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TRANSFORMING NYHAMNEN

USING EVOLUTIONARY DESIGN AS A TOOL FOR DEVELOPING FLOOD ADAPTED URBAN SPACES

Elin Karlsson & Elin Skagerling • Master's project 30 credits • Landscape Architecture programme

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Transforming Nyhamnen: Using evolutionary design as a tool for developing flood adapted urban spaces
Att utveckla Nyhamnen: Evolutionär design som ett verktyg för att utveckla översvämningsanpassade urbana miljöer

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ABSTRACT

This master's project aims at investigating how an evolutionary rather than static approach to design can be applied to harbour areas undergoing urban redevelopment. More specifically, this approach is used as a tool for developing a step-by-step design that is able to manage flooding from cloudbursts or a rise of sea level throughout different phases of an urban redevelopment process. Currently undergoing urban redevelopment, the harbour *Nyhamnen* in Malmö will constitute the area to which this concept of evolutionary, flood adapted design will be applied. From a flood risk point of view, this harbour can be argued to be a complex site for urban redevelopment; located on hardscape, infill land not far above sea level, Nyhamnen constitutes an area that is especially vulnerable towards flooding. Yet, Malmö stad has already started the process of turning this harbour into a dense city district.

The flood adapted, evolutionary design concept presented in this project is divided into three consecutive steps; the *first* step relates to the current structure of Nyhamnen, the *second* step relates to the awaiting constructional phase of the area, and the *third* step relates to its future structure, as it is proposed by Malmö stad. By relating our design proposal to several stages of Nyhamnen's transformational state, we are able to emphasize the changing, evolving requisites of this harbour. Our evolutionary approach to design is thus able to illustrate the difficulties of planning for an uncertain future, both in relation to the future state of the climate and to the future structure of Nyhamnen.

Through in-field studies and studio work, this master's project utilizes a method where research is conducted through design. This method centres on a design process that includes readings and explorations of Nyhamnen's *areas of influence and effect*, resulting in a delimitation of a specific site, an *area of control*, to which our design proposal is applied. This main method of this project is further complemented with literature studies and case studies. In addition to concerning theories about site, these studies also concern research about climate change and storm- and floodwater management, theories about the concept of temporary uses, and of practical examples of site designs that incorporate methods for flood management or temporary uses.

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CONTENTS

INTRODUCTION

BACKGROUND

Due to climate change, extreme weathers such as cloudbursts and storm surges are expected to become more common and more intense (IPCC 2013b:20). During these events, the downpour is so severe that the underground drainage system becomes strained and, eventually, flooded. Damages caused by cloudbursts has been noted to bring extensive economic, physical and emotional costs. These are costs that are argued to be even greater than what the costs for flood preparation and adaptation are (Malmö stad 2016b:5).

Although the effects of climate change are global, its impacts varies between, and within, countries. In Malmö, storm surges could potentially cause the sea level to rise temporarily with up to + 3 m by the coastline, especially causing damages to the city's harbours and canals (Malmö stad 2016a:40).

In 2014, Malmö stad initiated the process of developing a comprehensive plan for Nyhamnen, an old industrial harbour in the centre parts of Malmö. This harbour is to be transformed into a new urban district, including 6 000 new residences and 13 000 new work places (Malmö stad 2015:4). With its proximity to both the ocean and the central station, Nyhamnen is argued to possess great potential for creating new connections between the inner parts of Malmö and the sea. However, significant parts of Nyhamnen is located below +3 meter of the sea level, making it especially vulnerable to flooding during extreme weathers. Moreover, large parts of Nyhamnen also consists of hardscape surfaces, which aggravates stormwater runoff and increases the risk of flooding (Malmö stad 2015:34). The industrial activities in the area and the overall lack of green elements in this part of Malmö has furthermore resulted in a situation where both the air and ground are subject to pollution (Malmö stad 2015:43, 45). Although the chosen location for Malmö's new city district is attractive in some aspects, it could thus be argued to be complex in others.

In the comprehensive plan for Nyhamnen, Malmö stad acknowledges that Nyhamnen will need to be able to manage instances of flooding (Malmö stad 2015:34-35). However, the comprehensive plan does not suggest any specific methods for flood management. Such methods needs to be investigated and incorporated into the future development and design of this district. An approach where these methods constitutes a visible and vital part of the area could, furthermore, have the potential of enhancing the overall presence of water within Nyhamnen; since extreme weathers are expected to increase in frequency as well as in intensity, it could be argued that floodwater within urban areas henceforth needs to be considered as an asset, rather than an issue.

The redevelopment of Nyhamnen is an extensive project that will be ongoing for a long period of time. According to the

comprehensive plan for Nyhamnen, the last stages of this new city district will not be built for another 30-40 years (Malmö stad 2015:52). The effects of climate change, however, are already set in motion; both Malmö and Copenhagen has been subject to cloudbursts in the past few years, causing extensive material costs to buildings and infrastructure (Malmö stad 2016b:16, City of Copenhagen 2012:7).

Due to the expected increase of extreme weathers such as cloudbursts, methods for flood management needs to be integrated into the urban fabric sooner, rather than later. Currently undergoing development, Nyhamnen has the potential of implementing such methods from the very beginning; by adding temporary, flood mitigative elements to the area even before the most intense phase of redevelopment has begun, Nyhamnen has the potential of becoming an area that highlights the effects of climate change from the very beginning, thus informing the public of the need for flood management methods within urban environments. With time, as Nyhamnen develops its new urban character and structure, these temporary elements could be further developed into more permanent methods for flood management. The state of transformation that Nyhamnen is in thus creates opportunities for this district to become a showcase area for flood management that emphasizes both the evolving aspects of urban redevelopment, and of the climate.

RESEARCH QUESTION

The research question of this master's project concerns how methods for flood management can be integrated into different stages of redevelopment of a harbour area. Moreover, it also concerns how this approach can help bring a new perception on floodwater in urban areas:

> *- How can an evolutionary design concept be used as an approach towards developing methods for flood management in Nyhamnen, that also contributes to a perception where floodwater is considered as an asset, rather than an issue?*

GOALS AND AIMS

The main goal of this master's project is to present a design concept that explores how methods for flood management can be applied to harbour areas undergoing urban redevelopment. Deriving from the field of landscape architecture, the aim is to present a design proposal that uses vegetation, topography and permeable materials as the main instruments for flood mitigation. Hence, the aim is to research and propose landscape based flood management methods. The target groups that could benefit from reading this project are thus landscape architects and other professions or students engaged in city planning processes. Moreover, an aim of this master's project is to present how such methods could

be implemented into Nyhamnen even before the most intense phase of redevelopment has begun and, thus, to show how these methods, with time, gradually can be integrated into Nyhamnen's new urban structure.

Another goal of this master's project is to acknowledge the presented design as a general design concept, thus proposing principles for how methods for flood management could be applied to other harbour areas undergoing urban redevelopment as well. Moreover, another aim is to contribute to the debate about flood risk in urban environments in general, and about the specific flood requisites in Nyhamnen.

METHODS AND MATERIALS

This master's project utilizes an approach where research is conducted through design. According to this approach, the main methods used are *in-field studies* of the site and *studio work*. To complement these methods, this master's project also includes *literature studies* and *case studies.*

While the in-field studies include on site explorations of Nyhamnen, the studio work includes investigative sketch- and design work. These methods constitutes the basis for the development of an *evolutionary design concept* for Nyhamnen. The term *evolutionary* has in this master's project been defined as *"[…] a gradual process of change and development"* (Cambridge dictionary: 2017-05-07). Evolutionary *design* can thus be described as a design concept that considers the state of constant development and transformation that sites are in. While traditional approaches to city planning often defines an end-state for a design, thus embracing an approach that allows site's to transform overnight, an evolutionary approach to design rather allows a design to evolve over time.

The development of the evolutionary design concept will partly be based on design theories by Carol J. Burns, Andrea Kahn and Lisa Diedrich, explored through the complementary *literature studies.* According to Burns and Kahn, a site can be described as having three distinct areas; *The area of control, The area of influence* and *The area of effect* (Burns & Kahn 2005: xii). Burns and Kahn further defines this concept of design as the *dynamic relational construct,* by which they illustrate the fact that site's needs to be considered in relation to their surroundings, rather than being considered as isolated locales (Ibid). By this approach, Burns and Kahn illustrate the fact that a design simply does not impose on a site, but is rather a result of a designer's interaction with what the site is, and what it can become (Burns & Kahn 2005: xv).

The concept of the dynamic relational construct is also used by Lisa Diedrich in her thesis *Translating harbourscapes* (2013).

Diedrich further emphasizes the importance of understanding design as a transformation of the already existing, rather than being a creation of something completely new. According to this approach, Diedrich develops a tool for creating site-specific designs that considers both the transient and the place-bound qualities of derelict harbour areas. Alongside Burns' and Kahn's notions of the three areas of site's, Diedrich's concept for site definition and design will in this master's project be used as a tool for developing an evolutionary design that can accompany and adapt to the upcoming redevelopment phases of Nyhamnen, as well as to the future changes of the climate.

By using Burns' and Kahn's and Diedrich's approaches to site design, a site reading of Nyhamnen and how its surrounding environment is influenced by history, topography, material conditions, atmosphere, practices, water inundation etc. *(the areas of influence and effect)*, will lead to a delimitation of a specific site within Nyhamnen *(the area of control)* for which an evolutionary, flood adapted, design concept will be developed.

In addition to the above mentioned literature studies concerning theories about site definition and site design, the literature studies will also concern the concept of *temporary uses* and *tactical urbanism* in urban spaces. The aim with these studies is to further explore the evolutionary aspects of sites. Moreover, the literature studies will also concern research regarding the effects of climate change, with specific focus on an increase in precipitation, cloudbursts and rising sea levels. The literature used for this purpose mainly concerns research conducted by institutions such as the *IPCC, SMHI* and *Länsstyrelsen*. This review is subsequently followed by a presentation of the effects of flooding in urban environments; a study into different methods for managing urban storm- and floodwater runoff is based on literature by *Peter Stahre, Svenskt Vatten, Malmö stad* and *Movium Fakta*.

An important part of the literature studies is furthermore made out of the review of the *Comprehensive Plan for Nyhamnen*, developed by Stadsbyggnadskontoret at Malmö stad and approved in May 2015. Although the future structure of Nyhamnen yet is uncertain, this plan conveys some indications of what the future character of this new urban district might be. Hence, the comprehensive plan constitutes an important framework from which further explorations into the existing as well as the future qualities of Nyhamnen can be done.

To exemplify how site specific design concepts, temporary uses and methods for flood management can be implemented into a site design, this master's project also includes a segment of *case studies.* Through these practical examples, the aim is to further substantialize the discussed theories, studies and research.

LIMITATIONS

Climate change is a broad term that contains several different aspects and possible scenarios. Although many of the sources and effects of climate change are connected, this project will focus specifically on flooding caused by *cloudbursts*. Although the effects of flooding caused by *sea level rise* also will be discussed to some extent, it will not be the main focus of this master's project. Other aspects of climate change, such as drought and a rise in the average temperature, will not be considered.

Flooding in urban spaces have different effects on different types of environments. Hence, what methods for flood management that are suitable to use depends on the type of space it is applied to. This project will focus on methods that enables flood mitigation in public spaces by usage of vegetation, permeable surfaces, levels and inclinations. Consequently, more technical measures for flood management will not be discussed. Moreover, this technical delimitation means that the presented design concept will focus on the ways in which flood mitigated measures can be integrated into an urban fabric, rather than on giving exact depictions of the dimensions and technical demands of the proposed measures.

By focusing on landscape based methods rather than technical solutions, the assortment of suitable methods for flood management is delimited. In regards to this chosen approach, this master's project thus focuses on methods for flood management that can be implemented above ground. Hence, methods such as underground reservoirs and basins will not be discussed to the same extent. Although flood mitigation by usage of vegetation will be an important part of this master's project, it will not present any lists or specific examples of what plants that are suitable for these types of situations. This is mainly due to the limited amount of time available for completing this master's project. Even though the presented research and explorations regarding the effects of flooding will concern a larger context, the final design proposal will focus on a specific, delimited area of interest in Nyhamnen. Hence, solutions for flood management for all of Nyhamnen or other parts of Malmö will not be presented.

The comprehensive plan for Nyhamnen includes several different perspectives and themes for redevelopment. This master's project is not supposed to give a complete summary of this plan, but rather to present and discuss certain aspects of the document that can be related to flood management and site-specific design approaches

DISPOSITION

This master's project is divided into two parts.

PART I presents the research and theories that forms the

background of this master's project. This introduction thus includes studies into the sources and expected effects of climate change, and of different methods for urban storm- and floodwater runoff management. Continuing on this theoretical note, this part also presents design theories about site definition and site design, as well as concepts of temporary uses and tactical urbanism. Lastly, this part is concluded by a presentation of different case studies, which acts as practical examples of sites where either methods for flood management or temporary uses are part of the site design.

PART II introduces the site that is in focus in this master's project; Nyhamnen. In relation to Burns' and Kahn's notion that a site has three distinct areas, this part explores Nyhamnen's *areas of influence effect* through several scales as well as through past, present and future time-frames. This reading of Nyhamnen subsequently results in a delimitation of an *area of control*, thus enabling a definition of a specific site to which a design proposal is to be applied. Following this site definition is the presentation of a design concept, where the knowledge that is formed throughout this project is exemplified through a site specific design. In conclusion, this part ends with some final reflections upon the research questions, the design concept and the chosen method.

TERMINOLOGY

Throughout this master's project, a terminology is used that is related to the contexts of, for instance, climate change, hydrology, and flood management. To enable an easy read of this project, a short description of some of these terms can be found below:

» *Precipitation:* Precipitation includes as forms of atmospheric water vapour that falls from the sky, such as snow, hail or rain.

» *Cloudburst*: According to SMHI (2015), cloudbursts are defined as rainfalls where more than 50 mm of rain pours within one our, or when more than 1 mm of rain falls within one minute. Malmö stad defines cloudburst as rainfall that cannot be managed within the underground sewer system (Malmö stad 2016b:41).

» *Stormwater runoff:* Water that temporarily flows above ground, most often generated by everyday rainfall or by melted snow or ice.

» *Floodwater:* Runoff generated by occasional heavier rainfalls or cloudbursts.

» *Open stormwater management:* facilities that collect, delay and, to some extent, store runoff in completely or partly open systems.

PART I

This part acts as the theoretical introduction to this master's project. It begins with a review of research and theories regarding the sources and effects of climate change, followed by a presentation of how storm- and floodwater runoff can be managed within urban areas. Moreover, this part contains an introduction to design theories about site definition and site design, as well as to the concept of temporary uses of sites. Lastly, the theoretical reviews of this part are exemplified through some different case studies, acting as practical examples of how methods for flood management and temporary uses can be implemented into a site design.

Climate change due to the emission of greenhouse gases has been given an increasing amount of attention in the past decades. Today, many researchers argue that anthropogenic activity has a vital influence on climate change, causing the average temperature to rise and extreme weathers to become more common (IPCC 2013b:20).

A rise in the average temperature has several different effects. For instance, it causes the water in the oceans to expand and, consequently, to rise. In combination with melting land ices (glaciers), the global sea level is rising in a faster pace than what has been observed so far (SMHI 2012:10). As a result, the earth's hydrological cycle is intensified, which in turn causes extreme weathers such as cloudburst and storm surges to become more common, and more intense (SMHI 2014:21).

The hydrological cycle
Hydrology is the scientific study on the circulation, distribution and quality of water systems on Earth. This is known as the hydrological cycle, which describes the continous movement of water between ocean, atmosphere and surface (SMHI 2017).

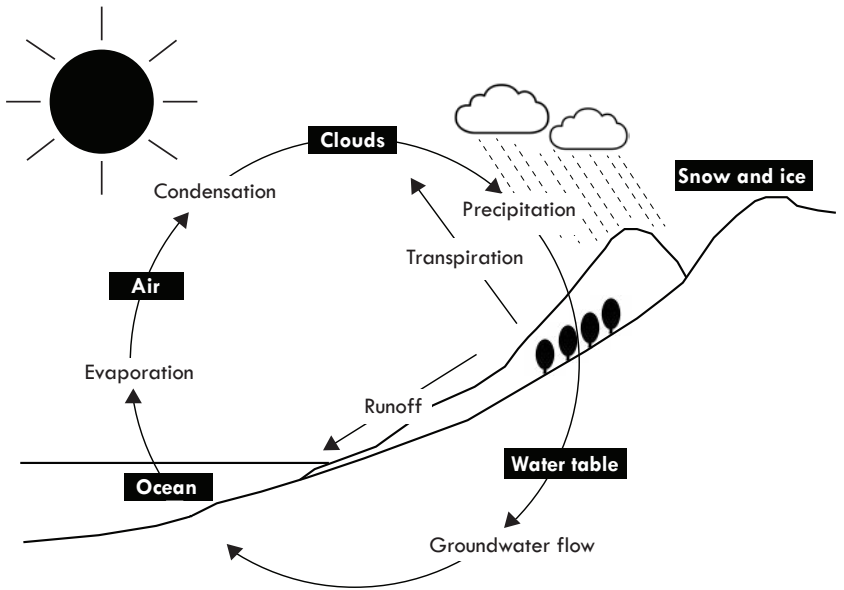


Figure 1. The hydrological cycle.

The sources and effects of climate change

In the Fifth Assessment Report (AR5), issued by the *Intergovernmental Panel on Climate Change* (IPCC) in 2014, climate change is defined as statistical alterations in the state of the climate that persists over a longer period of time. Hence, variations and changes in mean values that can be related to the climatic system are identified as climate changes (IPCC 2014a:39).

The sources of climate change can be divided into two main categories; *natural variability* and *anthropogenic climate change* (IPCC 2014a:39). *Natural variabilities* are natural, internal changes in the climate that has no connection to external (e.g. anthropogenic) impacts. These natural variations in the climate varies between years and between seasons; the fact that some summer seasons are dry and others are characterized by rain events are, therefore, part of the natural variability of the climate (SMHI 2017). *Anthropogenic climate changes*, on the other hand, are changes where human activity is influencing the climatic system (IPCC 2014a:12). The use of fossil fuel and its impact on the climate is an example of anthropogenic activity. These anthropogenic greenhouse gas emissions are considered to be the main driving cause of climate change (IPCC 2013a:467). According to the most recent IPCC report, only continuous reductions in greenhouse gas emissions, combined with climate adaptations, can limit the risks of climate change (IPCC 2013b:19).

IPCC

The Intergovernmental Panel on Climate Change (IPCC) is the leading body for assessment's of climate change. It was founded in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO), and is supposed to provide an unbiased, scientific view on climate change. IPCC reviews and evaluates the most recent research about climate change, and present neutral and transparent assessment reports on the current climate situation, its impacts and options for adaptation and mitigation. The 5th assessment report developed during the years of 2013-2014, called AR5, is the most recent IPCC report (IPCC 2017).

Within climate research, different scenarios of climate change are often modelled in relation to a 100-year period. According to this approach, the IPCC has developed several different scenarios that each reviews possible effects of climate change. These scenarios thus investigates instances where the emission of greenhouse gases are either reduced, unchanged or increased by the year of 2100 (IPCC 2014:9). Specific time frames like these are important tools for making future, and often uncertain, scenarios more substantial. However, it is important to acknowledge that the climate will continue to change even past these time frames (Länsstyrelsen Skåne 2012:22).

Although the effects of climate change are global, its impacts varies between regions. The effects that are in focus in this master's project, namely cloudbursts and sea level rise, have different impacts on global, national as well as regional scales.

Cloudbursts

According to the IPCC, the changing climate will alter patterns of precipitation in regards to the quantity, intensity, frequency and type of downpour. Research conducted by SMHI further suggests that the average amount of precipitation in Sweden will have increased with 20-60 % by 2100 (SMHI 2017). However, how much the amount of precipitation will increase varies within different parts of Sweden; coastal areas such as Skåne, for instance, are generally less exposed to precipitation than the midlands (SMHI 2012:5). There will also be differences within seasons; winters will become milder, and will also be characterized by an increase in precipitation. In turn, summers will become warmer, and more often be subject to both drought and intense cloudbursts (SMHI 2012:1).

Cloudbursts and heavy rainfalls are expected to become more common and more intense, both globally and nationally. By the end of the century, the level of intensity of heavy rainfalls is expected to have increased by 10-15% in Sweden. Furthermore, a 20 year cloudburst can be expected to occur as often as every six to ten years during summer in Sweden, and every two to four years during winter by the end of the century (SMHI 2014:36).

All around the world, extreme weathers will have some of its most severe impacts on cities and urban areas. This is mainly due to the fact that urban environments to a large extent consists of hardscape surfaces. During cloudbursts, these non-permeable surfaces aggravates stormwater runoff, causing flooding in streets, cellars and sewer systems (Malmö stad 2016a:53). In the report *Climate Adaptive Atlas for Skåne* (title translated by authors)[1] from 2011, Länsstyrelsen Skåne argues that the vulnerability of urban areas is greater today than ever before; while extreme weathers always has occurred to some extent, its impacts on the highly developed, hardscape cities of today and of the future can be expected to be greater than ever before (Länsstyrelsen Skåne 2011a:10).

Sea level rise

From a global perspective, there are two main factors that affects sea level rise; the thermic expansion of the sea, and the melting of land ices (glaciers) (SMHI 2012:48). These factors are consequences of an increase in the average temperature, which, in turn, mainly is caused by the anthropogenic emissions of greenhouse gases. In scenarios developed by the IPCC where there are no continuous reductions in greenhouse gas emissions, these two factors will cause a global sea level rise that, in a best case scenario, will

[1] *Original title: Klimatanpassningsatlas för Skåne län (2011).*

increase by 0,40 meters (scenario *RCP2.6*), and in a worst case scenario with 0,63 meters (scenario *RCP8.5*) by the year of 2100 (IPCC 2014:60).

The rise in sea level will differ between, and within, countries; there are several aspects that makes regional and local sea levels differ from the global average. Large-scale factors such as irregular changes in ocean density, ocean circulation and gravitational impacts affects the sea level rise. From a local perspective, sea level rise is also affected by differences such as salinity level, wind climate, extreme precipitation and land rise (SMHI 2012:48). For instance, the greatest land rise in Sweden takes place in the northern parts of the country, by Bottenviken, while it in its southern parts, in Skåne, is practically insignificant (Lantmäteriet 2017-03-21). As a result, Skåne is also considered to be more vulnerable to rising sea levels, as opposed to the northern parts of the country where the land is expected to rise consistently with the sea level (SMHI 2014:37).

Flooding

Cloudbursts and sea level rise are all effects of climate change that can cause flooding. Flooding mainly affect areas near lakes, canals and coastlines (Länsstyrelsen Skåne 2012:8), and are in some cases almost impossible to predict or even prevent (RIBA 2009:4-5). As mentioned, the effects of flooding are often most severe in urban areas, which predominantly consists of hardscape surfaces. The inability of these non-permeable surfaces to manage sudden and large amounts of water cause underground drainage systems and, by extension, streets and cellars to flood.

The causes of flooding differs, and each cause has different effects. In general, the severity of the flooding is mainly dependant on its level of predictability, the rate of onset of the flood, the speed and depth of the water and the duration of the flood (RIBA 2009:6). According to RIBA, the *Royal Institute of British Architects*, the sources of flooding can be divided into six different categories:

» *Tidal flooding.* Occurs in rivers or seas through a combination of high tides and low pressure weather systems. The onset of the flood is fast, but it is fairly easy to predict since both tide and low pressure weather can be predicted.

» *Fluvial flooding.* Occurs when the capacity of a watercourse is exceeded. Fluvial flooding can occur during heavy rainfalls or during winter when snow and ice are melting. It can also be caused by blockages of water in a watercourse. The onset of this type of flooding is most often slow, but it can be fast as well. This type of flooding is a common result of cloudbursts, which generally are hard to predict.

» *Pluvial flooding.* A type of stormwater flooding, caused by stormwater runoff in areas where there is a lack of permeable surfaces. This type of flooding is both rapid in its onset and difficult to predict, since it often affects areas where flooding is not generally managed.

