Intermediate Community Use during Brownfield Remediation

Phytoremediation's Applicability Analysis in the Post-Industrial City of Malmö

Rie Chimura

Independent Project • 15 credits
Swedish University of Agricultural Sciences, SLU
Faculty of Landscape Architecture, Horticulture and Crop Production Science
Department of Landscape Architecture, Planning and Management
Landscape Engineer Programme – Alnarp
Landscape Architecture
Alnarp 2022

Intermediate Community use during Brownfield Remediation. Phytoremediation's Applicability Analysis in the Post-Industrial City of Malmö

Rie Chimura

Supervisor:	**Marie Larsson, Swedish University of Agricultural Sciences, Department of Landscape Architecture, Planning and Management**
Examiner:	Åsa Ode Sang, Swedish University of Agricultural Sciences, Department of Landscape Architecture, Planning and Management

Credits:	15 credits
Level:	First cycle, G2E
Course title:	**Independent Project in Landscape Architecture, G2E**
Course code:	**EX0843**
Programme/education:	**Landscape Engineer Programme - Alnarp**
Course coordinating dept:	**Department of Landscape Architecture, Planning and Management**
Place of publication:	**Alnarp, Sweden**
Year of publication:	**2022**
Cover picture:	Vintergatan Urban Garden. [Photography].

Keywords:	applicability analysis of phytoremediation, brownfield remediation, intermediate community use, landscape architecture, post-industrial city of Malmö

Swedish University of Agricultural Sciences

Faculty of Landscape Architecture, Horticulture and Crop Production Science (LTV)

Department of Landscape Architecture, Planning and Management

Abstract

The general understanding of brownfield is a contaminated site often due to former industrial occupation. Brownfields are the environmental issue and redevelopment target in post-industrial cities, and the situation of Malmö, a former industrial city, is no exception.

Phytoremediation, applying plants to remove contaminants from soil and water, is an environmentally friendly method compared to other remediation techniques considering the disturbance to soil biodiversity, which provides ecosystem services in a city.

Phytoremediation's application is limited to the sites with minor to moderate contamination and often requires an extended application time and careful management of plants, which are considered weaknesses, compared to one-time application remediation methods. However, taking these features as an advantage, intermediate use of brownfields of communities, contributing to creating identity in the area, during the treatment may be possible in the form of a park, community gardens as examples.

This thesis investigates if phytoremediation is suitable for remediating brownfields with a temporal to permanent spatial use during the application in the post-industrial city of Malmö by understanding brownfields, their use, and remediation structure and methods by literature studies and reviews, case studies and GIS analysis.

Phytoremediation of brownfields, where their state generates proactive attitudes of people in the post-industrial environment, exhibits an opportunity for understanding Swedish contaminated areas not only as contaminated lands. The landowner's and municipality's broader understanding of brownfields may support bottom-up initiatives that form identity through interaction with the site. Acknowledging brownfields' state of vacancy without filling them with a fixed function and the phytoremediation method may change the situation and approach to brownfields with minor to moderate risks, often neglected due to the current remediation measure. The recognition of brownfields from ecological, spatial, sociological and economic standpoints may add a new layer of identity in revitalising the post-industrial city of Malmö.

Keywords: applicability analysis of phytoremediation, brownfield remediation, intermediate community use, landscape architecture, post-industrial city of Malmö

Table of contents

List of Tables and Figures

Tables

Figures

Abbreviations and Translations

The list displays abbreviations and translations of English, German, Japanese and Swedish words. Translations conducted by the author are shaded in grey.

Abbreviation	Original	English Translation	Original Language
	Boverket	The Swedish National Board of Housing, Building and Planning	Swedish
ES	Ecosystem Services		English
EBH-Support	Efterbehandling av förorenade områden-Stödet (EBH-Stödet)	The Post Treatment of the Contaminated Areas Support	Swedish
MIFO	En metodik för inventering av förorenade områden	A Methodology for Inventory of Contaminated Areas	Swedish
	Förorenade områden	Polluted Areas	Swedish
	Föroreningsskada	Pollution Damage	Swedish
	Förorenade mark	Contaminated Ground	Swedish
	Genfūkei (原風景)	Primal Scenery	Japanese
	Harappa (原っぱ)	Field (Direct Translation)/Brownfield (Substantial Meaning in the Context)	Japanese
IBA	Internationale Bauausstellungen	International Building Exhibition	German
IED	The Industrial Emissions Directive		English

Abbreviation	Original	English Translation	Original Language
KM	Känslig markanvändning	Sensitive Land Use	Swedish
LSS	Länsstyrelsen Skåne	The County Administrative Board of Scania	Swedish
LS	Länsstyrelsen/Länsstyrelsena	The County Administrative Board/s	Swedish
MS	Malmö stad	The City of Malmö	Swedish
	Markföroreningar	Soil Pollution	Swedish
	Marksanering	Land Remediation	Swedish
MF	Miljöförvaltningen	The Environmental Administration	Swedish
MKM	Mindre känslig markanvändning	Less Sensitive Land Use	Swedish
NVV	Naturvårdsverket	The Swedish Environmental Protection Agency	Swedish
PBL	Plan- och bygglagen	the Planning and Building Act	Swedish
RR	Riksrevisionen	The Swedish National Audit Office	Swedish
	Skåne/Skåne län	Scania/Scanian County	Swedish
SBK	Stadsbyggnadskontoret	The City Planning Office	Swedish
SGF	Svenska Geotekniska Föreningen	Swedish Geotechnical Society	Swedish
	Tätorter	Urban Areas	Swedish
USEPA	The United States Environmental Protection Agency		English
	Översiktsplan	Comprehensive Plan	Swedish

1. Introduction

1.1 Background

In the 1990s, I spent my early childhood in *Roppongi*[1], one of the districts in central Tokyo. There was an open field without any specific function next to Hinokichō Park in the area. The feeling of freeing my mind away from preconceptions of daily life by being in the abandoned plot taken over by grass is still a memorable experience. However, the principal office of the ministry of defence, located next to the park, moved out in 2000. Hence, the redevelopment project of *Tokyo Midtown complex*[2] took place there in 2007 (Tokyo Midtown Management Co., Ltd. n.d.b). The park and the field also became a part of the redevelopment and were renewed. Therefore, the scenery remains only in my memory today.

In 2018, my interest in the areas that previously flourished from industry started to develop through co-hosting a sensory and participatory workshop, Evolving Neighbourhood: Visions by the Community of Shibaura, at *Shibaura House*[3] in Tokyo to study the artificially reclaimed *Shibaura Sanchōme Island*[4], located in the former industrial area of Tokyo Bay. Further, my studies at the Swedish University of Agricultural Sciences Alnarp introduced me to the phenomena of brownfields, various benefits of urban agriculture and the existence of phytoremediation. The general understanding of brownfield is a contaminated site often due to former industrial occupation. The cleaning method of phytoremediation applies plants to remove contaminants from soil and water. In Berlin, personal involvement in the community garden *Gemeinschaftsgarten Allmende-Kontor* [5] at Tempelhof Field deepened my understanding of the

---

[1] *Roppongi*, a district of Minato Ward in Tokyo, Japan, has many foreign embassies and is known for its vivid nightlife (Wikipedia 2021).

[2] *Tokyo Midtown complex* is composed of six buildings with the functions of restaurants, shops, offices, a hotel, a green space and a museum (Tokyo Midtown Management Co., Ltd. n.d.a)

[3] *Shibaura House* is a redeveloped building on the plot of a former printing company, rental spaces, a cafe with a free space open to anyone in the area where there are not many public spaces (Shibaura House n.d.).

[4] *Shibaura Sanchōme Island* is a reclaimed island in Tokyo Bay where it flourished with industries.

[5] *Gemeinschaftsgarten Allmende-Kontor* is a community garden running since 2011, created in Tempelhof Field, Berlin, Germany where 500 gardeners take care of 250 raised beds in 5000m^2 (Gemeinschaftsgarten Allmende-Kontor e.V. n.d.)

community garden and brownfield's significant functions in the city as a form of neighbourhood community and the use of a brownfield site.

These personal experiences, together with the current environmental engagement, such as the United Nations' Sustainable Development Goals, SDG, led me to conduct this research of Intermediate Community use during Brownfield Remediation: Phytoremediation's Applicability Analysis in the Post-Industrial City of Malmö. Mainly, SDG Goal 11 Sustainable Cities and Communities aiming at secure access to public and green spaces (United Nations Department of Economic and Social Affairs The Division of Sustainable Development Goals n.d.a) and Goal 15 Life on Land targeting restoration of damaged soil (United Nations Department of Economic and Social Affairs The Division of Sustainable Development Goals n.d.b) apply on this topic in the field of Landscape Architecture at my present location of Malmö, under the transition from the city previously shaped by industries. Constructions have been taking place to convert several city areas, such as Västra Hamnen and Nyhamnen, to create more housing. Preserving the city's history as an element of identity, built upon residents' customs and integrating them as a part of the design will be a challenge in the large-scale transformation.

1.2 Purpose

Phytoremediation as a brownfield remediation method, applying specific plants for targeted contaminants to subtract from the soil, takes an extended application time. Taking this feature to the advantage, urban agriculture as an example of intermediate use may be beneficial for community formation, creating identity in the area of the city. It is not a widely practised method, and the reason for it may be the longer application time and management over time. The inflexibility contradicts the immediate development of brownfields.

This thesis will investigate if phytoremediation is suitable for remediating brownfields with a temporal to permanent spatial use in the post-industrial city of Malmö by understanding brownfields, their use and remediation structure, and methods in individual to municipal scales. Firstly, literature studies examine brownfields' identity. Secondly, the overview of brownfield remediation methods reviews the characteristics of each method, and the case studies show how brownfields undergo remediation and host intermediate use. Thirdly, the review of the Swedish administrative system for brownfield remediation with the focus of Malmö indicates the city's approach. Lastly, brownfield redevelopment projects in Malmö as cases and GIS analysis determine the potential of application of phytoremediation.

1.2.1 Research Question

The central research questions of this bachelor thesis are; *Is phytoremediation applicable to the brownfields in Malmö?* Hence, *is there a space for community development by preserving elements for shaping the site's identity in the intermediate use of brownfields during the application of phytoremediation?*

1.3 Method and Limitations

The research method of this thesis is qualitative content analysis with a quantitative angle. This thesis conducts qualitative research based on literature study and analysis combined with quantitative research based on statistics, such as numbers of brownfields and their risk level, for a deeper understanding of the topic in the context of Malmö, Sweden.

Amongst various, such as architectural, geotechnical and biological, understanding of brownfields and their remediation methods, the thesis intends to investigate and evaluate how Landscape Architecture can approach brownfields. Thus, it excludes the analysis of the phytoremediation method itself due to the focus on its applicability analysis. Furthermore, it investigates the current situation of brownfields in Malmö and if there is a capacity for introducing phytoremediation. Additionally, it includes site visits to physically understand the situation of brownfields and community gardens and an interview to deepen the knowledge of the situation of a community garden apart from the primary research method of literature study.

