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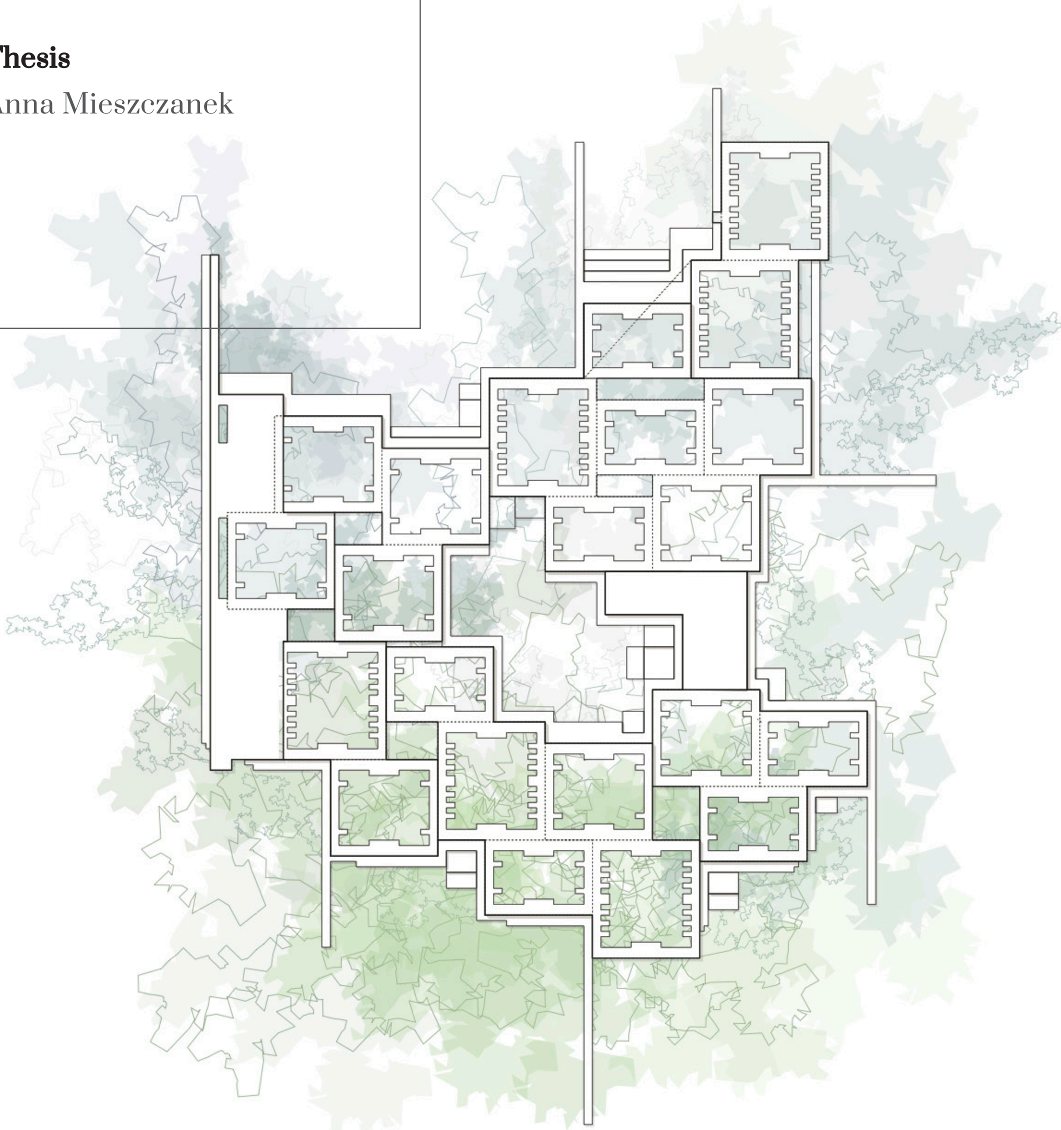
Master's Thesis

Karolina Anna Mieszczanek



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Maria Rasmussen, Supervisor
Christer Malmstrøm, Examiner

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Acknowledgements

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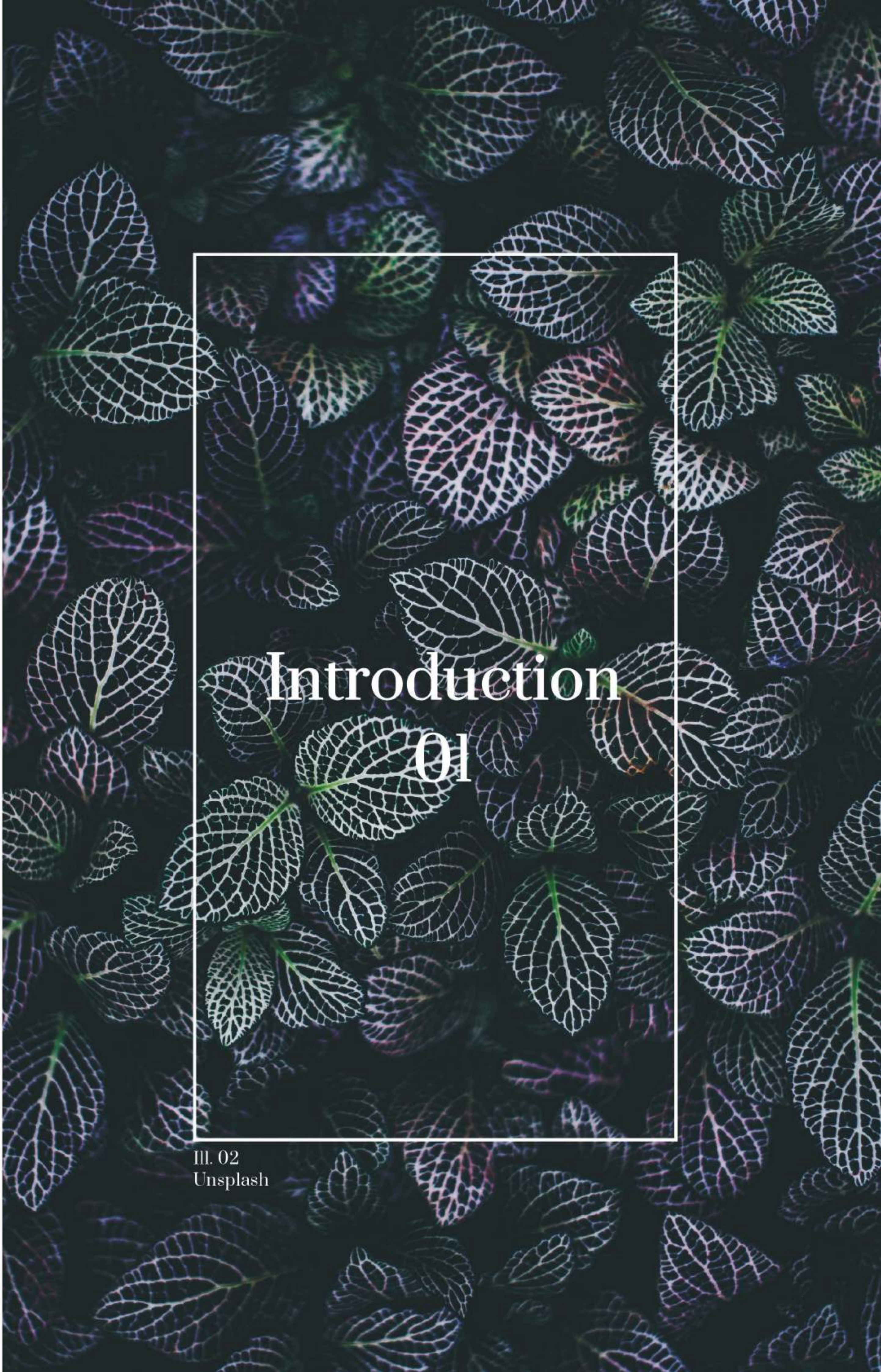

Introduction 01

Ill. 02
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Reading Guide

The booklet supporting the Master's thesis is divided into six chapters, namely introduction, research, site analysis, project presentation, conclusion and appendix.

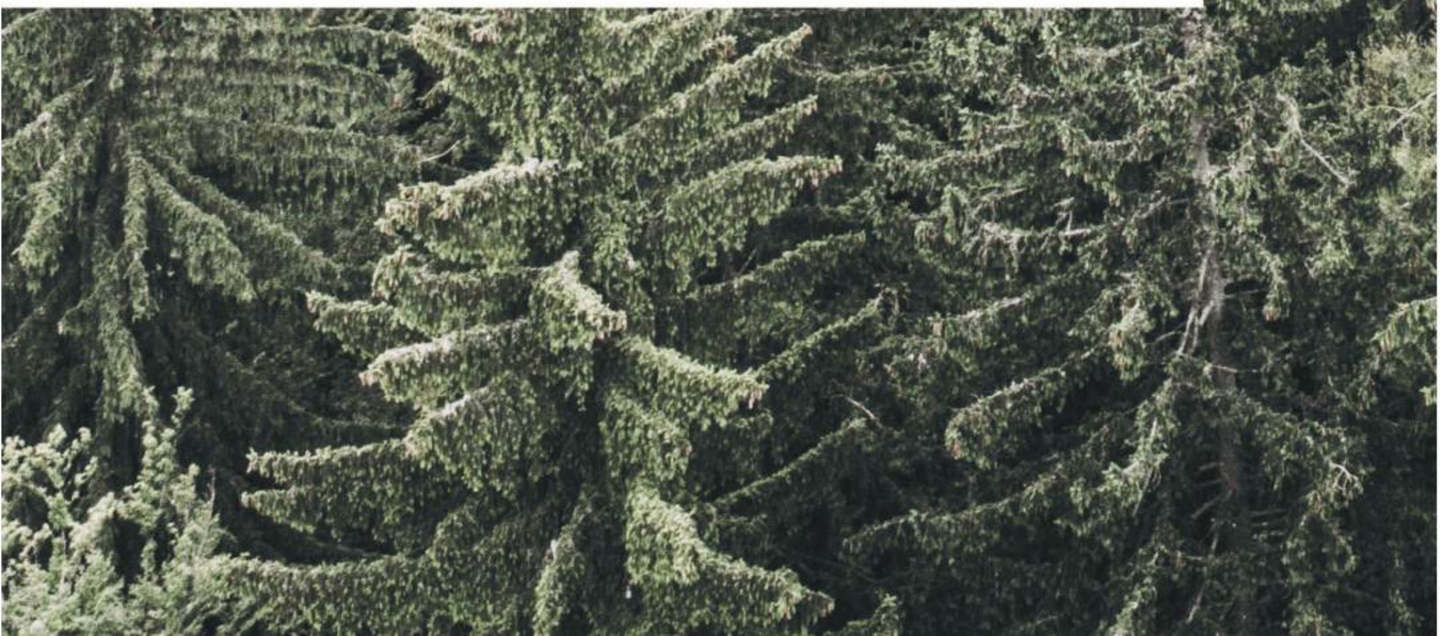
The first chapter is a rather brief introduction to the project and includes a reading guide, abstract and aims and goals for the project. The second chapter describes the overall challenges that might be considered when designing for flooding. This chapter consists of a variety of subchapters, such as passive housing, energy conserving landscape strategy, climate adaptation solutions and native planting. Following each of these subchapters, the Master's thesis is supported with a schematic summary, concluding on the most important points risen throughout the research. These sub-conclusions will form design parameters for the overall project proposal. The third chapter deals with the site analysis and is further divided into smaller sub-chapters: introduction to the project site, description of the site today, the natural potentials of the surrounding landscape and a context study. The fourth chapter represents the final design proposal and includes the master plan, description of the three dwelling typologies and the collective as a whole. The fifth chapter is a brief conclusion and reflects upon the challenges met throughout the thesis. The last chapter, appendix, include the bibliography and the list of illustrations.


1.1. Abstract

Today's architecture is no longer an isolated field of building design, but concerns human related issues including sociology and psychology and moreover climate adaptation, ecology, sustainability and technological innovation. Taking point of departure in intensification of precipitation due to the climate change in Denmark, this thesis project attempts to investigate the possibility of establishing a new type of community based on mutual respect and beneficial relationship between architecture, urbanism, human beings and nature.

Throughout a set of rules concerning energy conserving landscape, rainwater runoff connected to the climate change and benefits of native vegetation, the project envisions building and landscape design equipped for environmental climate changes and encouraging social interaction.

Located on wetlands between Søndersø lake and the old military air base in Værløse, outside of Copenhagen, the thesis proposes a living space for a community situated on top of a frequently flooded area and challenges the negative perception of humidity and intensified precipitation that is commonly associated with the Danish climate, in an attempt to embrace and enhance the subtle beauty of these natural conditions evident within the area.

Ill. 03 - Unsplash

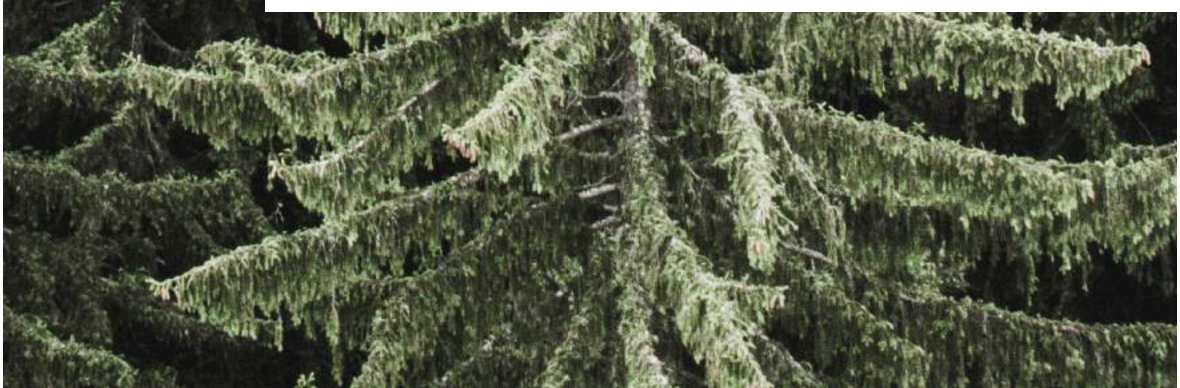
1.2 Aims and goals

Each new situation requires a new architecture. – Jean Nouvel

The aim of this Master's thesis is to, firstly, investigate the challenges of designing in accordance to the expected climate change in Denmark and the resulting increase in intensity and frequency of precipitation.