» *Groundwater flooding.* Occurs when low lying areas become flooded due to a rise of the groundwater level. The onset of this type of flooding is slow and often seasonal and fairly easy to predict.

» *Flooding from man-made infrastructure.* Occurs when man made constructions such as canals and reservoirs are unable to manage extreme amounts of water, causing flooding to areas downstream.

» *Flooding from sewers.* Occurs when the capacity of stormwater and sewer systems are exceeded during high levels of stormwater runoff. This type of flooding is hard to predict and has significant sanitary consequences. (RIBA 2009:4-5)

Pluvial flooding is the term most commonly used in relation to flooding from cloudbursts in urban environments. This type of stormwater flooding highlights the issues that a lack of permeable surfaces in hardscape cities can cause. Moreover, these problems are often exacerbated by overstrained, and sometimes outdated, drainage systems that are at risk of causing flooding from sewers (RIBA 2009:5).

The empirical knowledge formed in the previous chapter indicates that hardscape, urban areas are vulnerable to flooding. The following chapter thus presents possible solutions to these insights; how storm- and floodwater runoff is managed within urban areas in general and, more specifically, how storm- and floodwater runoff currently is managed within Malmö municipality. Moreover, this chapter also presents examples of above ground methods for flood management that are able to act as a complement to the underground drainage infrastructure during cloudbursts.

Urbanisation and stormwater runoff

Stormwater runoff is defined as water that temporarily flows above ground. Most often, it is generated by rain or by melted snow or ice. Water generated by, for instance, the washing of a car on the street is also defined as stormwater runoff, based on the fact that the water flow above ground is temporary (Dagvattenguiden 2017-04-01). In this master's project, stormwater runoff is mainly defined as the runoff generated by everyday rainfall. Floodwater, on the other hand, is defined as runoff generated by cloudbursts.

The expansion of urban areas brings a simultaneous increase of the amount of hardscape surfaces (Stahre 2004:9). These non-permeable surfaces leaves little room for water to infiltrate into the ground, thus generating large amounts of stormwater runoff. This aggravation of runoff results in a water flow that needs to be managed and mitigated somewhere along its path.

Due to the general increase in hardscape surfaces in urban areas, the graphs and patterns that depict the levels of stormwater runoff in the cities of today differs greatly from depictions of runoff patterns from before urbanisation. The amount of stormwater runoff that needs to be managed within cities has simply increased and, because of the non-permeable surfaces, the flow of this stormwater is also faster today than before. Due to the increase in both amount and speed, the peaks of water flows are thus much higher today than before urbanisation (see figure 2) (State of Green 2016:8).

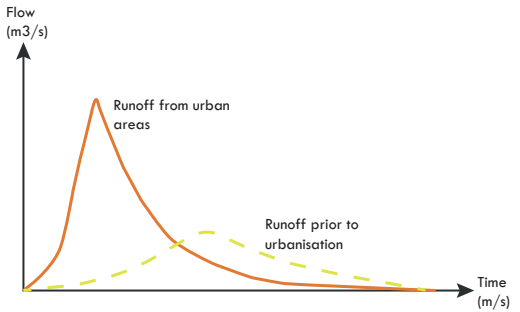


Figure 2. Runoff graph.

To be able to drain water from built areas as fast as possible, stormwater runoff in urban environments is most often transported through an underground drainage system (Stahre 2004:9). These underground systems manages both storm- and waste water, and are divided into either a *duplicate* (two part) system or a *combined* system. The duplicate system manages stormwater runoff and waste water separately, while the combined system manages both types of water within the same system (Malmö stad 2016b:40). The combined system was the most commonly used drainage system in many Swedish cities during the first half of the 20th century. After 1960, however, any additions to the drainage infrastructure has almost exclusively consisted of duplicate systems. This change has resulted in a situation where the older parts of many larger cities are connected to a combined drainage system, while the outer parts are connected to a duplicate system (Stahre 2004:9). The combined system, which manages large amounts of water through the same pipes, runs the highest risk of becoming flooded during cloudbursts. Such floods can result in a release of contaminated waste water directly into watercourses, or even into cellars in residential buildings (Malmö stad 2016b:19).

Stormwater runoff management in Malmö

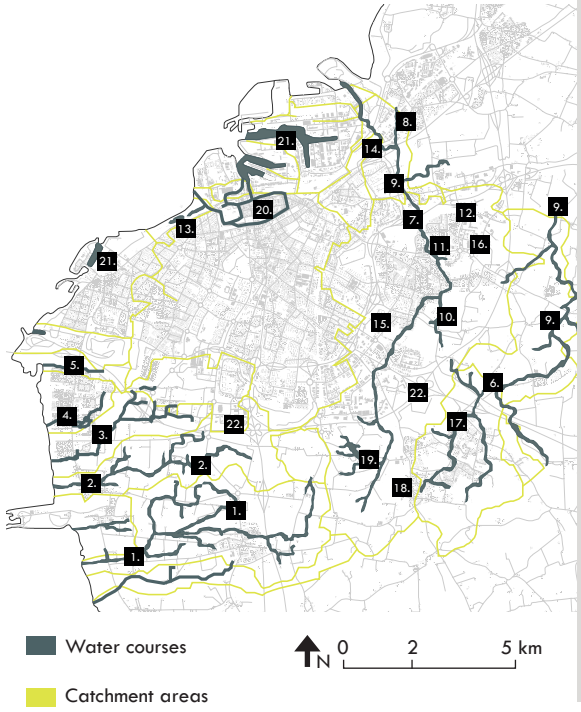
Malmö has been subject to cloudbursts and subsequent pluvial flooding three times in the past decade; in 2007, 2010 and 2014. These pluvial floods caused great material damages on both buildings and infrastructure. The most intense cloudburst occurred in August 2014, when 120 mm's of rain fell within 6 hours, which is the most severe cloudburst that has occurred in Malmö since measurements of rainfall began at the end of the 19th century (Malmö stad 2016b:16). The economic costs following the 2014 cloudburst is estimated to have reached approximately 600 million Swedish crowns (Malmö stad 2016b:24). To be better prepared for this type of extreme weather in the future, Malmö stad and VA Syd has recently started to develop a *Cloudburst Management Plan for Malmö* (title translated by authors)[2] (Malmö stad 2016b). This plan offers some planning directions for how cloudbursts could be managed within Malmö in the future. One of the goals of the cloudburst plan is that cloudburst strategies should be taken in city planning process (Malmö stad 2016b:7). In this document, Malmö stad acknowledges that visible stormwater management can contribute to additional values, such as recreational and improved microclimate (Malmö stad 2016b:6).

When mapping the effects of recent cloudbursts in Malmö, a pattern appears where the greatest damages due to flooding are concentrated to locations along the main pipes of the underground drainage system (Malmö stad 2016b:14). This illustrates the vulnerability of the city's drainage infrastructure and, hence, the need for supplementing solutions for floodwater management above ground. The city of Copenhagen reaches a

[2] *Original title: Skyfallsplan för Malmö (2016b)*

similar conclusion, when reflecting upon the effects and damages that followed the intense cloudburst in the Danish capital in July 2011. During this heavy rainfall, neither the drainage system nor the overground buffer areas, such as parks, sports grounds and open spaces, were able to cope with the extreme amounts of rain. During the aftermaths of the 2011 cloudburst in Copenhagen, the municipality came to the conclusion that a combination of under- and over ground methods for flood management are essential if the extensive effects and damages of cloudbursts are to be prevented. In the report *Cloudburst Management Plan* from 2012, the city of Copenhagen states that solutions for stormwater management needs to be implemented both below- and above ground, and that the above ground buffer and storage areas needs to be supplemented by measures that transports water out to the sea via roads, canals and urban waterways (City of Copenhagen 2012:7).

In Malmö, stormwater is transported through an underground drainage system that leads the runoff to stormwater *recipients*. These recipients are constituted by different kinds of natural or artificial watercourses, such as streams, canals, rivers, wetlands and harbours (i.e. the sea). In total, there are 21 main recipients for stormwater runoff in Malmö (see figure 3) (Vought 2006:11). Which parts of the city that is connected to what recipient is determined through the distribution of different catchment areas



Stormwater recipients in Malmö municipality

1. Tygelsjöbäcken
2. Skumparpsdiket
3. Bunkeflodiket
4. Strandängarna
5. Lernackendiket
6. Oxiediket
7. Risebergabäcken
8. Kalinaån
9. Segeå
10. Husie mosse
11. Sallerupsvägen våtmark
12. Toftanäs våtmark
13. Västra Öresundsdammen
14. Västkustvägsdammarna
15. Ögårdsdammen
16. Damm Lundiusgatan
17. Blekeparkdammarna
18. Damm Tingdammskolan
19. Nya och gamla Svängedammen
20. Malmö canals (incl. Turbinen)
21. Malmö and Limhamn harbours

(Vought 2006:11)

Figure 3. Stormwater recipients and catchment areas in Malmö municipality.

(Malmö stad 2008:28). Within these catchment areas, there are one or several stormwater recipients that manages runoff from that particular part of the city.

The main recipient for stormwater runoff in Malmö is the stream *Risebergabäcken*. It receives 20% of the total amount of stormwater runoff in Malmö, despite its relatively small size (Malmö stad 2016b:5, 37). The remaining percentage of runoff is further distributed between the other recipients within the municipality, as illustrated in figure 3. Due to its limited size, the capacity of Risebergabäcken would be surpassed if it would have to manage large amounts of water in a short period of time, for instance during a cloudburst (Malmö stad, 2008:5). Hence, in order to release the pressure on Risebergabäcken and other streams, canals, rivers or wetlands in Malmö, a proportion of the floodwater needs to be delayed and infiltrated elsewhere, before it reaches the recipients.

In Malmö, contaminated water (i.e. sewer waste water) is transported either through the duplicate (two part) system or the combined system. These waste water pipes leads the water to treatment plants where it is purified. After this purification process, the water is released into Öresund (VA SYD 2016-08-17). Since the duplicate system transports storm- and waste water separately, the risk of releasing contaminated water directly into a recipient during flooding is relatively small. The combined system, however, which runs a higher risk of becoming flooded during cloudbursts, can potentially release contaminated water directly into the stormwater recipients. Hence, recipients within the parts of the city that is connected to the combined system, as some parts of Nyhamnen are (Malmö stad 2016b:19), runs a higher risk of being contaminated by polluted waste water during cloudbursts.

Open solutions for stormwater management

The vulnerability of the drainage infrastructure, in Malmö as well as in many other cities, creates a demand for solutions where storm- and floodwater runoff is delayed, infiltrated and purified close to its source. A traditional approach towards avoiding flooding in urban areas has been to improve the capacity of the underground drainage systems. These types of efforts does, however, often demand considerable amounts of economic funds. Moreover, it often takes time before the full effects of these improvements can be seen (Stahre 2004:10). In Malmö, a more current strategy for managing floodwater is thus to delay or infiltrate the water elsewhere (Malmö stad 2008:5), an approach that is able to limit the amount of water that reaches the underground drainage system. This type of strategy, often referred to as *open solutions for managing stormwater runoff*, commonly include solutions that are less complicated and less expensive to implement (Stahre 2004:10).

In the book *A sustainable approach to stormwater runoff management*

(title translated by authors)[3] (2004), Peter Stahre defines open solutions for stormwater management as facilities that collect, delay and, to some extent, store runoff in completely or partly open systems (Stahre 2004:19). To define these solutions as *open* refers to the fact that large parts of the runoff management within these systems happens above ground and, hence, is most often fully visible. Moreover, these open facilities commonly resemble nature's own way of managing water through, for instance, infiltration and percolation (Stahre 2004:19, Fredell & Jergmo 2015:4).

As with drainage systems that are located below ground, the above ground systems are part of a larger chain of runoff management. When planning for storm- and floodwater management, the different parts of this chain should thus not be considered as isolated from one another, but rather be looked at as an integrated unit. Stahre further argues that a general principle when creating a well-functioning chain of methods is to strive after a system that is similar to stormwater runoff in the nature (Stahre 2004:22, Svenskt Vatten 2011:14).

Measures for managing stormwater runoff above ground can be divided into four different categories. Namely, these four categories are; *Local management on privately owned land*, *Delay close to the source*, *Slow derivation* and *Collected delay* (Stahre 2004:20, Svenskt Vatten 2011:13). In general, these categories refers to if a certain method is part of the beginning or the end of the overall chain of runoff management and, moreover, if it is located on privately- or publicly owned land. In order to release the pressure on the underground systems, above ground measures for managing stormwater needs to be implemented along the entire chain (Stahre 2004:21). It is important to note that different methods for runoff management can be a suitable choice for more than one category; whether a particular lot is privately or publicly owned does not necessarily effect what methods for runoff management

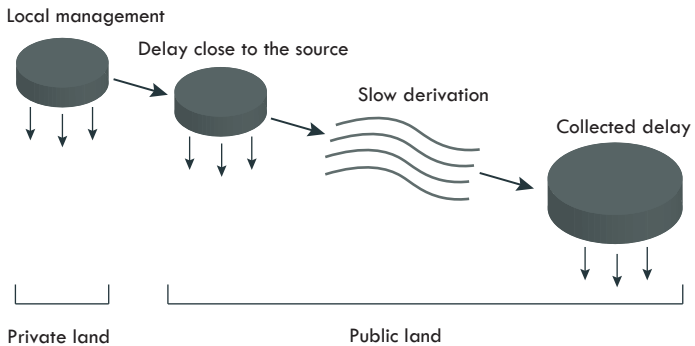


Figure 4. The four categories of stormwater runoff management.

[3]*Original title: En långsiktigt hållbar dagvattenhantering - Planering och exempel (2004).*

that are appropriate at that particular place. To separate the chain into different categories rather highlights the different parts and requisites of the chain and, moreover, who is responsible for implementing these methods (Stahre 2004:20).

The first category, *the local management of runoff on privately owned land*, is an important part of the overall chain for managing stormwater runoff; although some lots can seem small or insignificant within a larger system, the collected effect of these measures are still great. Since this has to be managed locally, the responsibility of implementing such methods lies on the estate or lot owner (Stahre 2004:23). Examples of suitable methods are green roofs, lawns, permeable surfaces, retention basins, trenches and ponds (Stahre 2004:24-35, Svenskt Vatten 2011:13).

The second category, *to delay the runoff close to its source*, refers to measures taken in the top of the overall chain on publicly owned land. Examples of suitable methods are permeable surfaces, floodable surfaces, dikes and ponds for delaying water (Stahre 2004:40-47).

The third category, *slow derivation of stormwater runoff*, include methods that typically are implemented on publicly owned land, and are methods that are supposed to slow down the water flow. Much like the underground systems, these methods often include longer paths or swales that transports the water and are therefore often space demanding. Example of suitable methods are trenches, creeks or canals (Stahre 2004:49, 50-57, Svenskt Vatten 2011:13).

The fourth category, *the collected delay of runoff*, refers to methods where water is collected in larger, open facilities. These facilities demand a lot of space, and are thus most often implemented on publicly owned land (Stahre 2004:59). Examples of methods are floodable surfaces, large ponds for delaying water, and wetlands (Stahre 2004:60-65, Svenskt Vatten 2011:13).

Through the usage of permeable surfaces, open canals, trenches and floodable surfaces, above ground storm- and floodwater runoff strategies are able to contribute to a flow levelling of stormwater and, hence, to reduce the risk of flooding (Stahre 2004:10). The following segments offers a closer look on some particular above ground methods that can be integrated into urban areas.

Constructing stormwater facilities

When constructing runoff facilities, one first needs to decide what the effect of the facility is supposed to be; is the desired function to reduce the amount of pollutants, to delay and reduce the water volume, or should the stormwater be transported to a recipient nearby? What method that is suitable for a certain situation is connected to the requisites of that specific area. For instance,

in industrial areas or roads strained by heavy traffic, it might be relevant to focus on a reduction of pollutants in the stormwater. Moreover, some situations demand a combination of several methods (Sweco 2017-05-07:3, Svenskt Vatten 2011:57). If the aim is to reduce the amount of pollutants of the stormwater runoff, the dimensions of the runoff facility depends on the amount of pollutants it can manage without taking damage. The dimensions of a facility that strives towards delaying the runoff, on the other hand, is based on expected water volume, water outflow, geotechnical prerequisites and the desired aesthetic expression. Moreover, it is also relevant to define other possible purposes of the facility; should it be filled with water permanently or just during flooding? In what context is the facility situated? Should it have an educational purpose? (Sweco 2017-05-07:7). According to Svenskt Vatten (2011), stormwater can be used as a positive resource within city planning. In addition to managing flooding, they argue that it should be integrated into the city structure based on functional and aesthetic principles.

The following segments of this chapter takes a closer look at some different examples of above ground methods for flood management.

Permeable surfaces

The most efficient way to reduce the amount of stormwater runoff within an area is to reduce the amount of non-permeable surfaces (Stahre 2004:22). Hence, the easiest way to reduce the damaging effects of runoff is simply to avoid non-permeable materials such as, for instance, asphalt (Stahre 2004:40). It is also possible to choose semi-permeable surfaces that are perforated or rasterized since the stormwater can infiltrate through the cracks (Svenskt Vatten 2011:68). The amount of water that can be infiltrated into permeable surfaces largely depends on the hydraulic capacity of the base course and on the soil below the surface. Moreover, the capacity of the surface also depends on the design of the paving or surface, and on what materials that are used (State of Green 2016:8).

Open canals

Open canals are hardscape facilities that has some similarities to the pipes of the underground drainage systems; hardscape canals has the ability to divert and transport runoff within the dense and hardscape parts of urban areas. In addition to managing runoff, open canals further attends some pedagogical aspects; by making the everyday runoff management a visible part of dense urban areas, the public's apprehension of the amount of runoff that is generated within cities is able to be improved (Stahre 2004:54). A common issue with these facilities is, however, that they tend to become waste bins for trash, and they therefore require some maintenance. Moreover, these facilities can, in some cases, be as expensive to implement as an underground drainage system.

Open canal system in Västra Hamnen, Malmö.

Open canals can thus be argued to mainly be a suitable measure in cases where there is a particular wish for making the stormwater runoff a visible and valuable part of a certain area (Ibid.)

Ponds for delaying runoff

In contrast to many other above ground methods for managing runoff, ponds are facilities that includes a permanent water surface. Hence, ponds are able to act as a water feature both during dry and wet periods (Stahre 2004:34, 46, 62). This type of facility is an efficient method for managing pollutants and delaying flow augmentations. The purifying methods of ponds are mainly based on the effects of sedimentation and plant absorption. Moreover, the effect of these purifying methods is largely dependent on the inflow of water, the duration of the water flow, the amount of vegetation used and the level of pollution of the water (Sweco 2017-05-07:8-9). The fact that floodable ponds incorporates a permanent water surface further includes some typical maintenance issues. The most common one is the growth of algae which, consequently, creates a consistent need for cleaning. Although some measures can limit the amount of algae, it is basically a problem that occurs in all ponds of this type (Stahre 2004:46: Svenskt Vatten 2011:83).

Floodable surfaces

A floodable surface is an area that is able to both manage and infiltrate water. Hence, this type of surface is a useful resource

Curb extension at Taasinge Square, Copenhagen.

when other parts of the runoff chain becomes strained and the water pressure needs to be released. During such occasions, the floodable surface fills up with water temporarily. Eventually, the water is drained off and the surface is restored to its normal and dry condition (Stahre 2004:44, 60). A floodable surface is lowered in relation to its surroundings and, in many cases, it consists of grass and/or vegetation (i.e. bioswales and wetlands) that is able to cope with occasional flooding. These type of surfaces are easy to construct and can be combined with other purposes since it lacks a permanent water surface (Stahre 2004:44, Svenskt Vatten 2011:81).

Rain gardens and curb extensions

In general, vegetation is a useful resource for achieving flood mitigative purposes. Plants has the ability to manage water in several different ways, where one of its most prominent features is that it can delay floodwater and, hence, attenuate extreme weathers. Moreover, it also has the ability to manage and purify pollutants (Fredell & Jergmo 2015:7).

In addition to being a common part of floodable surfaces, vegetation is also used as a regular feature in several other urban flood management methods. Examples of common methods in dense cityscapes are rain gardens and curb extensions, commonly referred to as *bio filters*. At a basic level, these types of methods consists of a plant bed that incorporates both purifying bio filter's

and plants, e.g. perennials, bushes and trees. Rain gardens and curb extensions can either be raised or sunken down into the ground (Fredell & Jergmo 2015:4), and has the ability to create a water flow resistance, to promote a levelling of stormwater, and to purify stormwater through the absorption of pollutants (Fredell & Jergmo 2015:7: Sweco 2017-05-07:8). As an example, this type of plant bed can infiltrate and reduce 50-80 % of the total amount of heavy metals in storm- or floodwater. While the plants absorb 2-7 % of the metals, the filter or the soil of the planting bed absorbs the rest (Fredell & Jergmo 2015:8).

As its name implies, a curb extension is an extension of the curb alongside a street. This type of method can be applied to any street of sufficient width, but are considered to be most efficient in connection to intersections where it is able to collect larger amounts of runoff (Watson & Adams 2011:115). The amount of water that can be delayed within curb extensions and rain gardens mainly depend on the dimensions of the plant bed (the infiltration area) and on the chosen type of soil or filter (Fredell & Jergmo 2015:9). In general, rain gardens and curb extensions are small scale facilities with the main purpose of managing everyday rainfalls. Hence, if this type of method is to be able to cope with extreme amounts of rain during cloudbursts, it often needs to be complemented with, for instance, ponds or floodable surfaces (Sweco 2017-05-07:8).

Linear tree plantings and drainage areas

This method is characterized as vegetated corridors, mainly near hardscape surfaces. These facilities can be constructed as a road trench or a small canal with vegetation. The main aim of this method is to delay and transport stormwater, and features purification processes through, for instance, sedimentation (Sweco 2017-05-07:9). Such corridors can be designed with a linear tree planting with amended planting soil. In addition to managing storm- and floodwater in a cost efficient way, these type of tree plantings have the ability to improve air quality and to reduce the heat island effect in urban areas (Watson & Adams 2011:114).

Suitable plants for flood mitigation

A common perception of flood adapted measures that include vegetation is that the plant material should consist of species that normally thrive in wet habitats as, for instance, wetlands. However, it is actually the opposite; plants used for flood management should be of species that are adapted to dry or normal conditions. This is mainly due to the fact that there is a great difference between water conditions in naturally wet habitats and in hardscape areas; while the runoff in natural habitats is characterized by a constant flow of water that slightly increases during rainfalls, the flow of water in urban areas is not as constant. The flow augmentation during storm surges is thus much greater in urban areas than in natural environments. Hence, plant inspiration for flood management

within urban environments should be derived from habitats that are occasionally, rather than constantly, flooded, as for instance banks by seas, lakes and creeks (Fredell & Jergmo 2015:10).

Furthermore, it is not only the access to water that indicates what plants that are suitable for flood management plantings; requisites concerning function and climate also has to be reviewed. Climate factors such as accessibility of nutrients, sun, wind, water and type of climate zone affects what species of plants that are suitable for a certain situation. Other aspects such as the depth of the delay-zone, the size of the designated runoff area and the size of the plant bed, soil capacity and the level of water pollution (e.g. road salt) are also important to consider (Fredell & Jergmo 2015:10-11).

Purifying stormwater

The stormwater runoff and floodwater that flows on hardscape surfaces are subject to pollution. Runoff from streets can contain oil, heavy metals, hazardous substances or road salt (State of Green 2016:18). Industrial areas, as for instance Nyhamnen, are especially exposed to this type of ground pollution (Malmö stad 2015:45). To avoid contamination, the runoff or floodwater in urban and industrial areas thus needs to be purified before it reaches its stormwater recipient. Flood management methods such as permeable surfaces, floodable ponds, rain gardens and curb extensions are all possible subjects to polluted runoff. However, as mentioned, there are some species of plants that has the ability to purify these types of pollutants (EPA 2000:3).