3.3. Case Study Analysis: Brownfield Transformations into Green Spaces with Phytoremediation reviews projects with temporality, two community gardens on brownfields and two reclaimed parks. Vintergatan City Growing in Malmö is significant due to the location in Nyhamnen, an industrial area and expecting redevelopment of the area. Due to the limited access to information online, the study includes an interview with the initiator and gardener, Jenny Sjölin. The other example, Allmende-Kontor in Berlin, Germany, one of the countries with many brownfields in the E.U. context, has been thriving for over a decade and displays the importance of studying their engagements with, perceptions of and situations at the brownfields. The two examples of parks turn their industrial heritages into place identity and exhibit the possibility of on-site remediation incorporated into landscape designs. Gas Works Park in Seattle, the U.S., one of the pioneering projects in terms of ongoing remediation and functioning as a park simultaneously, is crucial to be reviewed in discussing in-situ remediation's application. The Landscape Park Duisburg Nord in Germany is one of the limited numbers of existing park projects going through phytoremediation.

5.3. Case Study Analysis: Ongoing Redevelopment of Brownfields analyses two harbour areas that thrived with industries in Malmö in different time scales of redevelopment. Västra hamnen, the harbour area which was the centre of the industrial development of Malmö and has been redeveloping since shortly after its decline until today, is reviewed. Nyhamnen, another harbour area for which redevelopment will take place soon in the future, is consequently researched to find out the potential in phytoremediation application.

The quantitative part, including the study of brownfields' situation in Malmö and Scania County and GIS phytoremediation applicability analysis on the ArcGIS software, uses the hypothesis testing method based on the statistics provided by the City of Malmö and County Administrative Boards. However, this thesis does not evaluate the methods taken by the state for the data gathering.

GIS analysis examines relevant areas for phytoremediation application within Malmö Municipality based on the level of contamination. The target area of analysis refers to the targeted development areas of the City of Malmö on its

Comprehensive Plan from 2018, where those parts of the city will develop further. The other key material is the national-scale dataset EBH_Potentiellt_fororenade_omraden of the County Administrative Board based on MIFO Risk Classification, which exhibits risk-classified and unclassified brownfields, applied to determine the sites with suitable contamination levels for phytoremediation.

Time is another constraint, and time restriction limited the range of the project from reaching the part of designing brownfields. Also, this research covers the industrial revolution as the previous use of brownfields, its decline or the formation of brownfields and the time since then regarded as a post-industrial period.

2. Brownfields' Role in the Post-Industrial Environment

Post-industrial cities, once flourished with industrialisation, go through the transition of leading industries, and it has been changing the cityscapes. From an architectural point of view, declined industries are moving out, and redevelopment sets in, which is the cycle of building, demolishing and transforming. In between occupations, vacant spaces appear within the urban fabric. These spaces, brownfields, and their state generate new attitudes among people in the post-industrial environment. According to Sergio Lopez-Pineiro, an Interdisciplinary Architect and a Lecturer in Landscape Architecture at the Harvard University Graduate School of Design, the idea of public space to be a fixed space comes from "industrialised capitalist societies" (2020:93). Dr Rolf Kuhn is the team leader of the first edition of the International Building Exhibition, IBA, from 2000 to 2010 in Southern Brandenburg, focusing on the landscape of industrial relics, such as IBA Emscher Park (Internationale Bauausstellungen n.d.). In his article *Designing New Landscape*, Dr Kuhn mentions that "there is a willingness to create new landscapes and a need to rebalance social, economic and ecological concerns" (Kuhn 2014:17). He concerns the environment that intervention in the re-naturalisation of brownfields is unavoidable because the remaining contaminants may prohibit humans from accessing the site for centuries (ibid.). These observations seek an alternative meaning of public space in site use during the transition. Hence, this chapter will study brownfields' role in the post-industrial environment through investigating brownfields from ecological, spatial and sociological perspectives.

2.1 Definition of A Brownfield

The general understanding of brownfield is a contaminated site often due to former industrial use. The industrial to post-industrial era shift left many brownfields within the urban fabric. Brownfields are frequently left abandoned, waiting for transformation, or under the process of transformation since planning takes time.

Brownfields have different aspects, and the definition of brownfield in terms of management varies from country to country depending on which elements to cover, such as "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (United States Environmental Protection Agency 2021). The government of the United Kingdom defines it as "previously developed land"

(United Kingdom Ministry of Housing Communities and Local Government 2021:70), including fixed construction, housing and courtyards and permanent groundworks (ibid.). At the same time, a few potentially contaminated areas are excluded, such as buildings for agriculture and forestry, mineral extraction sites, landfill sites with a reclamation plan, green spaces within a densified area and developed lands merged into the natural landscape (United Kingdom Ministry of Housing Communities and Local Government 2021:70-71). In contrast, the County Administrative Boards in Sweden defines former plant nursery sites as brownfields due to the old-fashioned pesticides already likely to be banned today (Länsstyrelsen Örebro 2017:3), which are equivalent to buildings for agriculture and forestry in the U.K. government's definition. Brownfield management and treatment in each country vary depending on the local purpose for the brownfields.

There is no unified term referring to brownfields in the Swedish language. Swedish “förorenade områden” (Länsstyrelsen Skåne n.d.a), polluted areas, or “föroreningsskada” (ibid.), pollution damage, are the places concerned with the risk to human health and environment (ibid.). The municipality, the City of Malmö uses the words “markföroreningar” (Malmö stad 2021b), soil pollution and “marksanering” (Malmö stad 2021c), land remediation, and the Swedish Environmental Protection Agency writes “förorenade mark” (Naturvårdsverket 2009), contaminated ground. Previous or even current site use, often industrial, defines Swedish polluted areas (ibid.) as well as brownfield with its term of the United States Environmental Protection Agency and the U.K. government. Thus, it may affect “land or water areas, sediments, groundwater, buildings and facilities” (ibid.). The Swedish terms of polluted areas, polluted damage and polluted ground emerge “through emissions, spills and accidents at previous industrial operations” (Statens Geotekniska Institut 2020) that can contaminate the ground. Due to these characteristics, this thesis considers them equivalent to brownfields in the English language.

2.2 Ecological Function of Brownfield in the Urban Environment

2.2.1 European Union’s Soil Protection Strategy

The soil in urban areas does not gain much attention. However, it bears essential functions, which are taking a considerable part of the carbon cycle, providing ecosystem services and supporting biodiversity.

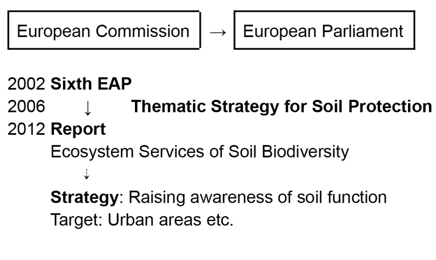

Figure 1. How Soil in Urban Areas Became a Target in the Sixth EAP.

The soil situations in the European Union and world urge the European Commission to appeal to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions to focus on soil protection and rescue. The Sixth Environment Action Programme's conduct, Sixth EAP, was in effect from 2002 until 2012, introduced by the European Parliament and the European Council. Sixth EAP introduced Thematic Strategy for Soil Protection in 2006 and released a report in 2012 (Figure 1). *The Report* addresses the soil situation, considering the soil in urban areas one of the primary soil protection and rescue targets (The European Commission 2012).

One of four significant aspects of the strategy is raising awareness of soil functions since they are taken for granted. Consequently, deterioration of soil quality caused by excessive exploitation, the shift of use, pollution, sealing, compaction, erosion and abandonment of land, among others (Publication Office of the European Union 2011/0571; Publication Office of the European Union 2011/0244; Publication Office of the European Union 2006/0231 see Drenning et al. 2020:2) take place gradually (The European Commission 2012). Therefore, the programme lists soil protection from erosion and pollution as one of the goals (Vanheusden 2007:563-564).

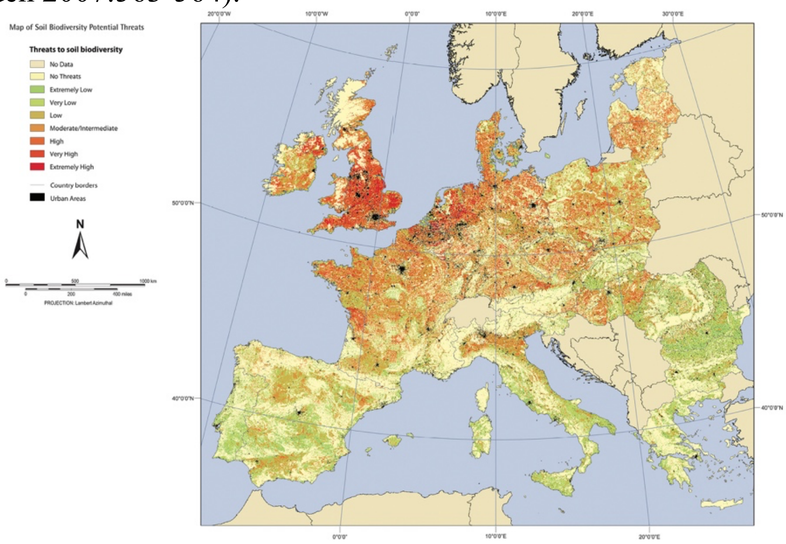

Figure 2. Map of Soil Biodiversity Potential Threats. (The Publication Office of the European Union 2010) https://esdac.jrc.ec.europa.eu/content/atlas-soil-biodiversity

Moreover, it reports a 60% loss of biodiversity and ecosystem services in the last 50 years (Drenning et al. 2020:2), announced in 2005 (Lidgren 2015:3). The map (Figure 2), illustrating European soils potentially in danger, indicates that the soils of densely populated areas and intensive agricultural lands in the E.U. are at risk. The City Planning Office at the City of Malmö, a city in Sweden and a part of the E.U., also acknowledges this critical situation.

Quality soil supports biodiversity and ecosystem services, ES. ES are "the direct and indirect contributions of ecosystems to human well-being" (TEEB 2010 see Drenning et al. 2020:2). Soil biodiversity provides ES, such as providing nutrients to plants and organisms, filtering and decontaminating water, supplying chemicals for human health and being a part of the carbon cycle (The European Commission 2012).

Soil sealing, one of the addressed issues for soil degradation on *the Environmental Report* by the European Environment Agency in 2010, removes the function of soil, such as the production of food, water filtration and retention when covered with impermeable materials (European Environment Agency 2010: see The European Commission 2012). Soil sealing contributed to the enormous loss of soil, 1,000 km2 each year from 1990 to 2000 (ibid.). All in all, the European Commission grants the importance of soil biodiversity and its provision of ES on the Sixth EAP, which advocates the protection of soil in urban vicinities.