Throughout a variety of research topics including passive house construction, energy conserving landscape strategies, climate adaptation solutions and use of native vegetation, the goal of the Master's thesis is to explore possibilities of creating a community-oriented dwelling units situated upon a site with a risk of local flooding incidents.

The aim of the project is therefore to include the weather conditions and the existing landscape and allow them to become an evident and active part of the proposal.



Research 02

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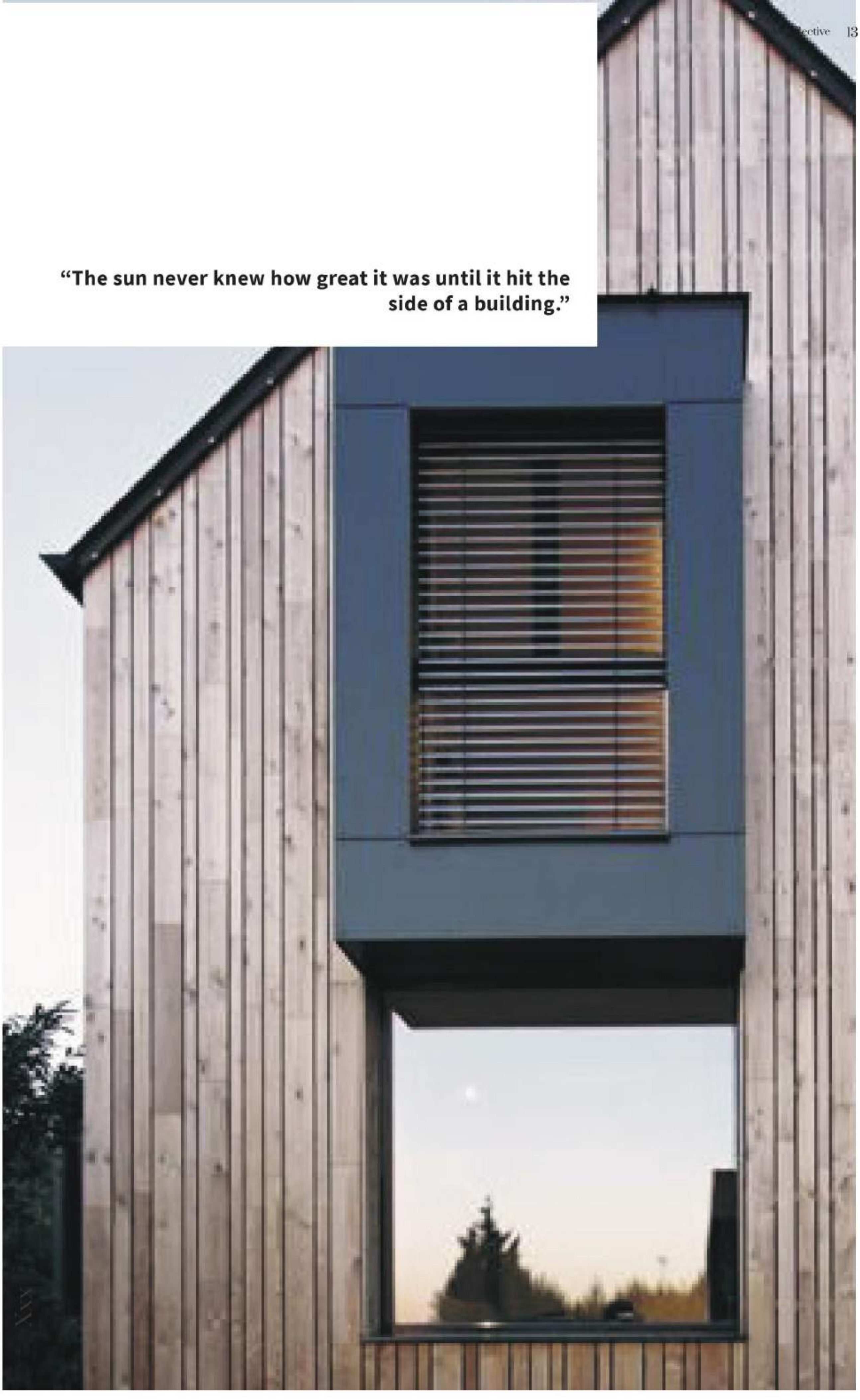
“The sun never knew how great it was until it hit the side of a building.”



Ill. 05: Passive house, Karawitz, 2011

2.1. Passive Housing

In 1988, professors Wolfgang Feist of the Institute for Housing and the Environment, and Bo Adamson of Lund University challenged the traditional building industry and envisioned the future of construction, which provided energy efficiency, comfort, indoor air quality, affordability and reliable performance without compromising on design. In the pursuit of optimizing thermal comfort in human dwellings, they decided that the key principles for low energy housing, which already was a required energy standard for new buildings in Denmark and Sweden, needed to be further developed . Their vision, launched in May 1988, became the Passive House standard, describing a performance standard that reduce the heating requirement of a building to the point, where a traditional heating system is no longer considered essential.

Even though there is a set of factors that need to be considered in order to fulfil the requirements of this category of buildings, there is no specific construction method, design or stylistic expression, leaving most of the decisions to the imagination of architects and future users.

The passive house concept is based on high-energy efficiency, and according to the current requirements, the building must not use more than 15 kWh to heat each square meter of living space over the course of a year . In order to ensure an energy demand of this minimal magnitude, the process of planning and executing a building should be fulfilled with the highest attention to details.

There are five crucial criteria that has to be taken into consideration when designing a building in accordance to the Passive House standard: overall high level of insulation, elimination of thermal bridge within the construction, securing airtightness of the building, well-insulated windows and glazing and ventilation with efficient heat recovery. These criteria will be discussed on the following pages.

Ill. 06: Passive house criteria

High level of insulation

One of the main features that has to be considered when designing a passive house is incorporating exceptionally high level of insulation, and in this way, reducing the heat loss through the building fabric. The total thermal heat loss coefficient (U-value), describing how much heat (in Watts) is lost per m2 at a temperature difference of 1 degree Kelvin, for a typical passive house ranges between 0.1 to 0.15 W/(m²K) and typically reaches 0,13 W/(m²K) . In order to fulfil these requirements in cool temperature climates, the thickness of the insulation layer for external walls and roof in newly built buildings should not be less than 24 cm, assuming a typical thermal conductivity of insulating material of 0.036 W/(mK), however, increasing the thickness to 32 cm and providing even more energy savings is often practiced.

An airtight building

It is observed that the indoor air has higher vapour content than outside air and, in colder climates, warm, interior air can escape through gaps in the building envelope. As the passing air cools, the moisture therein condenses, causing mould and structural damage. In order to avoid these problems, the external building structure of a passive house standard has to be built airtight. In order to ensure the airtightness of the building, it is, first of all, essential to specify the component, which will form the airtight layer for each external building component, then to determine how the ends of the airtight component layer will be joined and finally, to plan the necessary penetrations in as few places as possible.

Thermal bridge free design and construction

Apart from sufficiently insulating construction elements, it is equally important to avoid heat loss through connections and penetrations, called thermal bridging. Thermal bridges in the building envelope have a measurable impact on energy efficiency and thermal comfort, by reducing the building energy efficiency and increasing heating costs. In order to design a correctly insulated passive house, it is necessary to reduce the thermal bridge effects to such an extend, that they do not increase the overall building heat loss and do not need to be taken into account in calculations.

Ill. 07 Passive house, interior

Windows and glazing

By reducing heat loses throughout the building envelope, a passive house requires very little energy to maintain a constant, pleasant temperature and a significant part of heating demand can be covered by the sun's energy, entering the space through windows. In colder climates, passive houses have noble gas filled, triple-glazed windowpanes with well-insulated frames, allowing the sun's thermal energy into the building and minimising heat losses during the winter. During the warmer months, the sun sits higher in the sky resulting in reduced solar heat gains and in this way avoiding overheating. In northern Europe, large glazing areas should preferably be oriented towards south, increasing the amount of solar radiation entering the building in the winter period and leading to an optimal use of passive solar energy. Additionally, strategic placement of windows provides healthy living conditions and increases the functionality of the house and comfort of the dwellers.

Ventilation with highly efficient heat recovery

Apart from taking advantage of passive solar energy and a contribution from occupants and mechanical appliances, a passive house still requires additional heating, however, the heat demand is significantly reduced in comparison to other building types. One of the strategies that can increase passive pre-heating or pre-cooling of incoming air is ground heat exchanger. Taking advantage of the fact, that temperatures underground remain more constant than above the ground, fresh air can be led through air ducts placed under the house . Additionally, ventilation units with a highly efficient heat recovery are necessary in order to increase energy savings, as they reuse the warmth carried by the exhaust air and transfer it to the incoming fresh air. In order to fulfil the passive house standards, the ventilation systems installed in the building should be able to transfer 75% of the perceived warmth. In order to avoid cumulating heat inside the building when it is unnecessary, heat recovery ventilation systems are equipped with automatically controlled bypasses, allowing the incoming air to pass directly through heat exchange during the summer months.

Ill. 08 Unsplash

2.2. Energy conserving landscape strategy

In order to further reduce heating and cooling costs of a building, it is significant to implement energy conserving landscape strategies. Based on the moderate, marine west coast climate in Denmark, the main aim of these strategies include maximizing passive solar heat gains in the winter and reducing the risk of overheating by increasing shading in the summer months, in accordance to solar orientation. Another important aspect affecting thermal comfort inside a dwelling in this climate region is strong wind, especially from the west and southwest, which can be deflected in the colder months by planting dense windbreaks of trees and shrubs on the windward sides of the house.

The energy conserving landscaping strategies include three fields, namely landscaping for sunlight and radiant heat, landscaping for shade and landscaping for windbreaks. These strategies will be discussed in the following chapter.

Landscaping for sunlight and radiant heat

During the winter solstice in the northern climates, the sun is to be found low in the southern sky, generating rays that strike directly on the southern façade and providing radiant heat and natural daylight through the windows, while during the summer solstice, the sun's arc is displaced towards north, shining rather on the roof than the south windows. Accordingly, the east and west side of the building will receive significantly more exposure throughout the day in the warmer months. In this sense, planting for energy conservation must be planned with respect for the changing seasons. One of the best examples of plants offering direct solar benefits are deciduous trees, providing shading in the summer and letting the sun shine through their leafless branches in the winter. In order to increase the benefits of passive solar energy, deciduous trees with low branching density and open twig structure are preferable for maximum solar access.

Landscaping for shade

Incorporating shade from landscaping elements can help to control the amount of solar heat absorbed through windows and roofs during the warmer parts of the year. The optimal shading potential depends on the shape of the tree canopy and the distance between the tree and the house. In most cases, a 2-meter deciduous tree planted near the building will be sufficient to provide shade for the windows and shade the roof within 5 to 10 years.

Another important benefit from integrating trees, shrubs, and groundcover plants is evapotranspiration, the process accounting for the movement of water within a plant and the subsequent loss of water as vapour through its leaves into the atmosphere, and thus reducing surrounding air temperature. Due to the fact that cool air has a higher density, the released water vapour settles near the ground, reduces heat radiation and cools the air before it reaches the building envelope

Ill. 09 Unsplash

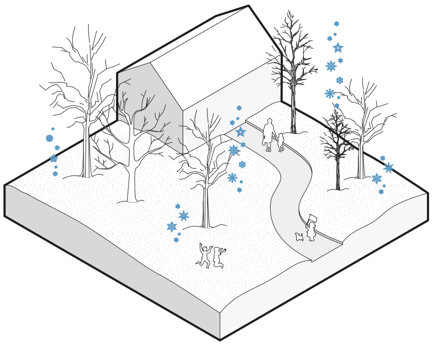
Landscaping for windbreaks

According to the annual average wind speed across Denmark of 5.8 m/s , which might increase heating costs of a building, it is relevant to consider the benefits of a properly planted windbreak. By choosing trees, shrubs and bushes that are dense throughout the height of the plants, the wind speed can be reduced for a distance of 30 times the windbreak's height. Taking into account the wind measurements for Copenhagen , the windbreak should be planted on the western and south-western part of the land lot, within a distance of two to five times the mature height of the trees, in order to offer maximum protection for the local climate.

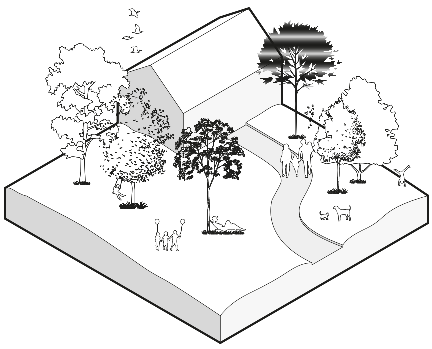
The windbreak should consist of a dense combination of shrubs and bushes with low crowns, blocking wind close to the ground, followed by taller deciduous trees and evergreens, deflecting and redirecting the wind from ground level to the treetops. However, as the placement of evergreens on the southern part of the house would reduce passive solar gain in the winter, this type of plants should be placed further apart from the windows. In addition to more distant windbreaks, planting lower shrubs and bushed closer to the building, creates dead air space, providing a supplementary layer of thermal insulation and stabilizing the temperature inside the dwelling. Besides from deflecting and impeding the wind and being an aesthetically pleasing landscape element, a properly constructed windbreak can also provide a barrier from sounds and smells, increase privacy and stimulate wildlife habitat.