To remediate contaminated sites by the usage of plants is commonly referred to as *phytoremediation* (EPA 2000:3). In comparison to other remediating measures, phytoremediation constitutes a method that has the ability to bring additional advantages that more technical, engineer-based techniques might not. As an example, the fact that this purification method always include some sort of plant material is argued to constitute an aspect that brings natural and passive aspects to the process, while at the same time bringing new aesthetic values to a site. Moreover, phytoremediation is by some argued to constitute a more efficient and economic process than more technical measures are (Westphal & Isebrands 2001:1). Since pollutants and contaminants can be transported by water, the ability of plants to remediate these contaminants depends on their ability to absorb water. Plants, and especially trees, that has many or deep roots has been noted to be especially suitable for remediative uses. Poplars and willows are examples of tree species that fulfils these requirements, and has thus become popular species to use for phytoremediative purposes. In addition to having a great and deep root system, thus enabling a large uptake of water, these species of trees are also rapid growing, hence able to deliver remediative profits to a contaminated site relatively fast (Westphal & Isebrands 2001:2).

One of the main aims with this master's project is to translate the presented research and theories into a flood adapted design concept. This design will be applied to a delimited space within Nyhamnen. To be able to make that delimitation, and to be able to find a suitable design for a specific, defined site, design theories about site definition and site design by Carol J. Burns, Andrea Kahn and Lisa Diedrich has been studied. An introduction to these theories can be found below.

Understanding site

Site notions and definitions are relevant for all of the disciplines and professions that are concerned with design of the physical environment. Since design actions reconfigures the environment in both physical and conceptual terms, a comprehension of site by both those terms should be fundamental within all design disciplines (Burns & Kahn 2005:viii). In the chapter *Why Site Matters* (2005), part of the book *Site Matters: Design Concepts, Histories, and strategies (2005)*, Carol J. Burns and Andrea Kahn argues that the basic definition of site refers to the ground chosen for something, and to the location of some set of activities or practices. Each discipline and profession that specializes in design, however, interpret the location of its activities and practices through their own, normative approaches. While architects traditionally focus' on buildings, hence defining the building lot as the ground for design intervention, landscape architects on the other hand deals with sites as material terrain (Burns & Kahn 2005:viii). These diverse interpretations of locations between different design disciplines illustrates that the act of *defining a site* is far less basic than it might seem. In the chapter *Defining Urban Sites* from 2005, Kahn discusses this act of defining sites further. She argues, that urban sites should be identified as both the whole city, as well as limited areas within it; even the smallest urban design intervention influences city building at large (Kahn 2005:282). Although being a word that inherently implies aspects of limitation and certain geographical scopes, the term *site* thus seems to call for a more complex definition.

In *Why Site Matters* (2005), Burns and Kahn argue that the common, delimited approach to site's can be related to the fact that a site too often is perceived as a straightforward entity, contained within boundaries that separates it from its surroundings. They further argue, that this approach can be related to the fact that most work of physical design focuses on spatially delimited places. In fact, the great majority of professional commissions begin with a pre-designated lot, owned or controlled by a client. Due to this approach, designers often seem to perceive a site as a delimited, given entity (Burns & Kahn 2005:x). Kahn further argues that there is an important difference between the idea of *site* that is linked to conventional notions of *place*, and between the idea where site is not associated with ideas of a limited location (Kahn 2005:284).

As an example, Kahn discusses the area Hell's kitchen, located on Manhattan, New York. Consisting of several structures and characters, such as a residential neighbourhood, a commercial district, and an important intersection for infrastructures, this area thus operates at several different scales (Kahn 2005:285-286). Through the intersection between these different structures, that each involves different scales of activity, the scale of this area cannot be characterized simply as *urban*. Instead, this site operates at local, metropolitan, regional, national as well as global scales. Through this example, Khan hence illustrates that urban sites are comprised of proximate as well as non-proximate relations, and physical as well as non-physical attributes. By this definition, urban sites are both conditioned by, and contributing to, their surroundings (Kahn 2005:285). These multiscalar, heterological aspects of sites offer a myriad of dimensions (e.g. economic, social, historical, physical and political), that each situates the site within a certain context (Kahn 2005:286).

The dynamic relational construct

> *"To be controlled or owned, the physical site needs delimitation; however to be understood in design, it must be considered extensively in reference to its setting. No particular locale can be experienced in isolation."*
>
> (Burns & Kahn 2005:xii)

If a site is to be perceived as reaching beyond its physical delimitation, Burns and Kahn argue that its very concept simultaneously refers to seemingly opposite ideas (Burns & Kahn 2005:xii). On the one hand, site refers to a physically specific place, i.e. a physical location to which design interventions are to be applied. On the other, it refers to its spatially and temporally expansive surrounding, i.e. its influences and effects on, and from, larger structures and systems. By conceiving sites over time in this way, Burns and Kahn suggests that a site can be said to consist of three distinct areas. The first is the *area of control,* which refers to the legal and geographical boundaries of a specific project. Hence, this is the most limited field in spatial and temporal terms, and is often simply referred to as 'site' within design discourse. The second area is the *area of influence,* which comprises the forces and systems that act upon a place without actually being confined to it, thus not necessarily taking place within its boundaries. The third is the *area of effect,* referring to the areas that reaches beyond the site, yet still are affected by the design interactions (e.g. water cycles, infrastructural systems). Although belonging to different geographical and temporal frames, Burns and Kahn argue that these areas exist simultaneously, and overlap (Ibid).

During a design process, the areas of control, influence and effect can be used as a way of defining *site,* thus finding its physical and non-physical attributes, and its proximate and non-proximate

relations. Burns and Kahn defines this concept of design as a *dynamic relational construct,* by which they illustrate the fact that a design simply doesn't impose on a place, but is rather a result of the designer's interaction with what the site is, and what it can become (Burns & Kahn 2005:xv). Through this interaction, sites appears as dynamic, rather than static.

The concept of the dynamic relational construct is also used by Lisa Diedrich in her PhD thesis *Translating harbourscapes* (2013). She further emphasizes the necessity of conceiving a site not only through its area of control, but also through its areas of influence and effect (Diedrich 2013:43). Diedrich writes:

> *"If, in popular language, a site is the ground on which something takes place, a site in a design context is first of all the area a designer receives from a client, to develop and shape. It is a given, and has clear boundaries. However, when the designer begins to explore the site, interest generally shifts to features that connect the delimited area of intervention with larger systems, and the designer's creative act often introduces elements that have an influence beyond the site itself."*
>
> (Diedrich 2013:42)

According to the chosen focus of her thesis, Diedrich argues that the concept of the dynamic relational construct can help detect site-specific design approaches which can be applied to harbour areas undergoing transformation. Diedrich's thesis thus focuses on the derelict harbours, the spatial leftovers from the late 19th- and 20th century industrial era, that are under the process of being redeveloped and integrated into the urban fabric. Diedrich argues that this pattern of redevelopment often is done in a too similar, generic way. As a result, many transformed harbour areas look the same all over the world, regardless of their geographical, social and historical backgrounds (Diedrich 2013:22). Relating back to the concept of the dynamic relational construct, the redevelopment of many of these harbour areas fails to acknowledge the site specific requisites of these sites. Hence, Diedrich argues that the potential variety and richness of different derelict harbour areas is overlooked, instead of being used as a resource during a design process (Diedrich 2013:24).

Design as transformation: site reading and site editing

According to Diedrich's site specific approach to design, a design should be understood as a transformation of the already existing, instead of being a creation of something completely new (Diedrich 2013). By emphasizing the transformative aspects of design, Diedrich further articulates the dynamic state of both sites, and designs. Building further upon Burns and Kahn's design concept of the dynamic relational construct, Diedrich separates the designers' thinking during a design process into two parts; the apprehension of a site and the imagined or realised transformation

of it. The apprehension of sites is defined as *site reading,* while the transformation is defined as *site editing* (Diedrich 2013:44). According to Diedrich, these two approaches to design can be used as a tool for developing a site specific, transformative design for derelict harbours areas (Diedrich 2013:90).

Diedrich further elaborates these tools by dividing them into different categories. The *reading* of a site is divided into categories of physical, dynamic and immaterial aspects, which, furthermore, also includes different *filters* through which a site can be investigated. These filters include aspects such as structures, materials, natural processes, existing and future practices, and atmospheres (Diedrich 2013:91-92). The reading of a site subsequently leads the designer into a *site editing* process. This site editing is divided into two categories; a *translation* and an *intervention* mode. The translation mode aims at bridging the gap between the derelict harbour area and the urban site, by either integrating (translating) the harbour area into the urban site or, conversely, by opening up the urban site towards the harbour area. In turn, the intervention mode concerns aspects of connectivity and appropriation. The connectivity aspect aims at connecting the derelict harbour with the rest of the city through the design, as well as overcoming the often enclosed and fenced off state within these industrial areas. The second aspect of intervention, appropriation, focuses on the users and their interaction with a site while it is undergoing transformation. According to Diedrich, this aspect of site editing further enhances the importance of implementing a transformative design upon harbour areas; since the redevelopment of these industrial environments most often run over a long period of time, a (static) design and function cannot be set from the very beginning. Instead, the future uses and functions of a site should be developed and appropriated during its period of transformation. As a result, the designer is able to evaluate the uses of a site before, during and after the design intervention (Diedrich 2013:93).

Through their dynamic, relational approach to the design process, Burns, Kahn and Diedrich all enhance the dynamic aspects of site, and of site design. By considering site design as a dynamic relational construct, one can gain further insight into the complex, non-static aspects of sites. In addition to creating a tool for site specific design, this approach emphasizes the need for a transformative design process, an evolutionary state that allows a site to evolve and change over time. This consideration of *time* enhances and acknowledges the uncertainty of future uses and requisites of sites. Perhaps, the future state of a certain site can be said to be as uncertain as the future state of the climate.

The design theories outlined in the previous chapter stresses the importance of regarding sites as reaching beyond its physical and temporal delimitations. This approach to design can be argued to illustrate the state of change that sites are subject to. Climate change and economic instabilities are just two examples of effects that can be difficult, or even impossible, to predict. Still, these effects has a great influence on both physical and non-physical aspects of sites. The following chapter thus explores the ever changing and temporary aspects of sites further, by presenting some non-static planning and design approaches that can be implemented to sites temporarily.

What is temporary use?

Temporary spaces and installations has become a popular trend within city planning in recent years. Temporary structures or events within cities are, however, not a new phenomenon; they have existed in the form of travelling festivals and fairs for almost as long as the city itself. Moreover, the very structures of buildings, spaces and activities of the pre-industrial city were predominantly of a temporary character (Bishop 2015: 136). In the dense cities of today, temporary uses of spaces are instead often used as a way of promoting sustainable urban development, for instance by a rationalization of land use or by a reuse of materials. In their article *Rethinking urban transformation: Temporary uses for vacant land* (2013), Jeremy Nemeth and Joern Langhorst uses a definition of temporary uses that mainly refers to its aspects of time limitation. They argue, that it does not matter if the temporary use of a certain area is accidental or planned, long or short, legal or illegal; what differentiates the temporary from the 'permanent' is that its features imply that the temporary use is secondary to a permanent option. Temporary use can, thus, be defined as time-limited in nature (Nemeth & Langhorst 2013:144).

Despite the changing, non-static aspects that Burns, Kahn and Diedrich argues to be inherent in the very concept of sites, a common approach to city planning and designing often seem to include long-term plans and permanent, static solutions (Blumner 2006:3). In relation to Kahn's notion that sites too often are perceived as straightforward entities with distinct boundaries, the city planning of today can be argued to be implementing a non-dynamic approach to site design. In the article *Temporary Urbanism as a Positive Force* (2015), Peter Bishop argues, however, that this approach to city planning is undergoing change. He writes:

> *"It is noteworthy that an increasing number of developers and landowners are beginning to grasp the importance of thinking about the design process as being sequential, a series of temporal events, rather than an end-state solution."*
>
> (Bishop 2015:141)

Moreover, the aspect of time-limitation that is inherent in temporary uses of sites is also the aspect that most often is subject to criticism. If temporary uses only exist until it gets replaced by something permanent, these temporary elements could be argued to be a waste of resources. Inherent in the concept of temporary site constructions, however, is that they often are low cost and fairly easy to construct; according to Nemeth & Langhorst (2013) there are few negative short-term economic perspectives regarding temporary uses, as long as its constructions are moderate or easy to remove. They even argue, that temporary uses of sites can generate revenue amongst landowners and developers fairly quickly (Nemeth & Langhorst 2013:147). Bishop acknowledges the criticism against the temporary aspects as well, and writes:

> *"Temporary urbanism, when properly applied, is a forum for experimentation, for subversion, for prototyping. Underpinning this is a growing recognition that the process and the event are as important as any long-term impact."*
>
> (Bishop 2015:137)

Bishop highlights the importance of experimentation and prototyping at an early stage of a long-term planning process, thus also emphasizing the importance of user participation and the part the public plays in the *making* of sites, either temporary or permanent. Relating back to Diedrich's theories about site design, and more specifically to the mode of *appropriation,* the temporary uses of sites could be able to act as a process where the designer, and the users, are able to evaluate the uses of sites before, during and after a design intervention. Temporary uses can thus be used as a way of enhancing the *evolutionary* aspects of a site design, by allowing the design to evolve alongside the site it is applied to. As a result, the design is able to change and adapt to the character, requested functions and uses of the site. Hence, temporary uses could be argued to be a possible part of a design concept that highlights the gradual, evolving and dynamic aspects of sites.

Temporary uses as tactical urbanism

As argued, cities are in a constant state of transformation; requisites and demands are constantly changing. Large scale transformations and financial and time-consuming investments are, however, still a great part of the city planning of today, despite the fact that these investments cannot actually guarantee long term economic or social benefits. In the report *Tactical urbansim - Short term action, Long term change* (2012), Mike Lydon argues that this approach to planning illustrates the fact that planners too often are preoccupied with control; instead of letting the public engage in a planning process at an early stage, they are more often asked to react to finished proposals that they might not even be able to relate to (Lydon 2012:1). Reactions towards these types of approaches to planning has come to establish different urban activist groups,

often referred to as *guerrilla urbanism, pop-up urbanism,* or *D.I.Y. urbanisms. Tactical urbanism,* a term used by Lydon, is a strategy that is similar to these approaches.

The main focus of the tactical urbanism strategy is a stage by stage strategy, relatable to the *evolutionary* approach to design used in this master's project. More specifically, tactical urbanism aims at instigating change with short-term and low-risk commitment. One of the main strategies within tactical urbanism is therefore to create laboratories for experimentation within urban spaces, thus engaging citizens in planning processes and, by extension, incorporation site specific solutions into these processes (Lydon 2012:1-2). Lydon argues that this approach, when succesful, is able to instigate changes that eventually are able to act as the very cornerstones of larger, more permanent transformations. On that note, Lydon argues that tactical urbanism is most efficient when used concurrently with long term planning (Lydon 2012:2).

The strategy of tactical urbanism can be further substantialized through specific *tactics* that are able to develop alongside the transformation of urban environments. According to the focus of this master's project, some of these tactics can be discerned as suitable methods for temporary flood mitigation, or as ways in which Nyhamnen's transformative state can be emphasized towards the public. These strategies are, as outlined by Lydon; *depave, site pre-vitalisation, park mobile* and *park-making:*

» *Depave.* The depave tactic aims at creating permeable surfaces for habitat restoration, urban farming, tree planting, planting of native vegetation and for social events. Moreover, this tactic is able to reduce the amount of pollutants in surface water runoff within urban areas; when reducing the amount of non-permeable surfaces, the level of pollution in water courses during rainfalls can, consequently, be decreased. In addition to being a tactic within tactical urbanism, *Depave* is also the name of an organisation that works according to the concept of removing unnecessary hardscape surfaces in vacant areas or parking lots. Instead, these lots are transformed into, for instance, parks, expanded school yards and community gardens (Lydon 2012:23).

» *Site pre-vitalisation.* This tactic strives towards temporarily activating sites that are undergoing redevelopment. Through this tactic, under-used sites are able to be re-activated by the engagement of a variety of food, art and retail opportunities. One of the main purposes of this tactic is thus to generate revenue for the landowner or developer, and to raise public awareness about the long-term potentials of a site before more permanent structures and buildings are built. Lydon writes:

"By activating a site during the planning, approval, and financing stages, a vacant site can therefore provide low-cost community building and economic opportunities while a more formal transition occurs, from inactive parcel of land to a fully redeveloped and programmed addition to the town or city."

(Lydon 2012:27)

» *Park mobile.* According to Lydon, the most useful aspect of tactical urbanism is the jumpstart effect it can have on more long-term plans within an area. Lydon further argues, that the tactic of park mobiles can be used as a tool for achieving this kind of jumpstart. The main purpose of these mobile plantings is to add vegetation to a neighbourhood, to activate its streets and to add public seating options. Created by, for instance, custom containers planted with trees, another purpose of the park mobile tactic is that the containers are able to be moved within an area. Hence, the spatial character of a site can be changed continuously and experimented with by its users (Lydon 2012:35).

» *Park-making.* By a reclaiming of vacant land or parking lots, the main purpose of the park-making tactic is to increase the number of parks within an area. As an example, Lydon highlights an area undergoing redevelopment in Miami, USA that has been used as a site for tactical urbanism. The original idea was to create a temporary park at this vacant land, located on the former site of the Miami Arena. By hosting events, concerts and food vendors at the site, the maintenance costs and the fees of the property lease was able to be paid and, as a bonus, the park became a huge success. In the end, the attention and appreciations from the public made it possible for this temporary park to gradually transform into a long-term, permanent park. Lydon argues that this example of tactical urbanism is one of many that each demonstrates how temporary uses can generate interest among planners and land owners, and that they are able to instigate more permanent changes (Lydon 2012:41).

The research and theories that has been presented thus far in this master's project illustrates the importance of implementing methods for flood management in urban areas. Furthermore, they also illustrate that a possible approach to site design is to use evolutionary and temporary design concepts. To conclude this theoretical part, this chapter thus presents some practical examples of sites where either temporary uses or flood management methods has been integrated into a site design.

New Order of Nature//FredericiaC, Denmark

New order of Nature is a project that explores and represents urban development in Fredericia, Denmark. The main design concept of this site is referred to as 'process urbanism', a concept where new areas within the project are developed piece-by-piece, gradually adapting to the specific requisites of the site and of the surrounding community (Diedrich 2015:124).

Located in an area that eventually will be exploited and built with new buildings and infrastructures, this park consists of temporary features that are supposed to bring value to the area while it is still unbuilt. By engaging the community into the transformation of the area, this site is able to raise public awareness of the processes of urban redevelopment. By this approach, the aim is to generate positive values amongst the public that are connected to the area

Figure 5. New Order of Nature, Fredericia C.

Figure 6. New Order of Nature, Fredericia C.

itself, rather than to its future built elements (Diedrich 2015: 124, SLA:2017-03-22). The architects behind the park, the danish office SLA, writes:

> *"It discards of the privilege formerly assigned to buildings and infrastructure and instead gives priority to green amenity values in the temporary landscape introducing a contemporary resilient framework that attracts people from day one."*
>
> (SLA 2017-03-22).

The trees and plants of New Order of Nature are planted in movable constructions, thus making the nature of this site mobile and adaptable to the desired functions of those visiting the park. Some of these trees are furthermore chosen according to a wish of achieving a phytoremediative process in the area, thus instigating the process of purifying the polluted ground on this former industrial site. Moreover, any additions of new elements at the site such as, for instance, pavement turf, has been done with caution; the industrial heritage of the area is still very much present and part in giving character to the site (Diedrich 2015: 124).

Sankt Annæ Square//Copenhagen, Denmark

Sankt Annæ Square is an elongated square located in the central parts of Copenhagen, close to the district of Nyhavn and to the sea. This site, reconstructed in 2016, is connected to *Kvæsthusprojektet*, a larger project that aims at reaching a cohesion between different districts where historic design and architecture overlap. This particular part of the project, Sankt Annae Square, is designed to function as a *cloudburst street* (skybrudsgade). The sqaure is thus meant to figure as a national and international demonstration area, showcasing how flooding can be managed within urban environments during cloudbursts. The square has a concave shape, with its lowest point in the middle of its green axis. This low point constitutes the area that gathers, infiltrates and transports floodwater through the square. During cloudbursts, the

Sankt Annae Square, Copenhagen.

floodwater is immediately transported away from the surrounding buildings into the green axis, by either above ground measures or through a drainage system below the surface. After reaching the green axis, the floodwater is then further transported to either the nearby area *Kvæsthuspladsen* or to the harbour, where other flood management facilities take over (Real Dania 2017-03-02, Schønherr:2017-03-02).

Parc de Boulogne Billancourt//France

Parc de Boulogne Billancourt is a park located on a loop of the river Seine in Boulougne-Billancourt in northern France, right next to a redevelopment area where a new urban district is to be built. The park's surrounding residential quarter's are built as a balcony towards the park, 1,6 meters above its natural terrain. This topography models Parc du Trapeze as being surrounded by riverbanks, enhancing the parks' shape of a basin.

Being located next to the Seine, this park incorporates an element of vulnerability towards the perpetual motion of the river. To adress this vulnerability, Parc du Trapeze has been designed to be able to manage temporary flooding. A river flows through the park in an east-western direction, and creates a variety of spatial and ecological characters in different parts of the park. At the same time, this river also incorporates an open basin that is able to manage instances of high water levels. During cloudbursts, the

Figure 7. Parc de Boulogne Billancourt.

Figure 8. Parc de Boulogne Billancourt.

river fills up with floodwater, which eventually spreads outthroughout the park, infiltrating through hollows in the topography and, hence, nurturing the soil. The park's ability to adapt to different water levels is part of one of its main characters; the natural fluxes of water within Parc du Trapeze has a great impact on how it is perceived. During dry periods, large parts of the park can be used for a variety of activities, while periods of heavy rainfalls limits the use to certain pathways on higher levels.

The main inspiration for the choices of material for Parc du Trapeze comes from the meandering shape and the characters of the river Seine. Parc du Trapeze is therefore designed as a landscape that incorporates water elements, gravel, banks, islands and marshlands, thus illustrating the duality between the urban landscape and the fluxes of nature (Diedrich et al 2009:80-81).

Euroméditerranée 2//Marseille, France

Euroméditerranée is a harbour transformation project in Marseille, France. *Euroméditerranée 2*, the second part of this large scale redevelopment project, takes place in an area that extends from the coast of Marseille, over a ridge and into a valley. This valley, the Aygalades River, constitutes the site of an old water course, but is currently used as the location of a rail yard (Diedrich 2013:104). This old water course was an important point of departure for the winning design proposal for the redevelopment of the site. The proposal suggested that a floodable park was to be the main feature of the site (Diedrich 2013:108), and that it should be located within the old river catchment.

During cloudbursts, this floodable park is supposed to operate as a retention basin, draining floodwater from areas that lie far beyond the project site. During these instances, water reaches the park through cleansed roof and road runoff (Diedrich 2013:124). During dry periods, the park is instead imagined to function as a hydraulic and hydrating machine for nearby districts. This large scale approach to the site inspired the designer's to take a wider view upon their design and thus to also address the overall site of hydrologic influence (Diedrich 2013:115).

The parks ability to manage changing water levels conveys an element of flux at the site; Euroméditerranée 2 is supposed to fulfil its purpose during all possible water levels and is, moreover, supposed to protect this whole part of town from flooding. Accordingly, the design process lead to a complex combination of urban planning, engineering and landscape architecture that includes a dismantling of the rail yard, a reshaping of the valley and modelling of large amounts of terrain (Diedrich 2013:124).

As for inspiration for the types of vegetation and other materials within the park, the designers have chosen to focus on what is rare

on site, rather than focusing on the materials that can be found in abundance in the area. Through extensive interventions with what is existing at the site, the designers propose to reduce prevalent materials and instead increase the stock of scarce materials, or to introduce entirely new ones (Diedrich 2013:128).