2.2.2 Brownfields as A Wildlife's Valuable Habitat

On the local scale, although brownfields may look deserted at first sight, the ecological value of brownfields could be high. Despite the contaminated grounds, the state of brownfields being abandoned or awaiting transformation, together with the site condition, some of the brownfields are a favourable environment for wildlife to develop. Those brownfields play a vital role in the city environment in preserving biodiversity.

Philip Hunter, a Freelance Science and Technology Writer and Journalist, suggests the ecological importance of brownfields in his article *Brown is the New Green: Brownfield Sites often Harbour a Surprisingly Large Amount of Biodiversity*. He indicates that wetland and dry areas in poor nutrition, often contaminated ground, have conservation value (Hunter 2014:1238). Sarah Henshall, a Lead Ecologist at Buglife in the U.K., the only invertebrate conservation organisation in Europe, referred by Hunter, illustrates that dry and malnutrition ground of the fabric for bigger scale industry or utility imitates sand dunes and heathland relatively precisely in terms of soil quality and allows endangered or minority species to have their refuge (ibid.). These site characteristics attract pollinators to the plants growing there, and the re-naturalised environment favours invertebrates to pass the winter, such as decomposing wood or bramble (ibid.). Henshall states that brownfields, compared to the natural environment, have intense, extraordinary and more diverse biodiversity (ibid.). The fact that two brownfields account for the "top five sites in the U.K. for rare and endangered species" (Robins et al. 2013:5 see Hunter 2014:1238) support their arguments. Furthermore, Henshall says that there is a need for a greenbelt or land for farming instead of architectural redevelopment on brownfields (Hunter 2014:1241).

On the other hand, brownfield redevelopment has favoured more than greenfield and urban sprawl development in the U.K. since the 1990s. The governmental aim of 60% new housing construction on brownfields was achieved eight years earlier than its aim of 2004 and reached 80% in 2008 (Schulze Bäing & Wong 2012:2990).

The efficient redevelopment has been successful, yet there is another perspective. The National Planning Policy Framework concerns preserving the natural environment, specifically habitats and biodiversity protection and suggests action guidelines (United Kingdom Ministry of Housing Communities and Local Government 2021:50-52); however, it does not mention a further explanation. The criticism of the National Planning Policy is that it, without specific guidelines, is allowing transformation on the wildlife-rich brownfields, in reality (Robins et al. 2013; Grant 2006 see McCallum & Sardo 2021:2). Over six years, more than 50%

of brownfields with thriving wildlife have already been transformed, lost or are in danger of disappearance in the Thames Gateway, 70 kilometres around the River Thames surrounding London (Robins et al. 2013:15-16). The situation requires more specific protection plans within the National Planning Policy to prevent the disappearance of wildlife-rich brownfields, vital for today's national biodiversity.

In short, urban brownfields are essential for preserving biodiversity and functioning ES. Despite being contaminated, brownfields can maintain biodiversity by providing suitable environments for certain species that generally lost habitable environments. Furthermore, the soil is a crucial part of the carbon cycle, and brownfields may take significant soil surface areas in densely built environments where the surface is often sealed.

2.3 Brownfield as An Urban Void

Due to their vacancy within the urban fabric, redevelopment targets brownfields. Although brownfields appear to be vacant, they host endangered plants and species and users who want to take or need space. Lopez-Pineiro suggests brownfields as an alternative public space in his book, *A Glossary of Urban Voids*.

In this aspect, vacant land is called by the terms "Terrain Vague" (Lopez-Pineiro 2020:144) and "Urban Void" (Lopez-Pineiro 2020:156). Certain states of urban brownfields, the post-industrial legacies, characterise urban voids. One of Lopez-Pineiro's 13 definitions of urban voids are

> "Sites and buildings that derive from the vast arsenal of nineteenth-century infrastructure, such as slaughterhouses, barracks, railyards, docks, and industrial complexes, and that are now falling into definitive disuse and disrepair; this ruined infrastructure tears huge holes - functionally as well as spatially - in the middle of the urban fabric or in the immediate periphery of city centers". (Lopez-Pineiro 2020:156)

Also, urban voids tend to look alike regardless of their location in the world, metaphorically like shopping malls as an example, for their generic formation (Lopez-Pineiro 2020:23).

2.3.1 Terrain Vague and Urban Voids

Terrain Vague

The introduction of terrain vague has changed the understanding of vacant land, which had been a problematic space that "needed to be redeveloped and reabsorbed again by the productive spacial fabric we call city" (Lopez-Pineiro 2020:11).

The term terrain vague acknowledges vacant spaces without assimilating them into a building scape. The text *Terrain Vague*, from 1995 and written by the Catalan Architect, Historian and Philosopher Ignasi de Solà-Morales Rubió, describes terrain vague: an "empty, abandoned space in which a series of occurrences have taken place" (Solà-Morales 1995:119), which may be an alternative to "planned, efficient, and legitimated city" (Solà-Morales 1995:123).

The socially and politically engaged artist Gil Doron, referred to by Lopez-Pineiro, portrays that "most of these terrains vagues have been populated by marginalized communities" (Doron 2008:204 see Lopez-Pineiro 2020:95-97). From these descriptions, terrain vagues emerging from vacant spaces can be considered an alternative to authorised space.

Urban Void

The term Urban Void has developed from terrain vague. Urban voids, referring to Lopez-Pineiro, are "spaces framed in time or as temporalities framed in space" (Lopez-Pineiro 2020:91) in the situation of "boundedness as a clearly defined interval of space within the city" (Lopez-Pineiro 2020:77).

The term void highlights "particular emptiness (of identity, control, use, meaning, etc.) within a codified or patterned environment" (Lopez-Pineiro 2020:95). He clarifies that the void's temporal emptiness within the urban fabric makes it physically and existentially noticeable.

2.3.2 Urban Voids in the Concept of Public Space

Urban voids can be an alternative public space apart from being redeveloped. The nature of urban voids suggests "a new type of public space that enables the temporary circulation of different collectives" (Lopez-Pineiro 2020:77), such as bottom-up initiatives and individuals. It contrasts to continual management, characteristics or use (Lopez-Pineiro 2020:89).

In contrast to the meaning of vacant lands, the essence of urban voids, they are "never completely empty and the opportunities they present have been noticed and enjoyed by different sensibilities and publics" (Lopez-Pineiro 2020:95). An example is vulnerable species thriving on a brownfield site.

Don Mitchell, a Professor of Cultural Geography at Uppsala University, wrote about several cases of marginalised people, such as homeless people being pushed away from parks by "the legitimate public" (Mitchell 2003:136) in his book *The Right to the City: Social Justice and the Fight for Public Space*. Mitchell, together with Richard van Deusen, Professor in the Geography and Urban Studies Department at Temple University, referred by Lopez-Pineiro, indicate that "a truly public space is one that makes room for contest and struggle" (Mitchell & Van Deusen 2001:104 see Lopez-Pineiro 2020:53, 207) in their analysis for the Downsview Park Competition.

The temporalities of urban voids may allow competition, yet Lopez-Pineiro explains that "industrialized capitalist societies" (Lopez-Pineiro 2020:93) has made public space permanent. This situation and recognition of public space challenge the urban void as an alternative public space (Lopez-Pineiro 2020:95). For these reasons, he further remarks that modern society has difficulty accepting "temporality as an intrinsic quality of public space" (ibid.) because it may evoke fears of affecting the public realm. For the strategic structure of the city, Lopez-Pineiro raises doubt if a regime that characterises and demands "power and authority" (Lopez-Pineiro 2020:195) can permit "freedom and indeterminacy" (ibid.). In order to recognise urban voids as an alternative public space, our recognition of public space must be revised.

2.3.3 Designing Urban Voids in Landscape Architecture

Landscape Architecture's Approach to Urban Voids

Landscape Architecture may find a suitable approach to urban voids. Solà-Morales, referred to by Lopez-Pineiro, claims that urban voids should be considered "as a new type of public space that is truly significant in both sociocultural and ecological terms" (Lopez-Pineiro 2020:71).

Architecture and Urban Design's perspectives see the vacancy as an opportunity for redevelopment (Solà-Morales 1995:122-123). Hence, Pier Vittorio Aureli, the Head of the PhD Programme at Architectural Association School of Architecture, suggests developing a new architectural term to acknowledge and allow the emptiness (Aureli 2013:126 see Lopez-Pineiro 2020:199) in his article *The Theology of Tabula Rasa*, credited by Lopez-Pineiro.

Thus, Landscape Architecture plays a vital role in understanding and approaching urban voids, which may influence the new understanding of voids in Architecture and the authority to acknowledge an alternative definition of public space and its users.

Designing Urban Voids

Three criteria of the designing method of urban voids, according to Lopez-Pineiro, are the following:

- The space should prevent fixed usage or occupation by "a singular form of expression (religious, political, racial, or commercial, for example)" (2020:209).
- Urban voids should enhance existing characteristics and not introduce new qualities to generalise different sensibilities (ibid.).
- "Absence of codification" (2020:211) is necessary to define urban voids as an alternative to public spaces (2020:209).

Voids are the utmost form at expressing "multiplicity of identities" (Borret 1999:240 see Lopez-Pineiro 2020:211) in their uncodified physical form in urban landscapes (ibid.) according to the text *The 'Void' as Productive Concept for Urban Public Space* of the Architect and Professor of the Urban Project at the University of Ghent, Kristiaan Borret referring to the Italian Architect and Urban Planner Stefano Boeri, credited by Lopez-Pineiro. For these characters, voids contrast to the top-down public space formation, for which the designer aims target groups and activities.

2.4 Brownfields as A Common Space

The term Common Space is similar to Urban Void in terms of being an alternative public space because the spatial quality of brownfields or vacant lands bears an alternative public space or a common space.

Stavros Stavrides, an Architect, Activist and Associate Professor at the School of Architecture, National Technical University of Athens, explores the sustainability of common space throughout his book, *Common Space: The City as Commons*.

2.4.1 Common Space

Common Space, according to Stavrides, is a space where "institutions take shape and shape those who shape them" (Stavrides 2020:7) and is in a continuous "process" (Stavrides 2020:259) without the form of completion. It means that people and the site feed onto each other in a common space. Stavrides further mentions that once the site is defined, the state of continuously being in the process terminates. In other words, ambiguity of use and potential of the site is the driving force of common space.

2.4.2 Space Commoning

Common spaces emerge through "space-commoning" (Stavrides 2020:261); thus, the capitalistic distinction of public and private ownerships cannot allocate common spaces (ibid.).

The general definition of space is "a concrete product which can be 'used'" (Stavrides 2020:259) and has monetary value and a predetermined use.