Energy conserving landscape strategies - subconclusion

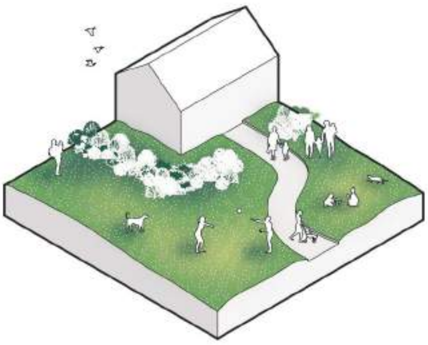
Ill. 10 - 15: Diagramatic representation



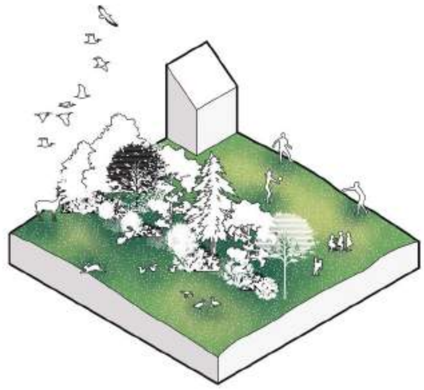
DECIDOUS TREES IN WINTER MAXIMIZE PASSIVE SOLAR HEAT GAINS, ALLOWING SUN RAYS TO PASS THROUGH HEIR BRANCHES



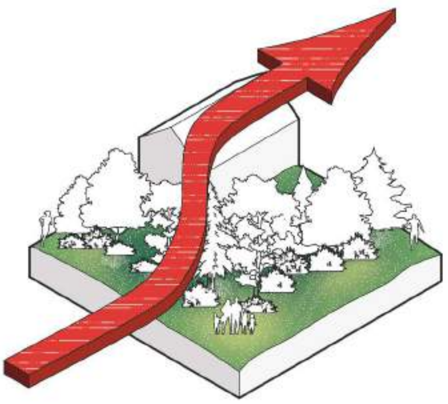
DECIDOUS TREES IN SUMMER REDUCE THE RISK OF OVERHEATING BY NATURAL SHADING AND REDUCE THE INDOORS TEMPERATURE



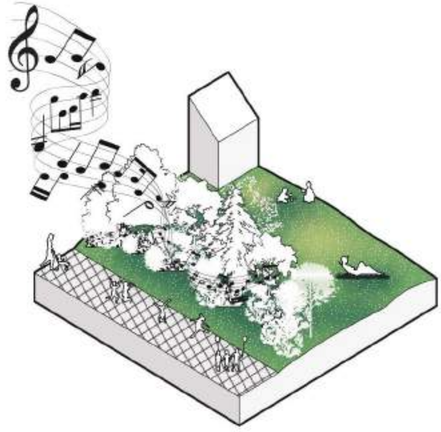
SHRUBS AND GROUNDCOVER VEGETATION NEAR THE HOUSE CREATE DEAD AIR SPACE PROVIDING A SUPPLEMENTARY LAYER OF THERMAL INSULATION



DENSE WINDBREAKS PROVIDE THE DWELLERS WITH PRIVACY AND SIMULTANOUSLY STIMULATE WILDLIFE HABITAT



DENSE COMBINATION OF VEGETATION OF DIFFERENT HEIGHTS BLOCK, DEFLECT AND REDIRECT WIND FORM GROUND LEVEL OVER THE ROOF



A PROPERLY CONSTRUCTED WINDBREAK CAN ADITIONALLY PROVIDE A BARRIER FROM SOUNDS AND SMELLS

2.3. Climate adaptation solutions

As mentioned in the previous chapter, water may return to the atmosphere through surface evaporation or plant transpiration, contributing significantly to natural water balance maintenance. However, the recent climate changes, human intervention and alterations to the natural landscape may result in local flooding.

Even though some excess of rainfall and melted snow, that cannot be evapotraspirated, will soak into the soil, providing moisture and shallow groundwater recharge, a large part of precipitation will result in runoff, flowing overland to the nearest swale, wetland, stream or costal water. The meteorological factors affecting the amount of runoff include type of precipitation, rainfall intensity, amount and duration, distribution of rainfall over the drainage basin, direction of storm movement, soil moisture, temperature, wind, relative humidity and season. Physical characteristics affecting runoff include land use, vegetation, soil type, drainage area, basin shape, elevation, topography, drainage network patterns, ponds, lakes and other reservoirs that prevent or delay runoff from continuing downstream.

Interruption of the natural hydrologic cycle causes the amount of water runoff after a rainfall to increase significantly, due to land use changes, such as establishing agricultural areas, lawns and impervious surfaces inside the cities. By altering the ground area that previously absorbed and held precipitation, such as woodlands and meadows, the volume of groundwater recharge and evapotranspiration decreases, causing larger amount of rainfall to be converted into stormwater runoff.

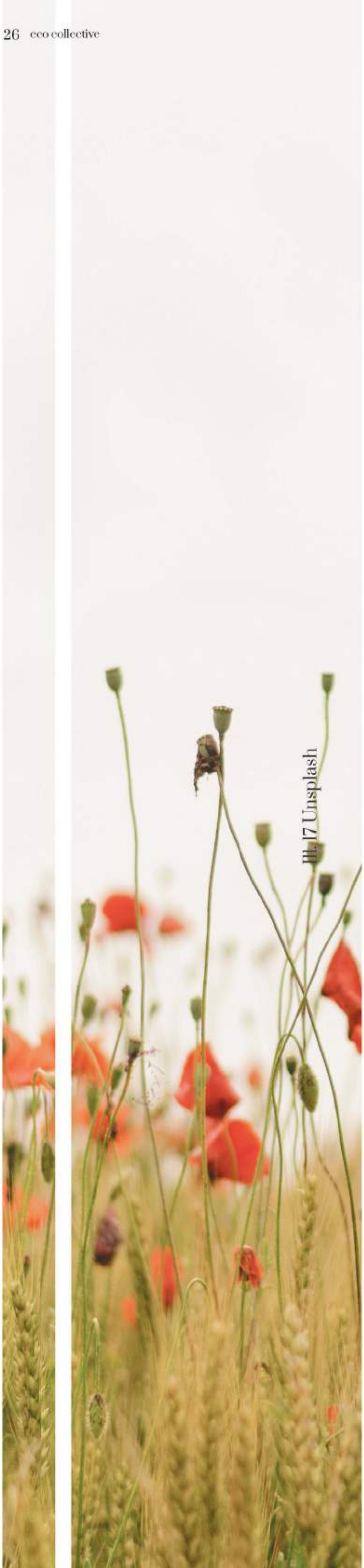
While natural vegetation and stream systems have been formed as an evolutionary response to the local intensity and distribution of precipitation, and therefore equipped to absorb adequate amount of water, impervious surfaces generate runoff almost immediately. Vegetated landscape altered by the human activity is able to withhold some initial rainfall, but its absorptive capacity has been significantly diminished. Additionally, an increase in impervious ground cover in urban areas, such as concrete pavement and asphalt roads, may contribute to the frequency of thunderstorms, due to the faster overheating of these surfaces and creation of local heat island effects. The increased amount of runoff water is typically accommodated by man-made drainage systems, which, in cases of extreme weather situations, may be insufficiently calibrated and create localized flooding.

Natural landscape

The water balance is established by the local conditions, and natural features, such as topography and soil, influence not only the amount of water that infiltrates through the soil and recharges groundwater, but also determines the path of water surface discharge into streams.

In cases of excessive precipitation, small swales, depressions and hollows in the topography are being overfilled and the additional water is being combined with smaller streams. As these streams join to form larger paths, the size and flow capacity of the stream increases, changing the shape and location of its channel. The flat areas adjacent to a stream channel, called floodplains, reduce flooding, by providing an additional area for the storage of water. After the floodwaters recede, the remaining water in the floodplains may infiltrate the ground, or form wetlands – areas, where saturated surface conditions occur for the most parts of the year.

The watershed system of streams, wetlands and floodplains serve three purposes – first of all, to moderate downstream flooding by providing storage and slowing the velocity of flow, to improve water quality by trapping sediments and nutrients, and finally to increase biodiversity and thus create healthier ecosystems.



Ill. 17 Unsplash

The altered landscape

Altering the absorptive landscape of natural vegetation disrupts the water balance, which typically results in increased amount of runoff and volume of water discharged downstream and affects the severity and frequency of local flooding.

In land developing, native species are usually substituted with non-native vegetation with reduced capacity to effectively absorb precipitation and may require additional irrigation. One of the most common examples of such practise is establishment of lawns on previously flattened house lots and urban green areas. In contrast to previously existing, complex structure of woodlands and meadows, the short and uniform characteristics of turf grass not only affect biodiversity, but also provide significantly diminished interception. The shallow root structure of this type of vegetation do not provide sufficient means of conveying rainfall into the soil, which is additionally compressed due to regular mowing, required for maintenance. In case of urban trees substituting forested systems, their ability to reach full maturity and develop an extensive canopy for rainfall interception is highly influences due to lack of appropriate soil condition and sufficient volume for root growth.

Natural systems, which were gradually shaped in response to long-term rainfall patterns, have evolved to absorb and store water form the most common, small, frequent precipitation events. The same cannot be said about urban environments, where natural and varied depressions have been removed and impervious areas may represent 60% - 75% of the total ground coverage, meaning that the amount of rainfall runoff increases significantly. The greatest difference in the volume of precipitation that cannot be conveyed into the soil occurs during small rainfalls events and the early portion of rainfall from a large storm event. Additionally, water runoff from developed areas can be extremely polluted and its temperature usually increases, as it passes through the streets and other impervious surfaces, which have a devastating effect on biological community in the soil and the overall water quality. Designing a system mimicking natural response of the unaltered landscape as opposed to conventional approaches may potentially provide greater security and redundancy from local flooding and its side effects.

Protecting natural features

In an intact ecosystem, rainwater moves through the soil's pores and passes through the ecosystem of fungi, bacteria, plant roots and other organisms that provide a filtering and cleansing mechanism. Additionally, aboveground vegetation contributes to controlling the rate at which water is absorbed by the soil and allows the sediments to settle down. When considering a site for future development, it is therefore highly important to identify existing natural resources and features that can be utilized for infiltration, storing excess water in case of a local flooding, habitat diversity and reduction of runoff, water pollution and thermal impact .

In order to protect natural resources, it is first of all crucial to examine the geological conditions of underlying soil. Some of the variables that may be included in such examination are soil's expected permeability, hydrologic soil groups, depths to high seasonal groundwater bedrock and presence of hydric soils or special geologic formations.

Secondly, it is important to understand the movement of water in the area, by defining topographical features, such as larger slopes, swales and depressions, and also the direction of stream system and flow pathway. This knowledge may then be applied to identifying areas that may be utilized and expanded in order to serve as stream buffers and rainwater storage, such as wetlands and floodplains.

Furthermore, identifying remnants of native vegetation and mapping out woodlands, riparian areas, meadows and other large tracts of contiguous open space should serve as a guideline while deciding on the type of vegetation that would thrive on site, and in this way, propagate native plants and enable continuous wildlife inhabitation.

Finally, existing structures and impervious areas, together with storm water infrastructure and facilities, should be mapped out and taken into consideration.

Ill. 18 Unsplash

Drainage patterns and disconnections

In altered urban areas water runoff is unable to be infiltrated through soil to ground water due to the high coverage of impervious structures, increasing the risk of more frequent and severe flooding incidents . In an attempt to channel and store the excess of water, impervious areas are connected to conveyance systems through pipes, which, due to increased intensity of precipitation, are often insufficient to meet the needs of continuously growing cities. In order to reduce the quantity of runoff and prevent pollution of the water due to spillage from sewer overflows, surface runoff can be disconnected from engineered systems and directed towards pervious, vegetated areas.

There is a set of strategies for on-site and off-site drainage that can be applied to a newly developed building in an urban context in order to establish a stable water discharge. One of these strategies includes disconnection of roof downspout from sewers and channelling the excess water to lawns, rain gardens or planter boxes or natural conveyance systems. Depending on the chosen practice, the runoff water can be ether stored for future use or infiltrate into soil. Instead of relying on one downspout, the building should be equipped with a decentralized system dispersing runoff throughout larger areas. Additionally, the site should be graded in a way that allows the runoff to move away from the built structures and follow natural flow path between the site and upstream and downstream systems.

Porous pavement

In order to address the issues caused by excess of impervious coverage in cities, it is first of all relevant to consider whether these surfaces can be reduced, by establishing narrower streets and sidewalks, applying smaller radii for turn-around, shorter, collective driveways or limiting parking ratios by implementing shared parking arrangements.

Once the infrastructural footprint has been downsized, the impervious land coverage might be reduced furthermore, by introducing porous pavement. Porous pavement surfaces are permeable surfaces that allow water to infiltrate into an underlying stone bed and soil below. Structures like porous asphalt, porous concrete and permeable pavers are similar to their conventional equivalents, however, they are able to reduce storm water runoff by allowing rainfall to drain directly through the surface. The runoff is then temporarily held in void spaces of underlying porous aggregate and slowly drained into the sub-base beneath the pavement, where it is stored until it infiltrates into the soil. In this way, these types of ground coverage are also highly effective in reducing pollution in runoff from pavements, roads and other impervious surfaces.

Ill. 19 Unsplash

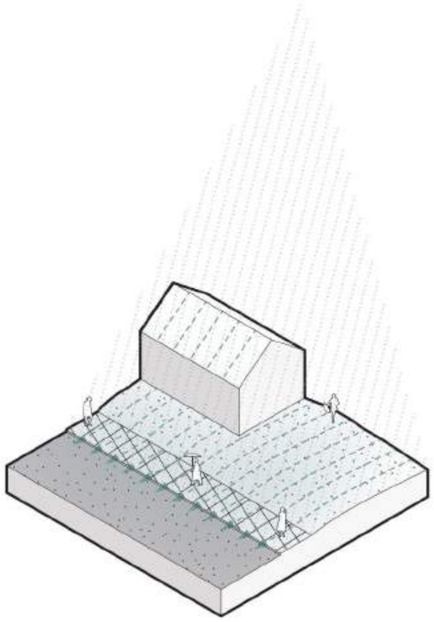
Blue-green infrastracture

A great application of native planting within urban landscape design is a set of blue-green infrastructural strategies that connects urban hydrological functions (blue infrastructure) with vegetation systems (green infrastructure). This carefully planned network of natural and semi-natural areas provides sustainable ecosystem services, such as water purification, better air quality, less heat stress and climate adaptation. By reducing the area of impervious surface coverage within cities, green and blue infrastructures are important tools when dealing with storm water management, as they provide a great opportunity for the excess precipitation to be absorbed and channelled further down the stream to the ultimate point of discharge, without the need of being connected to the public sewer system. Additionally, blue-green infrastructure provides an opportunity for integrating spaces for recreation, exercise, contemplation and social activity into urban landscapes, and in this way, provides benefits for human physical and mental health. By providing a space, where biodiversity can thrive on its own, these strategies increase social and aesthetic attractiveness of the surroundings and strengthen the bond between humans and nature, also within cities.

