam and the needs of these initiatives. Through this study, along with the need for a core group of volunteers through leading characters, it has been found that the most important factors for continuity from the perspective of initiatives are the awarding of land, the financial support from municipalities and municipal or political support (Henneman, 2021). All pointing into the direction of security and insurance from official governing bodies.

Some challenges that have been highlighted as a result of active citizenship in this regard are including the lack of technical capabilities, expertise and skills in gardening as well as dealing in an institutional environment and the organisation of the project (Buijs et al., 2019)

Some projects that show examples of the practical implication of community green initiatives and how certain previously mentioned key factors and challenge can be dealt with are explained, one of which is Tuinman (M/V). This program in Rotterdam is started with a focus on greening the city, helping people in vulnerable neighbourhoods to become self-reliant and to help people “*rediscover their own happiness*” (De Groene Stad, 2014). Through the program, gardeners are employed to bring people together and organise activities around green meeting spaces. Their role is therefore based on social and gardening tasks, they therefore act as leading characters that will form the core of volunteers and care for continuation and durability. Tuinman (m/v) is part of the project Creatief Beheer by Rini Biemans en Karin Keijzer, which employs independent craftspeople to revive neighbourhood through taking over certain maintenance tasks of the

municipality (Creatief Beheer, n.d.).

A project running on similar ground is the community garden Oeverloos. Buurttuin Oeverloos is a community garden set up by Stichting Tussentuin, they were hired by the municipality of Rotterdam, after a public forum pointed out the need for a communal function in a park in IJsselmonde. The park originally offered little program and the neighbourhood was suffering from dilapidated public space, nuisance and lack of social cohesion.

The garden operates around a gardener, who is paid by the municipality to offer activities on two afternoons per week, they maintains the garden with volunteers, gather people, activate participants and creates for an overall welcoming environment. Oeverloos' main focus is being a social function by combining gardening, nature education and simply a space to gather. Production is not high, but since the summer of 2021 they are offering little plots of around 1,5 m2 to neighbours to start their own little garden to experiment and have something of their own. It is a success, there are already plans for more. This information was gathered through visitations and conversations with the gardeners and volunteers of the garden.

3.3.5 Success factors

To conclude this paragraph the following success factors give direction to the organisation of possible public space applications of agroecology and will be used as the criteria for the design:

- Paid full time workers and coordinators with knowledge, experience and passion
- Paid by the municipality, in service of the community
- True costs but also true value (working on produce, working on the community, working for the environment, etc.)
- Community involvement throughout the project
- The importance of space and set spaces
- Community organising with a set group of key volunteers (opportunities for members to become more active, learn new skills, etc.) Seeing it as a association, with a board, members, meetings, fora, activities.
- Activate citizens for the best possible outcome, eyes on the streets, time investment, new ideas, partnerships with local businesses.
- Security of existence from the municipality, investments in organisations and soil take long.



figure98: Buurttuin Oeverloos in IJsselmonde

4. CRITERIA

4. CRITERIA

From the spatial, social and environmental analysis, as well as the exploration of agroecology, a number of organisational and design criteria have been composed to serve as input for the design stage, described in chapter 5.

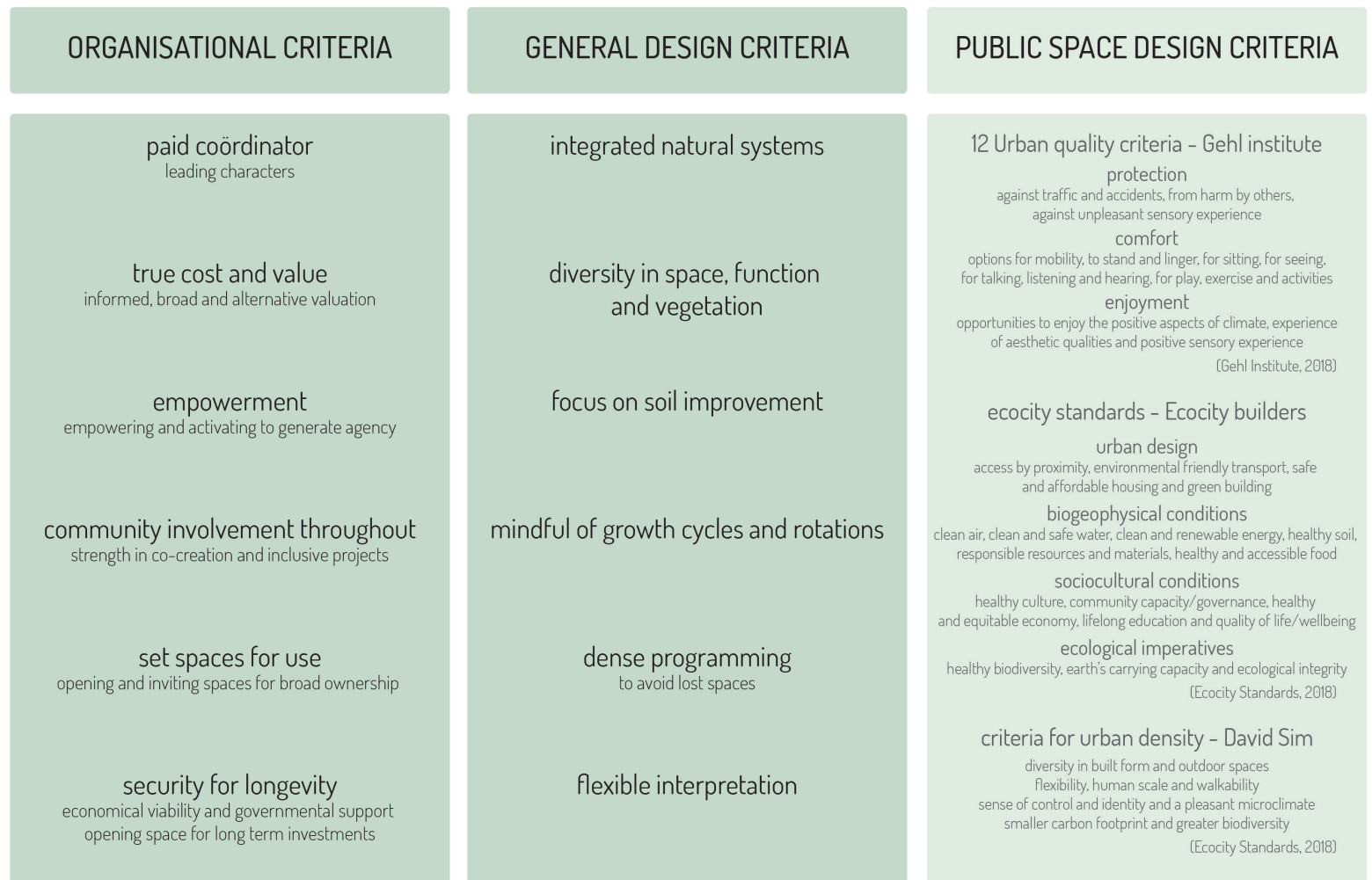


figure99:criteria for further stages

5. DESIGN

5. DESIGN

Coming from the criteria for intervention in the landscape and the objective to improve environmental and social issues through public space design, this upcoming chapter will showcase the projection of possible interventions in the landscape.

5.1 Strategy

5.1.1 Barn-farm-shed structure

To organise the interventions within Lombardijen, there is a need for a strategy that can streamline development, but more important, it can give a framework to strengthen durability.

The strategy is based around the hierarchical structure of Lombardijen, following the neighbourhoods and their independent functioning. Through this structure and the research proven need for leading characters within community organisations, the farm-barn-shed framework was born (see figures 88 through 91).

By imitating the model of an agroecological farm, the neighbourhood of Lombardijen gets the opportunity to receive direct valuation of its public space and communal infrastructure. A collective of farmers are hired by the municipality take on the responsibility to care for the public spaces in collaboration with the inhabitants of the neighbourhood (see figure 89).

The farm, barns and sheds act as both a physical space and as a organisational and social structure. The farm encompasses the whole neighbourhood and acts as main functional and social hub, offering a platform for social interactions, tools and activities like a store, a kitchen, a restaurant and an educational space.

The barn then acts as main meeting space within the sub neighbourhoods, nestled within the facility centres, rejuvenating these sub-centres and giving them a new burst of activity.

Finally the shed, which caters to the separate community gardens, it offers a place to store smaller tools, a place to have a break during the work and to meet to start days of harvesting.

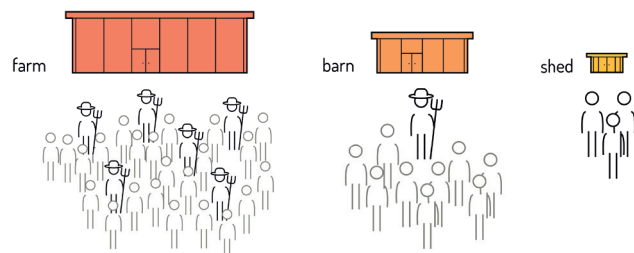


figure100: strategy structure

5.1.2 Governance

Through this structure, the farmer will act as main activators and will serve as translators for the wishes of the inhabitants and the municipality, being mindful of a viable business that takes all value in consideration.

Value can be found in the variety of functions within public space like recreation, the enhancement of biodiversity, water retention and food production as well as the social benefits of interaction between neighbours, the exchange of knowledge and experience, gaining skills, education on self-reliance, healthy nutrition and nature and in general active lifestyles.

Using public space and adding the function of food production will lead to the possibility of feeding around 35% of the inhabitants of Lombardijen, by means of food bags for 25 weeks a year (see full calculations in appendix 9.3). Making a direct monetary valuation of around 130.000 euros based on an hourly wage of 16 euros and the 'Solidarity Payment' system of the Ommuurde Tuin (see page 33).

Through the empowerment of the inhabitants of the neighbourhood and the sense of ownership that is created by the actualisation of their wishes and the learning of skills to contribute to this, the neighbourhood will benefit from social security and cohesion.

Furthermore, it can act as a platform for integration and a constant factor through the changes that the neighbourhood will have to undergo to respond to climate change and the need for densification.