The general features of space that common space does not own, described by Stavrides, are:

1. legal criteria (ownership, accessibility, etc.)
2. political criteria (forms of authority which control space)
3. economical criteria (value attributed to space by a certain historically embedded system of market relations) (2020:261)

Stavrides argues that the space-commoners should sustain common space by a fight against capitalistic forces (2020:262-263), and the listed features align with Lopez-Pineiro's designing criteria for urban voids for temporal occupation and non-codifiable space (Lopez-Pineiro 2020:209, 211). Hence, the nature of common space is adaptable and transformable in the constant change of the situation. Managing common space is an unconventional spatial practice in terms of ownership.

2.4.3 Space Commoning against Normalisation

A healthy common space makes the normalisation unstable (Stavrides 2020:263). "Normalization" (ibid.) dictates our relationship and behaviour in daily life and the topic of the society as well as the consequence of some agreement of "power relations” (Stavrides 2020:14-15) in the procedures of “sovereignty, discipline and security” (Stavrides 2020:263). The normalisation of common spaces happens when caging them by “literal or symbolic barriers” (Stavrides 2020:15), suggesting the end of being in the process (ibid.) of the site when the community stops feeding on each other. For these reasons, normalisation stabilises an idea or a space, and active space commoning functions against normalisation.

2.4.4 Challenge of Maintaining Common Space in the Urban Situation

Although they sound alike, common space differs from the public space of the capitalist system, according to Stavrides. “Urban enclaves” (Stavrides 2020:18) or “the islands of the urban archipelago” (ibid.) are the interpretation of the pieces of lands surrounded by buildings in a city, bounded and associated with specific codes of use that define selected user groups (ibid.). This situation can apply to ordinary public spaces, typically designed for target uses.

When this applies to common spaces, due to the nature of enclaves that are imposing regulations and attitudes (Stavrides 2020:262-263), enclosed communities in common spaces can turn into “collective privileges or ... misery” (Stavrides 2020:261).

In summary, membership can be considered a privilege, and falling out of constantly being in the process caused by normalisation may bring an existential issue, misery, to a common space. It is challenging to defend common spaces in urban enclaves with social codes based on the capitalistic definition.

2.5 Fields in Primal Scenery and Their Disappearance in the City with Active Urban Development

Brownfields have a spatial quality, and it influences people’s behaviour. This section discusses the image formation of a place at brownfields and how it affects the collective impression of the city.

2.5.1 Definition of Field in the Primal Scenery

A word can be associated with a shared image of a place among a particular group of people. Harappa in Genfūkei, is a collective image in the Japanese context.

Field

Saburo Kawamoto, a Japanese Film and Literary Critic and a Specially Appointed Professor in the Department of Letters, Course of Japanese Literature at Rikkyo University, considers that defining harappa is challenging (Kawamoto 2012). However, his article *Baseball at Harappa: Great Playground for Children of Shōwa Era* considers “vacant former factory, land for housing on sale, material storage and vacant mansion” (ibid.) as harappa.

Harappa means Field in direct translation by the author; however, Brownfield is the actual meaning in this context. Brownfields have existed in Japanese cities before and after World War II. Pre-war films, such as *Each Night I Dream* by Mikio Naruse from 1933 and *The Only Son* by Yasujirō Ozu from 1936, include scenes of harappa. A postwar film, Akira Kurosawa's *One Wonderful Sunday*, released in 1947, shows harappas where children play baseball and the main characters demonstrate their future dream physically. Cities like Tokyo, which suffered from bombings during the war, possibly had abundant harappas.

Primal Scenery

Fumihiko Maki, one of the well-known Post-War Japanese Architects and a Professor at Keio University, places importance on "Genfūkei" (Okuno 1972 see Maki 2019:243) of "Harappa" (ibid.) from Takeo Okuno's book *Primal Scenery in Literature - The Illusion of Fields and Caves*. Primal Scenery is the translation of genfūkei by the author and applied to the following text.

"Each ethnic group and climate has a common primal scenery" (Ueda et al. 2005:127) is the description of Okuno's definition of primal scenery in the research *Structure of Primal Scenery of Japan and Succession - Identity of Japan extracted from Nursery Rhymes*. The research members are the professor of the Design Culture Planning Education and Research Field in the Graduate School of Engineering, Department of Design Science at Chiba University Akira Ueda, the industrial designer at Life: Enjoyment & Convenience, Inc. Masayoshi Otani and the regular member of Japanese Society for the Science of Design, Special Director and Audit Kiyoshi Miyazaki.

Primal Scenery is associated with the Swiss Psychiatrist and Psychoanalyst Carl Jung's collective unconscious theory (Ueda et al. 2005:127), which claims that everyone inherits an assemblage of wisdom and images from ancestors (Fritscher 2020).

Thus, an image of the field is shared among Japanese people, suggested by Okuno. Jun Aoki, a Japanese Architect, writes in his article *Whereabouts of the Field* regarding Okuno's book that the field has a shared and fundamental sense for everyone beyond physical space, time and generation (Aoki 2019:21-22). In the context of primal scenery, the word field recalls a particular image of a place, which can be imaginative, timeless, may evoke feelings and could be shared over different age groups.

2.5.2 Primal Scenery's Formation in Childhood

Primal scenery is "generally formed through experience in one's childhood" (Ueda et al. 2005:128) by being in a field and learning the site's history through their discoveries.

"A secret playground for children that they unofficially and illegally occupied" (Okuno 1972 see Aoki 2019:19) is the review of field in Okuno's book by Aoki. He analyses the scenes, which evoke the sense of "ferociousness and playfulness" (Aoki 2019:19) to children by reflecting on his childhood memory in a field where children imagined a ragman dwelling there as a human trafficker and animal corpses and bones among dumped rubbish were lying around (Okuno 1972 see Aoki 2019:19). Okuno hypothesises that the brutality comes from the history of the field, which went through the transition of “a sanctuary as the origin of settlement turned into a taboo space” (Okuno 1972 see Aoki 2019:19) and stayed as an enclosed space in the city (ibid.). Lopez-Pineiro also depicts the orientation of open spaces that are “free and perhaps dangerous, interaction” (Mitchell 2003: 129 see Lopez-Pineiro 2020:55).

Hence, Aoki describes the reason why children play there “involuntarily and aimlessly” (Okuno 1972 see Aoki 2019:19) is because they are tracing back the background history of the field and “trying to return to the primitive and bare human nature” (ibid.).

Besides, a field is an attractive playground for children where they can find things to play independently through developing imagination rather than adapting themselves to given materials, such as park’s playground equipment in the regulated environment.

2.5.3 Primal Scenery and City’s Identity

The comprehension of primal scenery by Ueda et al. is “an inseparable people’s life and their awareness in the formation of living environments” (Ueda et al. 2005:127) and “the original form of ethnic hometown, which is shared by the majority” (Ueda et al. 2005:128).

Ueda et al. claim that Japanese identity shaped by the climate, history, and culture over time is no longer significant due to the introduction of Western culture, prioritising economic benefit, convenience, and chasing new trends (2005:127). Hence, “the nostalgic and warm image” (ibid.) can be seen solely in nursery rhymes because urban scenery is neither rooted to nor reflects the site history, described as “a state of being non-national regarding the view of high-rise buildings and apartments” (ibid.).

These explanations imply that an industry-based economy drastically changed the city space. Hence, Ueda et al. suggest that re-recognition of Japanese primal scenery is valid for comprehending Japanese identity and a crucial opportunity to assess the scenery of Japan. Site history plays an essential role in understanding where we come from and why we live in the way we live, and primal scenery is a way to understand our roots in the place.

Ihnji Jon, a Lecturer in International Urban Politics at the University of Melbourne, writes in her book, *Cities in the Anthropocene - New Ecology and Urban Politics*, from an urban historian’s point of view and demonstrates “what makes a city as a ‘city’” (Jon 2021:125) is a “‘sense of place’ that arises out of the complex processes of interaction amongst its people, histories, and physical/geographical settings” (ibid.). There, “'scent' or ‘atmosphere’” (Jon 2021:126) emerge from the compiled intense interactions in the form of “physical urban heritages, customs, cultures, and habits” (ibid.), which can last for more than the individual lifespan and generations (ibid.). Thus, people’s interaction with their environment shapes the sense of place, and it is constantly feeding onto the creation of the scent or atmosphere of the city.

In other words, primal scenery is a sense of place for this shared background. Forming primal scenery means creating the city’s identity, which is possible at fields.

2.5.4 Lack of Fields in the City

According to Ueda et al., the development of the city causes the disappearance of fields.

In Aoki's theory, a space constantly transforms from a field to an amusement park, and vice versa. Aoki understands fields as an unspoiled state in the continuous transition of spaces (2019:28) and metaphorically calls a space with a designated use an "amusement park" (ibid.). They are located on the opposite end and exist in the constant transition of the site (ibid.). The continuous transition of a site is the following: Shift of use or intention of an amusement park based on the saturation of rules turns the site into a field, and the use and intention shape a field in the process of transformation into an amusement park (Aoki 2019:27-28).

From the states of emergence and disappearance, Aoki's other recognition of field, the actual use of the space determines the use of the field (Aoki 2019:27), is along the same line with Lopez-Pineiro's perception of urban voids, "spaces framed in time or as temporalities framed in space" (Lopez-Pineiro 2020:91). In Aoki's theory, the state of every single space fits in between the range of field and amusement park, and amusement parks are dominant at present (Aoki 2019:27). That means that development leaves little space for fields' existence. The spaces with predominant functions monopolise the city, and spaces without allocated functions, such as fields, are not abundant.

Primal scenery, a shared understanding of a place, is likely to be formed in one's childhood through interaction with fields and their components, which allow one to experience the space physically, mentally and emotionally. Safeguarding a certain proportion of sites in the condition of a field or the unspoiled state from their transition into an amusement park or spaces with predetermined functions leaves space for citizens' primal scenery formation in a city. Primal scenery formation is the act of regaining a human being's primal nature. Brownfields, spaces that lost the initial function, or fields may play an essential role in forming primal scenery in the post-industrial cityscape.

This chapter explored the brownfield's role in the post-industrial environment from ecological, spatial and sociological perspectives. From the Landscape Architecture standpoint, brownfields, contaminated sites, can be a new type of landscape that harmonises societal issues (Kuhn 2014:17). It is crucial to approach brownfields in Landscape Architecture (Lopez-Pineiro 2020:195) and even work onto the field of Architecture and Urban Planning to accept the empty condition (Aureli 2013:126 see Lopez-Pineiro 2020:199).

3. Brownfield Transformation and Its Intermediate Use

This chapter will explore brownfield remediation methods, including phytoremediation and analyse case studies for brownfield's transformation into green space with phytoremediation.

3.1 Brownfield Remediation Methods

3.1.1 USEPA's Remediation Methods

Table 1. Comparison of USEPA and SGF Remediation Methods.