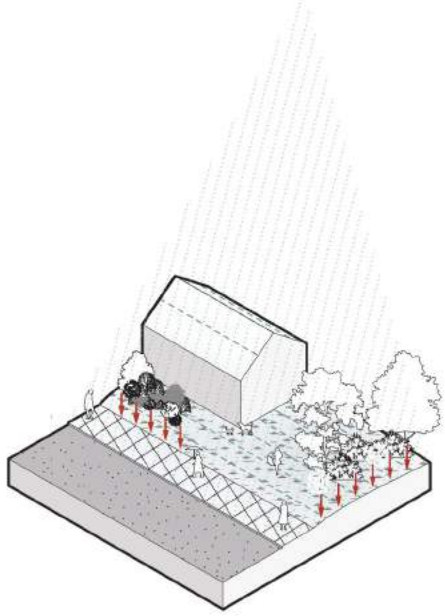
Examples of blue-green infrastructural application vary in scale and appearance and include larger areas (riparian buffer zones, wildlife corridors, urban parks and vegetated waterbodies) smaller spaces in direct connection to pedestrian and bike trails (bioswales, tree boxes and rain gardens) and even building elements (vegetated roofs, facades and balconies).

Climate adaptation solutions

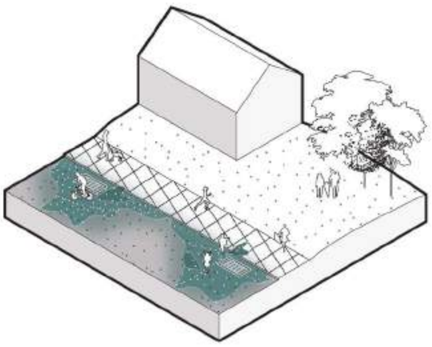
Ill. 20 - 25: Diagramatic representation



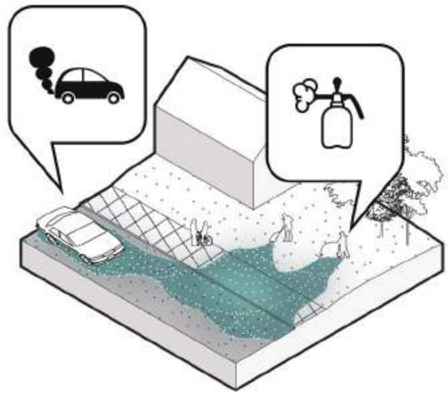
REDUCED INFILTRATION DUE TO IMPREVIOUS SURFACES SUCH AS PAVEMENTS, STREETS AND LAWNS RESULT IN LOCAL FLOODING



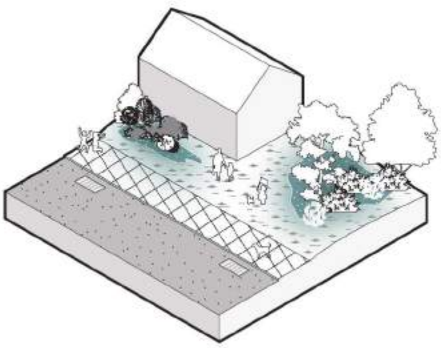
INCREASED INFILTRATION AND EVAPOTRANSPIRATION DUE TO REDUCTION OF IMPERVIOUS SURFACES AND LAWNS AND INTRODUCING DIFFERENTIATED VEGETATION



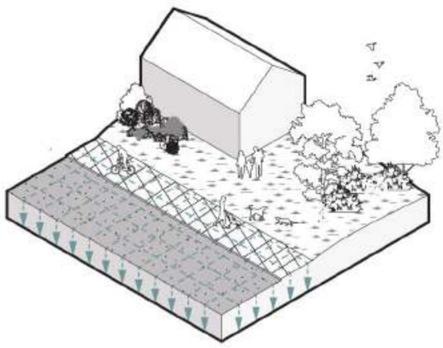
INCREASE IN URBANIZATION AND IMPREVIOUS SURFACES LEADS TO OVERFLOODING OF DRAINAGE SYSTEM AND ADIITIONAL RUNOFF



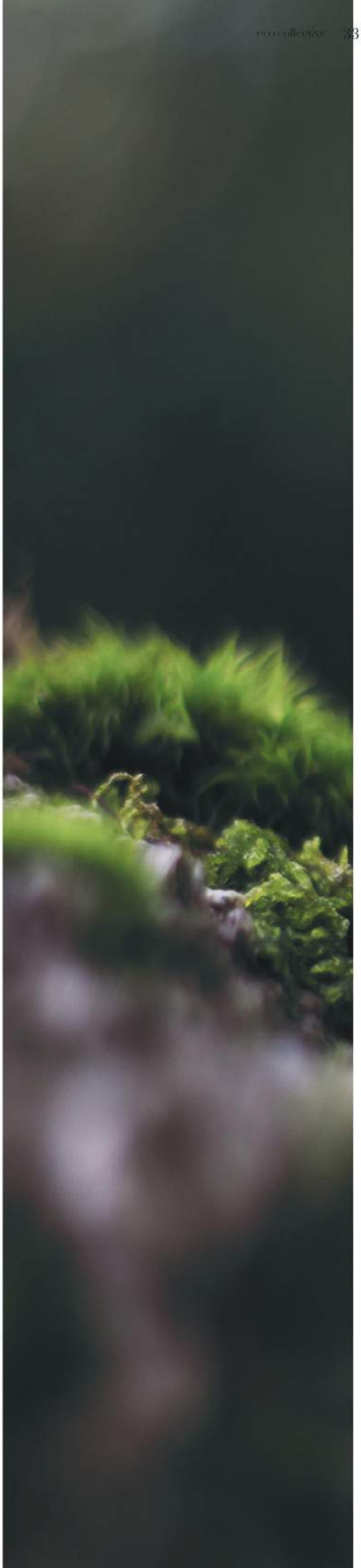
POLLUTION FROM CARS, FERTILIZERS AND ARTIFICIAL ARROGATION - DEVASTATING EFFECTS ON SOIL AND WATER QUALITY



DISCONNECTING PIPES FROM THE DRAINAGE SYSTEM AND LEADING IT INTO RAIN GARDENS AND OTHER FORMS OF VEGETATION INCREASES RUNOFF



USING PERVIOUS GROUND COVERAGE SUCH AS POROUS PAVEMENT AND ASPHALT ENABLES WATER TO INFILTRATE THROUGH THE SOIL INSTANTENOUSLY



2.4 Native planting

Due to the continuous increase in urbanisation, large areas of forests and natural landscape had to be altered in order to make space for buildings and infrastructure. In an attempt to incorporate vegetation within the cities, urban planners have introduced large recreational areas and parks, usually covered with uniformly cut grassplanes with minimal structural and species diversity. A similar tendency can be observed in various suburban areas, where house owners decide to tame natural vegetation and decide to invest in homogenous lawns. It is estimated that if turf grass were classified as a crop in the U.S., it would rank as the fifth largest in the country, after eatable corn, soybeans, wheat and hay.

Ill. 26 Unsplash

Even though these green areas may serve as a green oasis and an important place for recreational activities, there are highly problematic in relation to managing stormwater runoff. First of all, the surface of regularly mowed turf grass does not provide an appropriate surface for water to evapotranspire, while the shallow root structure of this type of vegetation is not sufficient in terms of absorbing rainfall into soil. Due to this inability to reduce runoff water, lawns are considered being impervious surfaces, with high similarity to concrete pavements and asphalt roads.

Secondly, the means of maintenance of lawns, such as artificial irrigation, mowing together with use of fertilizers and pesticides are not only unsustainable, but additionally lead to soil compression and erosion and may contaminate drinking water supplies with chemicals toxic to both human and aquatic organisms. In order to reduce maintenance cost and improve environmental benefits, it is worth considering replacing lawns and turf grass with other types of native vegetation.

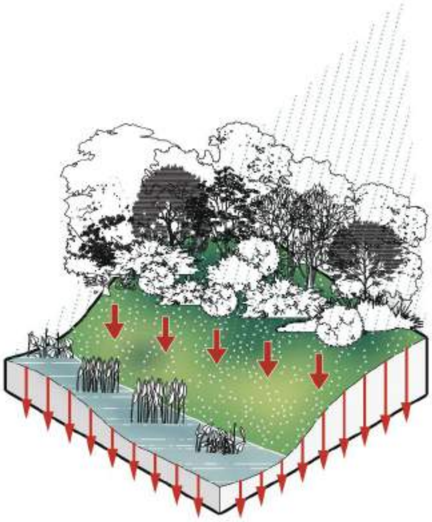
Native landscaping includes introducing plants, trees, and shrubs known to exist in the area during pre-settlement times. This type of vegetation provide unique ecosystem in the region, as it represents a highly diverse composition of plants, insects and animals that evolved over a long period of geological changes. Due to the fact that native plants progressed locally, they are well equipped to thrive in the specific climate and in accordance to intensity of precipitation within the region.

Native vegetation that has evolved and adapted to local conditions is often resistant to common pests and pathogens that plague non-native species within the area, which reduces the need for use of additional synthetic chemicals, pesticides and fertilizers. Additionally, native wetland plants have shown an ability to remove nutrients and other pollutants form runoff, which improves water quality and creates better habitat for wildlife. Another important benefit of landscaping with native species is the reduction of maintenance cost, as they do not require additional watering or mowing.

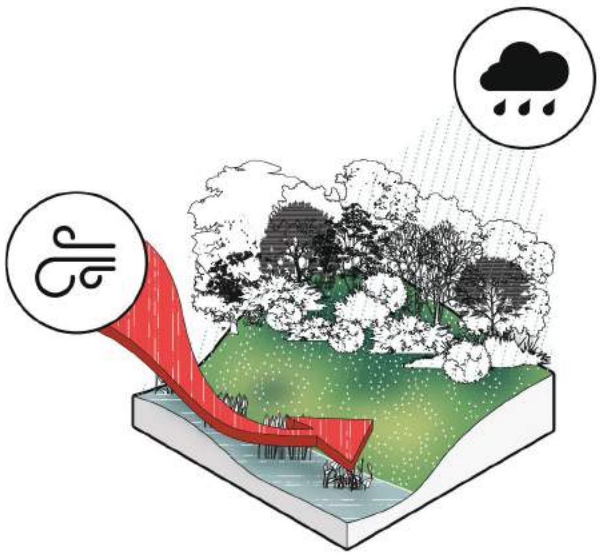
The benefits of native landscaping are not only limited to runoff maintenance and reduction of water pollution, but they are also environmentally and economically responsible. This type of region specific vegetation blend well with most surrounding developments and landscapes due to their authentic aesthetics and furthermore provide food and shelter for insects and animals, introducing increased biodiversity to gardens and parks in the cities.

Native planting - subconclusion

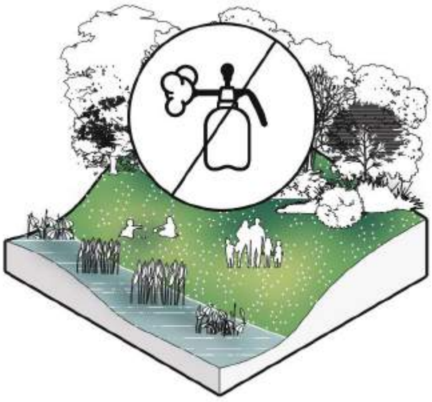
Ill. 27 - 32: Diagramatic representation



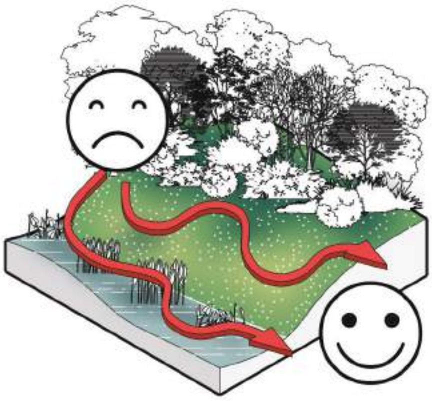
INCREASED INFILTRATION



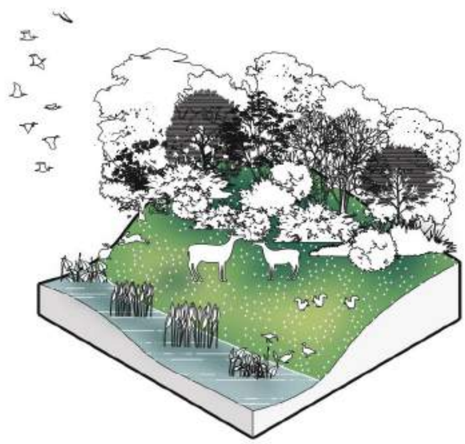
ADAPTED TO LOCAL CONDITIONS



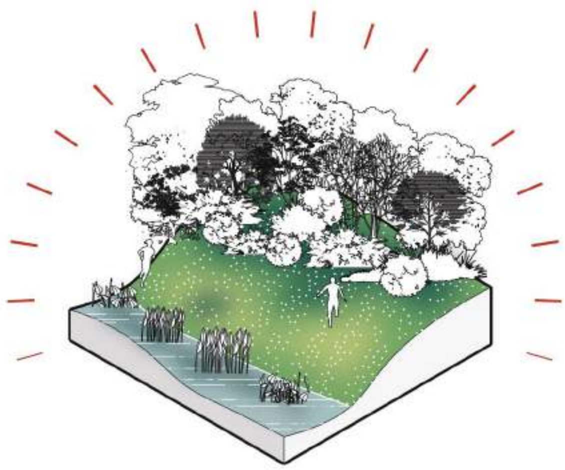
RESISTANT TO COMMON PESTS



REMOVES POLLUTANTS FROM RUNOFF



BETTER HABITAT FOR WILDLIFE



AUTHENTIC AESTHETICS

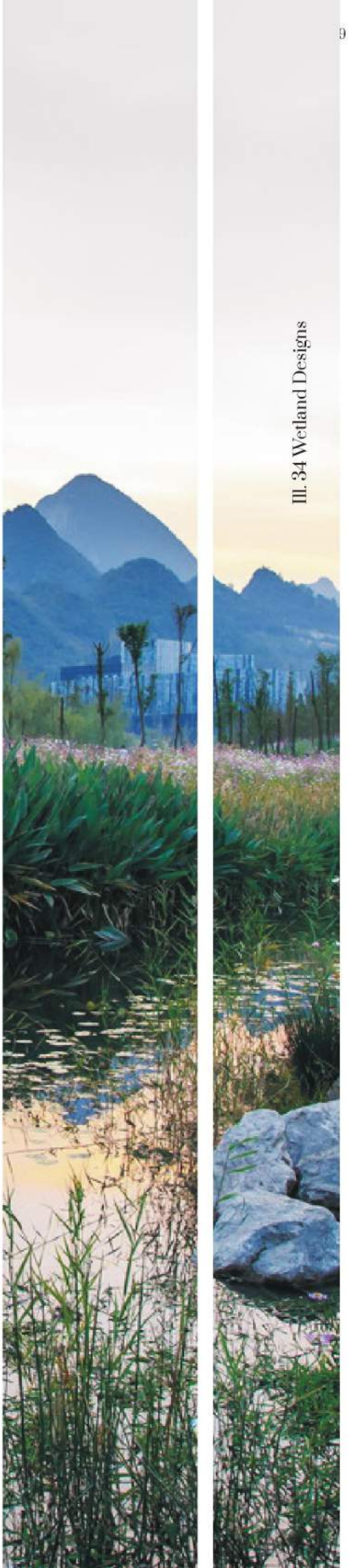
Ill. 33 Stilt Houses

1.3 References - Stilt Houses

Throughout my research I have been looking at different examples of stilt houses throughout the world. Stilt houses are buildings raised on piles over the surface of the soil or body of water and are built primarily as a protection against flooding.