Tagus cycle track//Lisbon, Portugal

The *Tagus cycle track* in Lisbon, Portugal, is a temporary bicycle track carried out in 2009, stretching alongside a harbour by the river Tagues that is to be redeveloped. As an agreement of the property conditions for the area couldn't be reached, the Tagus cycle track project was a result of a compromise between the port authorities operating within the harbour, and the city (Diedrich 2013:224). This compromise came with the condition that the track was to be built as a minimalist intervention, hence being realised with the least possible change of materials on the site; since this temporary project were to be removed once the property claims within the area had been sorted out, the designer's behind the track was given the condition that almost everything at the site should be leaved intact. The result was a track that solely consists of materials that already are in use at the port, which therefore also are easily removed. Hence, the materials of this bike track mainly include existing asphalt and granite, with minimal new additions such as new kerbstones, some cases of new asphalt and paint (Diedrich 2013:228).

In addition to acknowledging and reusing existing materials, the designers of Tagus cycle track has also considered the site's existing practices and functions such as, for instance, certain sounds or viewpoints. However, since the designers weren't allowed to make any large alterations to the site, these readings are instead translated through paintings or signs along the bike track (Ibid). Through this approach, the designers managed to keep the 'port as a port, and the city as a city'. Moreover, this approach can also be considered as the beginning of the redevelopment of the harbour, during which the uses and the properties of the port are to be changed into the ones of the city; the bike track has become a popular strip for biking, jogging, fishing, canoeing and sunbathing, and has furthermore also instigated spontaneous initiatives, such as cafés, sports facilities and night clubs (Diedrich 2013:232)

Île de Nantes//Nantes, France

60 km inland from the Atlantic coast, the river Loire in France form several river islands. In the 19th and 20th century, several of these islands where merged by land infills to create the district *Île de Nantes*. The city that this district is part of, Nantes, was a wealthy port city. Île de Nantes was consequently built to host the first residential districts of the expanding city and, later on, to include port activities and naval industries as well. However, when another port located closer to the sea, Saint Nazaire, was constructed in the 19th century, the industrial actvities of Île de

Nantes became challenged and soon fell into decline. The last industry of this district fell in 1989. At this point, Île de Nantes inhabited 13 000 people and 15 000 work places. Despite its proximity to the city of Nantes, this island was still perceived as a remote place by the locals. In 1999, the city of Nantes thus invited three design teams to draw proposals for a restoration of Île de Nantes. The architect-landscape architect duo consisting of Alexandre Chemetoff and Jean-Louis Berthomie was chosen as the winning team. Between 2000-2010, this office has thus carried out several both major and minor projects at the site. As a result, Île de Nantes is today considered to be a part of the central parts of the city Nantes (Diedrich 2013:166).

A particular aspect that distinguishes this project from most others is that the designers of Île de Nantes refused to show any finished master plans of their project. Instead, they only submitted a 'Plan & map guide', consisting of two superimposed ground plans, one site inventory plan and one redevelopment plan. Every three months, the designers then conducted surveys and comprehensive on-site studies and, accordingly, updated the map guide so that it corresponded with the current situation at Île de Nantes. Hence, instead of creating a finished masterplan for the site, the designers formulated certain 'game rules' that came to navigate them in their design process; to respect the site and its current state; to use the public spaces as prime objects and reconnect them to their surroundings; to acknowledge what can be left untouched; to create unity through diversity; to open up the enclosed industrial activities towards the river. By engaging clients, workers, the community and the press, the design team succeeded to achieve a dialogue that made it possible for them to realize this chosen design approach for the site (Diedrich 2013:168).

Figure 9. Île de Nantes

SUMMARY PART I

This part has posed as a theoretical introduction to this master's project. It has presented the present and future challenges of climate change, which are expected to bring an increase in cloudbursts and rising sea levels. Urban, hardscape areas are considered to be especially vulnerable to these types of climate effects. Hence, methods for flood management needs to be integrated into the fabric of urban environments. Deriving from the field of landscape architecture, this master's project focuses on methods for flood management that incorporates vegetation, permeable surfaces and topographical alterations that can be implemented above ground.

Moreover, this part has also illustrated the important process of site definition within design projects, as well as the transformative, temporal and dynamic aspects of sites, and of site designs. By reading and defining a site, one is able to gain a deeper knowledge of the site's correlation with other structures, contexts and timeframes which, in the end, can be used as a tool for site editing.

PART II

This part introduces the site that is in focus of this master's project; Nyhamnen. It begins with a presentation of the multiscalar settings of Nyhamnen, thus introducing the *areas of influence* and *effect* of this harbour area. These *site readings* further enables a delimitation of an *area of control,* hence defining the site to which a flood adapted design is to be applied. This delimitation is followed by a presentation of the evolutionary design concept, i.e. the *site editing*. In conclusion, this part ends with some final reflections that discusses the design concept and the redevelopment of Nyhamnen.

THE NYHAMNEN INITIATIVE

The process of developing a new city district in Nyhamnen officially started in May 2014 and is conducted by Stadsbyggnadskontoret at Malmö stad. The first draft for a comprehensive plan over the area was published in September 2015, and has since been evaluated by administrative authorities, organizations and by the public. In the fall of 2017, an additional evaluation will take place in the form of an exhibition. After this exhibition, the final edition of the comprehensive plan is expected to be approved by the municipality during 2018 (Malmö stad 2017-03-21; Malmö stad 2015).

Since the suggestion for the comprehensive plan for Nyhamnen was published in 2015, one additional, updated version of the structural plan has been developed by Stadsbyggnadskontoret at Malmö stad. This is not yet an official plan, and is rather to be considered as an in-house sketch of a structural plan, still undergoing development. In this master's project, we have gotten permission from Stadsbyggnadskontoret to use this most recent plan as a base for our illustrations and sketches (Böhme 2017-04-25). However, since this new plan still is not fully developed, some of the plans from 2015 will need to be used in some instances as well. As a result, some of the structures that are illustrated in this chapter do not always overlap (see the infrastructural plans on pages 70-71 as an example). Moreover, the future plans and layouts over Nyhamnen that has been developed so far, either being from 2015 or from 2017, are not to be read as exact depictions of what this future district will look like. However, they do give some indications of what structures and functions the area may consist of. In this master's project, these plans will act as a framework to which site readings and design proposals are made.

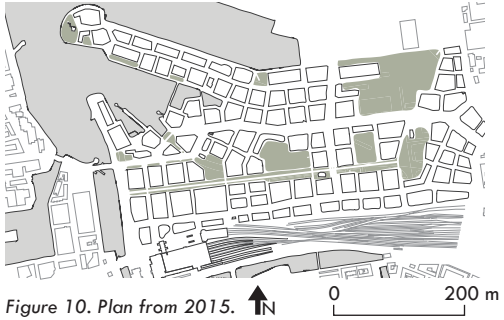


Figure 10. Plan from 2015.

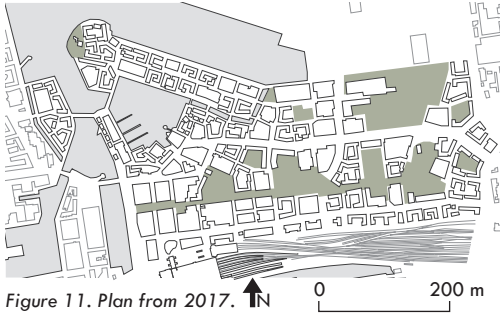


Figure 11. Plan from 2017.

CHAPTER F *Site reading: The areas of influence and effect*

Many of the characters and functions that can be found in Nyhamnen today is subject to an extensive ongoing and future transformation; the industrial activities of this harbour is under the process of being phased out and instead transformed into a new, dense city district by the waterfront (Malmö stad 2015:4). By Andrea Kahn's definition of site, urban sites are both conditioned by and contributing to their surroundings (Kahn 2005:285). By this definition, Nyhamnen is both affected by and, in turn, affecting areas stretching beyond the confines of its own district boundaries. These multiscalar settings of Nyhamnen can be further exemplified through Burns' & Kahn's notion that a site has three distinct areas; *the area of control, the area of influence* and *the area of effect* (Burns & Kahn 2005:xii). In this master's project, a delimited site within Nyhamnen will constitute the area of control, to which an evolutionary, flood adapted design concept will be applied. In order to find that area of control, Nyhamnen first needs to be read through the structures, systems, characters and materials that can be expected to have an influence on, and in turn be influenced by, the proposed design.

This chapter thus presents the different aspects that has been used as tools for a *site reading* of Nyhamnen. This site reading aims at addressing the qualities and characteristics of Nyhamnen which, further on, are to be interpreted into a site design. The chosen aspects concerns both large- and small scale elements and, due to the phase of redevelopment that Nyhamnen is in, these aspects are also related to both present and future time frames. Hence, while this chapter presents the requisites that defines Nyhamnen today, it also reflects upon the structures and characters that are proposed to be part of the future disposition of the area.

In order to get a better understanding of both the present and future features of Nyhamnen, a closer look into its past functions and requisites is just as important. A presentation of the history of harbour development in Malmö will thus act as the introduction to the site reading of Nyhamnen.

HARBOUR HISTORY IN MALMÖ

The Öresund region has been an important realm for ocean trading and fishing since the Middle Ages. Malmö, which was part of the Danish empire during this time period, was considered to be one of Denmark's largest and most essential cities for ocean trading (Jacobsson 1975:9). A still existing remnant of this period in Malmö is *Skeppsbron,* built during the 15th century to attend ships with goods and travellers (Jacobsson 1979:11). However, an era of war in the 17th and early parts of the 18th century resulted in a major decline in Malmö's ocean trading industry and, hence, the city's economy. This economic decline brought a neglection of the harbours and, eventually, they decayed completely (Jacobsson 1975:12-14). The latter parts of the 18th century, however, once again saw an increasing demand for ocean trading. In 1775, it was thus decided that the harbours of Malmö needed to be restored as well as expanded to make room for new shipping facilities (Jacobsson 1975:15). These expansions was mainly constructed on infill land (Jacobsson 1975:17-23) and, as a result, Malmö's coastline moved out into the sea (see figure 12 & 13).

Due to a development of new harvesting methods during the early 19th century, Malmö's export of grains increased and the city's

Figure 12. Malmö 1912. N 0 2 km

Figure 13. Malmö 2017. N 0 2 km

economy started to grow back again (Jacobsson 1975:31-33). This financial growth encouraged people to move into the city to find work and, as a result, the first industries was established in Malmö during the late 18th century. Between 1800-1898, the population of Malmö increased from 4 500 to 60 000 inhabitants (Malmö stad 2017-03-21). Along with the construction of the Swedish railway, this period marked the beginning of the industrialisation in Malmö. During this time period, the city's train station was built on infill land just north of the oldest city district (Jacobsson 1975:23). This constitutes the site of Malmö's central station still today.

Constructing Nyhamnen

As a result of the industrialisation, the capacity of ships had to improved and rationalized. As the ships grew larger during the late 19th century, Malmö saw a demand for constructing a new harbour; *Nyhamnen* (Jacobsson 1975:28). The construction of Nyhamnen was a result of a competition advertised in 1891. The construction phase began with the building of *Ångbåtsbron* between 1894 and 1895. The development then continued with the excavation of *Nyhamnsbassängen*, initiated in 1897. The construction of this new harbour was eventually finished in 1903 (Jacobsson 1975:29). The initial function of Nyhamnen was to provide regular shipping traffic to and from several European harbours. One of its main purposes was, furthermore, to load and unload goods that could be further transported by train. Hence, an important function of Nyhamnen was to be able to store large amounts of goods (Jacobsson 1975:28). In addition to the shipment and storage of goods, Nyhamnen has also constituted a point of departure for travellers. During the end of the 19th- and the beginning of the 20th century, Malmö's harbour's constituted the second largest point of departure for emigrants in Sweden (Malmö stad 2015:61). Today, Malmö is rather to be considered as a place for immigration (Malmö stad 2015:4).

During the 1960's, the shipping industry went through further transformations. Steamships were phased out and replaced by motor driven ships, which were bigger and able to store larger amounts of goods. The loading of goods saw an improvement as well, and came to include pallets, forklifts and containers. The use of containers consequently resulted in the development of container ships, which enabled loading of heavier cargo. This new form of trading efficiency lead to greater capacities in ocean trading, which came to see volumes of goods that had never been seen before. However, this standardization lead to that some shipping routes disappeared (Jacobsson 1975:71-75).

Nyhamnen has continued to grow throughout the years; the last extension to this harbour was made in the 1990's. Before this infill of land was added, the most central basin within Nyhamnen, *Nyhamnsbassängen*, stretched all the way down to Jörgen Kocksgatan. As of today, this former part of the basin, called *Stockholmskajen*,

instead constitutes a storage lot for cars (Malmö stad 2015:62) and a loading dock for grains (Länsstyrelsen Skåne 2011b:33).

In the *Development Strategy for Malmö* (title translated by authors)[4] from 2016, a complementary report to Malmö's comprehensive plan, some areas within the city are highlighted as especially interesting for urban redevelopment. In general, these areas have in common that they have the potential of enhancing existing nodes and paths, as well as the ability to connect to central parts of the city (Malmö stad 2016c:4). Since the harbours of Malmö throughout history has constituted important, central nodes within the city, they are, consequently, now also considered to be attractive areas for urban redevelopment. As an example, large parts of the former harbour Västra Hamnen has already been integrated into the urban fabric. This harbour redevelopment is currently in the process of continuing to the east, beginning with a reconstruction of the southern parts of Nyhamnen (Malmö stad 2016c:10).

Although many of Malmö stad's planning strategies appears to illustrate that the industrial activities of the city's harbours are in the process of being phased out, several of these harbours are still considered to be important industrial and infrastructural nodes, both nationally and globally. Due to their strategic location in the midst of the Öresund region, Sjöfartsverket has marked

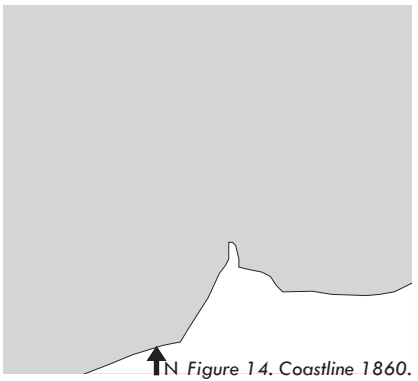


Figure 14. Coastline 1860.

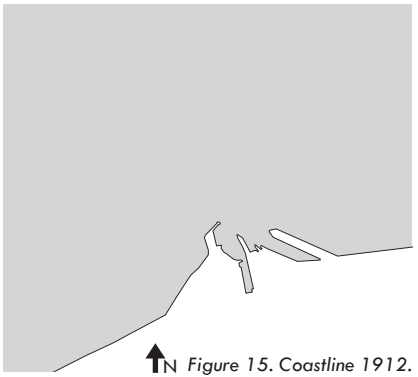


Figure 15. Coastline 1912.

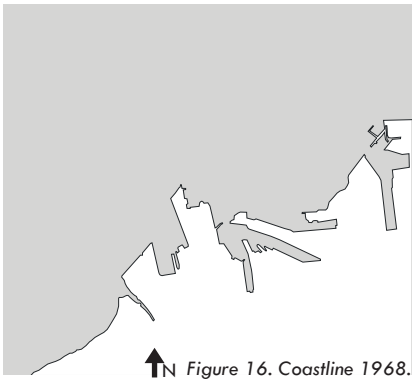


Figure 16. Coastline 1968.

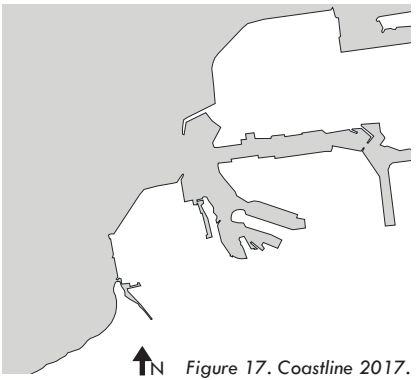


Figure 17. Coastline 2017.

[4] *Original title: Utbyggnadsstrategi för Malmö (2016).*

four of Malmö's harbours as national interests for ocean trading (Länsstyrelsen Skåne 2011b:6). Namely, these harbours are *Frihamnen, Industrihamnsrännan, Oljehamnsrännan* and *Norra Hamnen*. To mark these harbours as national interests protects them from being exploited and used for other interests such as, for instance, urban redevelopment. This marking furthermore indicates that there are still active harbours in Malmö that are not considered to be national interests, i.e. *Nyhamnen, Limhamns hamn,Yttre* and *Inre hamnen* and *Södra Varvsbassängen*. According to Länsstyrelsen, the industrial activities of these areas can not be argued to be dependant on the harbour's location; the activities of these harbours could just as well be relocated to another area (Länsstyrelsen Skåne 2011b:49-50). As an example, the report states that some of the activities in Nyhamnen are to be relocated to Norra Hamnen (Länsstyrelsen Skåne 2011b:51). By this rationalization, the harbours are able to increase in activity, while at the same time demanding less space. The report further states, however, that a lack of protection does not mean that the activities of unprotected harbours can be forced to relocate or to be phased out; the municipality still has to reach an agreement with the operating harbour companies (Ibid).

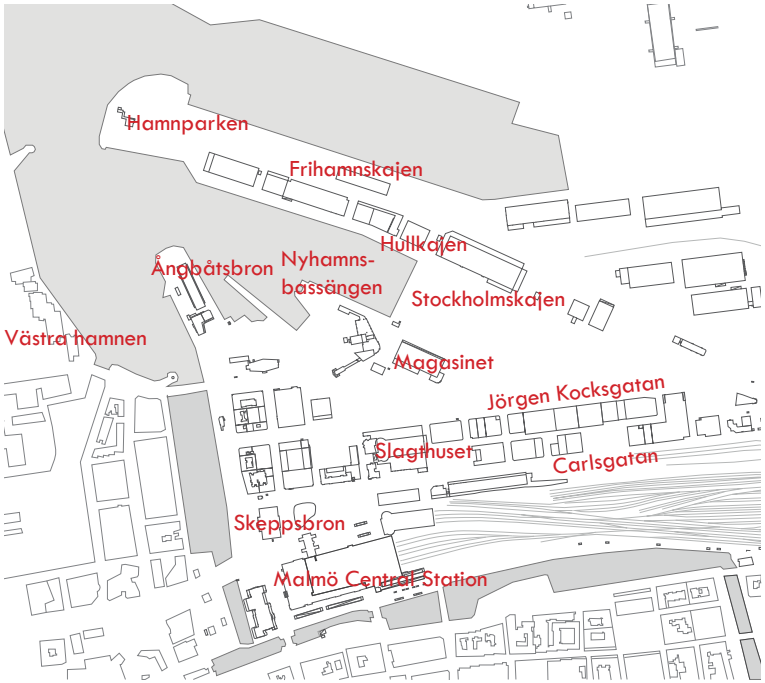


Figure 18. Nyhamnen today.

NYHAMNEN AND THE ÖRESUND REGION

TODAY

In the comprehensive plan for Malmö, approved in 2014, the Öresund region is acknowledged as an important point of departure for the future development of Malmö (Malmö stad 2014:10-12). Today, the Öresund region inhabits 3,7 million people and is thus the most densely populated region within the Nordic countries (Malmö stad 2015:22). Located in the very midst of this region is Nyhamnen.

By being a part of the Öresund region, Nyhamnen is situated within several physical networks of infrastructure and communities on both global, national and regional scales. Being located by the western coast and within 1 km of Malmö's Central Station, this site could be said to reach far beyond its physical limits. For instance, Copenhagen Airport can be reached by train from Malmö Central Station in 20 minutes, and Copenhagen Central Station can be reached within 35 minutes (Ibid). From these destinations, one could travel even further out into the world. Moreover, the cargo lines in both Nyhamnen, Frihamnen and Norra hamnen constitutes important infrastructures for ocean trading and thus connects with international harbours (CMP 2017-03-27a). Through its location, Nyhamnen can, in relative terms, be considered to be physically connected to the rest of the region of Skåne, to the rest of Sweden, to Denmark, and even to the continent.

FUTURE

According to the proposed comprehensive plan for Nyhamnen, the connection between Nyhamnen and the Öresund region will be even stronger in the future. A planned project of building a metro between Malmö and Copenhagen, *the Öresund metro*, will improve Malmö's connections with Denmark and the connections with the rest of the world as well. This global connection will be developed even further when a planned highway and railway tunnel between Denmark and Germany is finished. This tunnel, called the *Fehmarn Bält-connection* and expected to be built by the year of 2021, will allow travels between Malmö and Hamburg in approximately three and a half hours. Moreover, the proposed Swedish high speed railway will allow travels between Malmö and Stockholm in two and a half hours. This increase in accessibility is expected to create unique opportunities for stronger connections between Nyhamnen and other areas on local, regional and global scales (Malmö stad 2015:22)

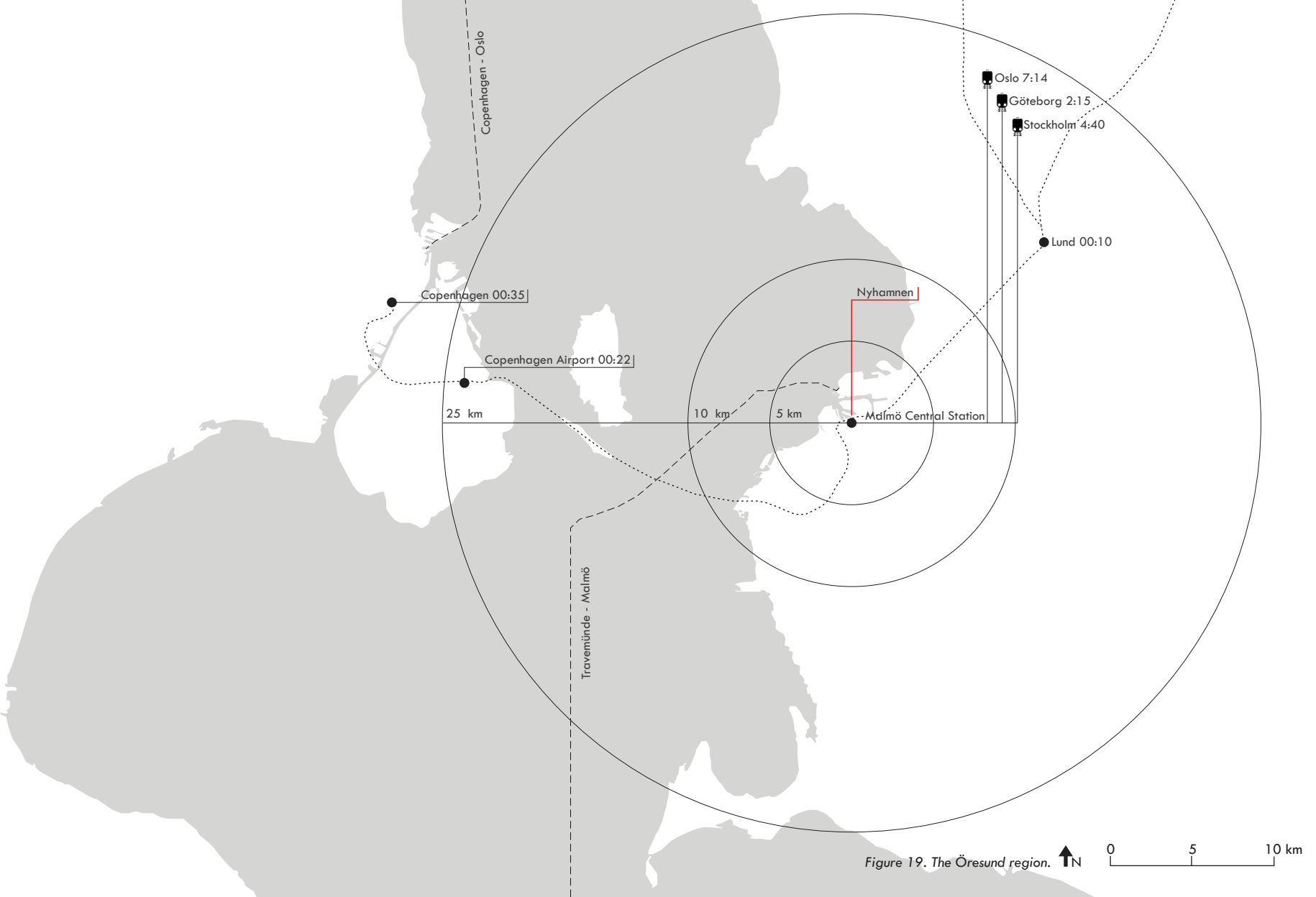


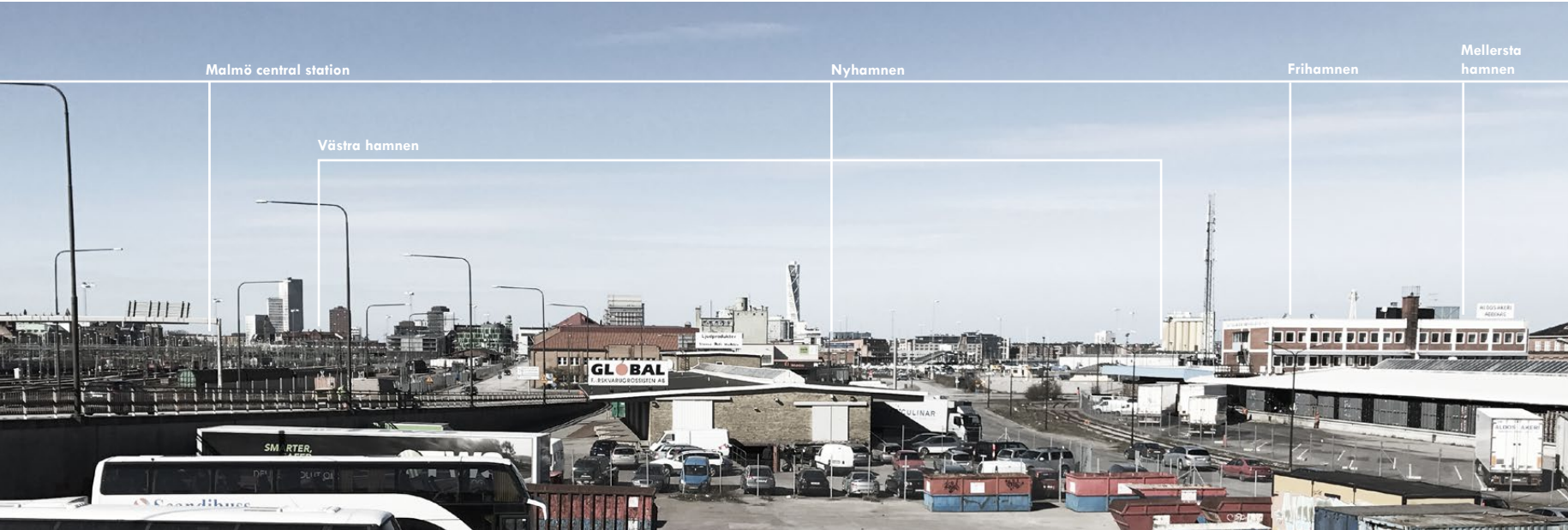
Figure 19. The Öresund region.