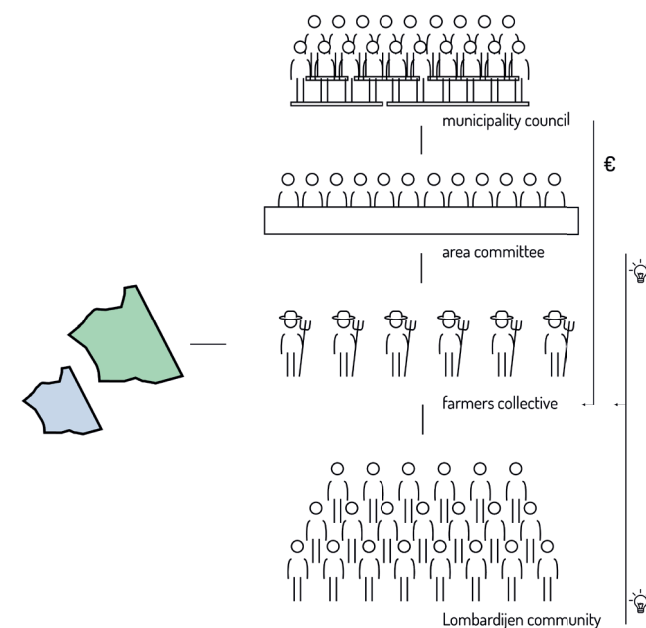


figure101: governance structure and the relationship between actors

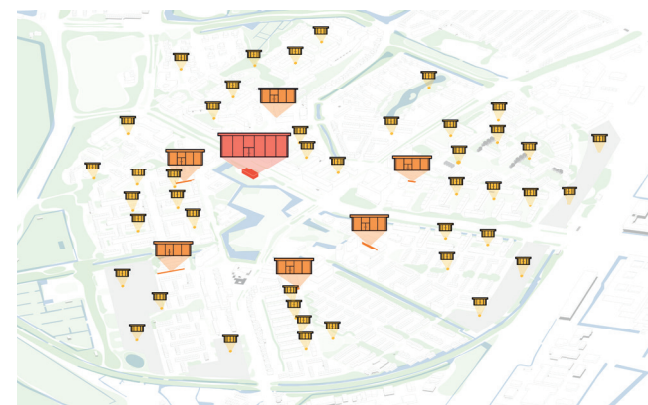
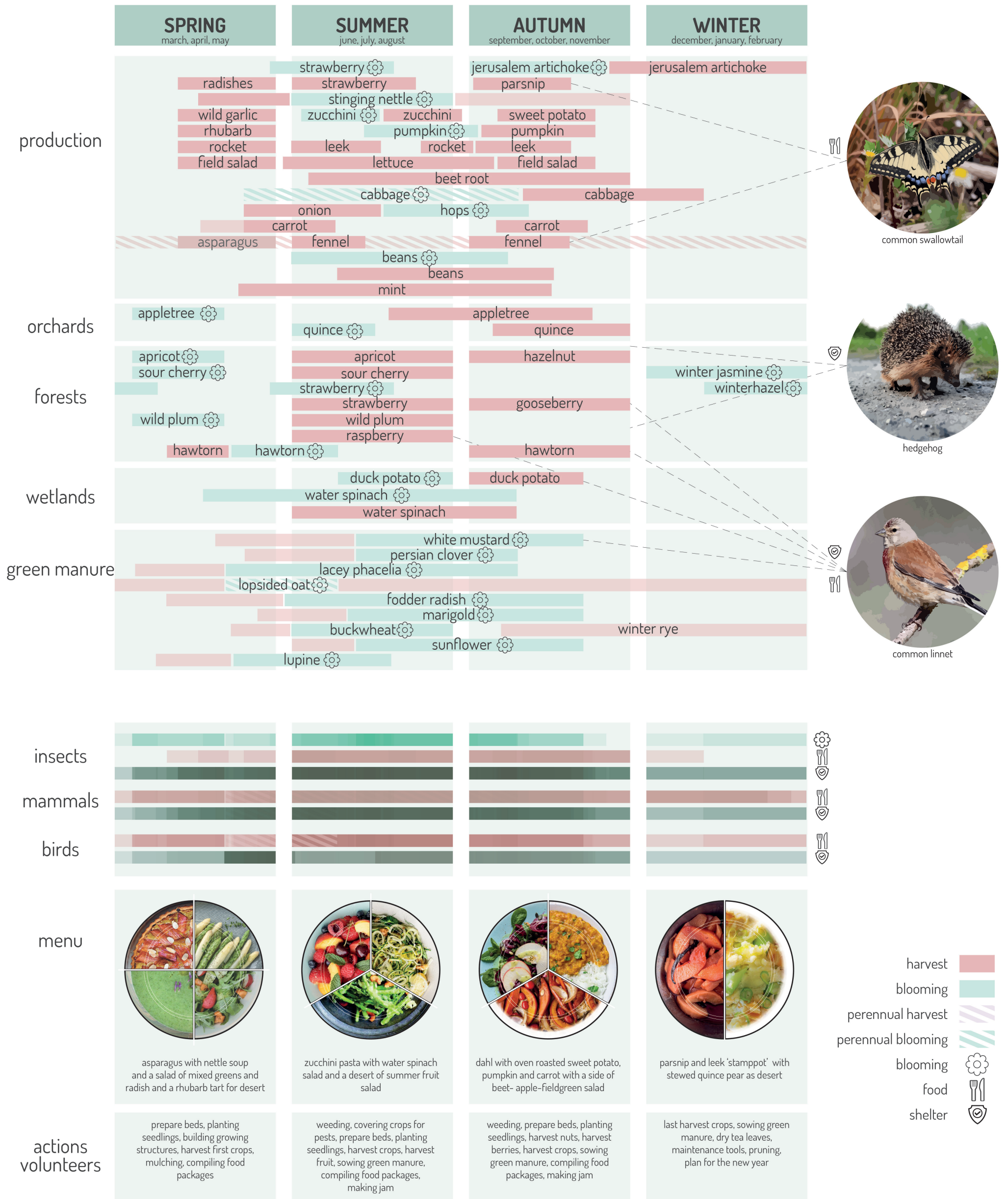


figure102: farm, barn and shed structure in the neighbourhood



5.1.3 Seasonal planner

The seasonal planner give an overview of the structure and how it interacts. Looking through the seasons the vegetation, crops and activities change for both human and non-human inhabitants. Being mindful of the different services throughout the

year will allow for the optimisation of coverage in terms of nutrition, shelter and activity. The planner shows one option, offering an example of what crops can grow in the different areas and how this interlinks with the value of the land.

5.2 Farm vision

5.2.1 Public space demands

Where the current Lombardijen is monotonous and lacks programming and activity, the new design needs to be diverse in spatial, ecological and social terms. The layout of the neighbourhood is determined by the different functions the public space needs to have, this layout is visualised in figure 104. In figure 104 the public space in Lombardijen is labelled on it's main function. Through analysis these functions and the correct placement of these functions had been established. The farms and barns following the hierarchy of the spaces which is underlined with the linear ecological and water retention structures. The current ecological structure in Lombardijen needs to be strengthened. For the water management strategy there will be an interlinking necessary with these linear structures, these allow for the transportation of precipitation and manages the water levels and availability in the neighbourhood.

As established in section 2.6.4, the largest part of the development of new houses will be actualised around the edges of the neighbourhood.

The central park is reiterated as main recreational area with a large emphasis on interaction with neighbours on a larger scale and relaxation.

Finally through the neighbourhood patches of food production form a system of connected gardens with a communal nature.



figure104: Lombardijen vision

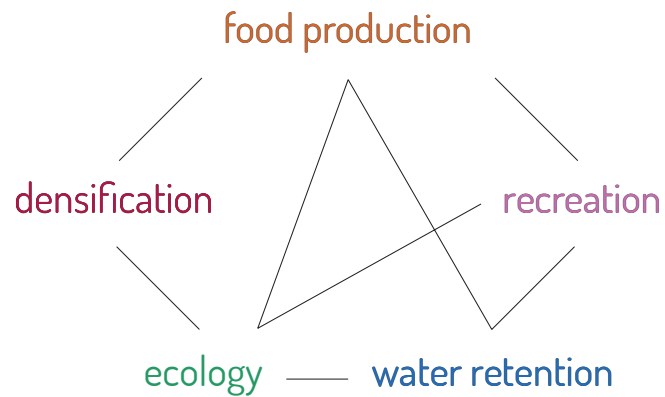


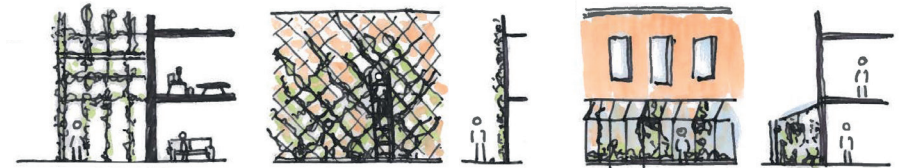
figure105: relationships public space demands

5.2.2 Spatial qualities space demands

The main functions as displayed in figure 104 give priority and hierarchy to its uses but allows for a great variety in combinations between the functions. In figure 105 the different relationships between the functions are highlighted and in figure 106 there is a zoom in on the spatial implications of combining food production with the different other uses of the space.