This type of architecture has a long tradition dating back to the Neolithic and the Bronze Age and may still be found in Oceania, Nicaragua, Brazil, South East Asia, Papua New Guinea and West Africa. Also in the Arctic settlements are built on stilts in order to keep permafrost beneath them form melting.

I was especially inspired by traditional houses in Inle Lake, in Myanmar. This stilt house settlements were built by the local population in four cities bordering the lake, in numerous small villages along the lake's shores, and on the lake itself, and are the homes to around 70.000 people within the area.



1.3 Reference projects Wetlands

I have also been interested in researching projects dealing with wetlands, areas that I had in mind for the site of my future proposal. I decided to search for projects cherishing the natural potentials of wetlands and even turning them into tourist attractions. One of examples of that is Suncheon International Wetlands Center by G.Lab* leading visitors through the wetlands of Suncheon Bay, where the buildings and pathways are designed to minimally affect the natural order of the protected wetland and allow for the wetland to continue under the structures.

Another interesting example of designing on wetlands is Minghu Wetland Park by Turenscape, where the architects accomplished to slow down the flow of storm water and transformed a dull peri-urban site into a wetland park that became the backbone of a city-wide ecological infrastructure planned to provide multiple ecosystem services, including storm-water management, water cleansing, and recovery of native habitat.

The last example on a rather smaller scale is The Red Ribbon by Turenscape, located in Qinhuangdao park– a site that was covered with diverse native vegetation, providing varied habitats for assorted species, but also representing a potential safety and accesibility problems, being covered by shrubs and messy grasses. The architects made a consious decision and decided to explore how a minimal and respectful gesture and design solution can achieve a dramatic improvement to the landscape.

Site Analysis
03

Ill. 35
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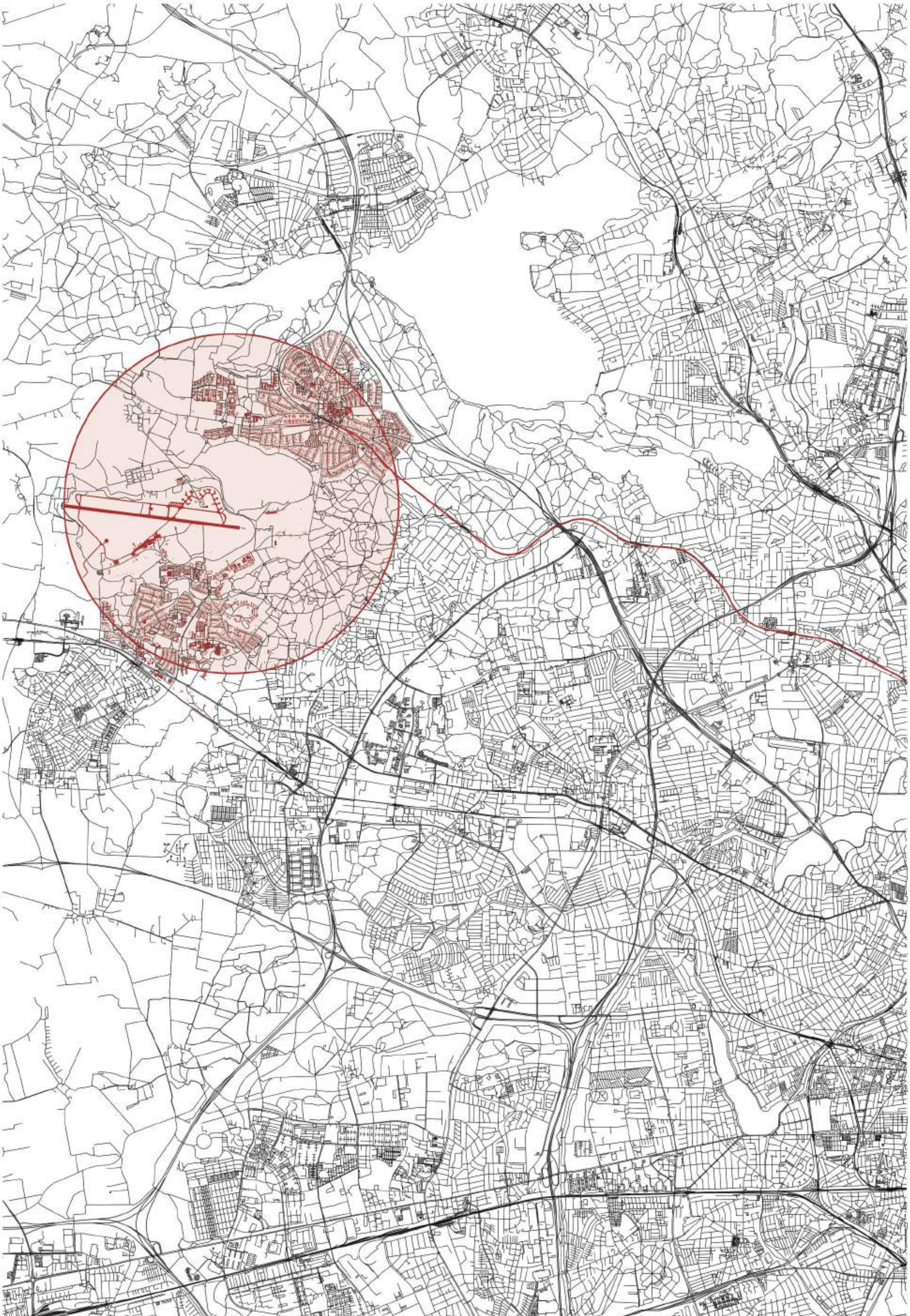


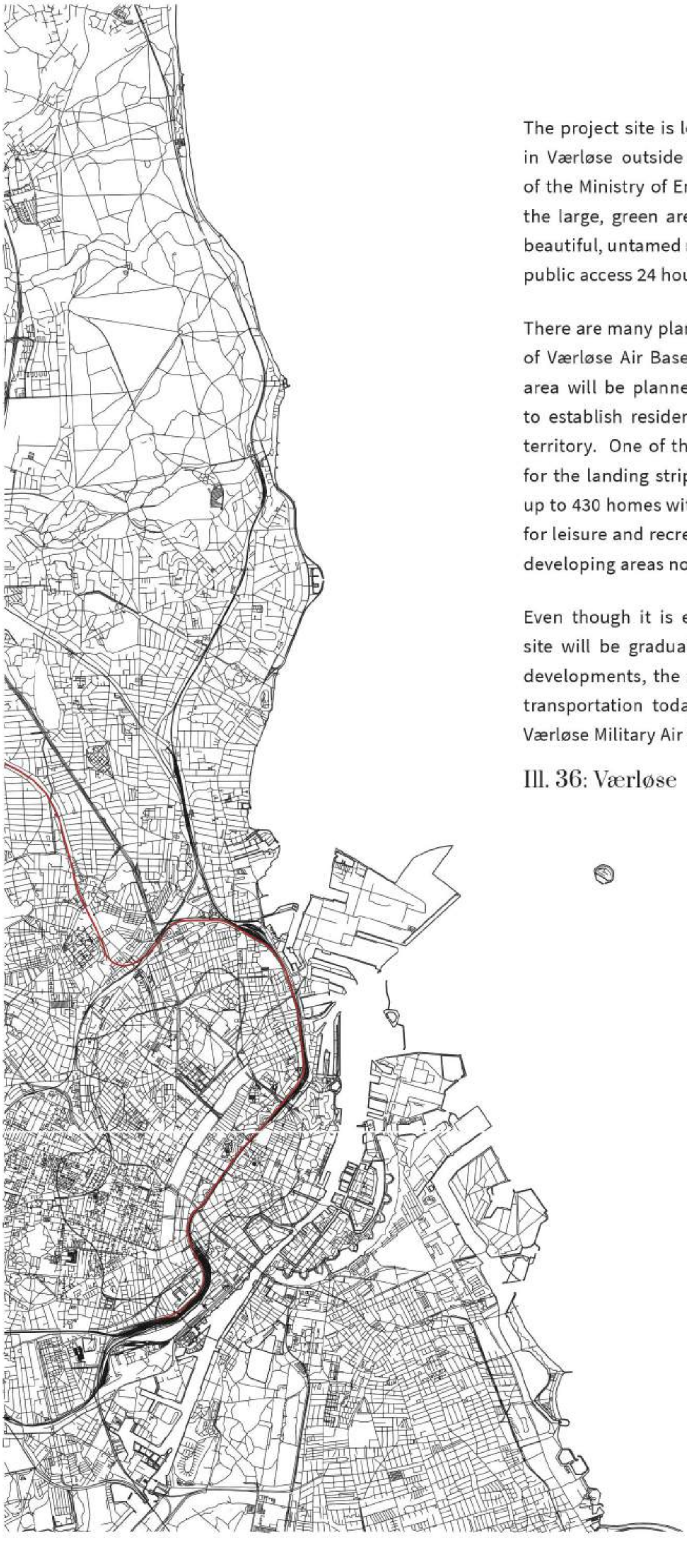
3.1 Project site Introduction

The project site is located close to the old military air base in Værløse outside of Copenhagen. Nature Agency, a part of the Ministry of Environment and Food of Denmark, owns the large, green area of 349 ha, which today is represents beautiful, untamed nature with recreational possibilities and public access 24 hours a day.

There are many plans and strategies for future development of Værløse Air Base, and despite the fact that most of the area will be planned designated to recreation, the plan is to establish residential areas in some parts of the overall territory. One of these areas includes 73 ha situated south for the landing strip, where the municipality plans to build up to 430 homes with associated private and public services for leisure and recreation purposes. There are also plans for developing areas north for the landing strip.

Even though it is expected that the infrastructure on the site will be gradually improved alongside with the future developments, the easiest way to reach the area by public transportation today is by the city train. The distance to Værløse Military Air Base is approximately 20km.

Xxx



Ill. 36: Værløse

3.2 Flyvestation Værløse

In addition to the wilderness on the site, there is an uncompromised presence of area's historical time as a military air base. One of the most prominent elements from the past is a 3-kilometre long asphalt-covered airplane runway supported by a network of other asphalt routes used by the military and eleven F16 shelters/hangars in decent condition. A walk in the area provides therefore a unique journey through past and history, while at the same time it is worth noticing how the nature begins to reclaim the area back in a patient, but decisive manner. The area as a whole becomes an interesting juxtaposition of manmade infrastructure and architecture and green, untamed body of trees, shrubs and grasses, a steady fight which results can be spotted in multiple cracks in asphalt and concrete and the presence of greenery climbing the walls of the buildings.

The area today is a support point for outdoors activities and it is refreshing to experience how the once closed and secured area is gradually being taken over by cyclists, roller-skaters and runners, bringing new life to the area. It is the Nature Agency's vision, that the area and its unique surroundings will become developed in order to support an even wider range of outdoor activity, building on the area's cultural history and undergoing a transformation into a recreational nature area, where the character traits from its military time will still be clear and evident.

Ill. 37 - 38: Site Pictures

Xxx

3.3 Natural potential

The Værløse Military Air Base contains larger moss and meadow areas placed on the edges of the altered landscape. Located in a direct connection to several water reservoirs and rivers, some parts of the area may become locally flooded in cases of intensified rain events.

The wet areas in the west, called Bringe Mose, provide a perfect scenery for the grazing cattle, helping to improve the ecosystems by combating the giant birch clown. The central part of the 3-kilometre long runway consists of a large open plain area. To the north, the area is defined against the Laanshøj area of south-facing slopes with overgrown vegetation. It is still possible to find field herds from the time around World War II, within the slopes. These slopes are nurtured by sheep, which both promote the natural values and cause the biodiversity in the area to flourish. In the eastern part of the area, the area becomes more hilly and contains a number of small biotopes and water holes. In the northern part near Søndersø, six of the hangars lay in a diffuse network surrounded by overgrown vegetation. It is also the location of a small heath and moss area.

There is a great desire to preserve and improve the light-opened nature areas, as they provide unique habitats for plants and animals and not very common in the Danish landscape. Due to the fact that these areas have evolved into the nature they are today based on regular grooming and mowing, they need to be cared for in a similar manner, in order to avoid overgrowing with shrubs and bushes and preserve the richness of biodiversity. Since 2014, The Nature Agency has been collaborating with volunteers groups focusing on preserving the area and already after a few years of controlled burnings, the area appears in even better condition with healthier and finer herbs and other forms of vegetation. This approach based on respect for the natural conditions present on site should definitely be encouraged throughout the rest of area.

Ill. 39: Site Analysis

The map represents the placement of the site in connection to the natural elements that are prominent within the area. The presence of water reservoirs of different size and character strengthens the site's potential for proposing a living space for a community based on wetlands and frequently flooded area. Combined with the presence of closely vegetated forest areas surrounding the Søndersø Lake, the site allows for appliance of several landscape-based strategies mentioned in the theoretical part of the thesis.