Figure 20. Nyhamnen's position in Malmö.

TODAY

Nyhamnen's location by the waterfront situates it in-between the city of Malmö and the sea, and also in-between an already transformed harbour area *(Västra Hamnen)* and a still active industrial harbour *(Frihamnen)*. Consequently, Nyhamnen can be described as situated in between larger structures.

As a part of Malmö's coastline, Nyhamnen differs from other waterfront districts, such as *Sibbarp, Ribersborg, Västra Hamnen* and *Norra hamnen*, in several ways. In addition to apparent differences in structures and functions between residential- and harbour areas, Nyhamnen further offers qualities that other waterfront districts might not. For instance, this is one of the only districts in Malmö where the sea reaches all the way into the inner parts of the city. Hence, Nyhamnen is one of the most central districts in Malmö where intimate water connections are made with the sea.



FUTURE

Malmö stad's vision for Nyhamnen is to create a dense urban district that, through its proximity to both the ocean and the Central Station, will bring new qualities to the city centre of Malmö. The aim is to build 6 000 new households and 13 000 work places within Nyhamnen, but also to preserve parts of the harbour that has historic values (Malmö stad 2015:4). The comprehensive plan for Nyhamnen presents some objectives that are connected to four different areas within Nyhamnen; *The station area*, *Nyhamnsbassängen and Nyhamnspiren*, the *Centre parts of Nyhamnen*, and *Carlsgatan and Västkustvägen*.

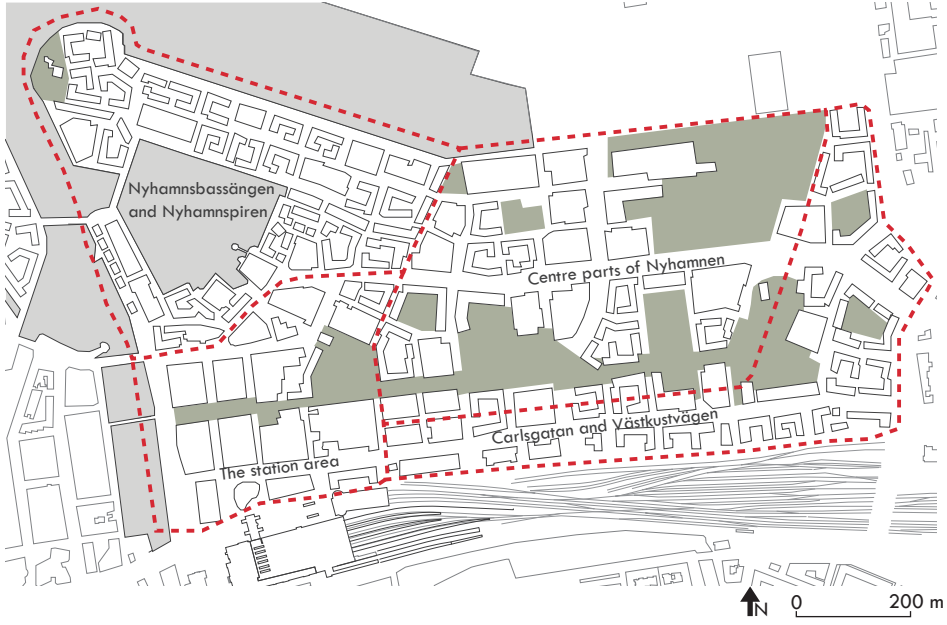


Figure 21. The suggested future areas of Nyhamnen.

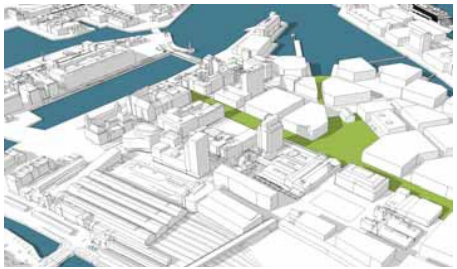


Figure 22.

The station area. This area is intended to be characterized by structures that promotes walking, biking and travelling by public transport. Today, this area mainly consists of office buildings, and any future additions will mainly consist of residential buildings with public establishments in the ground floor. Moreover, a park is planned to be built just north of Slagthuset, with the aim of creating a tranquil space in the midst of this otherwise lively district (Malmö stad 2015:10, 14).

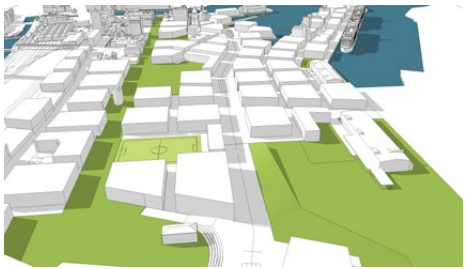


Figure 23.

Centre parts of Nyhamnen. Malmö stad wishes for the centre parts of Nyhamnen to have a predominantly green character. The buildings that are to be added to these parts will mainly consist of residential buildings, schools and playgrounds. Jörgen Kocksgatan, one of the main roads of Nyhamnen, is to be modelled as a green boulevard that connects the eastern parts of Nyhamnen with the sea. The largest park in Nyhamnen will be located along this boulevard. Malmö stad wishes for this park to be flood adapted and, hence, to be able to store large amounts of water during cloudbursts (Malmö stad 2015:11, 16).

Figure 24.

Carlsgatan and Västkustvägen. This is proposed to be one of the main entrances to the area, as well as an important connection between the central parts of Malmö and Nyhamnen. To enhance these connections, the ground level is proposed to be heightened in the eastern parts of the area. This is supposed to enable an improved connection between Nyhamnen and Västkustvägen. Moreover, Malmö stad intends to build three bridges that stretches over the rail yard by the Central Station, connecting Nyhamnen with, for instance, Drottningtorget and the inner parts of Malmö. These bridges are proposed to consist of walking and bicycle paths (Malmö stad 2015:11, 18).

Figure 25.

Nyhamnsbassängen and Nyhamnspiren. This area will be an important meeting point and node in Nyhamnen, both for people living in the district and for people visiting from other areas. Its character is intended to be highly influenced by its proximity to the sea and will, for instance, include bathing opportunities and a small boat harbour. The cruise ship facilities that exists at Frihamnskajen today are intended to be developed further. Moreover, this is expected to generate a visual protection towards the industrial activities in the nearby and still active harbours north of Nyhamnen. Moreover, Malmö stad is planning on constructing new infills of land in these inner parts of Nyhamnen, thus providing more exploitable land for residential buildings and public services. Malmö stad further argues that this land infill could be modelled in such a way that it is able to protect the inner parts of Nyhamnen from rising sea levels (Malmö stad 2015:11-12).

LAND OWNERSHIP

TODAY

The separation between private and public spaces in Nyhamnen is currently regulated by land ownership conditions within the area; while Malmö stad owns some parts of the land, CMP *(Copenhagen Malmö Port)* owns large parts of the area and are also currently managing the harbour activities within Nyhamnen (Malmö stad 2015:38). CMP is an important cargo operator within the Öresund region. They operate the container terminals in both Malmö and Copenhagen, and transports imported consumer goods to ports in both Hamburg and Rotterdam (CMP 2017-03-27a). In addition to transporting containers, CMP also constitutes the biggest Nordic port for cars (CMP 2017-03-27b). Large areas within Nyhamnen, for instance Stockholmskajen, is used for storing these cars (Malmö stad 2015, p. 47).

CMP has first access right agreements with Malmö stad for the larger parts of Nyhamnen. Some of these agreements will expire by the year of 2020, while other parts of Nyhamnen won't be available for urban development until 2035 (see figure 26) (Malmö stad 2015:2). Until CMP's land ownership contracts expires, Malmö stad is unable to begin the redevelopment of Nyhamnen. Hence, CMP's leaseholds controls when the different stages of Nyhamnen can be built.

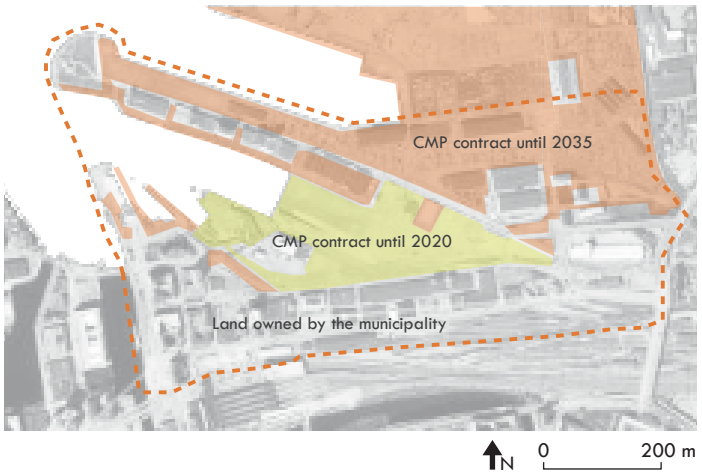


Figure 26. Land ownership within Nyhamnen.

FUTURE

As the redevelopment of Nyhamnen continues, the ongoing activities of CMP will have to be phased out. Malmö stad acknowledges that this will cause some areas to be caught in a transitional stage; as the harbour industries gradually disappears, some areas within Nyhamnen will remain empty while awaiting redevelopment. Malmö stad argues that these areas could function as buffer zones, offering temporary activities such as parks, playgrounds or areas for urban farming. According to Malmö stad, these types of temporary activities could attract visitors to the area during its transitional period and, thus, work as a catalyst for the redevelopment of all of Nyhamnen (Malmö stad 2015:53).

As shown in Figure 29, the last stages of Nyhamnen will not be built until 2055 (Malmö stad 2015:52). As an example, these last stages will contain some of Nyhamnen's largest parks, that also is supposed to contain stormwater management facilities. Hence, some of the most dense parts of this new city district will be built in the early stages of the redevelopment. Such hardscape areas will have to manage large amounts of water during cloudburst.

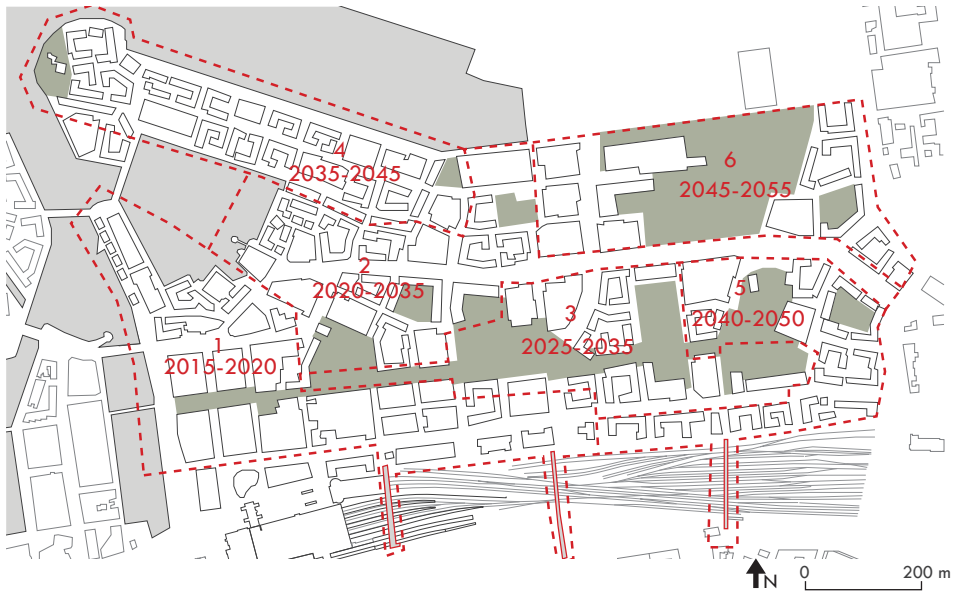


Figure 27. Stages of construction.

TODAY

The amount and scope of the public spaces within Nyhamnen is to a large extent restricted by the still ongoing harbour activities in the area; industrial activities demand a lot of space, either for storage, traffic or loading and unloading of goods. Moreover, these areas are most often fenced off, creating a distinct separation between what is public and what is private. The amount of space that is available to the public, for e.g. strolling or biking, is therefore restricted by the land ownership described in the previous pages. Hence, the mapping of land ownerships in Figure 26 can also be read as a mapping of available public space; the southern, western and eastern parts of Nyhamnen are thus more available to the public than the inner and northern parts.

Most of the public establishments that exist in Nyhamnen today are located just north and west of the Central Station, also stretching alongside the railway towards the eastern parts of the area. These public establishments include, for instance, a hotel, a second hand store, offices, a boxing club, a high school and a restaurant. Being located in the southern parts of the area and, hence, close to the Central Station, these establishments are part of the most publicly active area of Nyhamnen today. The northern and inner parts of Nyhamnen, however, contain less public features. Essentially, this is due to the fact that these parts to a great extent still consists of ongoing harbour activities. An important public feature within Nyhamnen is a public, dotted path that stretches through the inner parts of the area. This path stretches from Skeppsbron, in towards Stockholmskajen and further on to the ferry lines at Frihamnskajen. It is marked by white dots, thus guiding visitors to walk in between fencings and past storage facilities, parking lots and under harbour loading bridges. When reaching the inner parts of Nyhamnen, this path passes by the quay at Stockholmskajen and, thus, closely connecting to the sea.

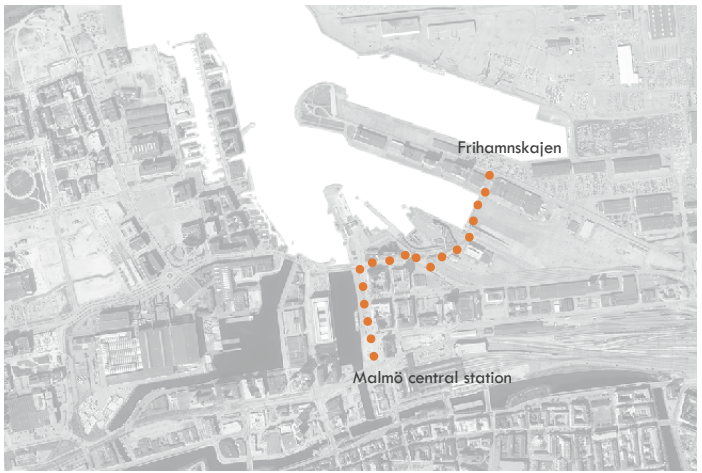


Figure 28. Dotted path. N

FUTURE

As the land ownership within Nyhamnen is transferred to Malmö stad, the amount of public spaces within the area will increase. The desired dense city structure that is presented in the comprehensive plan does, however, limit the possible extent of parks, squares and other public spaces. Malmö stad thus argues that creative, flexible and multifunctional solutions are ways in which a demand for public space can be fulfilled. As an example, the quays of Nyhamnen are mentioned as important meeting points, but is also proposed to be used for managing flooding, with methods such as floodable quays and barriers towards the sea (Malmö stad 2015:30,32-34).

Malmö stad further acknowledges that the redevelopment of Nyhamnen will demand a considerable increase in the amount of public services within the area (Malmö stad 2015:26). According to the comprehensive plan, these services could, for instance, include schools for different grades, a district health centre, retail services, and a variety of culture- and leisure activities (Malmö stad 2015:26-31).

TODAY

The existing infrastructure within Nyhamnen is structured according to two main car roads. These two roads, Carlsgatan and Jörgen Kocksgatan, stretches between the western and eastern parts of the area. In the west, they connect to Västra Hamnen and the central parts of Malmö, while they in the east connect to Västkustvägen, Hornsgatan, Stockholmsvägen and the highway.

The west-eastern disposition of these car roads can be related to the similar structure of the rail yard. The rail roads and the physical structure, noise and visual influence they bring can be argued to have a great impact on Nyhamnen. Moreover, the rail yard separates Nyhamnen from the central parts of Malmö, forcing any entrances to the area to be made either in its western or eastern ends.

Within Nyhamnen, the three main roads are connected to smaller roads stretching in a north-south direction. These roads tends to the buildings and establishments in the southern parts of the area such as, for instance, the Central Station. In combination with a current lack of particular public destinations within Nyhamnen, the horizontal disposition of this infrastructural system creates a situation where Nyhamnen is an area you mainly pass through, rather than it being a destination in itself. This, in turn, generates a high speed flow of the traffic that passes through Nyhamnen.

The car roads as well as the rail roads constitutes large scale infrastructural systems that, in Nyhamnen's case, leaves little room for pedestrians or bicyclists. People that wishes to visit the area by other means than by car, can choose to either travel by bus, or to walk or bike along narrow sidewalks or the dotted public path that stretches through the area (see Figure 28). Bus line number 32 passes by the area regularly, and makes three stops within Nyhamnen (Skånetrafiken 2017-04-03).

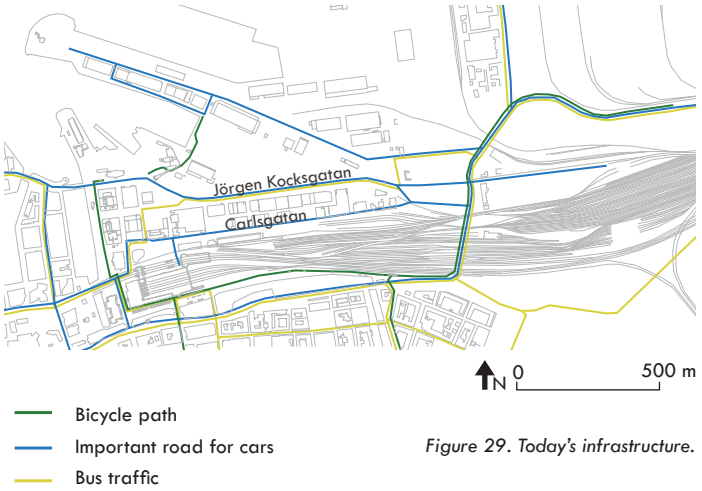


Figure 29. Today's infrastructure.

FUTURE

As mentioned, the infrastructural connection between Nyhamnen and the inner parts of Malmö is proposed to be improved by three new walking- and biking bridges. These bridges will stretch over the rail yard in the southern parts of Nyhamnen (Malmö stad 2015:39). The comprehensive plan further states that the redevelopment of Nyhamnen will demand better connections by public transportation to the rest of Malmö. As a part of this public transportation, the comprehensive plan mentions a possible future tram line that would pass through and make stops within Nyhamnen. Since the comprehensive plan was published in 2015, however, the plans of building tram lines in Malmö has been put on hold (Sydsvenskan 2017-03-09).

Malmö stad acknowledges that the development of Nyhamnen probably will increase the overall load of traffic within the area. Hence, Malmö stad argues that one of the main challenges with the redevelopment is to design streetscapes that can manage these traffic loads, while at the same time slowing down the pace of the traffic. According to Malmö stad, this would promote movement for pedestrians and bicyclist's in the area and, furthermore, create safe environments for both children and seniors (Malmö stad 2015:36-37). The comprehensive plan refers to Kungsgatan in Malmö as a possible inspiration for a green infrastructural node that prioritizes pedestrians and bicyclist's. In addition, it is possible to integrate flood management facilities in such green paths (Malmö stad 2015:33).

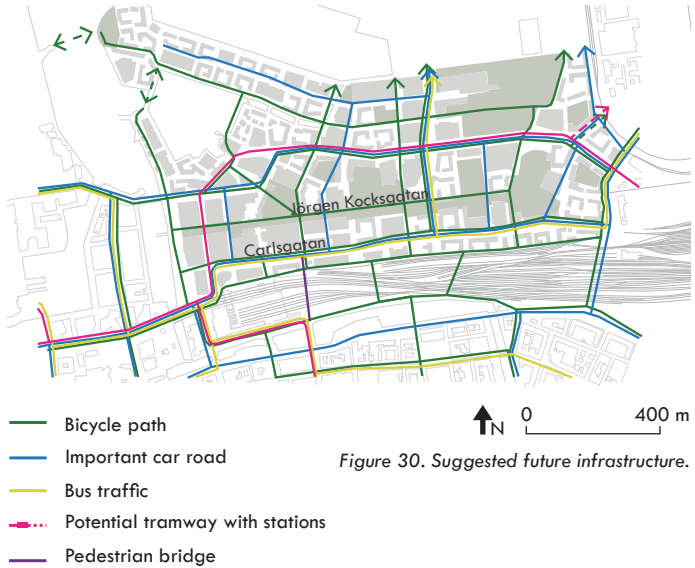


Figure 30. Suggested future infrastructure.

POLLUTANTS

TODAY

Since the harbour activities of Nyhamnen is in the process of being phased out, one could argue that a pluvial flooding in Nyhamnen today would not be much of an issue; in comparison to the inner city parts of Malmö, the amount of valuable buildings and structures that could be damaged during flooding are relatively low within Nyhamnen. However, as Nyhamnen has been an industrial area for quite a long period of time, measurements have shown that significant parts of the ground in Nyhamnen is polluted (Malmö stad 2015:45). During flooding, these pollutants could be at risk of being spread by flood water and contaminating its surroundings.