FOOD PRODUCTION

densification



ecology



recreation



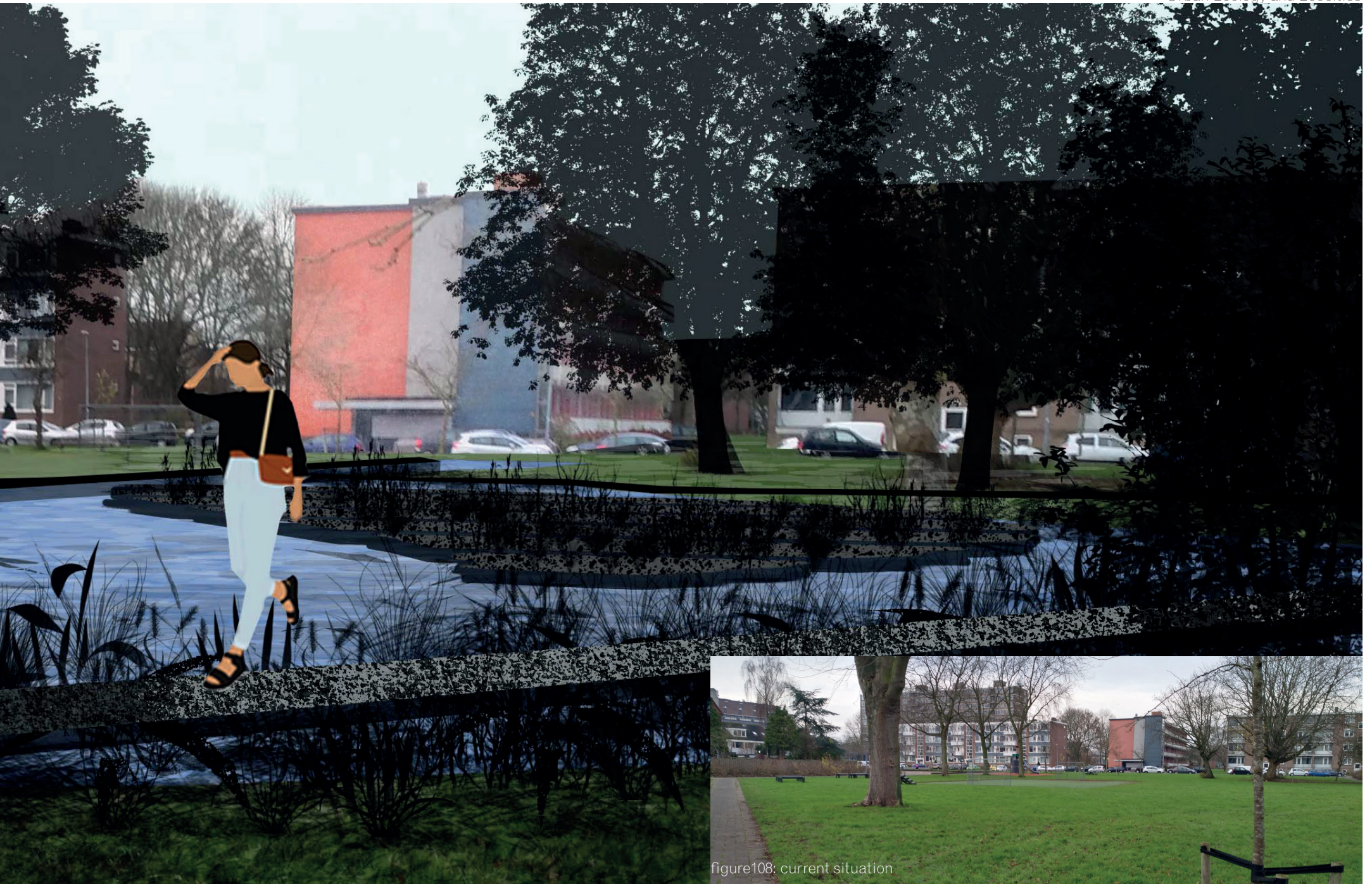
water retention



figure106: food production combined with public functions



figure107: visual barn design



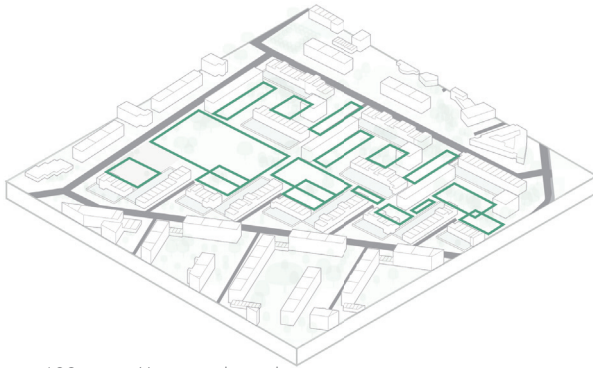


figure109: creating enclosed spaces

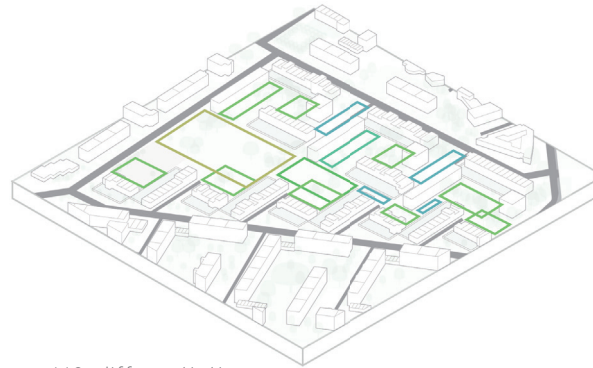


figure110: differentiating spaces

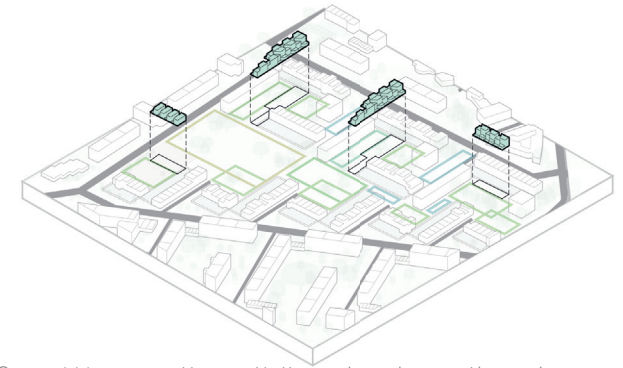


figure111: generating activity and enclosure through architectural densification

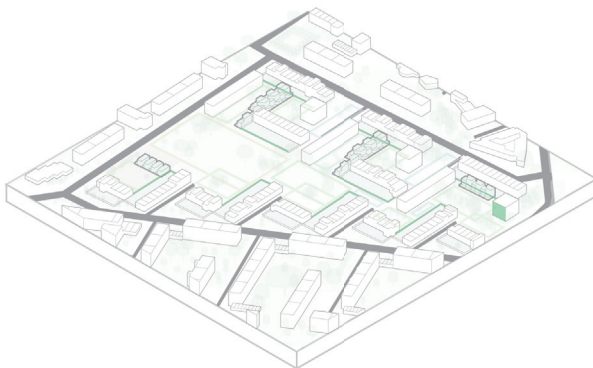


figure112: activating dead façades and fences through vegetation

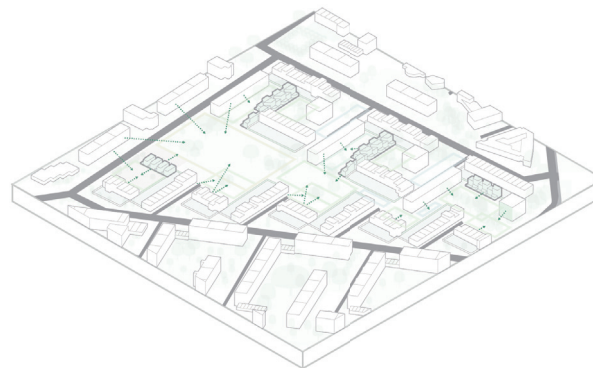


figure113: linking spaces with buildings for social control and eyes on the street

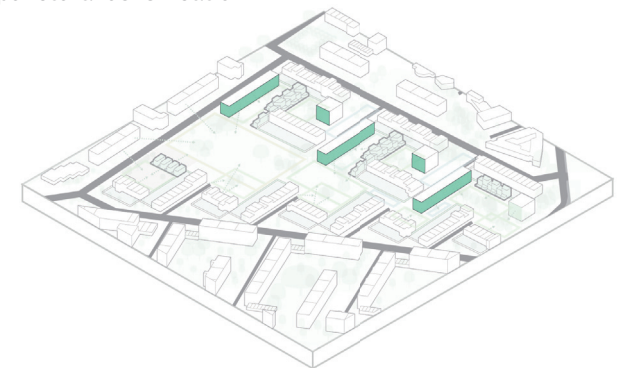


figure114: involving back façades through easy access

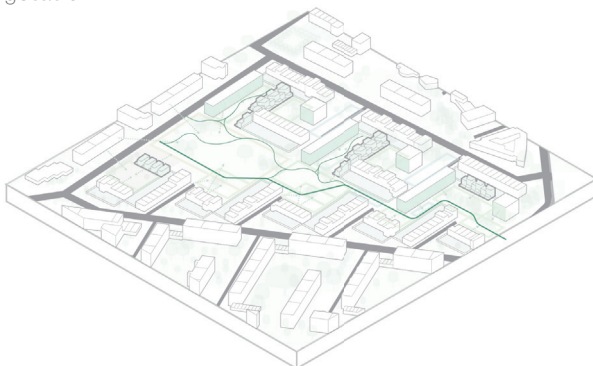


figure115: offering direct and organic routes through the contrast of maintained and wild characters

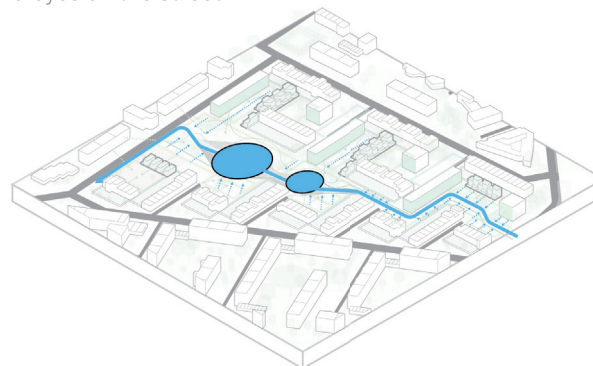


figure116: introducing a water structure for water storage, guiding movement and transporting precipitation

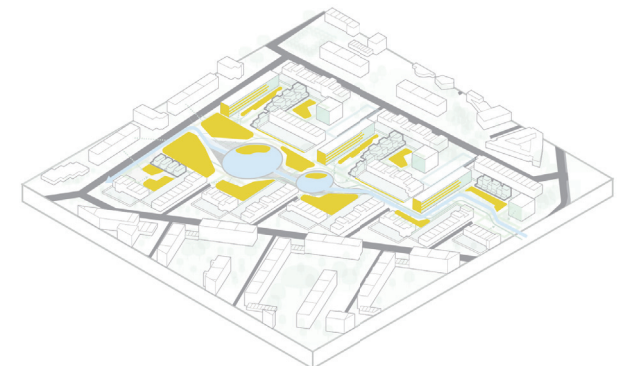


figure117: introducing food production for programming, social cohesion, biodiversity enhancement and resilience

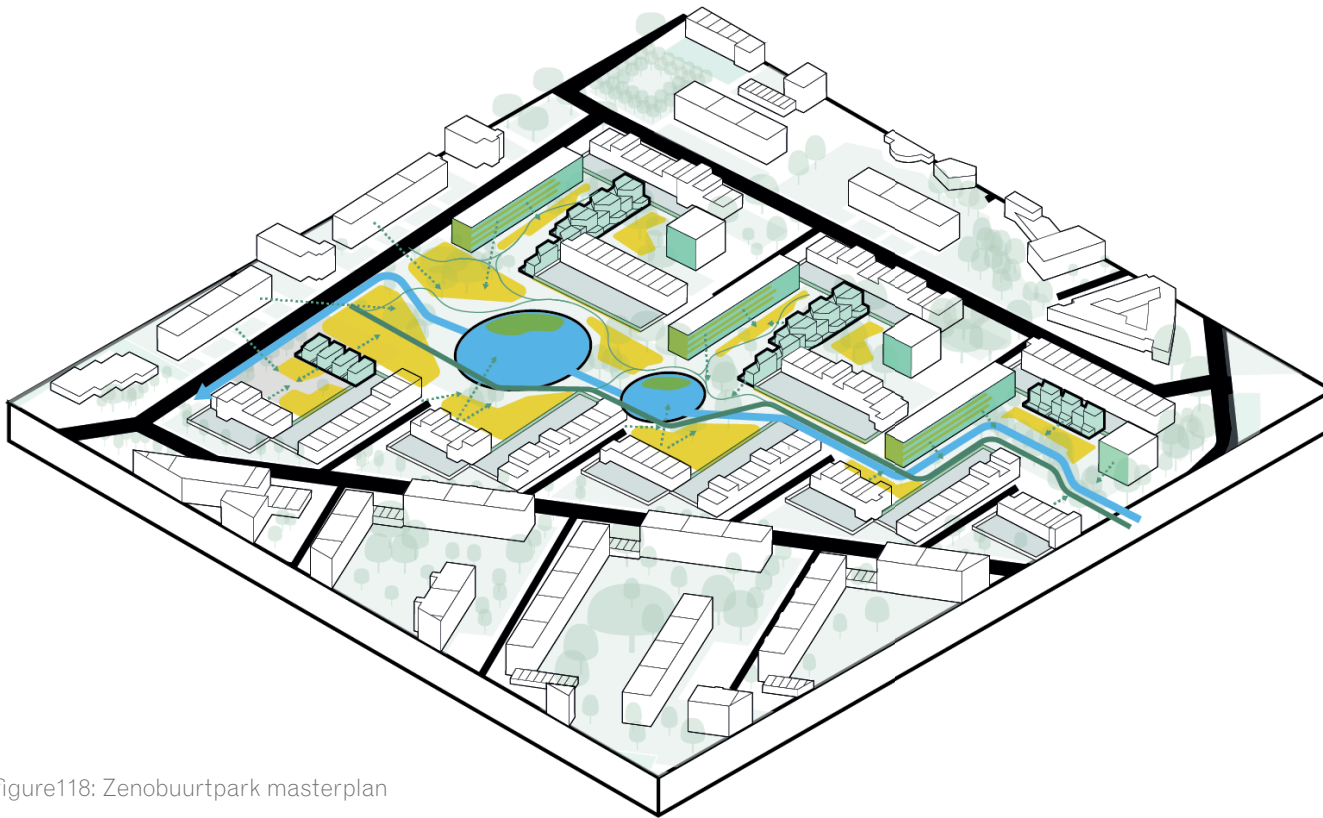


figure118: Zenobuurtpark masterplan

5.3 Barn masterplan

For the barn design there is a zoom in on one of the sub neighbourhoods in Lombardijen: the Zenobuurt. Organised around its sub-centre and barn building are a multitude of smaller and bigger communal and public gardens with different levels of interaction with the landscape and its harvest opportunities.