Areas of interest include mosses and meadows on the west and east part of the landing stripe currently enriched by the presence of animal husbandry, the richness of biodiversity in shape of water reservoirs including the Søndersø lake, waterholes and other smaller lakes and the placement of the landing strip within the air base area and its proximity to the site.

The most important element, which will determine the outcome of proposed eco collective in this Master's thesis, is the position of the beautiful Søndersø Lake and its adjcacent wetland areas protected by the density of forest vegetation. These interesting layering of natural elements and their interconnectivity were a remarkable source of inspiration suitable for the placement of the proposal.

3.4 Context Study

Ill. 40 Site Analysis

Ill. 41 - 42 Site Analysis

The site is placed close to the towns of Værløse (13.000 inhabitants), Jonstrup (1800 inhabitants) and Måløv (8500 inhabitants) with shopping possibilities, schools, kindergartens, swimming hall, sports hall, library, cinema and other services. Most of the currently present buildings situated on the air base close to the site include old F-16 hangars and other small military buildings. As mentioned previously, the area located south for the landing strip will be developed into residential area within the closest future. The distance to Copenhagen central station is around 20 km.

There is a city train connection to the S-train station in Værløse, which is easily accessible from Copenhagen centre. Other main infrastructural connections include motorways (Hillerødmotorvejen) and O4 beltway, both connecting the area directly to the capitol.

There are additional smaller roads that need to be taken in order to reach the site, either by bicycle, car or bus, including Ballerupvej, Jonstrupvangvej and Sandet, a road that was internally used by the military in the past. Despite the fact that the infrastructural connection today could easily be improved, it is believed, that according to the future development of the adjacent housing grounds, the accessibility within the area will significantly change for the better.

Project Presentation 04

Ill. 43
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4.1 Master plan

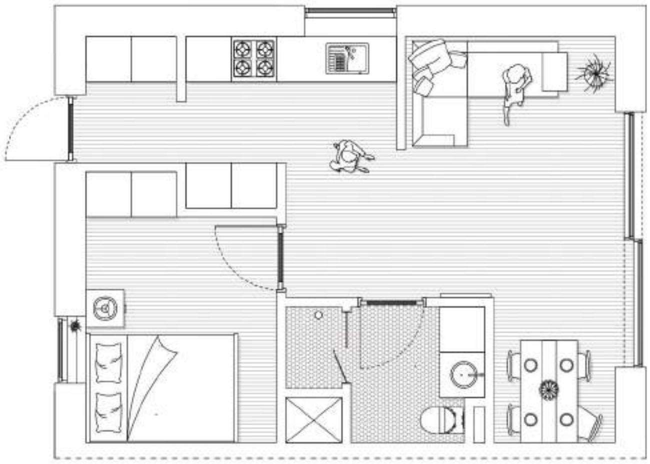
The master plan consists of a sequence of three different housing units combined together and connected through a corridor of shared greenhouses. Surrounded by a wooden deck – a common platform and extension of the living units, the proposed master plan challenges the traditional space division and encourages a gradual transition between the public and private areas, which can be influenced by and adapted to the needs of the dwellers.

The overall structure of the master plan is built around eight platforms on three levels with a difference in height corresponding to 0,5 m. The idea of this division is to visually differentiate between specific uses of the platforms: the recreational, public sphere located to the west, inviting passer-byes to explore the collective and its location close to the water, five platforms surrounding the variety of living units in close connection either to the lake or the forest, and two platforms designated for more private, intimate recreation and activity mainly for the dwellers located on the eastern part of the master plan. The platforms are surrounded by an additional, lower layer of wooden paths that might be locally flooded depending on the intensity of precipitation. There is a range of potential activities that might take place on the outskirts of the platforms and the wooden paths, including a promenade with places for sunbathing and eating outdoors, kayak rentals, small marinas, water games and a sauna.

The living spaces themselves have been compromised in order to minimize the square footage of areas impacting the natural wetlands underneath the structure. This is furthermore the reason for the multiple penetrations planned throughout the deck. By allowing the nature to flourish and, with time, unite with the built structures, the master plan strives to dissolve the boundaries between natural and human made.

The site is reachable from two directions. There is a straight connection leading to the most public activities, including cottages, greenhouses and kayaks for rent connected to the existing main roads in the western part of the master plan, while the more organic path on the opposite side is more known to the private dwellers, inviting them on journey through layers of differentiated landscapes.

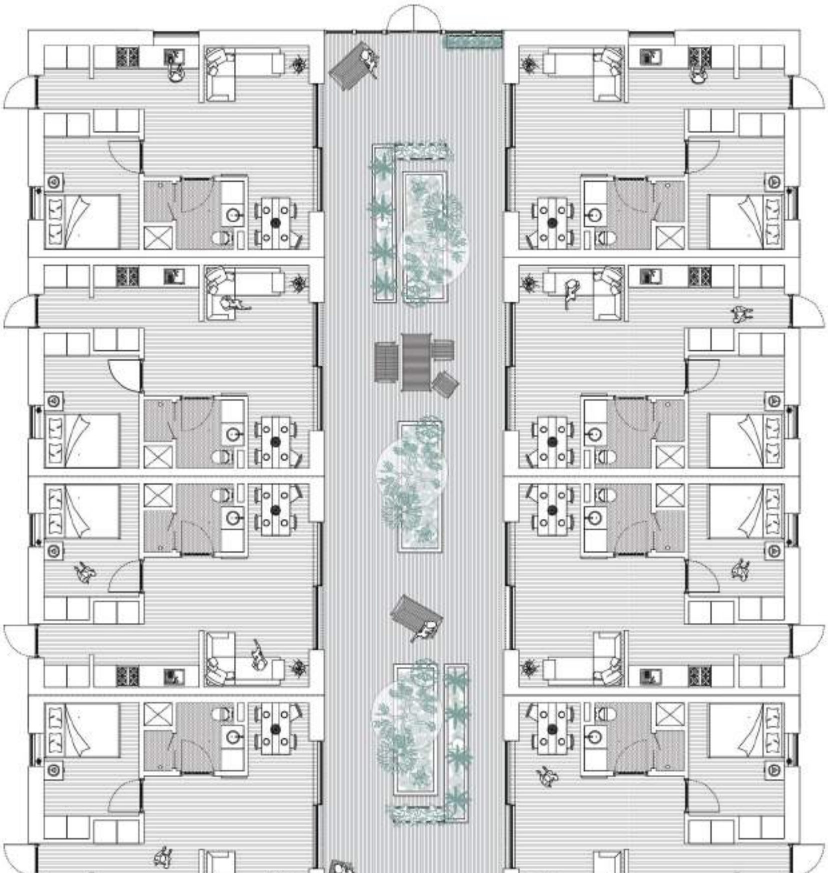
Ill. 44 Master Plan



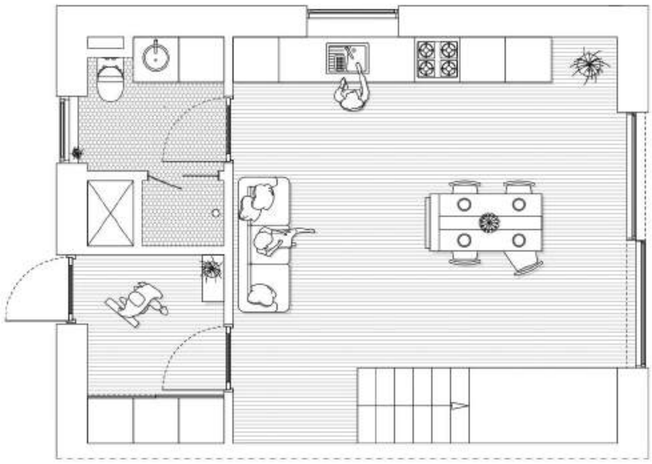
4.2 The Unit

The unit represents a living area of approximately 40 m2, including an entrance area, combined kitchen and living room, bathroom and bedroom. The unit represents an attempt to minimize the living space in order to encourage the dwellers to explore the common facilities placed within the area and in this way play an active part in increasing social activity within the collective.

The first typology presented in this proposal consists of eight identical units connected together by 110 m2 of common green house, accessible both from the apartments and the surrounding deck. All units are equipped with double sliding doors, enabling the dwellers to extend their private living space towards the green house. In this way, the inside and outside is allowed to blend in together, reducing the boundaries between the private, semi-private and public spaces on site.



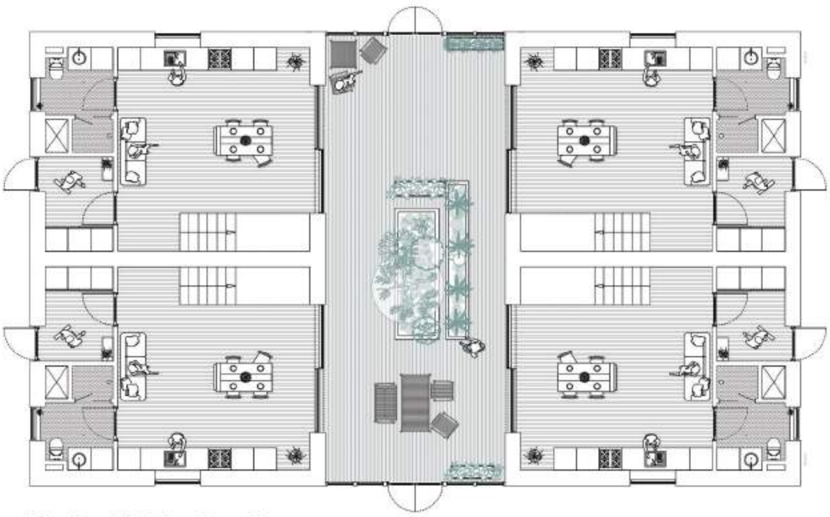
Ill. 45 - 46 The Unit



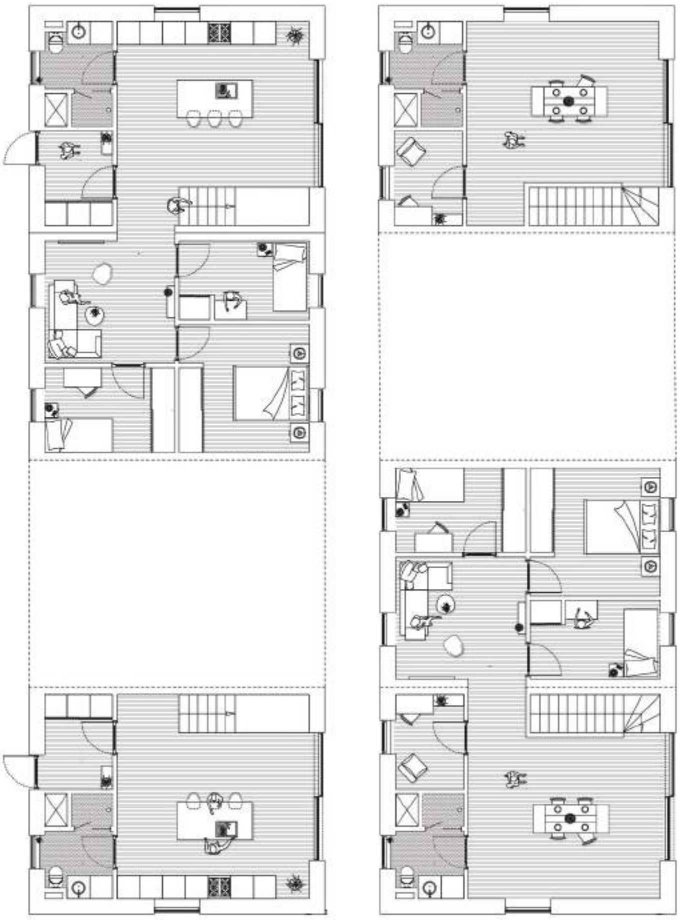
4.3 The Doublet

The doublet represents a living area of approximately 80 m2, including an entrance area, combined kitchen and living room, bathroom and up to three bedrooms upstairs. The doublet may be a good solution for a smaller family.

The second typology found throughout the proposed master plan, is a combination of four doublets connected by 55 m2 of green house area, similar to the one described before. This area is left unfurnished, allowing the four families living in the same typology to come to an agreement on how they desire to arrange the common area. Some suggestions may include introducing vegetation or eatable vegetables, in order to create a green oasis for the year-around use.