		USEPA	**SGF**
In-Situ	Planting	Phytoremediation (6)	Phytoremediation (3)
	Injection, extraction, thermal well or filter to the ground, connected to the machinery to control the chemical condition	Bioremediation (5)	Bioremediation (1)
		On-site or 'In-situ' treatment (4)	Multi-phase extraction (2)
		[All the Other In-Situ Methods]	Groundwater pump and treat (4)
			In-situ soil washing (6)
			Chemical oxidation (7)
			Chemical reduction (8)
			Soil vapour extraction (9)
			Stabilising or solidification remediation (10)
			In-situ thermal remediation (11)
			Supervised natural self-purification (12)
	Sealing		Containment or barrier technic (5)
Ex-Situ		Capping (3)	
	Soil excavation		Ex-situ soil washing (13)
			Drilled shaft remediation (14)
			Ex-situ thermal remediation (15)
		Excavation (1)	
		Tank removal (2)	
		Lead and asbestos abatement (7)	

The published remediation methods of the United States Environmental Protection Agency, USEPA (Table 1), are (1) excavation, (2) tank removal, (3) capping, (4) on-site or 'In-situ' treatment, (5) bioremediation, (6) phytoremediation and (7) lead and asbestos abatement" (United States Environmental Protection Agency 2019).

(1) Excavation replaces contaminated soil around the surface to clean soil from another location. The contaminated soil goes to landfills. (2) Tank removal

applies to fuel tanks to excavate the soil below the tanks. (3) Capping covers the contaminated soil with a geotextile not to spread the contamination to the surrounding area. (4) On-site or 'In-situ' treatment adds chemicals in the contaminated soil to break down contamination. (5) Bioremediation inserts "nutrients, oxygen or chemicals" are added to activate the development of microbes in the soil, which breaks down contaminants into "water, gas or less harmful or toxic substances". (6). Phytoremediation employs the plant root system to take up contaminants. (7) Lead and abatement are conducted by professionals with specific types of machinery (United States Environmental Protection Agency 2019).

3.1.2 SGF's Remediation Methods

The Action Portal of the Swedish Geotechnical Society, SGF, explains land remediation methods in the categories in and ex-situ, on and off-site remediations (Table 1).

The listed in-situ remediation methods are (1) bioremediation, (2) multi-phase extraction, (3) phytoremediation, (4) groundwater pump and treat, (5) containment or barrier technic, (6) in-situ soil washing, (7) chemical oxidation, (8) chemical reduction, (9) soil vapour extraction, (10) stabilising or solidification remediation, (11) in-situ thermal remediation and (12) supervised natural self-purification (Svenska Geotekniska Föreningen 2020). Apart from phytoremediation, all the listed in-situ methods influence the chemical composition of the soil on-site by injection or extraction—otherwise, a thermal well or filter insertion.

Ex-situ methods are (13) ex-situ soil washing, (14) drilled shaft remediation and (15) ex-situ thermal remediation (ibid.). All the ex-situ methods require soil excavation to treat the contaminated soil elsewhere.

3.1.3 Remediation Methods Analysis

USEPA specifies a few more variations of remediation methods than the methods listed by SGF, which can be due to different land management policies. Overall, phytoremediation appears to be the gentlest management of contaminated ground in terms of the soil environment, not inserting artificial tools and chemicals into the ground. The method lets plants handle the chemicals in the soil.

All the listed in-situ and ex-situ methods apart from phytoremediation require heavy machinery or facilities, which are expensive to operate. (1) Excavation, (2) tank removal of USEPA and (13, 14, 15) ex-situ methods listed by SGF require excavation and replacement of soil. These methods and filter insertion of some of the methods may disturb the existing microbial environment. (3) Clapping traps contaminants in the ground, which postpones the issue to the future.

Excavation, tank removal, and ex-situ methods finish in one step and are convenient. On the other hand, most of the ex-situ and in-situ treatments of soil may change the chemical composition of soil drastically.

Compared to other methods, phytoremediation without heavy machinery is virtually unopposed from an economical and sustainable point of view regarding the effect on the atmospheric carbon cycle.

3.2 Phytoremediation of Brownfields

Phytoremediation is one of the brownfield remediation methods, which is less harmful to the soil environment and is not economically demanding (The Science Communication Unit, University of the West of England, Bristol 2013:16) compared to other remediation methods yet requires management and time for the completion.

One definition of phytoremediation is:

> Plant root systems release substances which help plants neutralize, stabilize or increase microbial degradation of contaminants in contaminated soil or water near roots. Select plants can also take up contaminants through their roots, reducing soil and water contamination over time. United States Environmental Protection Agency (2019)

Phytoremediation is one of the in-situ remediation methods, often applied for surface contamination of soil and water (Svenska Geotekniska Föreningen 2019). It can treat moderate contamination of "metals, pesticides, explosives, chlorinated solvents and volatile petroleum contaminants" (ibid.). High contamination sites may damage the plants.

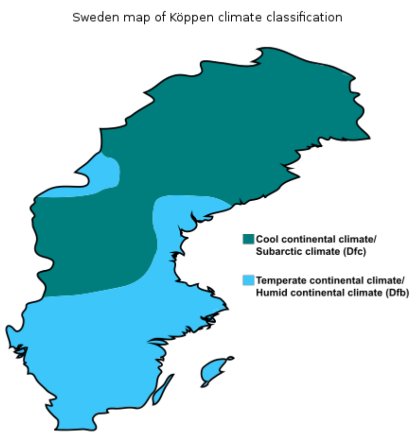

Figure 3. Sweden Map of Köppen Climate Classification. (Wikipedia 2016) (CC BY-SA 4.0)

Warm and temperate climate zones are suitable for Phytoremediation (Svenska Geotekniska Föreningen 2019). Phytoremediation is apt to the southern part of Sweden (Figure 3), where Malmö is.

3.2.1 Phytoremediation's Mechanism

Several purification systems are collectively called phytoremediation, including phytoextraction, phytostabilization and phytate degradation (Svenska Geotekniska Föreningen 2019).

Phytoremediation process is the following:

1. Phytostabilization of the roots collect contaminants in the rhizosphere and prevents the spreading in the area (Bolan et al. 2011:145) permanently (Svenska Geotekniska Föreningen 2019).
2. Phytoextraction of the roots takes up contaminants from the soil.
3. Phytate degradation is the transformation of contaminants into biomass in the upper part of the plants (Svenska Geotekniska Föreningen 2019).

The biomass can be harvested or incinerated (Svenska Geotekniska Föreningen 2019). If the contaminants are metals or inorganic matters, the plants must be managed regularly, such as by cutting or harvesting, and the harvested biomass goes to landfill or hazardous waste (ibid.). Essentially, specific plant species remove specific chemicals. In addition, root depth is crucial to reach out to the contaminants.

3.2.2 Evaluation

Unlike other mechanical remediation methods, phytoremediation depends on plants' nature to interact with the environment and moderately interferes with the existing soil environment. When smaller areas go through excavation, the biodiversity overground is more likely to be conserved.

On the other hand, phytoremediation requires careful management from planning and application to on-site management, and there is a risk for an unfavourable result. Moreover, regularly and at the end of the application period, on-site plant management and harvesting are required, if necessary. Furthermore, there are concerns, such as if the plants on the application may spread the contaminants through pollinators and the sustainability of disposal methods of harvested plants. The introduction of phytoremediation needs to address these matters in advance.

Another remark is the long application time. Phytoremediation takes a long time, which can be more than a decade. The application time depends on the applied species and the level of contamination on site.

To sum up, phytoremediation costs and modifies the site less than other remediation methods without heavy machinery yet requires careful planning and a long-term application, often over a decade. It may preserve the local biodiversity by its application on several stages.

3.3 Case Study Analysis: Brownfield Transformations into Green Spaces with Phytoremediation

Phytoremediation's aspect of moderate intervention to the local biodiversity, less application cost and the extended application time may bring ecological, sociological and economic benefits to communities through various scales of planning from municipal to citizen-oriented spatial practises.

Intermediate land use, such as urban agriculture as an example, may contribute to the formation of flourishing communities in the newly redeveloped area on previous brownfields in their transition. This section will review urban agriculture as the intermediate use of brownfields and the transformation of brownfields into parks through remediation.

3.3.1 Temporal Use of Brownfields

Urban agriculture has been a common practice in many cities worldwide for various reasons. A wide variety of benefits the practice offers are affordability of the harvests with better nutritional values, contribution to better health conditions through gardening and intake of healthy harvests, economic benefit when combined with job training and start-ups, formation of communities through greenspaces protection and connecting with people, learning opportunities, moderation of extreme weather conditions (Dewey 2020). Thus, it is an example of "community open space" (Hou et al. 2009:3). Different actors organise urban agriculture—citizens who demand "an alternative form of open space" (ibid.) initiate community gardens, organisations who adopt it as a tool for vocational education or therapy as examples, and municipalities provide physical activity and joy through that (ibid.). Community gardens employ unutilised spaces within a city; hence, brownfields are the sites they frequently dwell. Hence, the land lease issue often characterises such projects as they struggle to hold the project site.

Vintergatan Urban Garden

Figure 4. Vintergatan Urban Garden.

Vintergatans Stadsodling (Figure 4) in Nyhamnen is one of the community gardens in Malmö. It was a temporary community garden realised via collaboration with students, the landowner, the Swedish Society for Nature Conservation and the City of Malmö, MS (Vintergatan Urban Garden n.d.). It opened in 2019 and moved out in 2021.