5.3.1 Interventions

Where there was once big open spaces with little enclosing features, the design focusses on creating sep-

arate space that allow for intimacy and the differentiation of these spaces and their characters. On of the ways of enclosing these spaces is by the accupunctural densification of the area, by placing small land-bound houses there is direct connection with its surrounding and helps activating dead façades and closed fences. This is also done with vegetation walls and living fences with give natural edges to the space. Furthermore, through the differentiation of the spaces there is space for a clear design centres around a large waterbody that collect the rainwater from the

area. Around this main space, small pockets of more enclosed and more intimate locations are found. The spaces interact with the repetition of the built environment and take care for allowing comfortable transitions between public and private spaces. Throughout these pockets of denser vegetation routes are laid out to create a variety of experiences from open to enclosed and with different view lines through the landscape. See figures 109 to 117 for an axonometric visualisation of these interventions, figure 121 on page 59 for a 1:2000 plandrawing of the design and figure 143 in appendix 9.4 for a detailed 1:500 plandrawing.

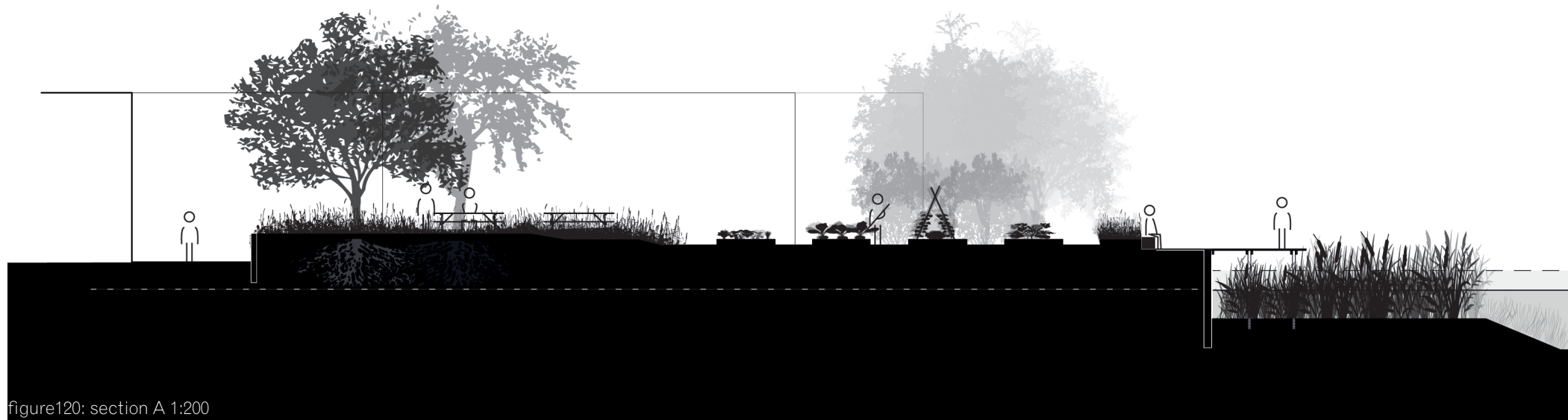
On the page on the right there is a 1:2000 plan drawing of the design of the Zenobuurt farm, with in red the sections and cut outs displayed in the following sections.

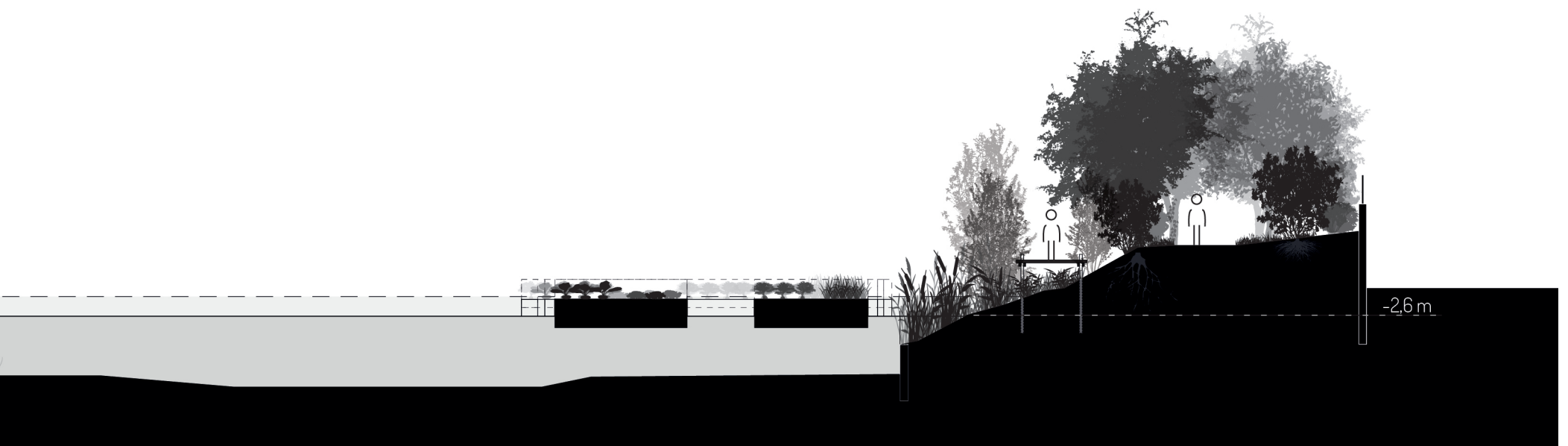


figure119: design plan 1:1500

5.3.2 Section A

Figure 120 showcases the entire section through the main design area with the succession the orchard leading in to the production fields, the main footbridge along the water with a view on the floating growing fields and the wet forest growing up the hill to dryer grounds.





5.3.3 Section A.1

The 1:100 detail of the northern water edge in figure 121 shows the different experiences of the two pathways along the wilder forest. One in the wet landscape with varying view lines over the water, while the other is enclosed route through dense vegetation where you move in between the trees of the food forest.





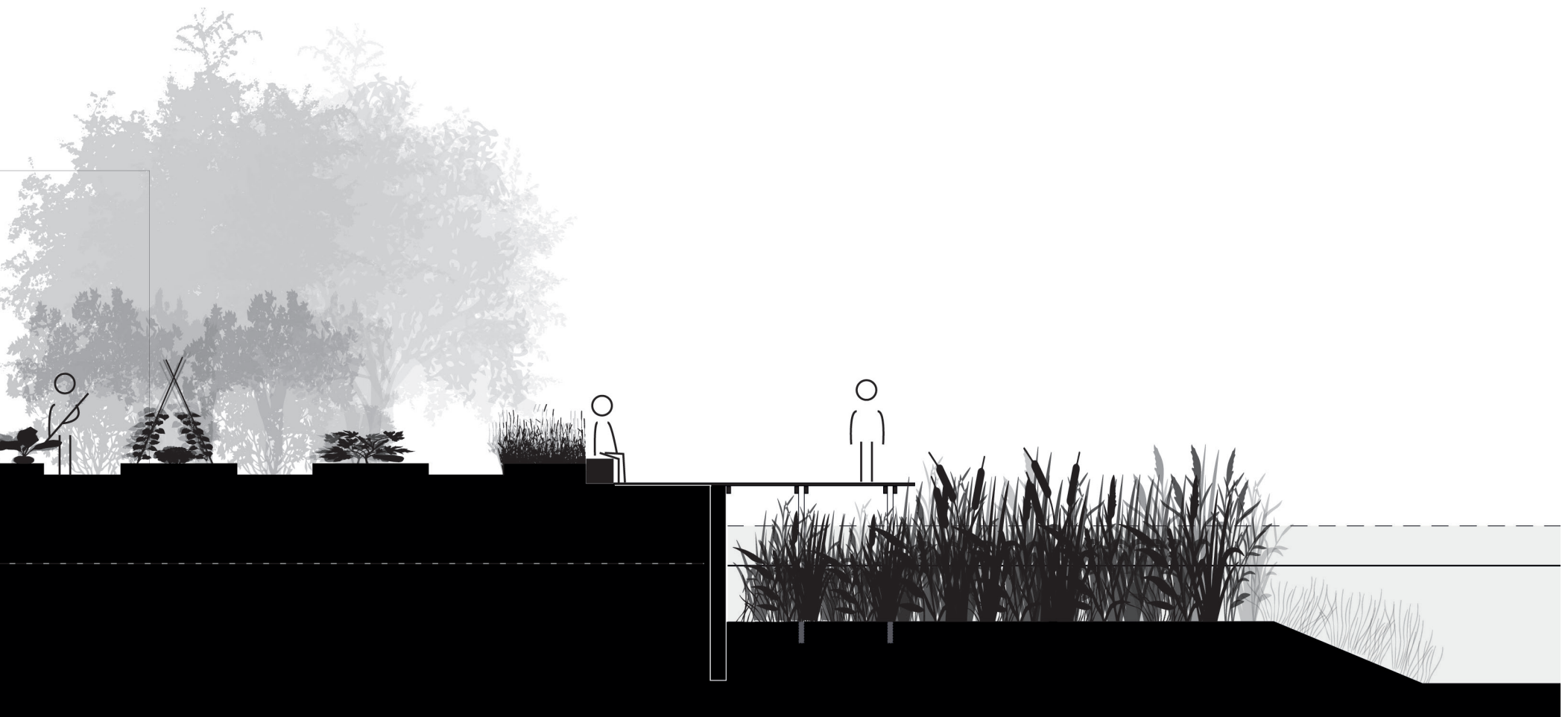
figure121: section A.1 1:100

5.3.3 Section A.2

Section A.2 shows the transition between public and private, the orchard acting as semi-transparent screen that makes an enclosed and personalised space under its tree crowns.