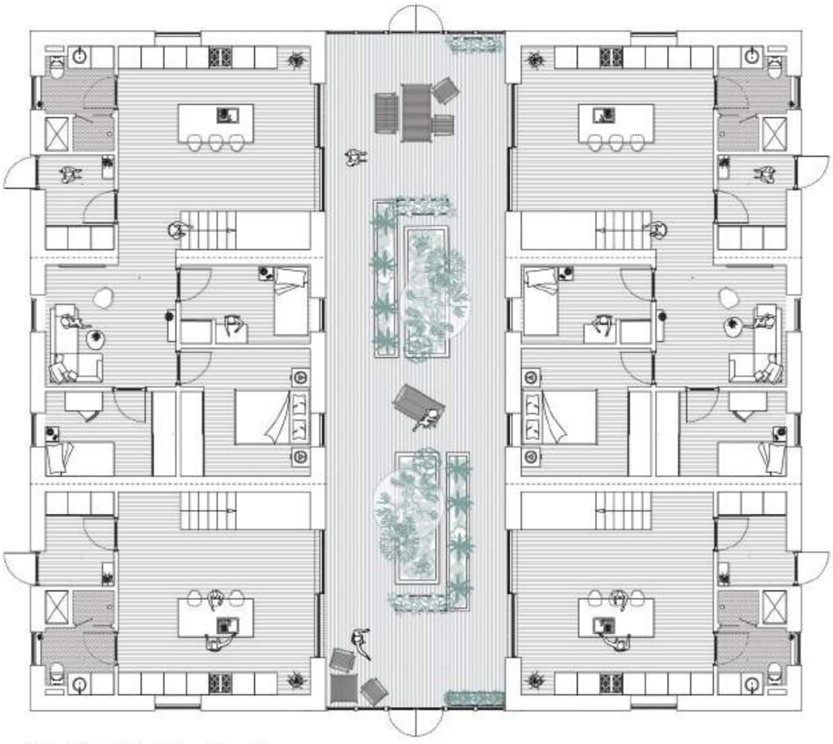
Ill. 47 - 48: The Doublet



4.4 The Family

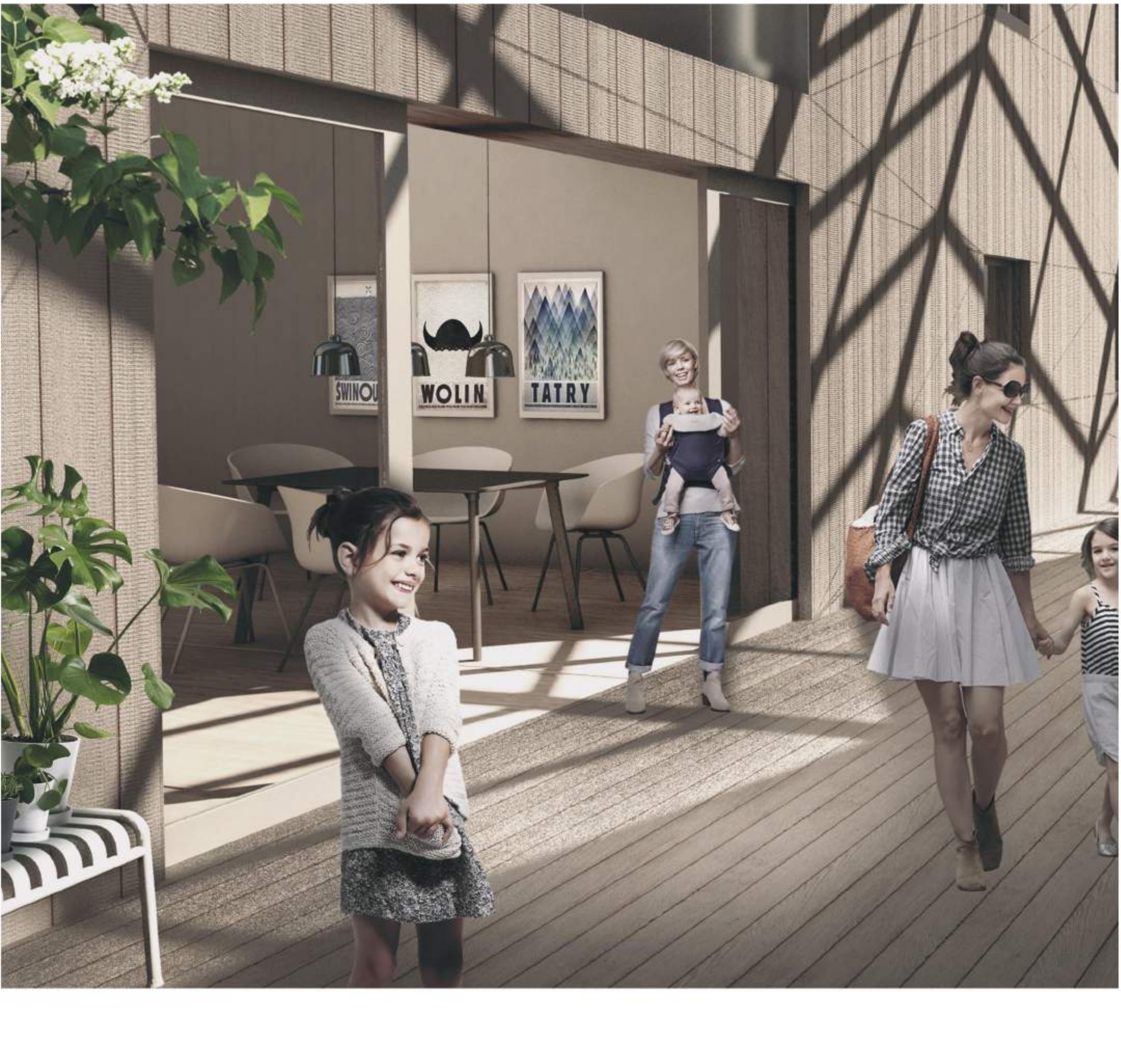
The family represents a living area of approximately 120 m2 and is designed in two versions. Both types include an entrance area, large kitchen and living room, two bathroom, three bedrooms and an additional study room.

The third typology embodied within the master plan contains four family units and is once again connected by a corridor of greenery, which in this case represents 85 m2 shared between four families.