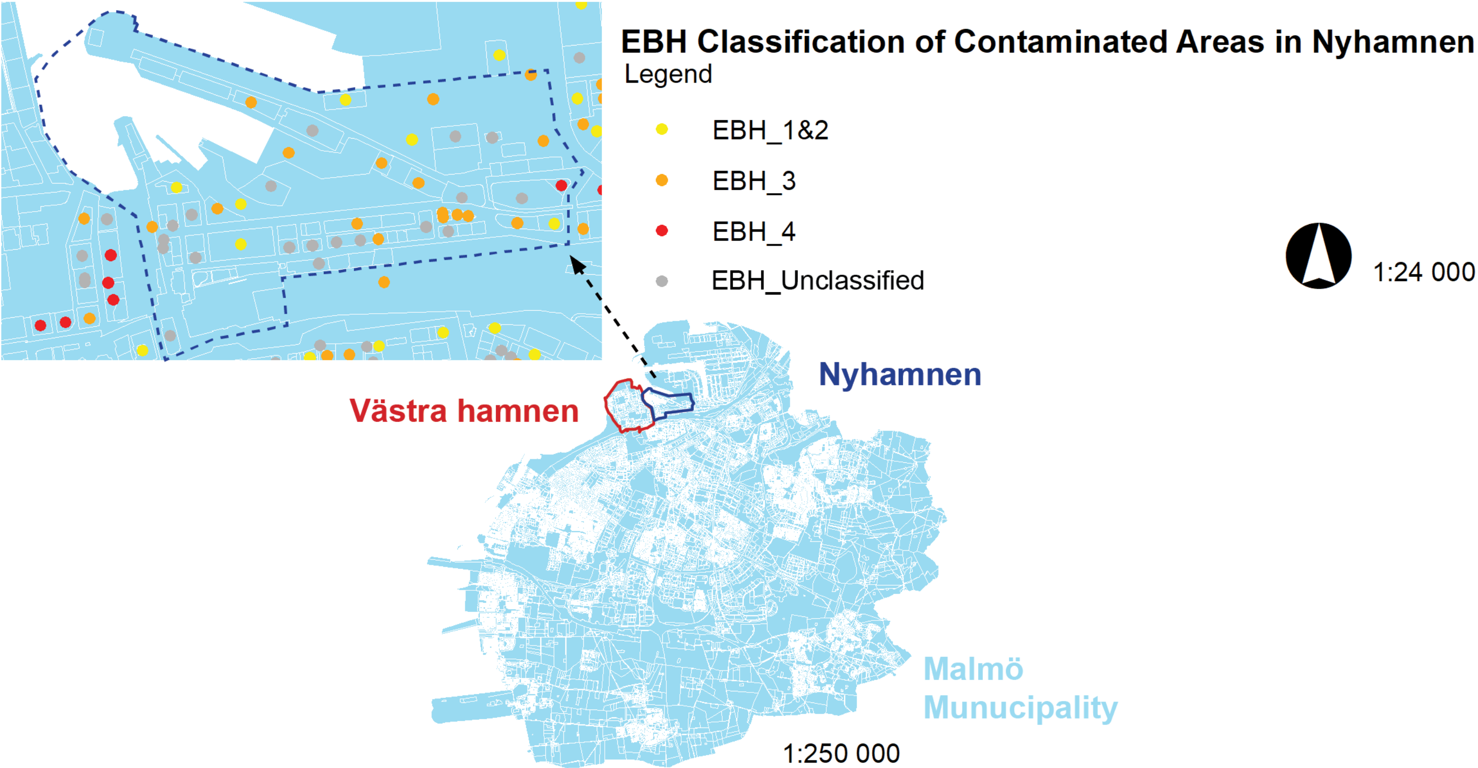

Figure 5. Map of EBH Classification of Contaminated Areas in Nyhamnen and Vintergatan Urban Garden's Location. [Map]. © Länsstyrelsen, Lantmäteriet & SCB.

Johanna Vikell, Jenny Sjölin and Anna-Karin Brunberg, students of Project Management Course at Malmö University, initiated "a garden for students to reduce stress" (Vintergatan Urban Garden n.d.) in 2018, and the garden had been thriving there until it moved to the rooftop of the culture centre, workshop and project space STPLN in Västra Hamnen in 2021 (Naturskyddsföreningen Malmö). Sjölin[6], in the interview, said that Skanska Öresund was already in contact with MS for green use of its land when the garden initiators contacted them.

Skanska Öresund owned a building before, torn down due to the visits of uninvited public and vandalism, Sjölin explained. Thus, an amusement park (Aoki 2019:28) with predetermined functions of a building in Aoki's term transformed into a field, the unspoiled state in the continuous transition of spaces (ibid.) of a brownfield. In 2022, the site transformation into an urban void is confirmed again after the move of the garden (figure 6).

[6] Sjölin, J., a community gardener and initiator, Vintergatan, Interview 2022-03-03

Figure 6. Skanska Öresund's Plot after the Move of the Community Garden.

She goes on that the planning went without a struggle because MS already had a contract with urban gardens, and a landscape architect was involved in the project. Furthermore, the landowner Skanska supported the garden by supplying tools and environment except for plants and seeds and even its move to STPLN. Students of the Fenix Environmental Association at Malmö University and the Swedish Society for Nature Conservation Malmö were growing together in container boxes on Skanska Öresund's land. Sjölin points out that Skanska's site is contaminated, although EBH inventory does not indicate that (Figure 5). Apart from gardening, the garden had hosted social activities (Stadsodling Malmö n.d.), such as lectures and meet-ups. Sjölin explained that the move was due to already decided future site development, the difficulty of having long-term gardeners and rubbish brought in by visitors. She further mentions that the original contract was for 2.5 years, which was prolonged by the postponed development, yet the garden terminated the contract. The new contract at STPLN is open-ended, yet it depends on MS's plans. She expects more gardeners in the calmer and residential environment of Västra Hamnen compared to Vintergatan, where it was an industrial area and in front of heavy traffic. Vintergatan Stadsodling's growing method, container growing, made moving to the new location possible, and the garden's location and long-term contract are essential.

The Community Garden Allmende-Kontor

Figure 7. Berlin-Stadtteilgarten Schillerkiez (5). (Ji-Elle 2016) (CC BY-SA 4.0)

Gemeinschaftsgarten Allmende-Kontor (Figure 7) in Tempelhof Field is one of the most famous community gardens in Berlin, Germany. Tempelhof Field used to be an airfield and currently Berlin's largest park, as big as New York's Central Park (Bartlick 2014). Despite the established image of the park and garden itself, the garden has always been under stress for whether it can continue existing in the future or not.

The enormous brownfield park in the city has constantly been on the target for redevelopment with the issue of housing shortage and the city's economic situation. In 2014, a referendum, held by the citizens' initiative 100% Tempelhofer Feld, won against the city's development plan "to build 4,700 apartments and commercial spaces, as well as a public library" (ibid.) in Tempelhof Field. Consequently, Berlin's Mayor of the time, Klaus Wowereit, agreed on the park being "undeveloped for a few more legislative terms" (ibid.), suggesting the temporal stability of the park's existence. Therefore, the future of the community garden is still unknown.

Despite the contaminated ground due to the former use of the airport, gardening plots are built directly on the ground. Tree branches are applied on the bottom to separate the clean soil added on top from the contaminated ground. Plants, such as beetroots, which could easily take up contaminants in the soil, are prohibited. Due to the semi-fixed containers, the community garden is not physically flexible. The garden, divided into nine areas with 250 beds, has invited many gardeners and attracted visitors since 2011 (Gemeinschaftsgarten Allmende-Kontor e.V. n.d.). Gardeners Get Together, the weekly picnic at the garden, creates a horizontal connection among gardeners. The uniquely shaped handmade benches along the beds are beloved hidden quiet corners to relax in the open field.

These examples of Vintergatan City Cultivation and the Community Garden Allmende-Kontor indicate that land lease conditions constantly burden community gardening projects. Combining a community garden with phytoremediation, which often takes an extended application period, can secure the project for a more extended period. Even though it will not be a permanent solution, community gardens are not confronted with the land lease issue repeatedly, and the time may allow the project to develop and strengthen the community.

3.3.2 Semi-Permanent Transformation of Brownfields

This part introduces former industrial sites that are transformed into parks and simultaneously undergo remediation. A park is a favourable form of brownfield transformation under the long application time of remediation.

Gas Works Park

Figure 8. Gas Works Park. (Tsai 2019) (CC BY-NC 2.0)

Gas Works Park (Figure 8) in Seattle, the U.S., was planned with the idea of saving the industrial legacy from dismantling by the American Landscape Architect and the Founder of Landscape Architecture Program at the University of Washington Richard Haag. Dr Kuhn, who designed IBA Emscher Park, the series of reclaimed industrial sites, raises a correlated thought that "dismantling and conventional regeneration measures only serve to rob people of their identity, history and life histories" (Kuhn 2014:17). Gas Works Park is significant in preserving the site's history, converting it to the city's identity and the ongoing remediation while the park is open to the public.

Previously the world's "most complete" (De Poli & Incerti 2014:160) gasification plant of coal and oil in terms of gas production assembly, according to the Geological Engineer Allen W. Hatheway, operated from 1906 to 1956. The plant was turned into a park by Haag from 1973 to 1976 and became the National Register of Historic Places, United States's "objects worthy of preservation" (United States General Services Administration 2019) since 2013. It was one of the first public and reclaimed parks reconstructed on a former industrial site. The park is reviewed as "pioneering recycling of obsolete structures and bioremediation of the terrain vague" (De Poli & Incerti 2014:160) and triggered to shift the common understanding of a park (ibid.) as Haag mentions the Landscape Architect Laurie Olin's statement.

The City of Seattle acquired about 8.3 ha of the land of the Washington Natural Gas Company to regain the leisure areas as it was there before the industrial occupation (Washington State Department of Ecology et al. 1997:8). The $1.3

million contract, signed in 1962, was funded by various city departments (Sawyer 2020). The company kept the estate for an extra decade with the conditions of the payment's completion and dismantling of structures yet evading the responsibility of ground contamination (ibid.).

Haag's idea of bioremediation was received step by step. The discovered economic benefit by preserving the existing on-site structures, saving $100,000 to the owner by keeping some structures (De Poli & Incerti 2014:161), was significant in 1971. Therefore, Haag conducted an on-site test of bioremediation "to plow it up and let air and sunshine in" (Jones & Konick 1984 see Sawyer 2020) for bacterias to decompose contaminants. Eventually, the city council approved the master plan in 1972 (Sawyer 2020). In the first construction phase, "13 concrete purifiers, concrete slabs, cinders, and approximately 15,500 cubic yards of contaminated soil" (ibid.), about 14200m3, were introduced. The park faces lake union, and when the soil contamination combines with ground and surface water contamination, it requires in-situ tools in the ground. Bioremediation and air sparging, which injects air and removes vapour, was applied to the soil. Sludge, sawdust and other organic composts from the streets of Seattle (ibid.) were added to the site to stimulate biodegradation. Furthermore, soil from excavation of the Safeco Building in the city was relocated there (ibid.).

Over the ground, industrial relics became places for people. The boiler house turned into a picnic shelter, and the oil-loading platform became a gathering space. Areas with highly concentrated contamination within the park were detected by the examination eight years after opening in 1984. Newly introduced soil covered these areas (Sawyer 2020).

Gas Works Park suggests that ground and surface water contamination may come along with soil contamination, which requires in-situ treatment. The case-by-case approach is also dependent on geographical and topographical conditions. Also, the park has added contaminated soil beneath. Although the park hosts remediation, the effect of buried extra contaminated soil on the groundwater and adjacent lake is unknown.

The Landscape Park Duisburg Nord

Figure 9. Landschaftspark Duisburg Nord. (Ra'ike 2009) (CC BY-SA 3.0)

Meiderich Ironworks, the production plant of coal and steel located in Duisburg within the North Rhine-Westphalia region in Germany, stopped operating in 1985

(Boroş & Micle 2015:472). After the abandonment, the 180-ha plant was transformed into a the Landscape Park Duisburg Nordv from 1990 to 2002 as a part of the International Building Exhibition Emscher Park, called IBA (Latz + Partner n.d.). IBA is a collection of projects focusing on environmental, economic, and social aspects in transforming the once-prosperous industrial region.