figure122: section A.2 1:100



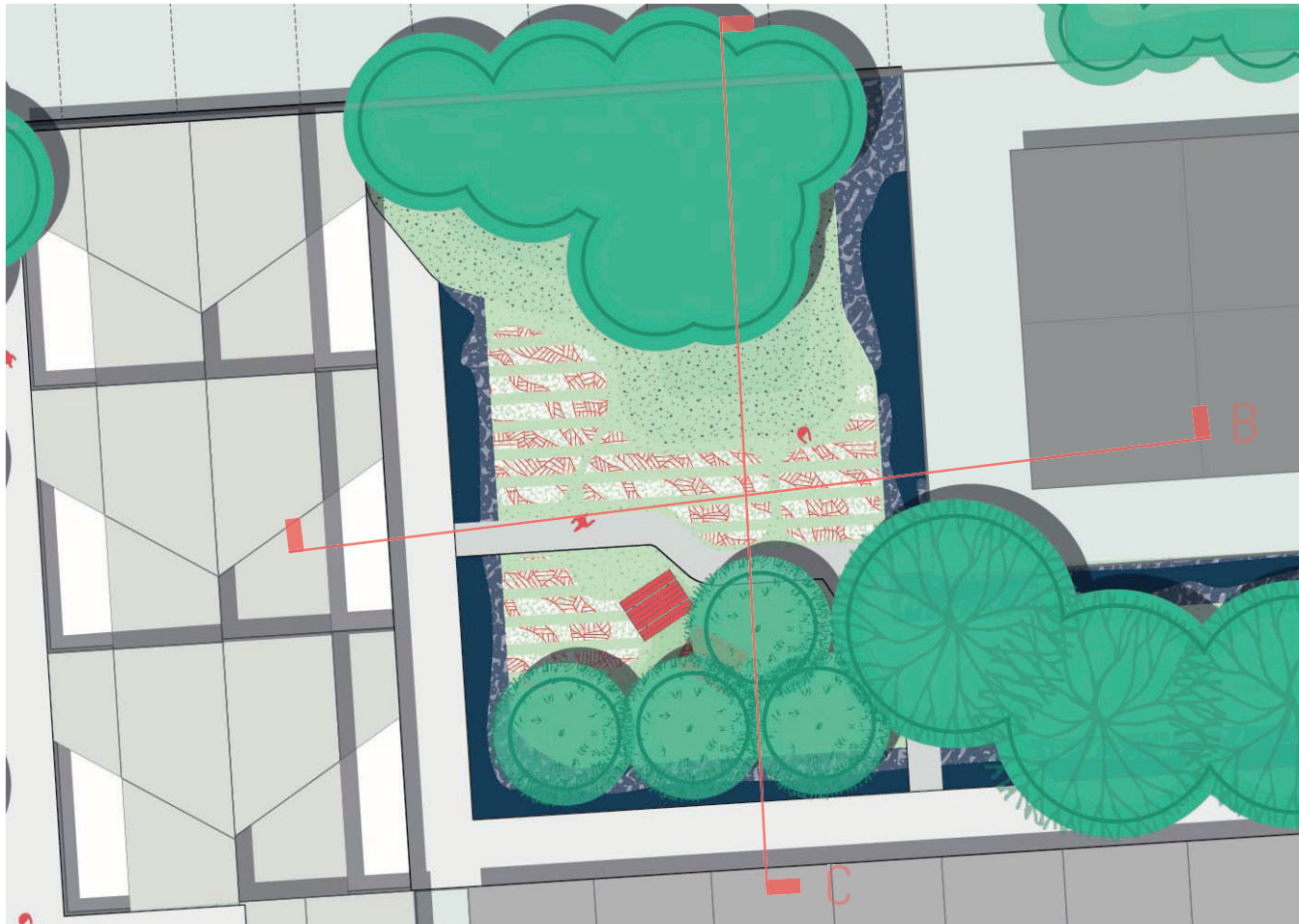


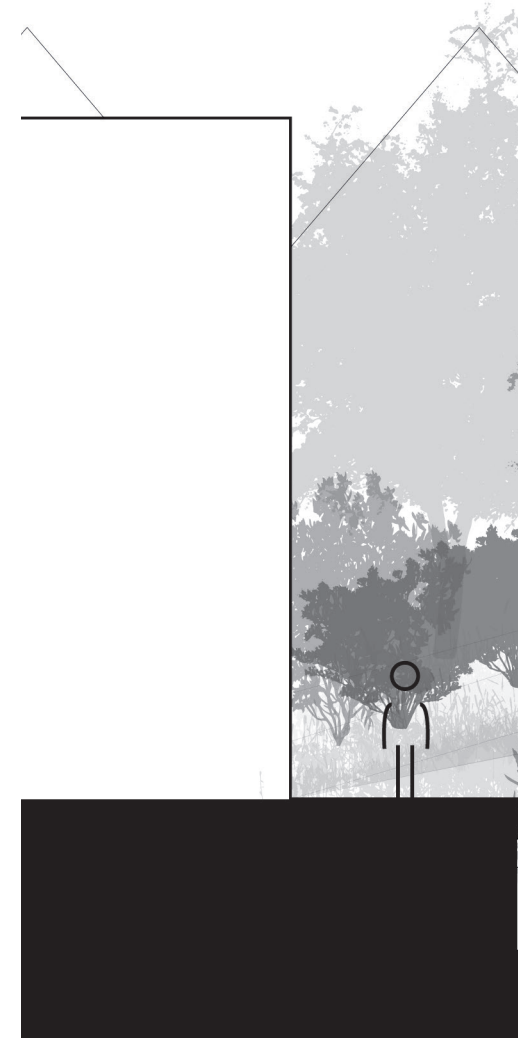
figure125: communal garden

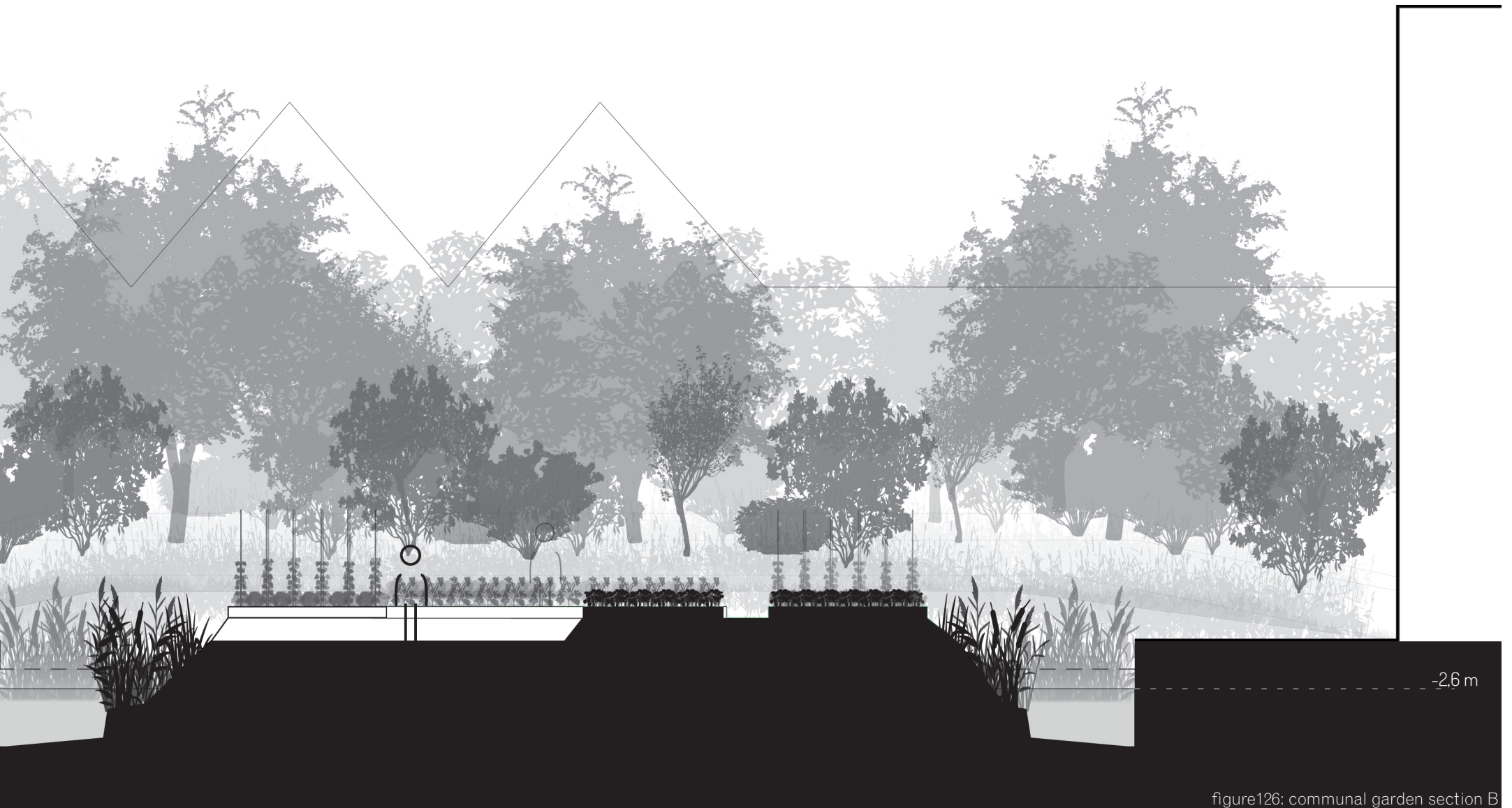
5.4 Shed design

5.4.1 Communal garden

For the shed design there is a zoom in on one of the communal gardens formed by the new development. The new buildings create an enclosed and intimate space that allows the residents along the garden to take ownership.

Dorien Tulp





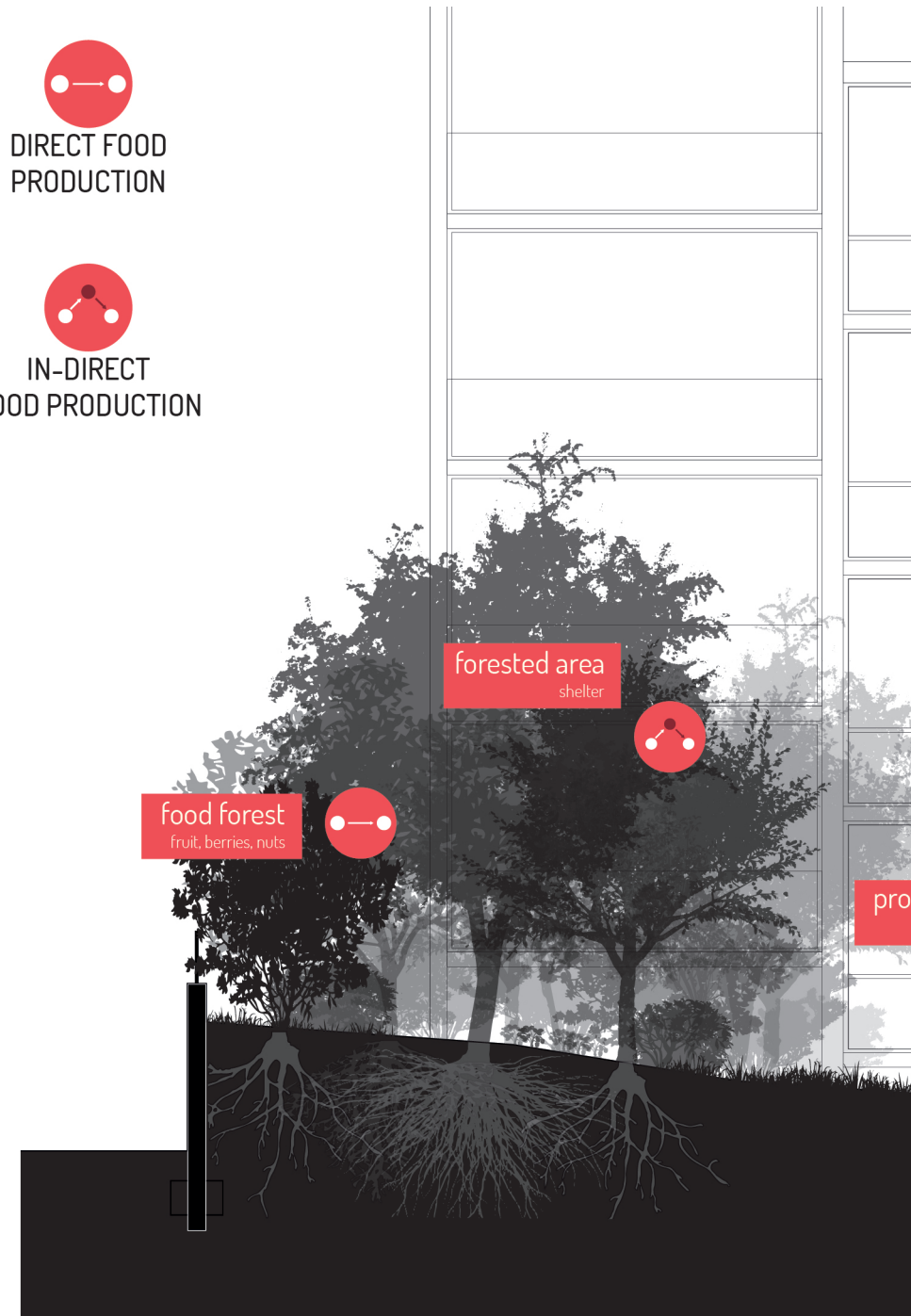
5.4.3 Direct and in-direct food production

Section C in figure 127 shows the different habitats that are formed by a variety of food landscapes on a small scale. There is a succession between forest, field and orchard, this all enclosed by ditches that catch precipitation and can transport it towards the larger retention ponds.