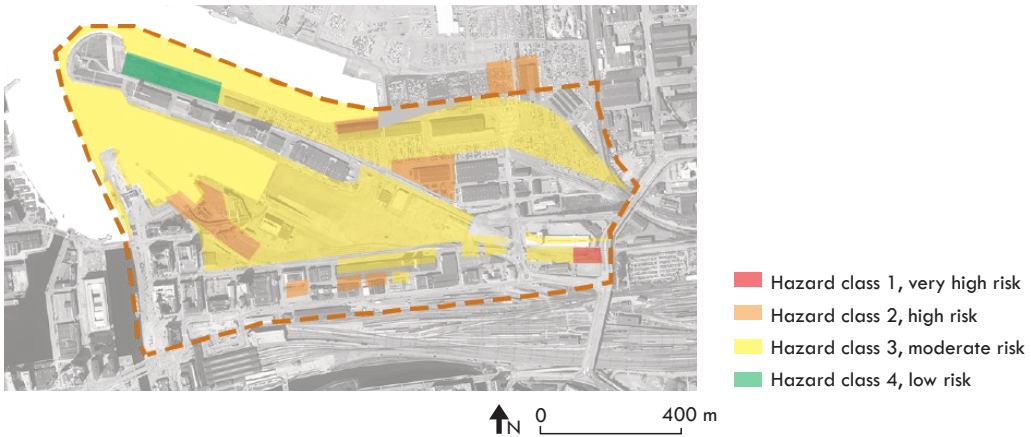


Figure 31. Ground pollutants in Nyhamnen.

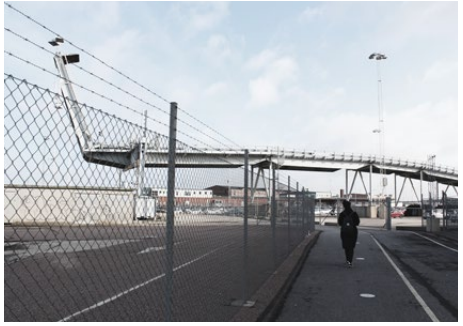
FUTURE

There are several Environmental Quality Standards for the outdoor air regarding nitrogen, dioxide/nitrogen oxide, sulphur, dioxide, lead, particles, benzene, carbon monoxide, ozone, arsenic, cadmium, nickel and benzypren. Malmö stad acknowledges that the large amount of air pollutants in Nyhamnen indicates that travels by foot or bike needs to be prioritized over cars in the future structure of the area (Malmö stad 2015:44).

MATERIALS

TODAY

The past and present functions of Nyhamnen has generated an area that to a large extent consists of hardscape, non-permeable, surfaces. Such prerequisites aggravates stormwater runoff, and can cause flooding during cloudbursts or sea level rise. Elements of vegetation are scarce, and restricted to a few locations within the area. Instead, more strict elements, which typically are associated with harbours, can be found throughout the whole area; boat anchoring facilities, bridges for loading of goods, storage buildings, grain silos etc. Due to the structures and functions of these elements, the main materials that can be found within Nyhamnen are solid and mainly consist of sheet metal, asphalt and concrete, which are materials that are able to manage the heavy industrial activities of this harbour.



FUTURE

Since the future character of Nyhamnen still is at a visionary stage, it is not yet clear what specific materials that will be used within the area. As an overall approach, one of the main aims presented in the comprehensive plan is to create a district that is both dense and green (Malmö stad 2015:7). Malmö stad also expresses a wish for enhancing the qualities of the sea, making it a natural part of the urban life in Nyhamnen. Moreover, Malmö stad mentions that parts of Nyhamnen's history will be preserved, for instance by a reuse and representation of some of its existing materials and buildings (Malmö stad 2015:24-25).

VEGETATION

TODAY

Vegetation can contribute with flood mitigative measures; except from allowing water to infiltrate the soil, plants absorb water and pollutants in the water, which is positive during flooding (EPA 2000:3). However, the large quantity of non-permeable surfaces within Nyhamnen leaves little room for vegetation to establish itself. Features of vegetation that does exist consists of modest perennial or shrub plantings outside a few office buildings, the grass lawn and trees in *Hamnparken,* brownfields, or of weeds that has grown through the cracks in pavings and along rail roads.

Although being sparse, the existing elements of vegetation makes the otherwise large scale structure of Nyhamnen easier to relate to. Moreover, it allows some areas within Nyhamnen to change as the seasons go by, in ways that this hardscape environment otherwise can not.

FUTURE

Malmö stad argues that the current lack of green elements in Nyhamnen constitutes an unbalance that needs to be a vital part of the redevelopment of this area (Malmö stad 2015:4). This vision is further substantiated by the statement that every household within Nyhamnen should have a maximum distance of 300 meters to a park (Malmö stad 2015:32). Furthermore, Malmö stad argues that a greater amount of green elements within Nyhamnen could function as an important improvement of its micro-climate and, moreover, as wind and sun protection. In general, these green elements are proposed to consist of parks or green boulevards along car roads. Malmö stad further argues, that these green elements should be accessible for residents living in areas nearby Nyhamnen as well. Hence, new green features within Nyhamnen is proposed to compensate for a lack of green structures in other parts of Malmö (Ibid).

Moreover, Malmö stad acknowledges that the amount of greenery in Nyhamnen will have a great impact on the ability to manage flood water within the area. Hence, they argue that squares and streets within Nyhamnen should be designed to be able to function as basins for flood water during cloudbursts. Consequently, another aim is that water will be considered as a natural element within the green areas of Nyhamnen (Malmö stad 2015:33). Moreover, Malmö stad wishes to enhance the coastal character of Nyhamnen by using plants that has a typical coastal character in areas that borders to the water (Malmö stad 2015:32).

In general, one of Malmö stad's main planning guidelines for Nyhamnen is to create both blue and green environments with high levels of biodiversity. They argue, that the vegetation should be selected carefully, and aim at benefiting and protecting species that are common within the region (Malmö stad 2015:33).

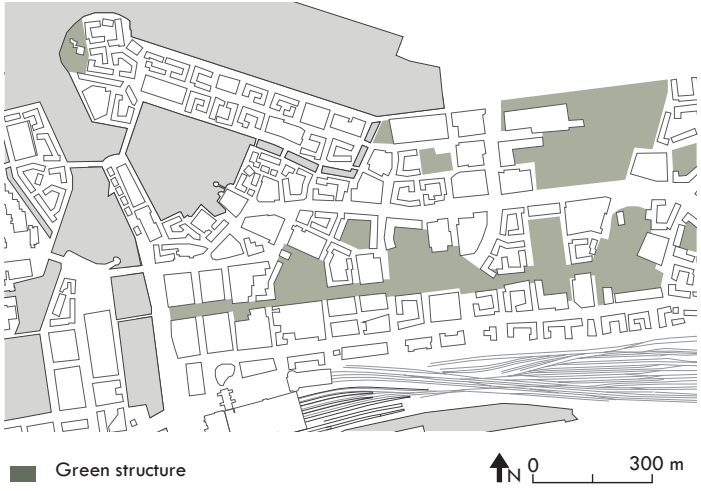


Figure 32. Proposed green structure of Nyhamnen.

ATMOSPHERE

TODAY

As of today, the atmosphere in Nyhamnen is largely affected by the harbour activities in the area. The noise and visual impacts of the still active industries, the loading and unloading of goods, forklifts driving in-between the warehouses, the structural elements of quays, anchoring facilities and boats, the fenced off areas, the open asphalt and vast views, or the sea and its presence of wind and scent from the seaweeds - all of these aspects has a great influence on the character and identity of Nyhamnen, thus affecting how the area is perceived. The still ongoing harbour activities gives hints of Nyhamnen's past functions, such as the small fishing boats that anchors at the quay at Hullkajen, or the turquoise sheet buildings owned by Lantmännen that has been sun-bleeched over the years. It gives you a sense of understanding of what this area has been. Yet, large areas are, as previously mentioned, fenced off from the public, making the industrial activities of Nyhamnen hard to approach and grasp.

FUTURE

It is difficult to describe the atmosphere of a site that has not yet been built. However, the dense urban structure that Malmö stad wishes to create indicates that the atmosphere of the future Nyhamnen might be of a more intimate character; the proposed enclosed city scape structure will be a strong contrast to the current, more open, structure of Nyhamnen. High buildings will cast new shadows, and act as shields towards the strong western winds. Some views of the sea can be expected to be blocked, while some might be enhanced or framed.

SITE READING: FINDING THE AREA OF CONTROL

The different aspects that has been presented in this chapter thus far acts as *the areas of influence* and *effect* of Nyhamnen. To be able to take the next step in this site reading process, to find the *area of control*, these readings further needs to be related to the research question of this master's project:

- *How can an evolutionary design concept be used as an approach towards developing methods for flood management in Nyhamnen, that also contributes to a perception where flood water is considered as an asset, rather than an issue?*

When relating the conducted site readings of Nyhamnen to this research question, the aspects of **flood risk** and **water connections** appears as two of the main elements that would have influence on the delimitation of an area of control. Hence, a closer look at these two aspects will help define the specific site within Nyhamnen where an evolutionary, flood adapted design is to be applied.

Flood risk

The large amount of non-permeable surfaces within Nyhamnen aggravates surface water runoff. If Malmö was to be subject to a cloudburst comparable to the one in Copenhagen in 2011, several parts of Nyhamnen would be heavily flooded; according to a mapping developed by Malmö stad, Stockholmskajen and the parking lot just south of the newly renovated office building *Magasinet* (Wihlborgs 2017-04-03) are the two areas within Nyhamnen that, as of today, would be most vulnerable to this kind of cloudburst (Malmö stad 2015:35). This is largely

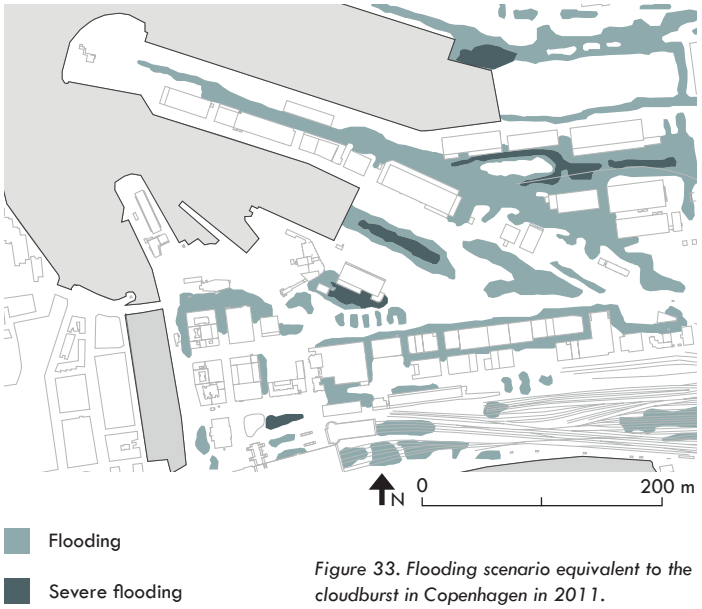


Figure 33. Flooding scenario equivalent to the cloudburst in Copenhagen in 2011.

explained by the topography of the site; the area at Stockholmskajen that is at risk for flooding is located within the lowest point in Nyhamnen. Today, this low point mainly functions as one of CMP's storage lot for cars. Flooding at Stockholmskajen today would not affect any buildings or other valuable structures, but could cause damage to cars that are parked at the parking lot.

In the proposed future redevelopment of Nyhamnen, the flood risk at Stockholmskajen and the parking lot south of Magasinet is dealt with in two different ways. The south side of Magasinet is proposed to consist of a park; a permeable surface that has further potential of integrating flood mitigative measures. The north side of the building, however, is part of the most dense structure of the future character of Nyhamnen and, apart from suggested elements such as green roofs and facades (Malmö stad 2015:34), this area will presumably mostly consist of hardscape surfaces which will aggravate storm water runoff.

The comprehensive plan for Nyhamnen further illustrates that a sea level rise by two and a half metres would cause all of Stockholmskajen to flood, as well as large parts of Hullkajen (Malmö stad 2015:34). Malmö stad acknowledges that Nyhamnen eventually will be exposed to some sort of sea level rise, but argues that this should be considered as an opportunity, rather than an issue; the comprehensive plan states that Nyhamnen has

the potential of becoming a showcase area for methods for flood management (Malmö stad 2015:9). Although not presenting any detailed visions for flood management, Malmö stad argues that methods such as green roofs, green facades and open canals could be used for delaying storm- and flood water runoff within the dense city structure of Nyhamnen. In addition to this, Malmö stad proposes that both temporary and permanent barriers should be applied to Nyhamnen's docks and quays (see figure 34). As an example of a permanent barrier, the comprehensive plan states that some parts of Nyhamnen should be heightened to a ground level of a minimum of +3 m above sea level. However, Malmö stad further acknowledges that this minimum level might need to be heightened further, depending on how the climate will continue to change (Malmö stad 2015:34-35). What sort of temporary solutions that could be used to prevent flooding is not further discussed.

The permanent barriers and the heightening of the ground level are both measures that considers the risk of flooding caused by sea level rise. They do not, however, consider the risk of flooding generated by cloudbursts; although the comprehensive plan acknowledges that the most important measure for managing flooding is to increase the amount of parks and other green elements in the area (Malmö stad 2015:34), large parts of the future inner structure of Nyhamnen is still proposed to consist of hardscape surfaces. In general, the proposed dense and hardscape city structure of Nyhamnen seems to leave little room for integrating methods for flood management. Still, the comprehensive plan states that Nyhamnen has the potential of becoming a showcase area for these

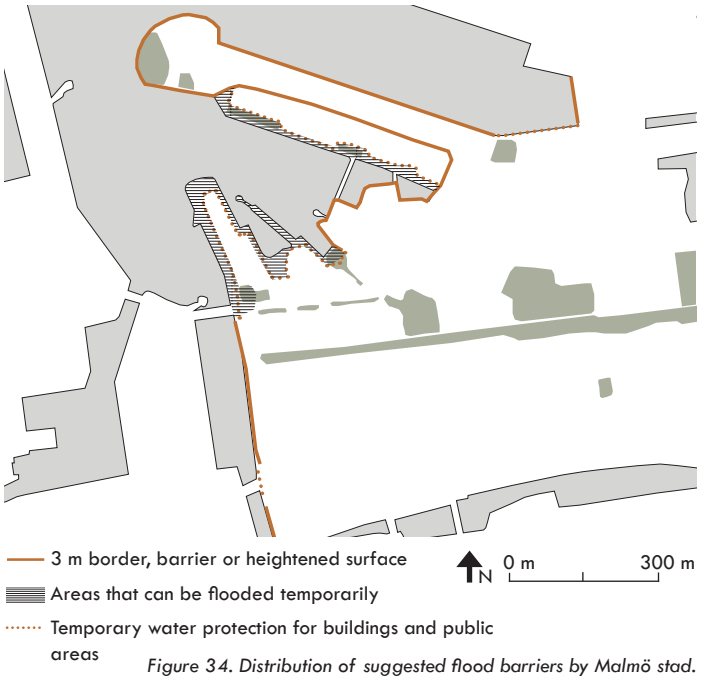


Figure 34. Distribution of suggested flood barriers by Malmö stad.

types of measures. A significant challenge will thus be to implement rather small scale measures that still has the potential of managing occasional large amounts of flood water. In order for this approach to be successful, the comprehensive plan acknowledges that parks and squares will play an important part in the overall chain of runoff and flood water management within Nyhamnen. These parks and squares are therefore supposed to incorporate floodable surfaces that are able to manage large amounts of water (Malmö stad 2015:34). Yet, some of the most important parts of Nyhamnen's chain of flood water management will not be implemented until the very last stages of its redevelopment; the largest parks of Nyhamnen, and thus important floodable surfaces, will not be built for another 30-40 years (see figure 27). As a result, the inner, dense parts of Nyhamnen will lack important measures for flood management for quite some time.

Water connections

An important part of Nyhamnen's general character and atmosphere is its close connection to the sea. In relation to other coastal districts in Malmö, the location of Nyhamnen could, in fact, be argued to be unique; located close to both the city centre and the sea, Nyhamnen offers an intimate and central connection to the water that other districts in Malmö does not. Although areas such as *Västra Hamnen* and *Ribersborg* are situated on attractive locations by the waterfront, they lack the proximity to the very

centre of Malmö that Nyhamnen can offer. Moreover, Nyhamnen has the unique quality of embracing the sea, bringing it into the site; while the waterfront at Västra hamnen consists of a consistent coastline, Nyhamnen allows the water to seep into its central and inner parts. This generates intimate perceptions and connections with water within Nyhamnen and, compared to the vast spatiality that can be sensed at both Ribersborg and Västra hamnen, this could be argued to be a special and valuable character.

Although being one of Malmö's most central districts that connects to water, the water surface within Nyhamnen is, however, largely inaccessible. Since this area initially was constructed to manage the expansion of the ocean trading industry during the turn of the 19th century, its waterfront structures are dimensioned after such requisites. Moreover, the loading and unloading of goods has consistently demanded an open water surface with no obstacles, limiting the amount of constructions that can be done close or on top of the water surface. The comprehensive plan thus states that the water surface within Nyhamnen should be utilized in a more versatile way in the future. Activities and installations such as houseboats, a small harbour, temporary events and various water activities are suggested as ways in which the water surface can be perceived as more accessible (Malmö stad 2015:9). Moreover, the plan states that the quays of the inner parts of Nyhamnen should be designed with a variety of qualities (Malmö stad 2015:11). Although not specifying how these quays should be designed, Malmö stad suggests that some could include stairs to the water, hence enabling bathing and swimming within the basins (Malmö stad 2015:12-13).

In addition to improving the accessibility to the water surface within the area, the comprehensive plan also expresses a wish of enhancing the intimate qualities of Nyhamnen's water connections. This is suggested to be achieved by creating smaller waterscapes within the harbour basin; three infills of land is proposed to be added in *Nyhamnsbassängen,* the most central basin in the area. According to Malmö stad, these infills are to be built with residential buildings and public services, placed in close connection to the waterfront (Malmö stad 2015:12-13). By adding these land infills and building structures, Malmö stad argues that a closer and more intimate connection to the sea can be reached (Malmö stad 2015:12). However, this approach could also be argued to be a risk of reducing these very qualities; the most recent sketch developed by Stadsbyggnadskontoret suggests a significant reduction of the amount of available water surface within Nyhamnen. Moreover, the entire coastline of Nyhamnen is proposed to almost solely be built with enclosed blocks of buildings. Hence, while the proposal might enhance an intimate connection between building facades and water, it seems to block out some of the existing qualities and characters of the water perceptions and connections within Nyhamnen. The spatial openness by the waterfront and the visual

impact of the sea are both important aspects that are part in creating a unique character and atmosphere in Nyhamnen today. Some of the qualities of this character seems to be somewhat lost in the proposed future structure of the area.

CHAPTER G *The area of control*

When relating the site readings of Nyhamnen's areas of influence and effect to the research question of this master's project, one specific area can be discerned as, on the one hand, especially vulnerable to **flooding** and, on the other hand, as conveying close **connections to water**. Namely, this area is *Stockholmskajen*. Hence, Stockholmskajen constitutes *the area of control* of this master's project.

In regards to the flood risk aspects discussed in the previous chapter, this area is at risk of becoming flooded during cloudbursts; as of today, this site constitutes one of the lowest points in Nyhamnen. Moreover, the ground within this area is subject to pollution, hence creating a need for some sort of purification. Together, these two aspects illustrate that Stockholmskajen is an area where measures for flood management needs to be taken. Moreover, in addition to these flood risk aspects, Stockholmskajen further includes aspects that, as of today, enhances it as an area that is particularly connected to water. As an example, it constitutes the area where one first gets close to the water; this is the area where the public, dotted path passes by the waterfront for the first time. Stockholmskajen is also one of the only areas within Nyhamnen where one can sit down and rest on benches in direct connection to the quays. This sunny (and windy) spot offers a great view over *Nyhamnsbassängen* and of the harbour activities in the area. Hence, Stockholmskajen can be argued to be an area that communicates both the maritime and the industrial atmosphere of Nyhamnen.

In the proposed future design of Nyhamnen, Stockholmskajen is continuously considered to be an important node within the area; located in its most central parts, Stockholmskajen is proposed to constitute the area where infrastructure, residential buildings and public services meet. Stockholmskajen will thus be part of the very heart of the future structure of Nyhamnen. However, although being characterized as an important, central part of Nyhamnen, the proposed future structure of Stockholmskajen lacks larger public spaces or parks. As a result, the water connection that is a great part of the identity and atmosphere at Stockholmskajen today, seems to become somewhat lost. Instead, the proposed infill of land in Nyhamnsbassängen reduces the amount of available water surface, and the edge along the waterfront is to be bordered with buildings that will have the character of enclosed blocks. Hence, the spatial openness and great views over the basin that are existing qualities at Stockholmskajen today, will to some extent be blocked out in its future structure. As a result, its close connection to the water is at risk of being reduced as well.

The enclosed blocks and overall dense city structure that Stockholmskajen is proposed to consist of appears as a strong contrast to the open structure and atmosphere that characterizes the area today. To maximize the amount of residential buildings, retail

opportunities and office spaces does, of course, generate greater economic profits than what open, public spaces might do. During a lecture in March 2017 held by Lars Böhme, the project leader for the redevelopment of Nyhamnen at Stadsbyggnadskontoret, the infill of land by Stockholmskajen was mentioned as an expected profitable addition to the area due to the amount of exploitable land it will add (Böhme 2017-03-09). This statement enhances the economic perspective of this redevelopment and, thus, some of Malmö stad's main priorities.

When looking at the different phases of construction in Nyhamnen, Stockholmskajen is part of one of the very first stages of the redevelopment process (see figure 27). Since some of the most important parts of the overall chain of flood water management in the area, i.e. the parks in the western sections, will not be built until the last stages of the construction, Stockholmskajen needs to be part of a process that implements methods for flood management from the very beginning. Hence, Stockholmskajen can be discerned as an especially suitable site where flood adapted measures can be implemented, while at the same time being able to bring recreational, ecological and social values to the most central parts of Nyhamnen.

The effects of climate change are already set in motion. Methods for flood management thus needs to be integrated into the urban fabric sooner, rather than later. Due to its state of redevelopment, Nyhamnen constitutes an area where such methods can be implemented from the very beginning. As the redevelopment of Nyhamnen continues, these methods needs to be developed as well, gradually adapting to the changing urban structure of Nyhamnen and, thus, the altering flood risk requisites of the area.

Although the exact future character and structure of Nyhamnen, to some extent, could be said to be as uncertain as the future of the climate, we do argue that it is important to relate the design proposal to the one developed by Stadsbyggnadskontoret at Malmö stad. Since the redevelopment of Nyhamnen already has begun (Stage 1, see figure 27), this proposal can, at the least, be considered as a credible overview of what the future character of Nyhamnen might be. Yet, since it does not offer more than an overview, we further argue that our proposal also should consider the existing qualities and characters of Nyhamnen; since the structures, features and elements that can be found in the area today are the only ones that can be taken for granted, we argue that our design to some extent needs to originate from these aspects.

If the site editing at Stockholmskajen would start already today, its design and flood management functions has the potential of evolving alongside the redevelopment of Nyhamnen, thus being flexible and adaptable to future (uncertain) changes and challenges.

This evolutionary approach to site design constitutes the basis of this master's project design concept.


DUNKER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CHAPTER H *Site editing: Design proposal*

The knowledge that has been formed in this master's project so far constitutes the basis of the design proposal that will be presented in this chapter. Research, theories and explorations into climate change, flood management methods, site definition and temporary uses have thus all been part in the process of developing this design. Moreover, the design relates to a specific site, an area of control, which was able to be defined as a result of the conducted site readings of Nyhamnen's areas of influence and effect. This area of control, Stockholmskajen, constitutes an area within Nyhamnen that is particularly vulnerable towards flooding.

The main approach of the design process of this master's project has been to create an evolutionary design that is able to manage flooding, while at the same time evolving alongside the proposed redevelopment of Nyhamnen. This evolutionary approach to design is conveyed through a three step strategy; rather than proposing a finished, end-state design, we propose a *step-by-step* development. Through this approach, we are able to illustrate the importance of looking at sites as non-static and ever-changing, in constant need of adapting to changing requisites.