Latz + Partner, an office near Munich in Germany, designed the Landscape Park Duisburg Nord (Figure 9). "A new "landscape"" (Latz + Partner n.d.) was sought through protecting industrial history to a feasible extent and pursuing a new perception. The enormous industrial components received a new usage, existing buildings as event sites, the gasometer to the biggest diving centre in Europe, ore storage bunkers to climbing walls, and the blast furnace to a viewing tower. The uniqueness of the activities' location attracts an average of one million visitors per year.

The contaminated soils, which contain slag, cinder, coal and coak, from the industrial operation, have been treated with phytoremediation by indigenous and foreign plants as a part of 700 species on site. Judith Stigenbauer, a Professor and Director of the Master of Landscape Architecture Program at the University of Hawaiʻi at Mānoa, reviews Latz's approach in the anthology *Now Urbanism: The Future is Here* as "an alternative to more traditional, expensive, static, and inflexible open-space and planting solutions" (Stilgenbauer 2015:96). She also mentions that the Landscape Park Duisburg Nord, together with Gas Works Park, reviewed in the previous section, and other pioneering landscape projects in Europe illustrate change over time in regeneration and raising awareness through exhibiting the damage from industrial use and inviting visitors to experience the transition (ibid.).

Industrial heritage and newly introduced plants create a unique atmosphere. Depending on the situation of the site, urban agriculture takes place temporarily to semi-permanently, and parks with long-term remediation. It is a new definition of a park where visitors experience the transformation of industrial relics rather than readily prepared and fixed public spaces. Active gardeners of the community garden revitalise the otherwise unutilised contaminated ground.

4. Brownfield Administration and Management Strategy

Figure 10. The Scales of Brownfield Administration and Management.

Since the 1980s, polluted areas have gained worldwide recognition in industrial countries. Poison scandals from the 1970s to 1980s gave recognition to brownfields in the U.S. and raised awareness (Naturvårdsverket Förlag 1999:55) of their influence on the environment and health. Consequently, the Superfund Program was introduced in the 1980s to fund remediation of polluted areas (Naturvårdsverket Förlag 1999:55-56) in the U.S. as the start of the global recognition and remediation trend. This chapter will review brownfield management of the E.U., Swedish national, Scanian County and Malmö city scales (Figure 10).

4.1 Brownfield Remediation in the European Union

Ecological Function of Brownfield in the Urban Environment, Sixth EAP, concerning soil functions by the European Parliament and the Council, ran from 2002 to 2012. The Sixth EAP released the Thematic Strategy for Soil Protection in 2006 and issued the report in 2012. The report addresses that contamination from newly introduced industrial activities should not affect the environment, and the industry itself will manage the pollution. The Industrial Emissions Directive, IED, released in 2010, presents "zero tolerance" (The European Commission 2012) regulations to make sure newly installed industrial activities do not worsen soil quality and groundwater of the site.

Moreover, it introduced the "'polluter pays' principle" (The European Commission 2012), the person who caused the pollution is in charge of the treatment. However, the European Commission criticises IED that it does not cover many suspected and existing polluting activities. Only 144 installations of soil contamination compared to about 3000 with water and 11,000 with air pollution were reported in 2009 (ibid.).

Thus, the cohesion policy granted funding to restore industrial sites and contaminated lands within the E.U. under the integration category. €3.1 billion were distributed from 2007 to 2013 within the planned €49.6 billion disbursements of the European Union Environment Theme (The European Commission 2012). Most of the budget was distributed to Hungary, the Czech Republic and Germany, and to the projects of the member states received 28% of the share (ibid.). After that period, the commission intended to aid brownfield transformation from 2014 to 2020 through the Cohesion Funds and the European Regional Development Fund (ibid.).

Before 2007, Member states could apply for state aid in the environmental aid guidelines for contaminated soil remediation. The state aid covered the cases when the "polluter pays" policy could not be applied, such as when unable to contact landowners and the owners are insolvent. Schemes and measurements were adjustable to the individual member states, and over €8 billion were paid to Austria, Belgium, the Czech Republic, Estonia, Germany, the Netherlands, Slovakia, and the U.K. from 2005 to 2010 (The European Commission 2012).

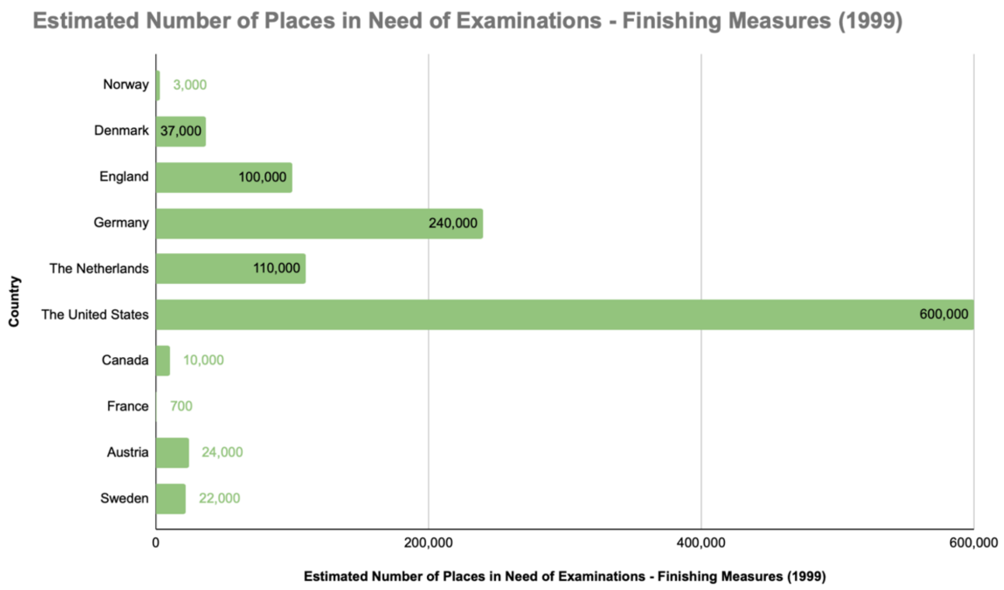

Figure 11. Estimated Number of Places in Need of Examinations - Finishing Measures (1999).

The chart "Estimated Number of Places in Need of Surveys - Finishing Measures" (Figure 11) shows ten countries' recognised numbers of brownfields based on incomplete statistics due to lack of standardisation (Naturvårdsverket Förlag 1999:55-56). However, it shows that the U.S., Germany, the Netherlands and England are leading the field by the found number of contaminated places.

4.2 Brownfield Remediation in Sweden

Sweden is not an exception from the risk of soil contamination, although being not the most active country in terms of brownfield recognition and remediation in the E.U.

According to the Swedish Geographical Survey, approximately 80,000 polluted areas are identified in Sweden today. According to the evaluation, about 1,000 carry significant risk, and 7,000 highly affect the environment and human health (Statens geologiska undersökning 2021). These 8,000 highly polluted areas together account for only 1/10 of the country's total number of identified polluted areas. Compared to some other E.U. member states, the number of estimated polluted areas in Sweden are not outstanding; however, it does not mean that the risks are not significant.

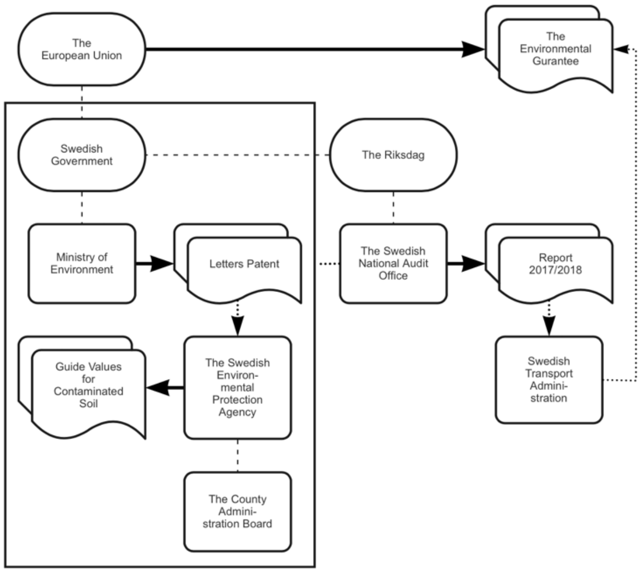

Figure 12. Swedish National Brownfield Management in Connection to the European Union.

RR, the Swedish National Audit Office, is independently managing national finance (Riksrevisionen 2021). The Ministry of the Environment in the government initially regulates Brownfields in Sweden under the annual Letters Patent. The Letters Patent concerning the Swedish Environmental Protection Agency, NVV, reflects their intentions, assign duties, and state finances, such as budgeting based on fees and grants (Miljödepartmentet 2020). It also requests the County Administration Board who lies below NVV (Figure 12), to report the applied measures to encourage remediation managed by private funding and state subsidies (Länsstyrelsen Skåne n.d.b). 452 million Swedish krona in 2020 (Naturvårdsverket n.d.d) and 825 million Swedish krona in 2021 are distributed to after treatment of polluted areas in Sweden (Naturvårdsverket n.d.a).

RR released the Report of the Environment and Agriculture Committee 2016/2017:MJU19, which is about the State's Polluted Areas in 2017. The report investigated the preconditions for efficient prioritisation of the remediation of state-owned polluted areas, the potential of enormous expenses and transparency of expense notification (The Riksdag 2017:5). The government indicates measures in this report, such as NVV to develop the outline with prepositions for prioritising different needs of remediation and the Swedish Transport Administration to survey the scope of the government's commitments according to the E.U.'s environmental guarantee (The Riksdag 2017:1). The commission requires member states to report national provisions and how to manage them, referred to the fourth point on the

Environmental Guarantee of the European Union on Article 95 of EC Treaty, Treaty Establishing the European Community (Nice Consolidated Version).

Table 2. MIFO Risk Classification.

Classification	Risk Level
1	Significant risk
2	High risk
3	Moderate risk
4	Minor risk

The Methodology for Inventory of Contaminated Areas, MIFO, the tool to determine the risks of each contaminated area, manages the situation. There are two classifications, industry class and risk class. According to the land-use history focusing on the on-site activity, potentially contaminated sites receive industry classes 1 to 4 (Naturvårdsverket n.d.b.). There is a list of industries (ibid.) to industry classification based on the risk of contamination of each industrial activity. The risk class is set based on geographical information. The smaller the number is, the bigger the risk is in the risk class: 1 = Significant risk, 2 = High risk, 3 = Moderate risk, and 4 = Minor risk (Table 2).

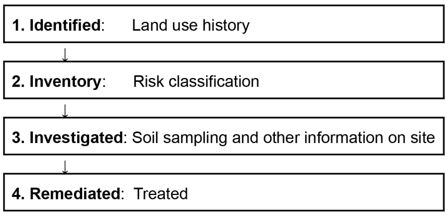

Figure 13. EBH Support on the County Administration Board.