This mini ecosystem of the different food landscapes shows the interactions between the different crops, vegetation and soil conditions that attract wildlife. Pollinators attracted by the blossom of the trees, the herbaceous undergrowth in the forest and the flower strips intercropped within the production field pollinate the crops, plants and trees. Shelter provided by dense vegetation and tall grasses attract birds that eat pests and ponds and ditches attract helpful insects and give better soil conditions. These aspects are all part of the production of the food within the neighbourhood but can not be directly harvested and eaten. Therefore, these aspects can be called indirect food production and are vital for the strength of the ecosystem and the overall balance within the landscape.


DIRECT FOOD
PRODUCTION


IN-DIRECT
FOOD PRODUCTION



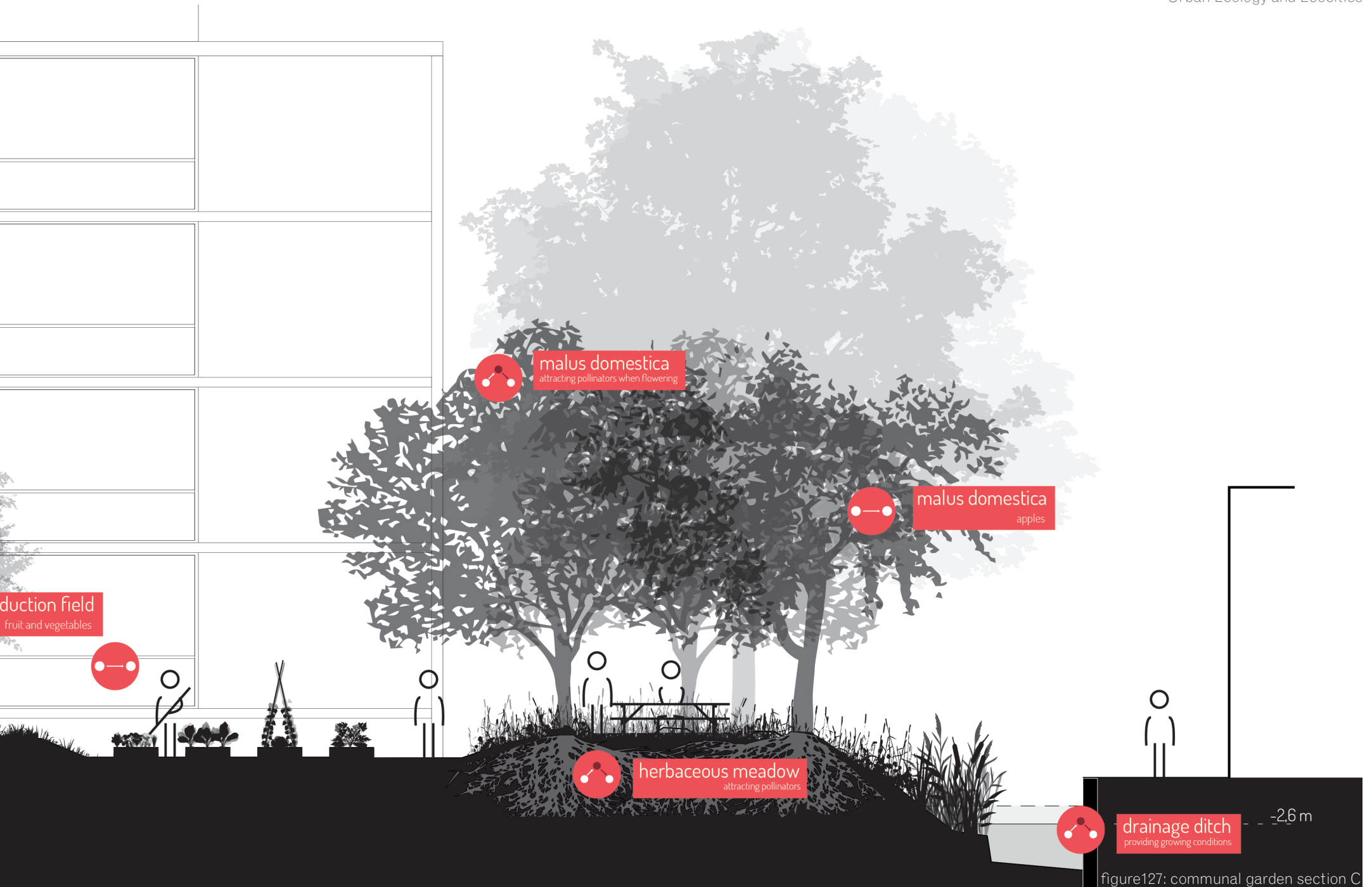




figure128: Lombardijen in the Groenplan of Rotterdam

5.5 Lombardijen in Rotterdam

Through this strategy and design Lombardijen will become a social and ecological hub within its surroundings. The neighbourhood contributes towards the overall ecological and green structure in the greater Rotterdam region by hooking up on one of the radial connections through the south of the city. Together with the infrastructure zones, this project will allow dense and diverse vegetation to carry different animals within the area and therefore contribute to the overall biodiversity of the city.

6. CONCLUSION AND RECOMMENDATIONS

6. CONCLUSION AND RECOMMENDATION

Through the analysis, the formation of criteria and the design I have come to some conclusions on the way similar projects and researches can be executed. Being able to offer a guide to establish certain spatial and organisational qualities to improve environmental and social structures in public space.

6.1 Organisational recommendations

The main organisational recommendations are based on creating spaces for interaction between inhabitants and providing a strategy for durable development and maintenance. This strategy involves security based on paid full time workers and coordinators that guide volunteers and acts as direct line between the inhabitants and the municipality. This security is further supported by the valuation of the land and the direct and indirect profit the area can give and therefore form a durable circular model of in- and output.

6.2 Design recommendations

The main design recommendations can be found in the activation of spaces through programming and vegetation, generating varied spaces. By creating different ecotopes and habitats around food production landscapes a direct connection between human and non humans can be formed and a wide variety of different spaces and spatial characters can give locations meaning and aesthetic value.

6.3 Project principles

In figures 129 to 140 you can find the most important project principles that have served as guide for the actualisation of the project in its context.

6.4 Reapplication

Opportunities for reapplication can most easily be found in the other three southern garden city extension neighbourhoods, their similar soil and spatial structures allow easier comparisons. As well as other

garden city neighbourhoods of which there are many in the Netherlands and beyond. In general the strategy has wide application possibilities, through the establishment of varied values in different landscapes as well as some detailed elaboration on specific elements.

6.5 Final conclusion

Finally, to answer the research question of this project and to conclude this report: landscape architects can tackle environmental and social issues with agroecology through spatial design. This can be done by thorough analysis of the current and possible values of the spaces and generating strategies for the harvesting these values through integrated and holistic design and offering these outcomes as inspiration and knowledge to communities.

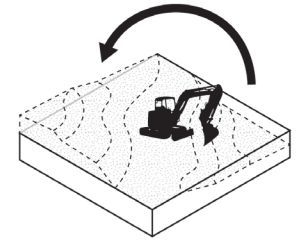


figure129: creating relief

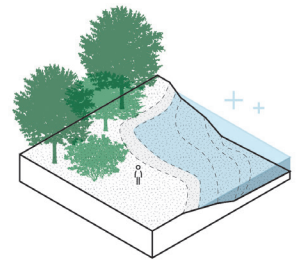


figure130: adding surface water

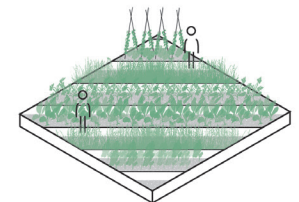


figure131: production fields

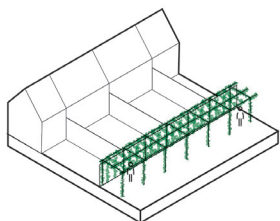


figure132: living fences

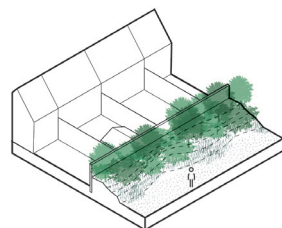


figure138: vegetation wall

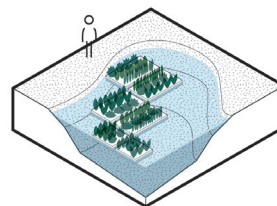


figure135: hydroponics

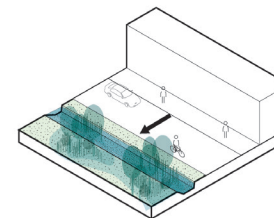


figure138: water buffering

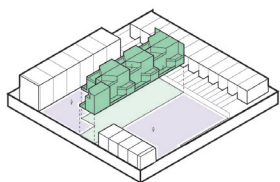


figure133: densification for activation

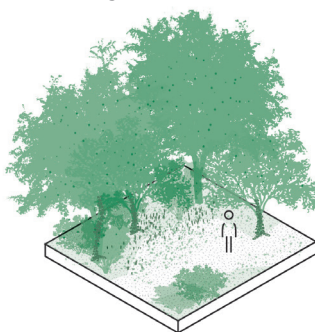


figure139: food forest

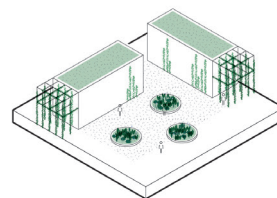


figure136: integrated food production

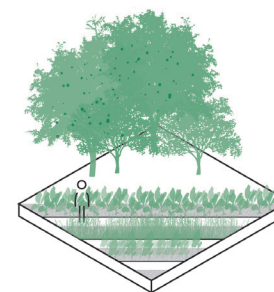


figure139: direct food production



figure134: meeting spaces

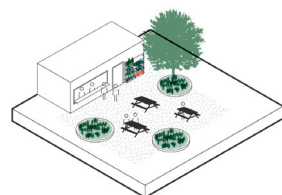


figure140: social hubs

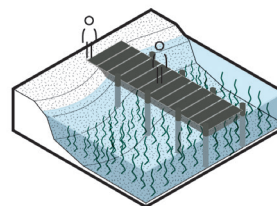


figure137: aquatic agriculture

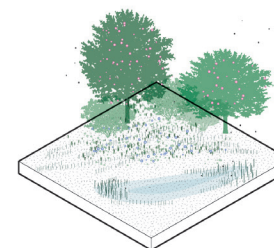


figure140: indirect food production

7. REFLECTION

7. REFLECTION

This report starts with a wish, a wish for me to save the world. This has been my constant guide throughout the past year, motivating me to keep working, to find the best solution. It has also been a burden, I set myself this goal, a goal which I knew I could never reach. The goal is wide, it is complex and it is of a scale which I could never fully impact in this graduation project. While I knew this was true, it was still often hard to accept. One of my main challenges was to find the scale and the width in which I could operate, to maybe not save the world, but to at least contribute to improvement.