What the precise future structure of Nyhamnen will be and when its different parts will be built is yet uncertain. As an acknowledgement of this uncertainty, the different phases of our design are to be read as consecutive steps, hence as the *first*, *second* and *third* step, instead of being read as connected to precise years of realization. While the first step relates to the current structure and character of the area, the second step relates to its awaiting constructional phase, and the third step relates to the future structures that are presented in the most recent structural plan (2017) for Nyhamnen. Although the different steps of the proposed design thus relates to different phases of construction within Nyhamnen, the exact time frame during which these phases occur are not important for the design.

The evolutionary design concept entails that the level of detail will differ between the three different proposals. Hence, since the first step relates to the structures and characters that can be found in Nyhamnen today, it is also able to communicate a greater level of detail. However, as the design proceeds to develop with the second and third step, the level of uncertainty increases and, consequently, the level of detail decreases. The second and third step are thus to be read as depicting desired functions and structures, rather than exact proposals of what the design should look like. However, another part of this evolutionary design concept is to keep some of the areas original structures, materials and characters; as presented in the three different design proposals, the existing quay line at Stockholmskajen keeps its function as a walk- and bike path throughout all the consecutive steps. Hence, this quay line is able to act as a framework from which the different design proposals

evolve.

Although the three different steps of this design proposal contains different levels of detail, they all have in common that they incorporate methods for flood management. Moreover, a general approach towards the design of all of these steps has been to illustrate the uncertainties of the future, thus highlighting the challenges of the future climate as a central, pedagogical part of Nyhamnen. The following segments will contain a closer introduction into the three different steps of this evolutionary design concept.

Paths

Green structure

Water/floodable surface

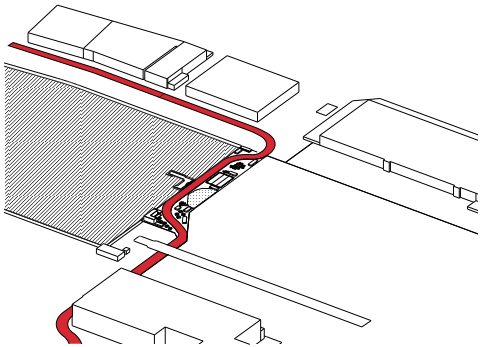


Figure 35. Step 1.

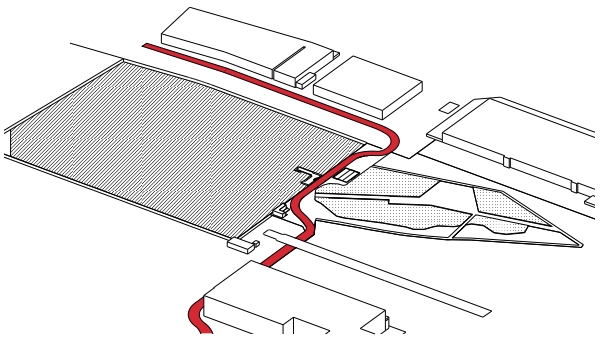


Figure 36. Step 2.

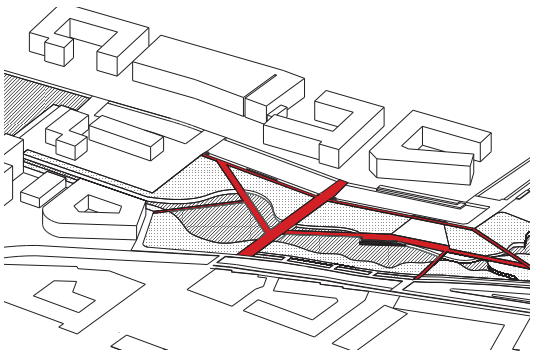


Figure 37. Step 3.

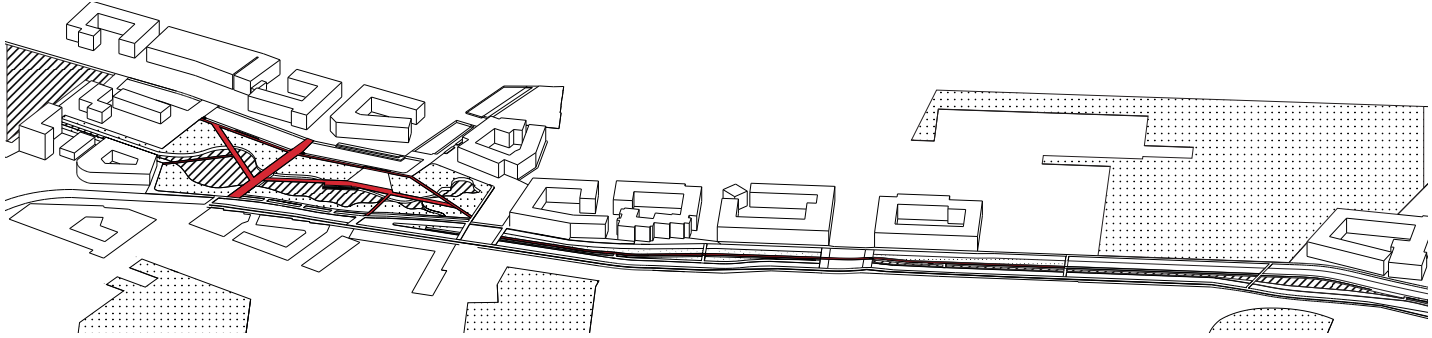
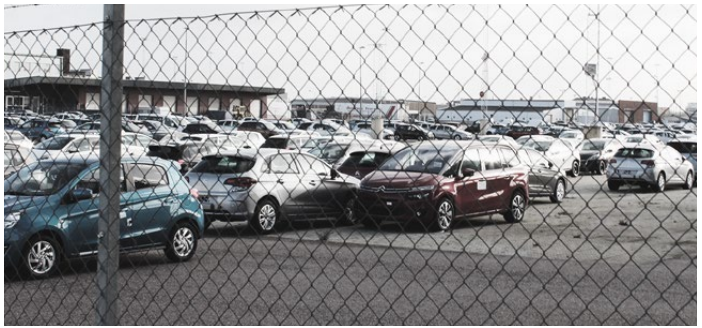


Figure 38. Larger perspective of Step 3.

STEP 1: TEMPORARY USES

Large parts of our chosen area of control, Stockholmskajen, will not be accessible for development until the year of 2020. However, an area of approximately 1400 m², located in-between a fenced off area and the quay, is already available for site editing. Hence, this part of Stockholmskajen will constitute the site for the *first* step of our design proposal. By instigating the process of developing flood management methods for Stockholmskajen already today, we are able to illustrate the importance of making this type of climate adaptation a vital part of the early stages of Nyhamnen's redevelopment. Moreover, the temporary installations of this site are able to raise public awareness about flood management issues within urban environments, as well as giving indications of what the future structure and character of Stockholmskajen might be.



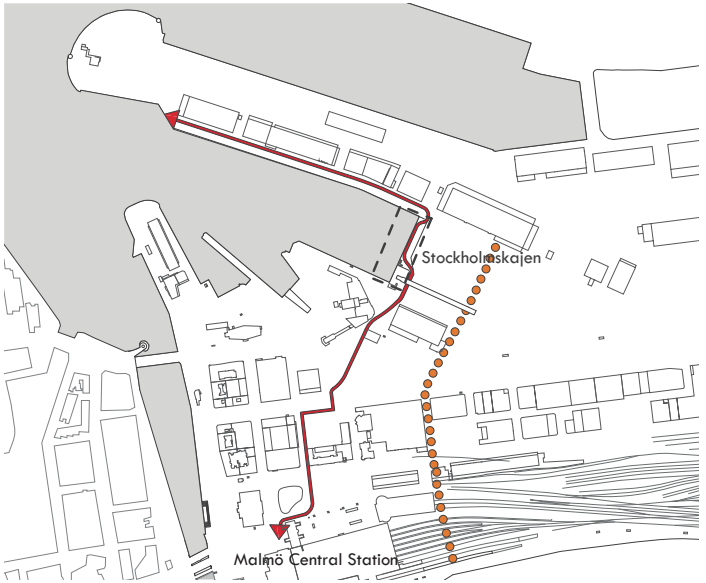


Figure 39. Stretch of new walk- and bike path.

Stockholmskajen constitutes an area that will be subject to extensive structural changes during the transformation of Nyhamnen. Hence, any design actions that are added to this area today might need to be adapted to its changing surroundings in a relatively near future. Therefore, our chosen approach for this first step of the design is to implement temporary uses at the site. With small means and interferences such as *depaving* and *park mobiles*, our design is able to achieve a *site pre-vitalisation* that, on the one hand, is able to deal with minor flooding and, on the other, highlights the changing requisites of both Nyhamnen, and the climate.

To depave large parts of the area is an important strategy of this first step. By reducing the amount of non-permeable surfaces, this site will become better suited for managing storm- and flood water runoff. Moreover, another quality of this depave tactic is its ability to illustrate the

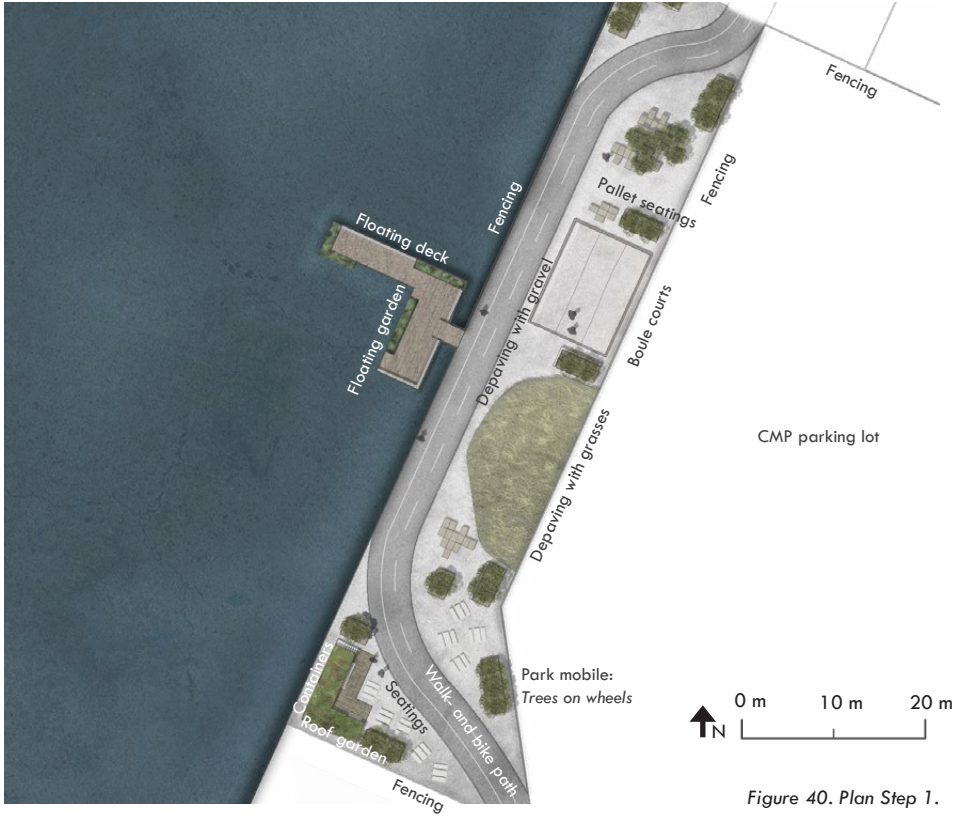


Figure 40. Plan Step 1.

flood management issues that hardscape environments typically bring. Hence, a pedagogical approach is an important part of this first step, thus highlighting the challenges that the effects of climate change will bring to urban environments The park mobiles at this site are planted with trees that will be part of the consecutive steps of the design as well. Hence, these mobile plant containers are meant to act as temporary plant nurseries for trees that are to be part of a future, more permanent structure. As an example, this means that some of the trees planted in the park mobiles are proposed to be of species that are able to purify pollutants.

Pallet seatings in Copenhagen, Denmark.

Temporary uses at Sorgenfri, Malmö.

Naturally existing vegetation acts as inspiration.

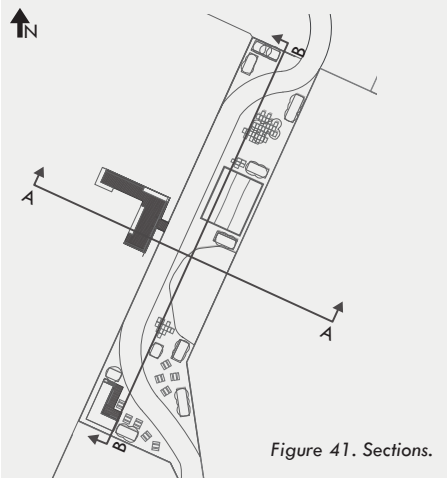


Figure 41. Sections.

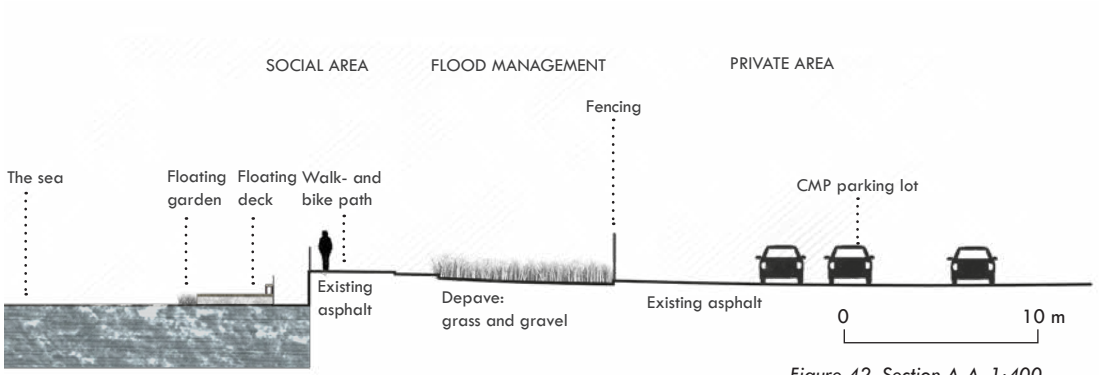


Figure 42. Section A-A. 1:400.

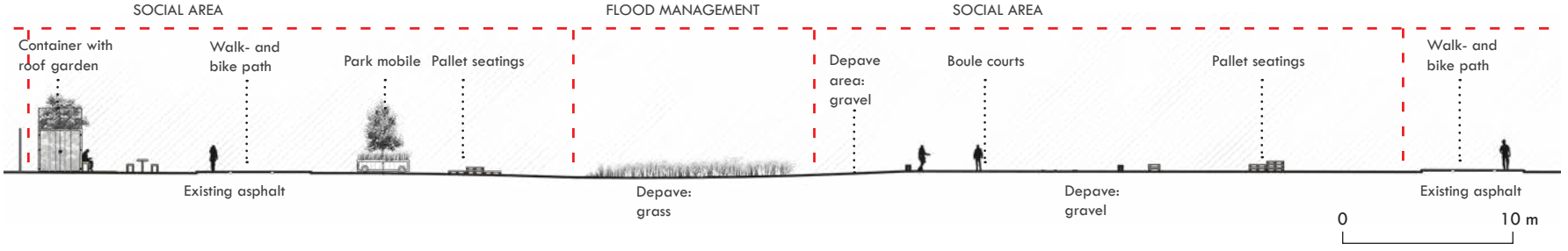


Figure 43. Section B-B. 1:400.

Temporary uses in Sorgenfri, Malmö.

Figure 44. Temporary use of an urban space.

STEP 2: PHYTOREMIDIATION

As the land ownership of Stockholmskajen is transferred to Malmö stad, a larger part of the area will become available for site editing actions. The structures that are part of Step 1 are, as a result, able to be developed further as well. *Step 2* refers to a phase of redevelopment during which large amounts of Nyhamnen's inner parts are undergoing construction. As argued by Malmö stad, this constructional phase can be expected to result in a situation where some parts of Nyhamnen are caught in an in-between state while awaiting further construction. In our design proposal, this in-between state is argued to enable a phase of further site pre-vitalisation and, moreover, a phase of purification of ground pollutants.

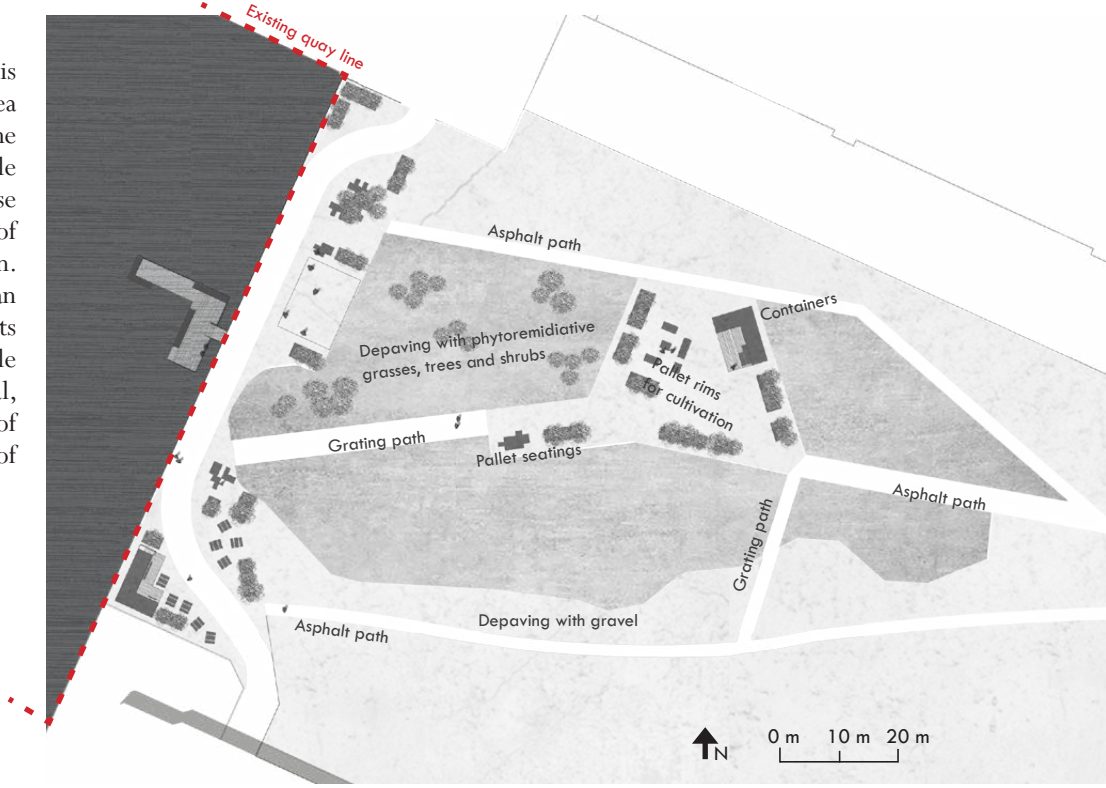


Figure 45. Plan Step 2.

Since Stockholmskajen is situated at one of the lowest point within Nyhamnen, it is especially vulnerable to flooding during cloudbursts. Moreover, this site is also subject to ground pollution (see figure 31). During flooding, it is thus likely that floodwater generated at Stockholmskajen will become contaminated. Hence, this area needs to be part of a purification process that manages these pollutants. Building on the depaving structures implemented in Step 1, Step 2 thus further increases the amount of permeable surfaces at Stockholmskajen, while at the same time implementing phytoremediative processes at the site. The remediative species of trees that were planted in the park mobiles in Step 1, are now able to be planted within phytoremidiative areas in Step 2. The site pre-vitalisation aspects of this second step are meant to give some indications of what the future structure of this area might come to look like. The paths and phytoremidiative spaces of the proposed design thus acts as indications of where future paths and vegetative materials will be located. However, it is important to note that these structures mainly are to be read as concepts of design, rather than exact depictions of its future character; if the requisites of this site were to change before the construction of the next, third, step of the design has begun, the structures proposed in Step 2 should be allowed to adapt to these requisites.

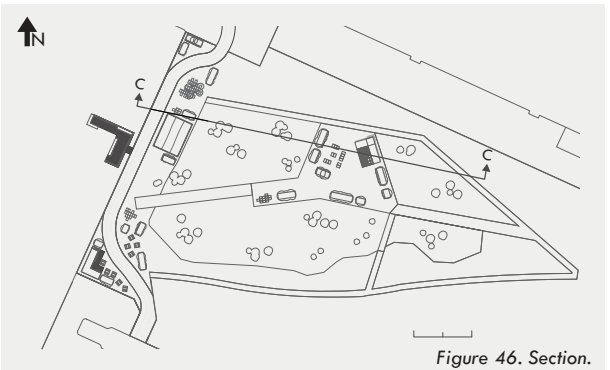


Figure 46. Section.

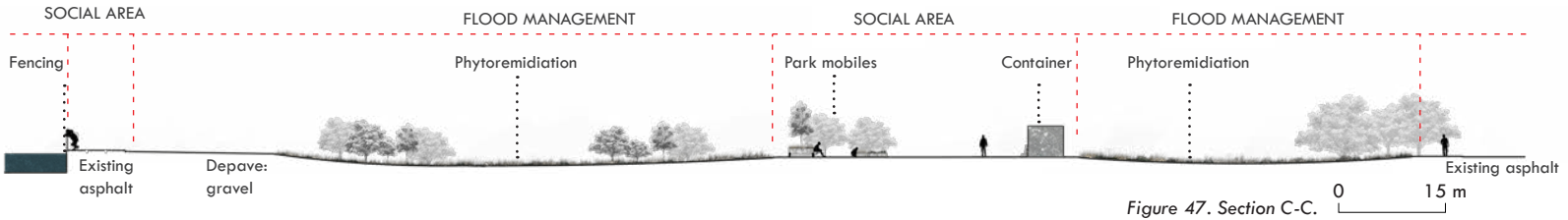


Figure 47. Section C-C.

STEP 3: NYHAMNEN WATER LINE

The third step of our evolutionary design concept relates to the future structure of Nyhamnen that is presented by Malmö stad (2017). The structures that has been part of Step 1 and Step 2 are thus in this third step developed into becoming a more permanent structure in Nyhamnen, now constituting a *linear, flood adapted park* that stretches from the waterfront at Stockholmskajen towards Västkustvägen. In our illustrations, the hatched areas are structures made by Malmö stad, while the filled areas are part of our design Proposal.

In the proposed future structure of Nyhamnen, Stockholmskajen is supposed to act as one of the most central and dense parts of the area. By integrating a flood adapted park into this area, it has the potential of bringing the showcase-factor to Nyhamnen that Malmö stad desires; by proposing an implementation of large scale flood management measures in the very heart of Nyhamnen. While, on the one hand, being a functional space that fulfils climate adaptive demands in the midst of an urban fabric, it is also able to bring recreational and ecological values to an otherwise dense, hardscape environment.

An important part of Malmö stad's proposed structural plan is an infrastructural axis that stretches from Stockholmskajen towards Västkustvägen, incorporating structures for both a tram line and car traffic. Since the prospect of building tram lines within Malmö has been deemed unlikely since this structural plan was drafted, this axis instead has the potential of implementing green and blue structures that connects the floodable surfaces at Stockholmskajen to other parks within Nyhamnen. In addition to acting as a green link between these parks, this axis is thus proposed to incorporate a floodable trench that is able to manage storm- and floodwater from surrounding hardscape structures. If Malmö was to be subject to a cloudburst, this axis, or cloudburst street, would hence act as an above ground system that transports floodwater into floodable areas where it is able to be delayed and infiltrated. Moreover, by connecting this cloudburst street to the sea, it is also able to manage flooding coming from sea level rise; if the sea level by the waterfront of Stockholmskajen would rise, this cloudburst street would be able to lead the floodwater to the floodable surfaces of the area.

The cloudburst street that is part of *NyhamnenWater Line* is proposed to be supplemented by flood management methods that connects it to other parks within the area. Measures such as, for instance, rain gardens, curb extensions and open canals are examples of methods that can be implemented in the dense, hardscape quarters that surrounds the main axis. Through this connective approach, we are able to create a hydrological system that is manages floodwater from large parts of Nyhamnen.