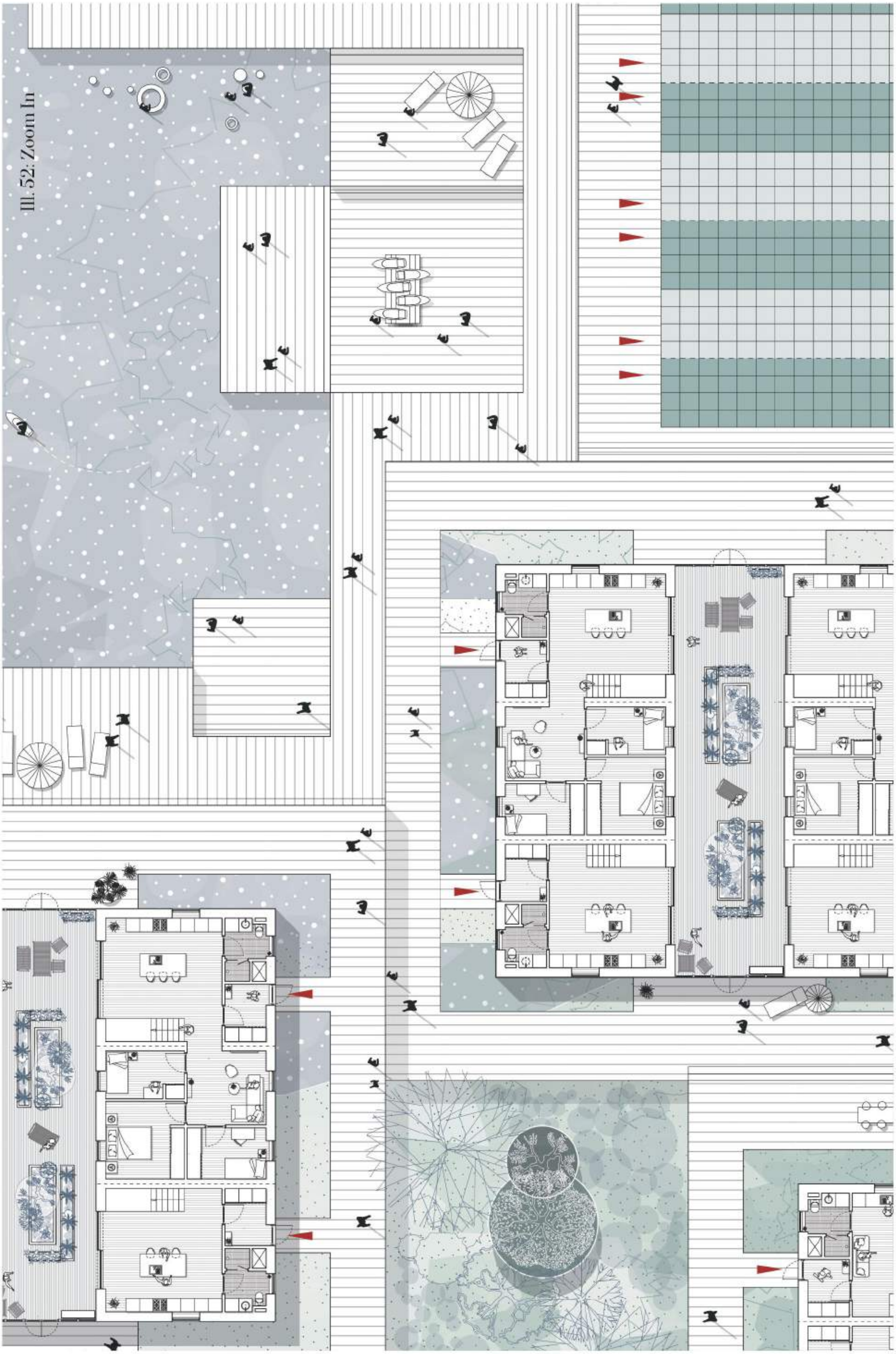


Ill. 49 - 50: The Family

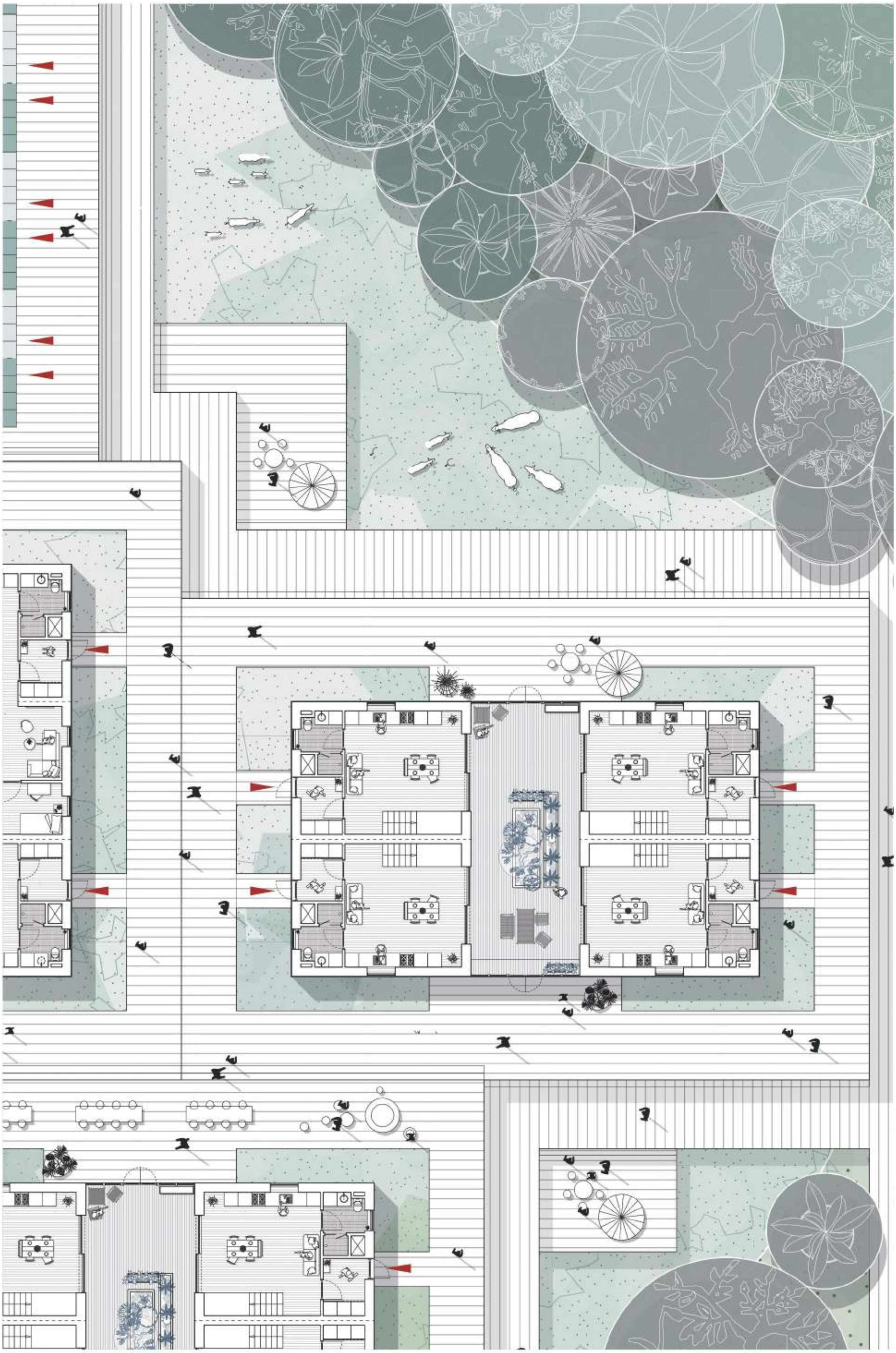
Dwellings



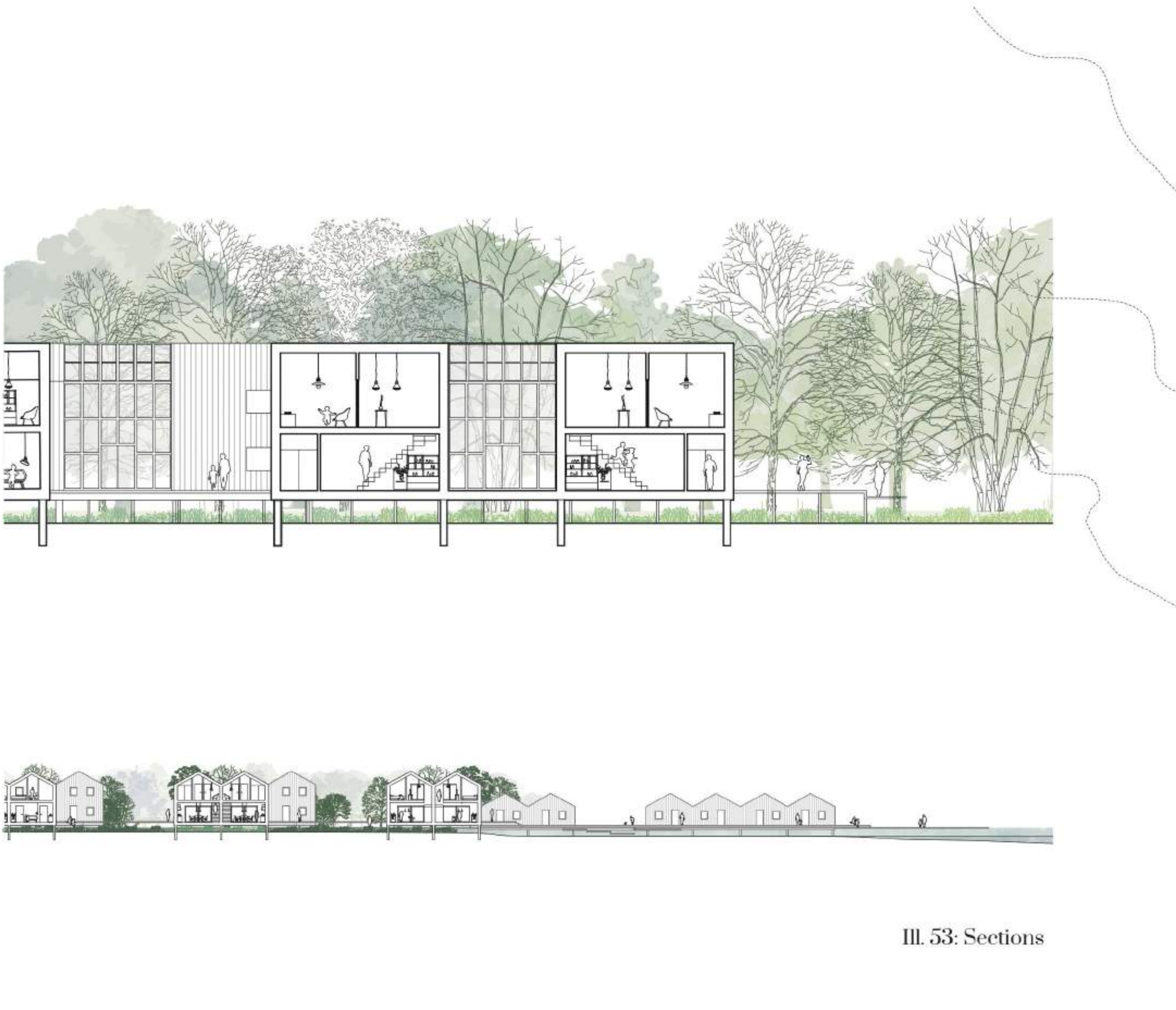
Ill. 51: Interior render



Ill. 52: Zoom In



Dwellings



Ill. 53: Sections

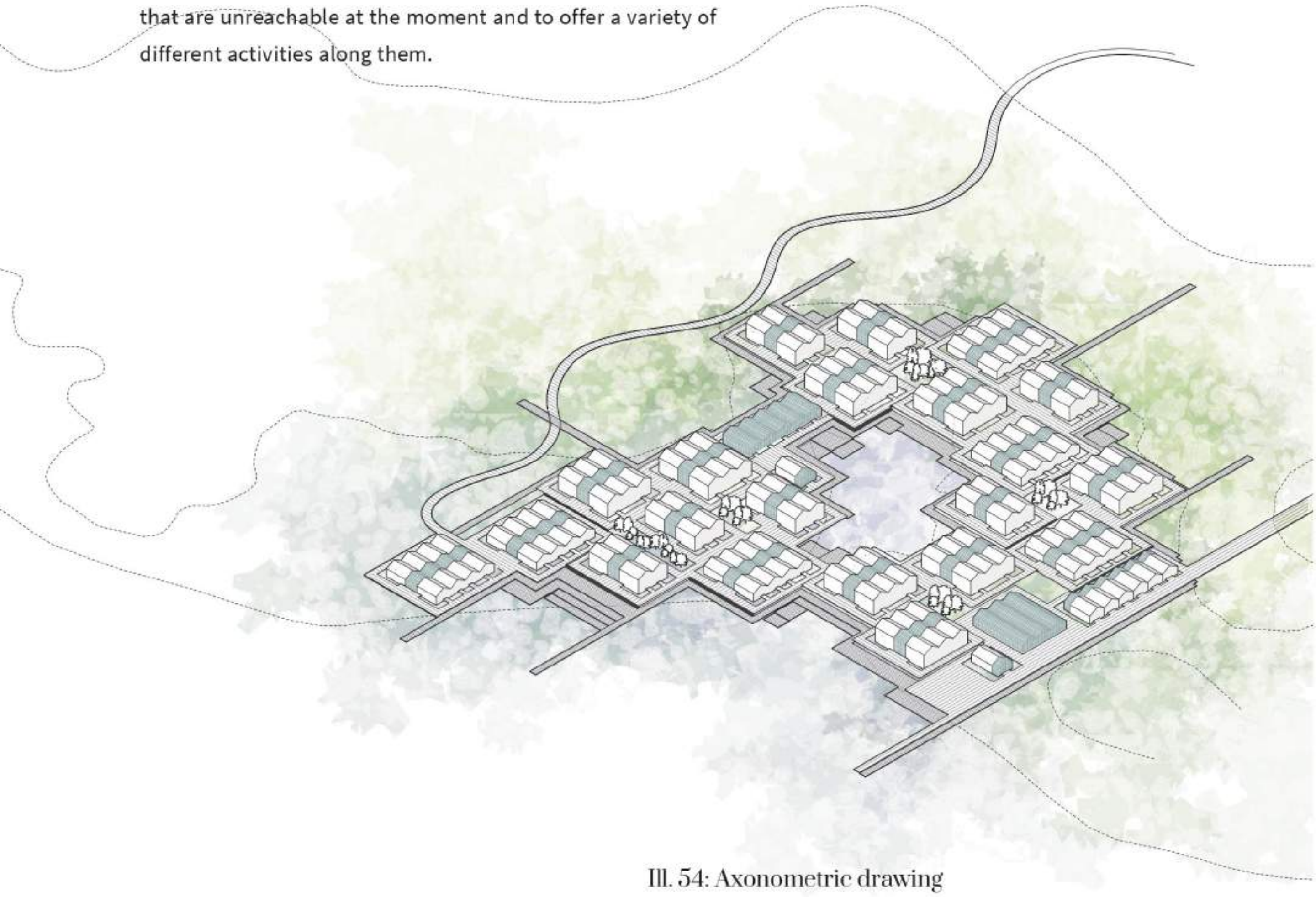
4.5 The collective

The axonometric view of the site represents four of the most important components embodied within the proposal.

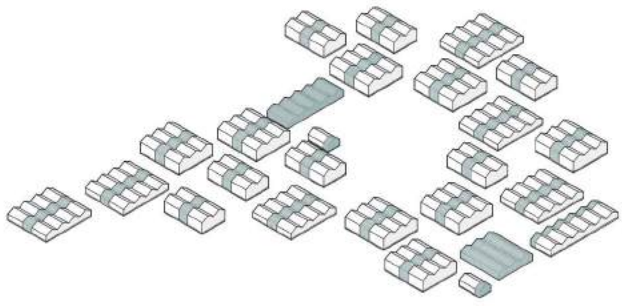
It is first of all the nature and landscape that has played an important role in deifying the final outcome of the eco-collective and has also been noticeable in determining the overall atmosphere on site.

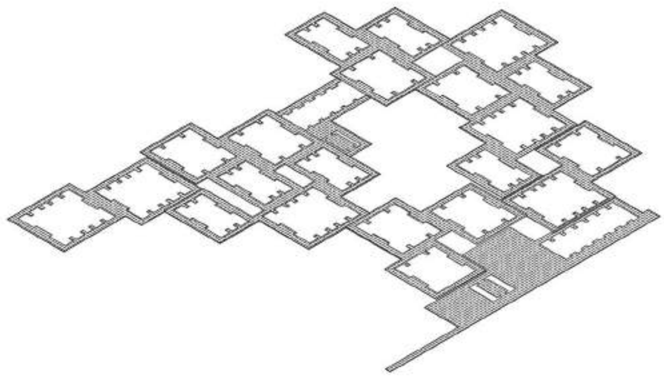
The existing vegetation and water on site has influenced the placement of housing units, which then consequently controlled the final shape of platforms, with a variation of height corresponding to its primary function.

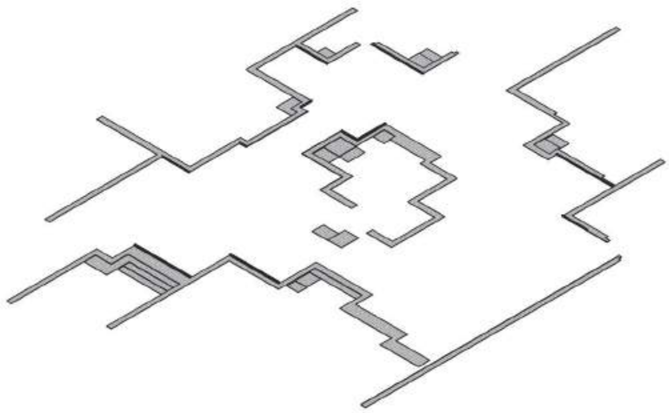
The additional paths and penetrations have been planned out in order to allow the public to access parts of the site that are unreachable at the moment and to offer a variety of different activities along them.

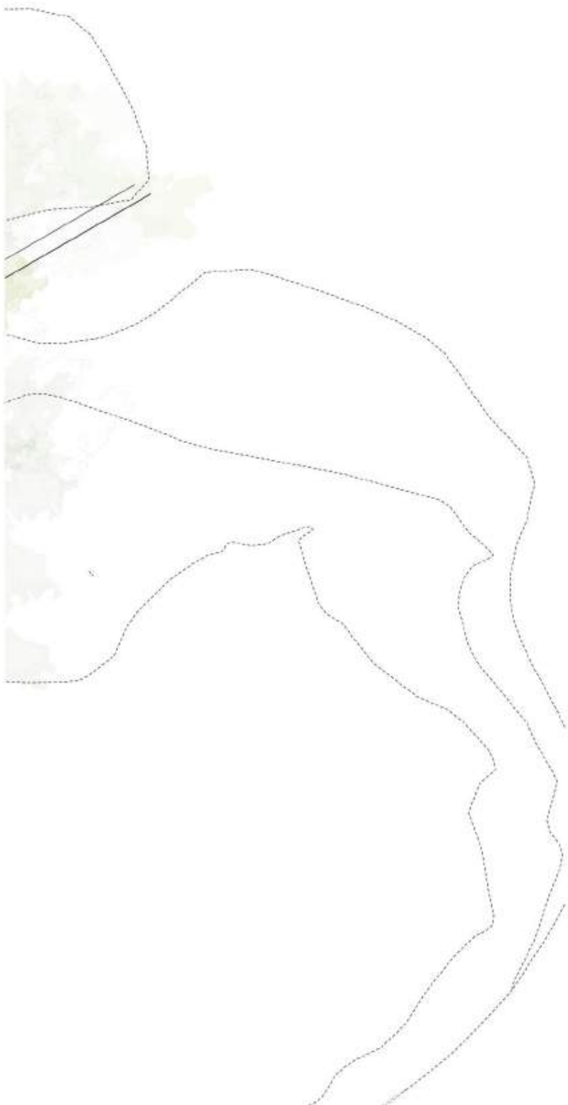


Ill. 54: Axonometric drawing

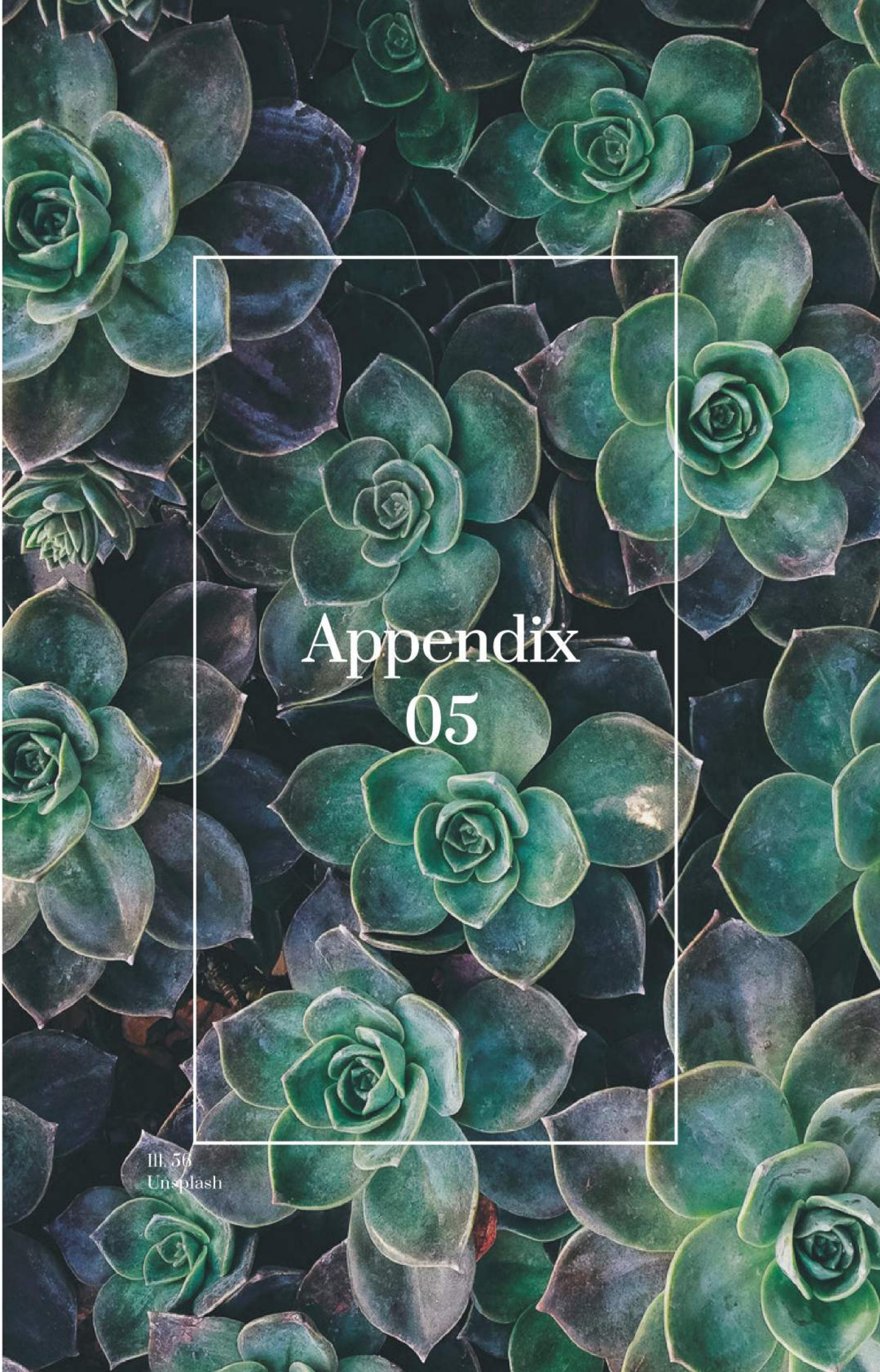








Ill. 55: Rendering, the collective



Appendix 05

Ill. 56
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5.2 Illustration list

eco-collective

Karolina Anna Mieszczanek