As previously discussed in the problem statement, the current urban landscape is dealing with a lot of problems on a socio-economic and environmental level. At the same time the cities keep growing, there is need for new ways to transform cities into sustainable urban systems.

For me the fact that the world needs saving is obvious, it is something that I see as a fact. We are alive during the anthropocene, an non-official unit of geological time that describes the age of mankind. I was first introduced to this term by landscape architect and co-founder of H+N+S Landscape Architects Dirk Sijmons during a talk he gave at the Independent School of the City in February of 2019 called 'Mobilis in Mobile: Navigating the Anthropocene'. Sijmons' lecture felt as a call for action. In this age climate change is one of the biggest issues we are facing, but seeing the differences on a local and global scale on the significance and urgency of this problem has shown me the importance of involving people in raising awareness and driving change.

Through the graduation lab Urban Ecology and Ecocities I was able to find a scope to operate. The graduation lab Urban Ecology and Ecocities has a focus

on improving the quality of life and environmental performance through the lens of urban ecology.

Within this studio the project will use agroecology and the production of food as a tool for the improvement of the quality of life and the environmental status of cities by designing possible applications in public space interventions that are developed through the interaction with its current and future users, its site and the ecosystem services.

The original goal of the project emphasised on creating tools for inhabitants and city-makers to take action in their public space to combat environmental and social issues and create a healthier living environment. There are many initiatives and projects already started up but there is a need for a guidance that makes scientific information, professional structure and social studies applicable in these endeavours.

Throughout the year my opinion that landscape architects can and should play a key role in this development had been reaffirmed. Due to their ability to work through scales and with the process of time, while also having the knowledge concerning ecoservices and human experience, landscape architects can give practical and spatial solutions to abstract problems.

By the choice of the case study location of Rotterdam, the lab gives a framework for the actualisation of research and the incentive for condensation of the design to gain overarching conclusions and wider application possibilities. In this specific case, through the neighbourhood of Lombardijen in the south of Rotterdam, the project is able to give clear examples of wider problems and possible solutions concerning post-war extension neighbourhoods based on the garden-city principles established by Ebenezer Howard. Lombardijen is one of ten post war neighbourhoods

built to combat a housing crisis through garden-city design principles to offer safe and healthy living environments in Rotterdam. Similar developments can be seen in cities all around the Netherlands and the world, showing similar typologies, problems and therefore possible solutions.

Research served as input for the design. The design is the process of finding approaches of solving the research question. Through the process reiteration and condensation is key to develop from products of the research and design and generate a cross contamination between the two. As shown in figure 141, throughout the process different forms of research and design have been part of the project. Constant reiteration between research for design, design through research, design for research and design for research give information on specific topics, practical implications of abstract notions and opportunities for the distillations of conclusions and concepts.

At times this process felt quite messy, also because the model was still very much evolving. The benefits of this process are found in the organic development in the design and the research, being able to switch fast between different techniques allowed for unexpected outcomes.

When looking back at the process I would have advised myself to make clearer guidelines for the execution of the different tasks throughout the spectrum of research and design. Pre-constructed models were often fast outdated and allowing time for re-establishing order and closure of certain topics would have been helpful.

Co-creation and participation is one of the key elements within the agroecological framework. It was an aspect which has been part of the project at different times throughout the process but was never fully integrated. In the original structure for the project it

was planned to involve public figures and organisation from the case-study location to establish practical application possibilities. This however was never executed. Through the limited contact with local parties that were done, the impracticality of integrating this

process into the graduation project became more and more evident. This caused me to re-imagine the role of 'Growing Society', where once the plan was to make a guide for direct application it grew into a direction that highlights the possibilities, aims to inspire and to

establish the role of landscape architects within these types of projects.

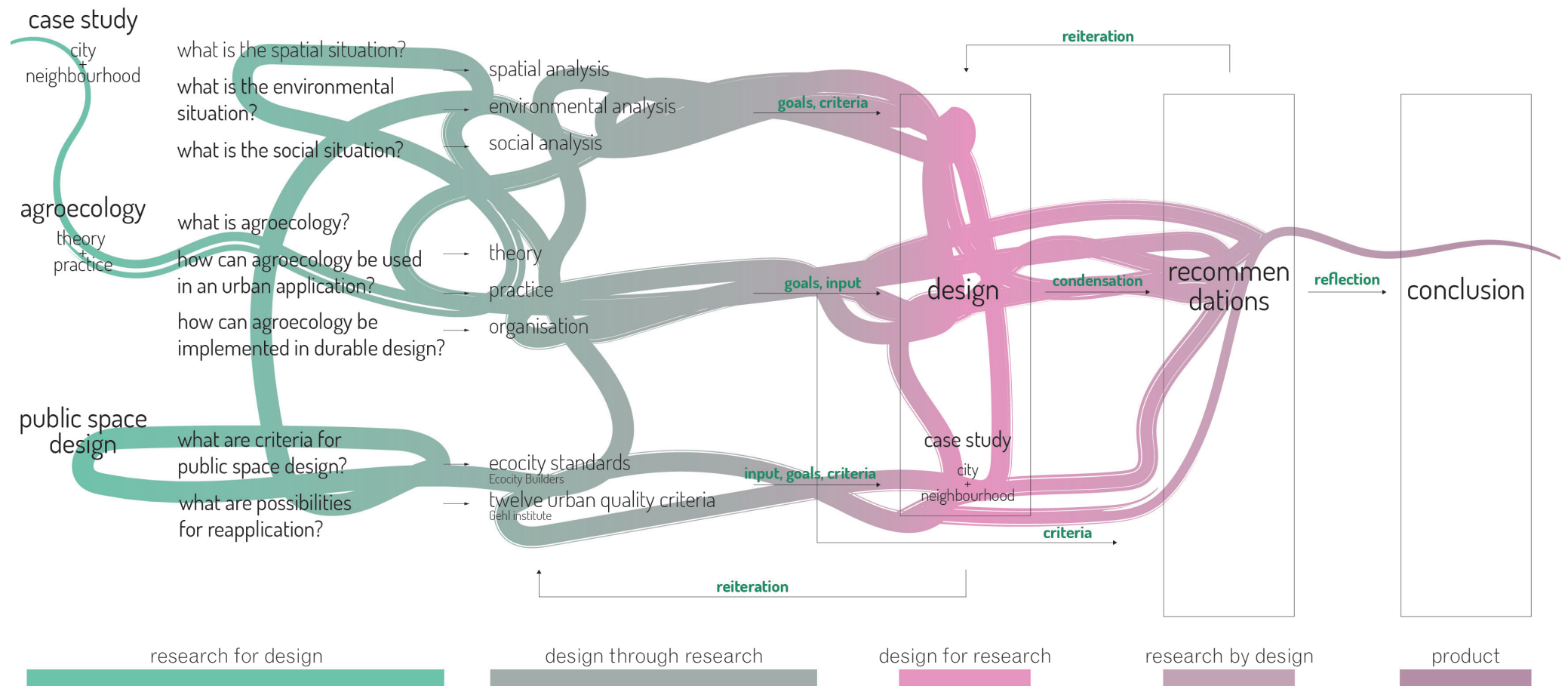


figure141: Design process

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9. REFERENCES

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figure1: page 7 of IPCC. (2021). *Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, Cambridge University Press.
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figure4: by author

figure5: screenshot from Pakhuis de Zwijger. (2020, October 29). *A Just Transition #3: De wereld voeden met agro-ecologie* [Video]. YouTube. <https://www.youtube.com/watch?v=SUKHyuVzWu8&t=1548s>

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figure6: by author based on FAO. (2018). *The 10 elements of agroecology: Guiding the transition to sustainable food and agricultural systems*. FAO. Retrieved from <http://www.fao.org/documents/card/en/c/I9037EN>

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figure7: by author

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figure8 to 13: by author based on Palmboom, F. (1987). *Rotterdam, verstedelijkt landschap*. Rotterdam, Uitgeverij 010.

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figure15: page 34 of De Greef, P., Den Heijer, M., Tillie, N., Soeterbroek M. (2005). *Groenplan Rotterdam 2005*. Rotterdam: Gemeente Rotterdam.

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figure80: Ten Have Seeds. (n.d.-c). Persian clover [Photograph]. <https://www.tenhaveseeds.nl/product/perzische-klaver/>

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9. APPENDIX

9.1 GREEN MANURE

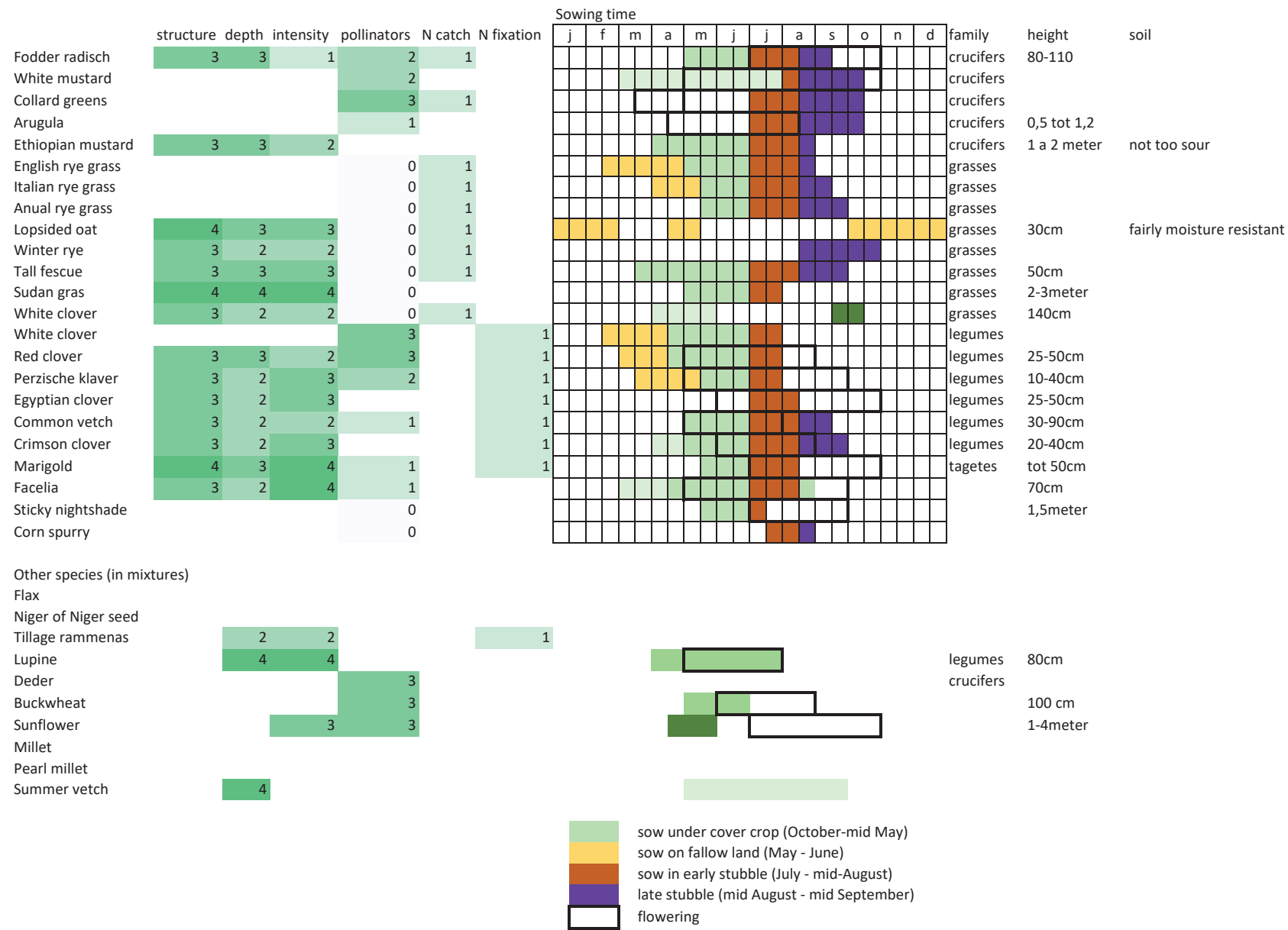


figure142: Green manure valuation

9.2 SPECIES

Observed species:

Common Pipistrelle (Pipistrellus Pipistrellus)

linked to icon species Hedgehog and is part of the Urban Environment Biotope.