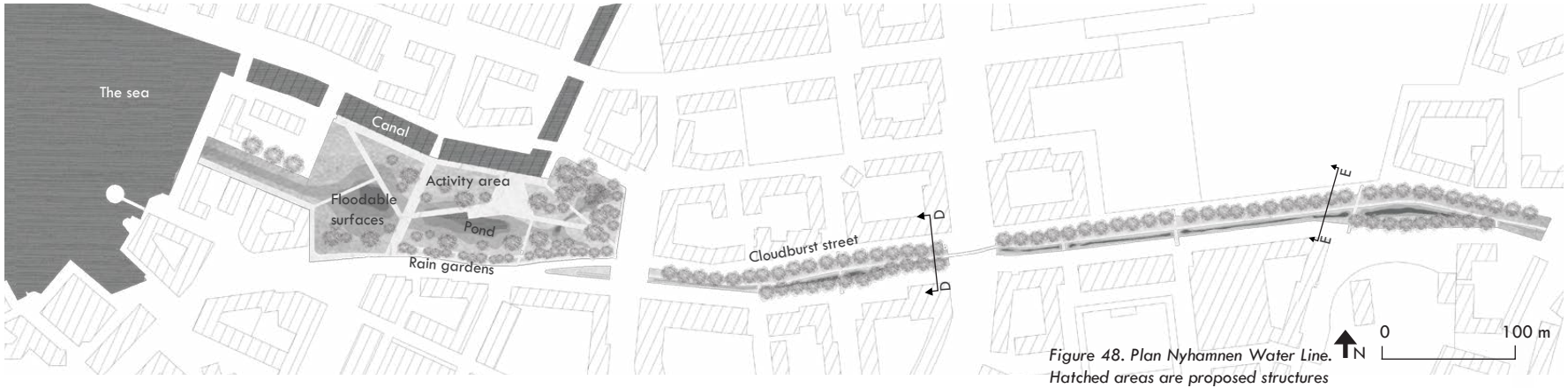


Figure 48. Plan Nyhamnen Water Line. Hatched areas are proposed structures made by Malmö stad.

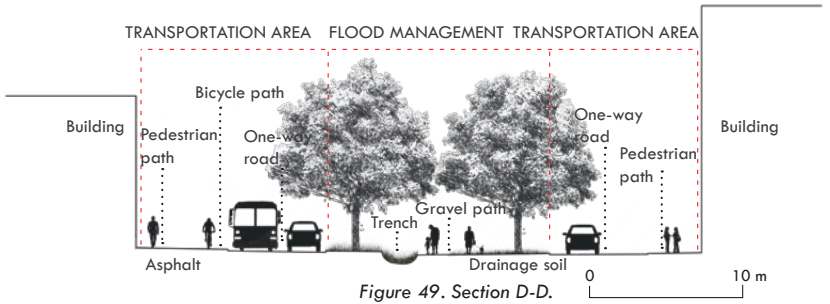


Figure 49. Section D-D.

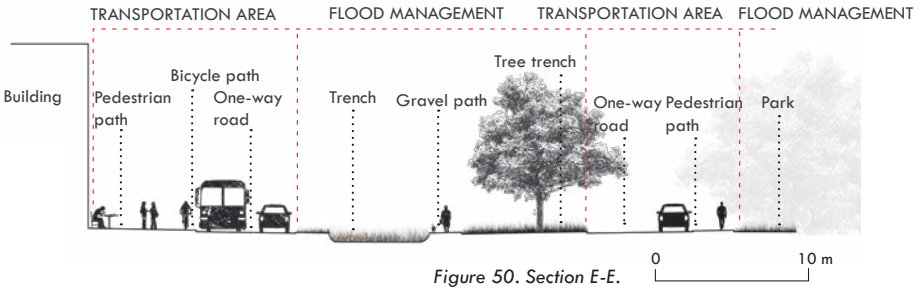


Figure 50. Section E-E.

When comparing the structure of the third step to the first and second one, a structural difference between the different steps appears; as the redevelopment of Nyhamnen has continued, this park has continued to grow out into the sea, proceeding out on top of the proposed infill of land in Nyhamnsbassängen. However, this extension of the park's structure is not essential for the overall character and function of Nyhamnen Water Line; if the infill of land in Nyhamnsbassängen for some reason would be put off, the design of this floodable park would still maintain its main character and function.

As a means of relating this future design to Nyhamnen's past and present character and functions, this design also suggests an incorporation of materials that has been part of both the first and second step of this evolutionary design. Materials such as concrete, rusted steel and gratings are thus able to act as reminders of the structure and function that Nyhamnen once had. As a result, this park is able to bring new vital flood management functions to this new urban district, while at the same time conveying some aspects of the site's past character.

Consisting of permanent water features, floodable surfaces, inclinations and site adapted vegetation, this park is able to manage flooding within Nyhamnen during instances of cloudbursts or sea level rise. Incorporated into the design of this park is, moreover, that it is usable both when dry, and when flooded; elevated paths and platforms enables for this park to act as a public space within Nyhamnen even the water level within the park is high.

The lowest point within the park of the park, distributed along the area that constitutes the low point at Stockholmskajen today as well, contains a permanent water surface. By incorporating this element of water, the park is able to be characterized by its´water features even when it is not flooded. Moreover, the park's connections to water is further enhanced by its position close to the waterfront; through connecting the park to the sea, this space is able to translate the open and spacious waterfront connections that can be argued to be a vital part of the atmosphere of Nyhamnen already today.

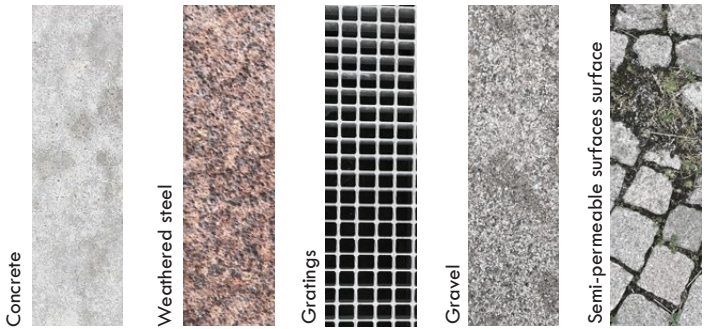


Figure 51. Concrete.

Figure 52. Plan of floodable park in Step 3. Hatched areas are proposed structures made by Malmö stad.

By connecting the green areas in Nyhamnen, we aim to create a network of flood management that also contributes to a physical coherence in the urban structure. This proposal does not present specific solutions for each connection, but rather proposes principles for how flooding could be managed in different areas. What method that is suitable mainly depends on what part of the stormwater management chain it can be connected to, that is *Local management, delay close to the source, slow deriviation* or *collected delay*. Since the local management of stormwater is located on private land, this part are best suited for small scale management such as green roofs or infiltration on permeable surfaces. Larger areas are best suited for collected delay, such as the pond and floodable surfaces in our proposed park at Stockholmskajen.

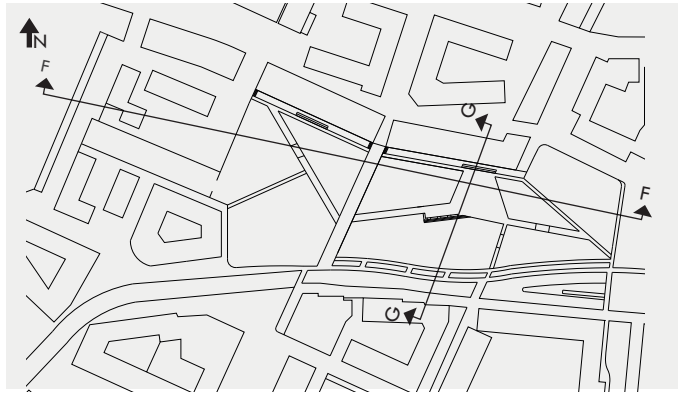


Figure 53. Sections.

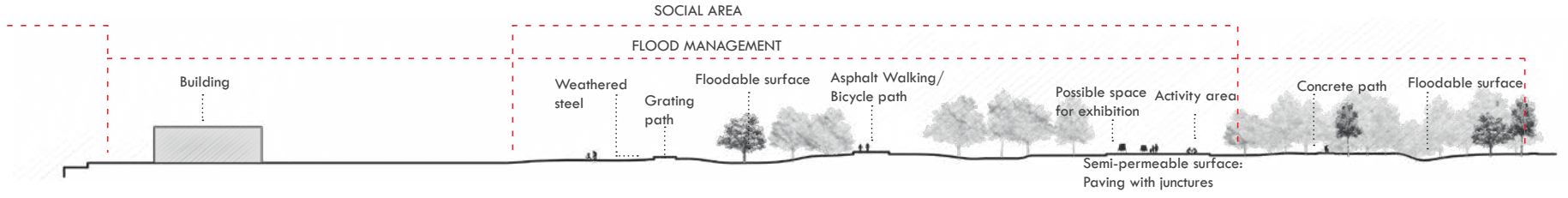


Figure 54. Section F-F.

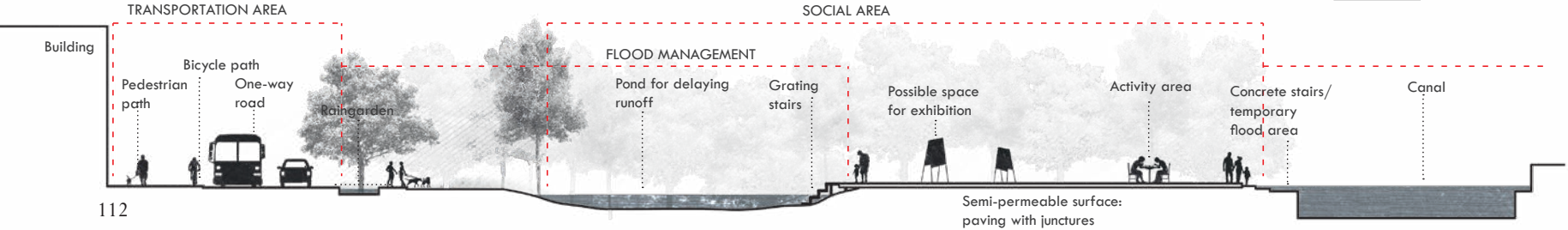


Figure 55. Section G-G.

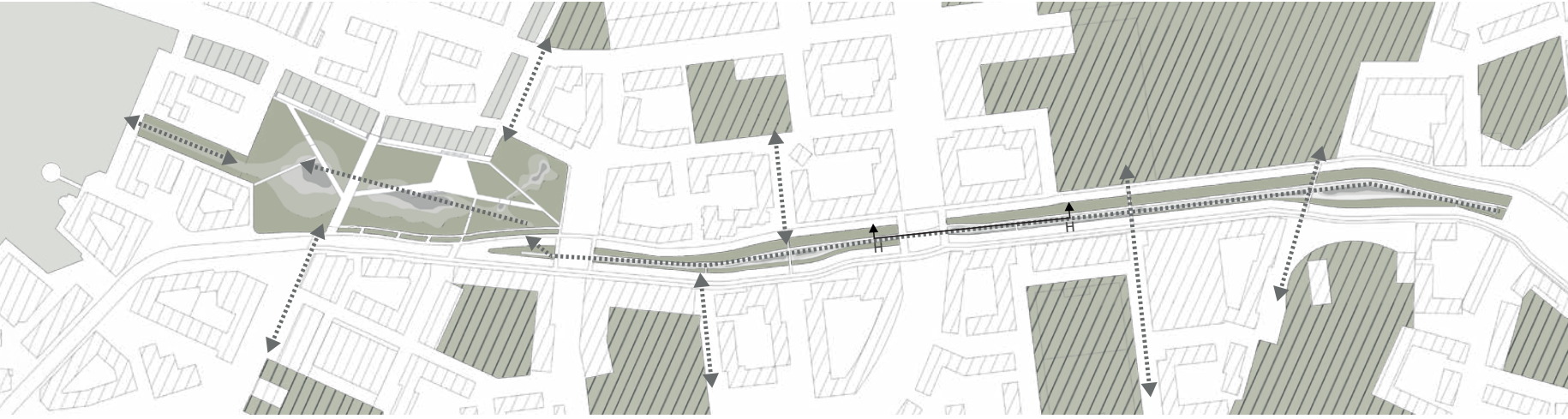


Figure 56. Principle of flood management connections. Hatched areas are proposed structures made by Malmö stad.

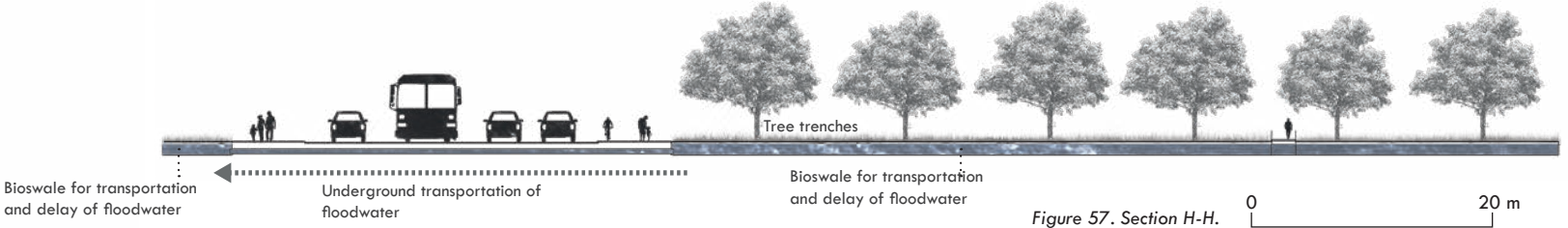


Figure 57. Section H-H.

ON THE EVOLUTIONARY DESIGN CONCEPT

The research question of this master's project has been:

> *- How can an evolutionary design concept be used as an approach towards developing methods for flood management in Nyhamnen, that also contributes to a perception where floodwater is considered as an asset, rather than an issue?*

To answer this question, we will reflect upon the proposed design concept. The main aim of this master's project has been to find an approach to site design that is able to manage flooding from cloudbursts, while at the same time evolving alongside the redevelopment of Nyhamnen. This evolutionary design approach is largely a result of two different notions.

Firstly, research concerning the sources and effects of climate change include a relatively high degree of uncertainty. Although anthropogenic activity is known to cause changes in the climate, it is not possible to establish what the precise effects of these changes will be, neither in the near nor distant future. It is known, however, that the severity of these effects depends on whether or not a reduction of the emission of greenhouse gases is achieved, and on to which extent climate adaptive measures are implemented around the world. However, since the effects of the future climate cannot be predicted it is, consequently, difficult to make exact plans or designs for what climate adaptive measures needs to look like in the future.

Secondly, the plans for the future structure and character of Nyhamnen could be argued to include aspects of uncertainty as well. During our correspondences with Lars Böhme, one of the project leaders for the redevelopment of Nyhamnen at Stadsbyggnadskontoret, Malmö stad, he has repeatedly emphasized that the current plans for this redevelopment merely are to be regarded as drafts or sketches. The comprehensive plan is, hence, to be considered as a work in progress, as an instigation of a large scale, a time consuming redevelopment process that is dependant on the state of the economic climate, laws and guidelines and on interests and demands from landowners, administrative authorities and real estate developers.

The two notions mentioned above have both acted as important parts of the development of this master's project. While our intention during this process always has been to present a flood adapted design for an urban context, the main focus of this intention has shifted during our process. As an example, our initial goal was to present a single, detailed design that related to a specific site in Nyhamnen. As a result, some of our early sketches mainly concerned flood adapted, urban solutions for sites such as Hullkajen. To a great extent, this initial approach was a

result of the ideas and reflections upon climate adaptation that we gained during our first readings of the comprehensive plan for Nyhamnen. As our process continued, however, we soon came to acquire a greater apprehension of the complexities of the future climate, of sites and of large scale redevelopment projects. As the understanding of these complexities grew deeper, the goals and aims of our project consequently changed and, as a result, came to concern larger scales, structures and timeframes.

The shift and development of our main focus is one of the reasons as to why we chose to focus specifically on Nyhamnen. For us, the redevelopment of Nyhamnen has constituted an interesting practical example of how flood management issues are approached within large scale, municipal projects from the very beginning. In the early stages of our process, our main aim was to investigate how a flood adapted, detailed design could complement the aims that are expressed in the comprehensive plan for Nyhamnen. As our focus developed into concerning a more evolutionary approach towards design, our interest in Nyhamnen still remained; instead of starting fresh and searching for a site that is, perhaps, even more vulnerable towards flooding, we thus chose to search for the most at risk site for flooding within Nyhamnen. Through this approach, we were able to utilize the thorough site knowledge that we already had started to gain.

As our project process continued, we came to develop a design concept that acknowledges the uncertainties of both the climate and the future structure of Nyhamnen. This design concept, described as being evolutionary, refers to an intention of creating a design that considers the ever changing requisites of the climatic situation, as well as the transforming structural conditions within Nyhamnen. Rather than proposing a finished, end-state design, we thus propose a step-by-step development, an approach to design that enables re-evaluation and adaptation to changing requisites and structures. Moreover, this approach also includes the important process of *site reading*, thus incorporating an exploration into the areas of influence and effect of a site. In this master's project, these explorations has been able to act as tools for achieving an even deeper understanding for the site specific requisites of Nyhamnen, a knowledge that we believe we might not have achieved otherwise. More specifically, this tool helped us in finding the specific site that our flood adapted design should be applied to; rather than choosing the most attractive, sunny or lively site, the site readings of Nyhamnen helped us in finding the most essential and suitable site for our specific aim.

According to our evolutionary approach towards design, the different stages of our proposal include different levels of detail and definition. While the first step relates to the current structure of the area, thus relating to existing features, the following second

and third steps are to be read as less defined. Inherent in the design of the second and third step is, hence, that the concept or function of the design does not depend on its surrounding structures; if the redevelopment plans for Nyhamnen would change, the two latter steps should be able to adapt to these changes. While the evolutionary design concept throughout this project has been used as a tool for communicating how Nyhamnen will develop over time, it is in fact difficult to predict what these developments will be; we can not state the actual ways in which Step 1 will develop into Step 2. Hence, the evolutionary design concept should be considered as a continuous process that needs to be revised and adapted to its surroundings as it develops or changes. In general, the designs that are presented in this project are thus to be read as design concepts that emphasizes the dynamic, non-static aspects of both urban redevelopment and of the climate, rather than being read as defined and detailed designs.

Although relating to different scales and timeframes, the first, second as well as the third step of our design proposal all include methods for flood management. Continuing on the concept of evolutionary design, the extent and function of these methods differ depending on what site requisites they are able to relate to. Although the second and third step of the proposal could be argued to relate to structures that might not actually be part of Nyhamnen in the future, we argue that practical examples of how these methods could be implemented within the area enables a deeper understanding for their potential of being part of an urban redevelopment process. As a result, these practical design examples could also be able to instigate a thought process that re-evaluates some of the proposed structures of Nyhamnen, which can be argued to lack some important aspects of flood adaptation.

FINAL REMARKS

Comprehensive plans are, per definition, supposed to consist of guidelines rather than exact depictions of a desired structure. Designs or detailed plans for specific sites are thus not supposed to be a part of this type of document. The visions that are presented in the comprehensive plan for Nyhamnen can thus be related to the basic definition of what this type of plan should consist of. However, one can discuss if these, supposedly general, visions actually correspond with the structural maps and plans that also are part of the comprehensive plan; are the aspects that are argued to be important points of departure actually part of the structural plans?

The structure, statements and illustrations that are presented in the comprehensive plan seems to convey a quite specific approach to planning; the precise forms of buildings, streetscapes and parks that the plan includes manages to communicate more exact

depictions of the future than what is perhaps desired. Relating back to arguments made by Carol J. Burns and Andrea Khan, Malmö stad's way of communicating their intentions for Nyhamnen seems to relate to a traditional, common approach within city planning; large scale redevelopment projects often seem to include a definition of a static, end-state of a design or plan. Yet, the sites that these designs are applied to can be argued to be the opposite of static, thus rather being subject to a constant state of change; the requisites of sites are constantly shifting in relation to aspects such as politics, user groups, the economic situation, or, the changing climate. What the requisites of Nyhamnen will be during its last stages of construction in 30-40 years, or what it will be beyond this time frame, are impossible to predict today. Nonetheless, these requisites will have a great impact on the designs and plans that are applied to Nyhamnen during its phase of redevelopment. When relating this type of reflection to the specific focus of this master's project, one can discuss if Malmö stad's wish of making Nyhamnen a showcase area for flood management, of creating intimate meetings with water, and of creating spatial connections between the inner parts of Malmö and the sea, actually are conveyed in their proposed structure of the area.

Nyhamnen's close connections to water are in the comprehensive plan argued to be a prominent feature that needs to be enhanced in the future structure of this new city district. By constructing new infills of land, thus increasing the amount of exploitable land, Malmö stad aims at creating a more intimate water scape within Nyhamnsbassängen. However, this strategy can be argued to convey a one-dimensional approach towards creating water connections; to a great extent, the proposed intimate water connections within Nyhamnen consists of buildings bordering the waterfront. The connections to water that can be experienced in Nyhamnen today, largely consisting of open, vast views over the sea, is thus proposed to be replaced by a new type of connection. Moreover, the strategy of creating infills of land also seem to contradict Malmö stad's wish of creating closer connections between the inner parts of Malmö and the sea; through the proposed infills of land, Malmö continues to grow out into the sea, thus creating an even further distance between the waterfront and the inner parts of the city. Building upon the way in which Malmö has expanded throughout history, the coastline of Malmö is proposed to continue to grow out into the sea and, as a result, the inner, older parts of the city becomes less and less connected to the waterfront.

The expressed wish of becoming a showcase area for methods for flood management can be argued to be somewhat contradicted by the structural plans over the area. Mainly, the ambition of implementing measures for flood mitigation within the parks of the area inherently implies that these measures won't be realized until the very last stages of the redevelopment. The overall character of

the area will thus be that of a hardscape, dense cityscape for quite a long period of time. As a result, the inner parts of Nyhamnen would be vulnerable to flooding if a cloudburst were to occur before these parks are built.

Moreover, to propose for some of the largest parks of Nyhamnen to be built in the very last stages of its redevelopment conveys an approach that prioritizes a maximization of exploitable, profitable land. Hence, this plan can be argued to overlook the multifaceted values that green environments within urban areas are able to bring. While stating that the parks of Nyhamnen are to be able to act as complements to the otherwise hardscape structure of the inner parts of Malmö, the structural plan seems to prioritize differently. Furthermore, the general aspects of uncertainty that is inherent in the redevelopment process, puts these green areas at risk of being delayed even further. While, on the one hand, emphasizing the importance of both flood adaptation and the integration of green environments, the stages of construction on the other hand contradicts these statements, instead prioritizing the development of dense city blocks and hardscape structures.

Building upon the very same wishes that are expressed in the comprehensive plan, the third stage of our design proposal manages to act as a design that is able to manage flooding, while at the same time making multifaceted connections to water and to the rest of Nyhamnen. Through these connections, our design proposal manages to bring the water into the inner parts of Nyhamnen, rather than pushing it further away. Its location in the very heart of the area acts as a powerful statement that highlights the importance of implementing flood management methods within urban environments.

FUTURE WORK

Several of the subjects that merely have been touched upon in this master's project could act as interesting topics for further studies. As an example, a study into how the evolutionary design concept could be communicated by more general terms and visualizations could help illustrate the ways in which the concept can be applied to other sites as well. Moreover, another interesting point of departure is to further investigate the effects of the proposed site editing at Stockholmskajen; how will Nyhamnen's areas of influence and effect be affected by the proposed design concept?

The technical aspects of flood water management is another subject that would be interesting to study further. As argued by Svenskt Vatten (2011), geohydrological and topographical conditions are aspects that needs to be considered when planning for flood management (Svenskt Vatten 2011:21,33). Deriving from the field of landscape architecture, this master's project, however,

has mainly focused on the design aspects of storm and floodwater management. A study into how more technical, engineered solutions could complement this design could thus act as a possible continuation of this project. On a similar note, another interesting topic would be to further investigate how one can design for the specific effects of flooding from sea level rise; while this master's project mainly has focused on the effects of cloudbursts, an important future challenge within urban environments will also be to manage flooding deriving from sea level rise.

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