The Common Pipistrelle hunts in closed to half-open landscapes and flies on average on a height of 2 tot 5 meters. They fly through the cover of vertical green elements in green built-up areas, along linear structures like canals, tree lanes, Singels, forest edges, wooded-banks and sunken lanes, as well as through gardens, open spaces in wooded areas and parks with ponds. Favourite hunting grounds can be found around waterbodies and covered banks. Shelters are inhabited by large colonies in buildings, cavity walls, woodpaneling and underneath roof tiles. The bats use multiple shelters for different uses in different seasons. Hunting ground should be available within a range of 2-5 km from their shelter and accessible through linear green structures. (Zoogdierenvereniging, 2003)

Nathusius' Pipistrelle (Pipistrellus Nathusii)

linked to icon species House Sparrow and is part of the Urban Environment Biotope.

Like the Common Pipistrelle, the Nathusius' Pipistrelle travels mainly along linear green structures. They hunt in relatively fast, straight and long flights catching insects from the sky, mainly Lake Flies (Chironomidae). (Zoogdierenvereniging, 2019-b)

White Stork (Ciconia Ciconia)

linked to icon species Early Bumblebee and Blackbird and is part of the Urban Environment Biotope

The White Storks natural environment is in extensively managed fields in peat meadows areas and flood planes with high water levels, but can also be found more and more in urban environments. White Storks hatch their eggs on high spaces, like telephone poles, trees, chimneys, church towers, power pylons and man made wooden poles with wooden platforms. (Vogelbescherming, 2016-d)

Gray Heron (Ardea Cinerea)

The Gray Heron is a common inhabitant of the urban environment and can be found everywhere there is shallow waters and plentiful food. They have a preferences for areas that are largely inaccessible for predators like islands in ponds or lakes. Their nest exists of branches, sometimes supplemented with reed and water plants. (Vogelbescherming, 2016-a)

Common Blue Butterfly (Polyommatus Icarus)

The Common Blue Butterfly can be found in an assortment of herbaceous vegetation, like semi-natural meadows, low pioneer vegetation, parks, verges and dykes with legumes such as trefoil, lesser trefoil or hop clover. (Vlinderstichting, 2017)

Small Copper Butterfly (Lycaena Phlaeas)

Habitat: relatively open and often dry areas, like poor spots on sandy soils in meadows, heathens, logging areas, dunes, fallow lands, gardens and verges, as well as poor meadows in swamps and on moist fields with Sheep Sorrel. (Van den Boogaard, 2019)

Ambassador species Natuurlijk Tuinsteden Rotterdam:

Common Pipistrelle (Pipistrellus Pipistrellus)

See observed species.

Hawthorns (Crataegus)

Grows on sunny to lightly shaded locations with moist to dry, poor to fertile, lightly acid to calcareous soil. In hedges, scrubs, forest edges, forests, seadunes, sedges, steep ridges, rocks, creek, river and ditch banks and dykes. (Van den Boogaard, 2019)

Target species urban environment:

Hedgehog (*Erinaceus Europaeus*) (**redlist**)

Habitat: upright green. Hedgehogs live amongst forest edges, brushwoods and deciduous forests with lots of undergrowth. They also can be found in the urban environment, as long as there is plentiful vegetation and hiding spaces. The male Hedgehogs territory covers around 20 to 40 ha, the female's is between 10 and 20 ha, traveling around a few kilometres each night. (Zoogdierveniging, 2019-a)
Companion species: European Pine Marten (*Martes Martes*) (**redlist**), European Polecat (*Mustela Putorius*), Eurasian Ermine (*Mustela Erminea*) (**redlist**), European Rabbit (*Oryctolagus Cuniculus*) (**redlist**), Bank Vole (*Myodes Glareolous*) and Weasel (*Mustela nivalis*) (**redlist**) (Van den Boogaard, 2019)

Common Swift (*Apus apus*) (**redlist**)

Habitat: buildings (breeding area), sandy areas, shrubs. The Common Swift builds its nests in buildings, underneath gutters, behind down-spouts, dormer-windows, roof tiles, or in holes in walls as well as in man-made nesting stones. They hunt above a wide range of habitats, in villages and cities, and catch their prey, insects, mid air. (Vogelbescherming, 2016-b)

House Sparrow (*Passer Domesticus*) (**redlist**)

Habitat: buildings (breeding area), sandy areas, shrubs. The House Sparrow makes its nests underneath roof tiles, in holes and cracks in buildings and in nesting boxes. They like their habitat to be a messy and human environment with scrubs, sheds, meadows with cattle and leftover grains, but without high and large trees. (Vogelbescherming, 2016-c)
Companion species: True Sparrow (*Passer Domesticus*), Pond Bat (*Myotis Dasycneme*) (Van den Boogaard, 2019)

Blackbird (*Turdus Merula*)

Habitat: buildings (breeding area), sandy areas, shrubs. Blackbirds like lawns, meadows, verges, trees and shrubs and can be found most in green suburbs and in moist forests with lots of undergrowth. (Vogelbescherming, 2012)
Companion species: Peregrine Falcon (*Falco Peregrinus*) (**redlist**), Song Thrush (*Turdus philomelos*), Red-tailed Bumblebee (*Bombus Lapidarius*), Early Bumblebee (*Bombus Pratorum*), Mason Bee (*Osmia Bicornis*) (group), Chicory (*Cichorium Intybus*) (old walls), Wallflower (*Erysimum Cheiri*) (old walls), Maidenhair Spleenwort (*Asplenium trichomanes*) (old walls) and Hart's-tongue Fern (*Asplenium Scolopendrium*) (old walls). (Van den Boogaard, 2019)

Early Bumblebee (*Bombus Pratorum*)

Habitat: flowery gardens, roadsides, city and hinterland
Companion species: butterflies (including the icon species Wall Brown Butterfly), flora, grasshoppers and other insects (Van den Boogaard, 2019)

Bitterling (*Rhodeus amarus*) (**redlist**)

Habitat: clear ditches with rich aquatic plants and helophytes, with freshwater mussels for reproduction.
Companion species: Three-spined Stickleback (*Gasterosteus aculeatus*) (city and grasslands). (Van den Boogaard, 2019)

Target species small scale agriculture:

Little Owl (*Athene Noctua*) (**redlist**)

Habitat: agricultural buildings, landscape elements. The Little Owl hatches its eggs in natural cavities in trees, mostly knotted willows and fruit trees, as well as in quiet corners and alcoves in buildings or barns and in special nesting boxes. Their habitat consists of small scale cultural landscapes with a variety of wooded banks, hedges, small meadows and gnarled trees. Hunting grounds are open spaces with yearlong low vegetation and have seating spaces on 1 to 1,5 meter poles. (Vogelbescherming, 2016-e)
Companion species: Barn Swallow (*Hirundo Rustica*) (**redlist**), Common House Martin (*Delichon urbicum*) (**redlist**), Barn Owl (*Tyto Alba*) (**redlist**), Common Linnet (*Carduelis Cannabina*) (**redlist**), European Goldfinch (*Carduelis Carduelis*), Eurasian Tree Sparrow (*Passer Montanus*) (**redlist**), Cuckoo Flower (*Cardamine Pratensis*), Red Pimpernel (*Anagallis Arvensis* subsp. *Arvensis*), Serotine Bat (*Eptesicus Serotinus*) (**redlist**) (Van den Boogaard, 2019)

Target species flowery grassland:

Wall Brown Butterfly (*Lasiommata Megera*)

Habitat: flowery verges, dykes, meadows and waterbanks.
Companion species: Brown Argus (*Aricia Agestis*) (**redlist**), Small Heath Butterfly (*Coenonympha pamphilus*), Common Blue Butterfly (*Polyommatus icarus*), Small Copper Butterfly (*Lycaena phlaeas*), Lesser Trefoil (*Trifolium dubium*), Lesser Marsh Grasshopper (*Chorthippus albomarginatus*) and Bow-winged Grasshopper (*Glyptobothrus biguttulus*)

Southern Marsh Orchid (*Dactylorhiza praetermissa*)

Habitat: moist and wet roughlands
Common Green Grasshopper (*Omocestus viridulus*), European Mole Cricket (*Gryllotalpa gryllotalpa*) (**redlist**), Eurasian Curlew (*Numenius arquata*) (**redlist**)

9.3 CALCULATIONS FOOD PRODUCTION

By use of the example of the Ommuurde Tuin a rough calculation of the amount of food production was made. The Ommuurde Tuin has a production plot of around 1 ha, on this they are able to produce around 95 food bags for 25 weeks out of the year. These food bags range from small to extra-large and therefore interprets the size of families. From a conservative estimation, these 95 food bags can supply around 150 people with fruit and vegetables.

Using the calculations in the chapter on the case-study location on page 33 for the amount of green public space available. There would be an overhead 36 ha after providing all households with 75 m² green space, this would be 16 ha if the public green space is reduced by 20% to limit municipal. This would result in the following numbers:

36 ha = 5400 persons food bag for 25 weeks

Total amount of inhabitants Lombardijen: 14230

$5400 / 14230 = 0,38 * 100\% = 38\%$

16 ha = 2400 persons food bag for 25 weeks

Total amount of inhabitants Lombardijen: 14230

$2400 / 14230 = 0,17 * 100\% = 17\%$

Considering the overall improvement of valuation of the public space as well as the shifted maintenance costs through the farm-barn-shed structure, there would be little reason for reducing the amount of public green space in the neighbourhood. Therefore the calculations come to 38% of the people in Lombardijen to be able to receive a food bag for 25 weeks per year. Considering the difference in priorities between the Ommuurde Tuin and the neighbourhood of Lombardijen with a wider social and recreational function, this number has been reduced to a conservative 35%.

It should be noted that these numbers are purely based on public space and do not consider the possibilities on integrated food production on dwellings.