The county administrative board, LS, oversees recording and classifying risk classes. The data is gathered on the national database Post Treatment of the Contaminated Areas Support, EBH Support (Figure 13), indicating potential and actual contaminated areas and their details (Naturvårdsverket n.d.e.). Risk class 1 and 2 are prioritised for higher levels of examination (Naturvårdsverket n.d.b.). Although the risk is classified based on archive material, site visits and interviews (ibid.), this method does not evaluate actual soil contamination by sampling. It is instead the initial action for further investigation.

According to NVV, 26,000 contaminated areas are analysed and documented on the map, of which 128 heavily polluted areas are remediated (Naturvårdsverket n.d.d). Furthermore, 24 residential areas exist in polluted areas (ibid.). In terms of risk class, 1 about 1,100, 2 approximately 7,900, 3 about 11,000 and 4 approximately 6,000 are categorised (Naturvårdsverket n.d.e).

NVV has released Guide Values for Contaminated Soil - Model Description and Guidance in 2009. The guide value model is a recommended tool and not a legal measure to determine if the polluted area requires treatment (Naturvårdsverket n.d.c). A site-specific guide value model is applied when MIFO is not applicable. The site-specific guide value model is based on environmental and health risks to protect the soil, ground and surface water (Naturvårdsverket 2009:21). The measures categorise polluted and surrounding areas' land use into

Sensitive Land Use, KM and Less Sensitive Land Use, MKM (Naturvårdsverket 2009:23). KM and MKM areas require protection of on-site ecological function, ground and surface water and aquatic life. KM requires complete protection yet allows full-time visits, and the land use would be schools, arable lands and housing (Naturvårdsverket 2009:17). MKM necessitates limited protection of ecological function, groundwater protection for 200 m around the downstream area, and complete protection of aquatic life (Naturvårdsverket 2009:23). Offices, trading sites and industries (Naturvårdsverket 2009:22) are the allocated usage of MKM lands.

4.3 Brownfield Remediation in Scania County

The total size of industrial areas in Scania is 92km2, which accounts for less than 1% of the county's land. Scania's leading industries are coal mining, clay, brick, cement, concrete, asbestos cement, porcelain as sanitary appliances, and single-family homes for construction in Sweden (Länsstyrelsen Skåne n.d.b). Industries around food, such as packaging, mechanical workshops of agricultural machines, fertilisers and pesticides, are also present in Scania, where half of the country is notable agricultural land (ibid.). Moreover, fuel handling, metal industry, landfills, car management, chemical industry, graphic industry, nurseries and dry cleaners are the most frequent industries (ibid.). Hence, only 7% of the county are nature reservation areas (ibid.).

The County Administrative Board of each county deals with the local situations and works parallel to the nation to manage brownfields in Sweden. The County Administrative Board of Scania, LSS, aims to densify within cities partly by remediating contaminated sites, which have environmental issues, by 2050 (Länsstyrelsen Skåne n.d.b) with the principles of protecting Scanian water and agricultural land (ibid.).

According to LSS, "Geological and hydrogeological conditions" (Länsstyrelsen Skåne n.d.b) control the spreading of contaminants (ibid.). Southwestern Scanian bedrock, including the area of Malmö, is a sedimentary rock consisting of limestone, sand, silt and clay (ibid.). The Scanian soil components are likely to separate and protect surface and groundwater due to its impermeability, yet some deposits are permeable (ibid.). Furthermore, Scania has rich groundwater sources; thus, groundwater protection, being one of the focuses, aims to protect many red-listed freshwater species and marine lives (ibid.).

LSS sets priorities for supervision and state funding on the contaminated areas, which have an immediate danger to human health, a nature conservation value, instant hazard caused by contaminated water, and subsidies for housing construction. Regarding the last point, the updated rule from 2021 (Länsstyrelsen Skåne n.d.b) does not allow Malmö, the metropolitan municipality, to receive the housing subsidy any longer.

Table 3. The Number of Classified Contaminated Sites in Scania (2021-10-14) on EBH Support.

	1	2	3	4
Risk Class	84	921	1,162	580
Industry Class	0	1,271	1,601	463

Table 3 shows the number of classified contaminated sites in Scania (Länsstyrelsen Skåne n.d.b) on the national database EBH Support, indicating that sites with high to moderate contamination are predominant in Scania. The contaminated sites with the risk class 1 and 2 are the priorities for further investigation (ibid.). The prioritisation based on the MIFO result especially leaves class 3, one of the highest groups in numbers and is moderate contamination that may still negatively influence health and the environment.

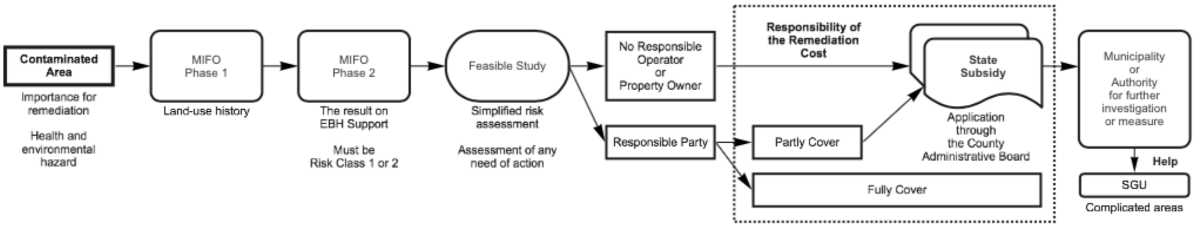

Figure 14. The Obligation of Payment and Subsidy Application.

State subsidy from the Swedish Environmental Protection Agency selects applicants in the following procedure (Figure 14):

1. The state and regional measures indicate that the contaminated area has a remediation demand due to concerning health and environmental hazards.
2. It goes through MIFO phase 1 of studying land-use history, and the result will be a risk classification recorded on EBH support.
3. A feasible study produces a brief risk assessment and announces actions required.
4. In case of the vacancy of a responsible person for the contaminated area, LS applies to the state subsidy for remediation.

However, first and foremost, the site must be categorised to risk class 1 or 2 to be considered to start this procedure. LS has an EBH group that works specifically with the supervision of contaminated sites. They run about 10 to 15 investigations each year.

4.4 Brownfield Remediation in Malmö

The Department of Environmental and Health Protection oversees Malmö's contaminated areas in the Environmental Administration, MF, at the City of Malmö, MS.

European commission's "'polluter pays' principle" (The European Commission 2012) explained by MS is

> The person contributing pollution is responsible for investigation and remediation and applies even if the company or business has been closed or transferred. The obligation applies until the damage or problems have ceased. If the business cannot carry out or pay for the investigations and decontamination, other people may be liable in the alternative. (Malmö stad 2021b)

MS offers self-initiated and event-driven supervision. Self-initiated supervision occurs upon request of current or previous business owners of the site who suspect that the ones may have contributed to contamination to the site. Event-driven supervision runs before the owner sells the site or building or new development occurs, which is the most frequent circumstance in MS (Malmö stad 2021b).

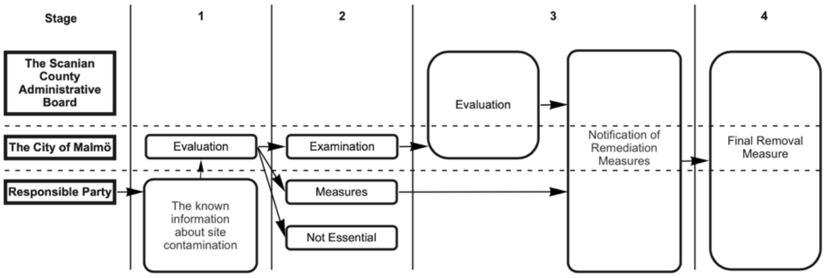

Figure 15. Supervision Process of the City of Malmö.

The supervision process is in four steps. First, the suspected contaminated site information is given to MS by the person who applies for supervision. Second, the submitted information is processed to see whether examinations or measures are essential. Third, based on the assessment result, the person in charge submits a notification of remedial measures to MS. Then, MF contacts the County Administrative Board of Scania for consultation that ends with remedial measure notification. Lastly, the agreement of all parties concludes the measures (Figure 15). Since 2009, there have been about 40 to 80 registrations of contaminated sites for post-treatment per year (Malmö stad 2021c).

The hourly supervision fee, which covers the work of MS for the project, is paid by the person who requests supervision (Malmö stad 2021e). The reason behind fewer applications for self-initiated supervision than event-driven supervision may be because cases are not urgent and due to the cost of supervision and remediation.

5. Brownfield's Situation in Malmö

5.1 Malmö's Transformation from An Industrial to Knowledge-Based City

5.1.1 Malmö as the Industrial Centre of the Scanian County

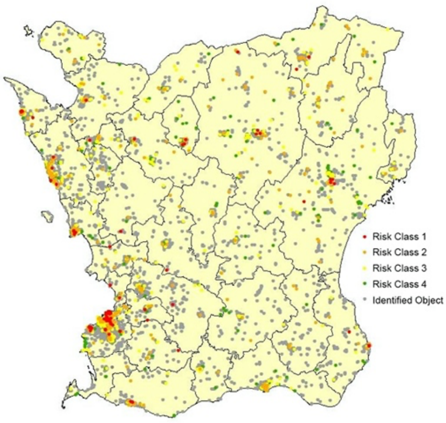

Figure 16. Inventory of polluted areas in Scania. [Map]. © Länsstyrelsen Skåne & Lantmäteriet.

Malmö, the largest city in the Scanian County, is also the most significant industrial area of the county. Figure 16 indicates intensity of industrial activities in the form of contaminated areas. In the city's industrial history, engineering, textile, limestone and cement industries, such as Kockums Mechanical Workshop Limited Company, Malmö Wool Factory's Limited Company, The Scanian Cement Foundry Limited Company, have been dominant. In addition, Gullvik's Factory's Limited Company produced pesticides. The 1980s was the fall of large engineering industries, and the working-class city started to shift its direction (Persson & Lindqvist 2018:25).

5.1.2 Malmö's Transition to the Post-Industrial City

The decline of large industries in Malmö has been changing the city's situation and creating vacant spaces in the city. Several studies have investigated the transition of Malmö from an industry-based to a knowledge-based city.

Malmö went through an economic crisis from the late 1980s to the early 1990s (Nilsson 2016:4). The crisis hit Malmö's medium to large industries from the mid-1980s (Dannestam 2009:113). Kockums, the well-known shipyard company with many local employees, started in the early 1980s, peaked in 1986 and declined as a part of the world shipyard industry recession (Nilsson 2016:13 see Dannestam 2009:114).

As a result, debts abroad change in the cooperative taxation method from the 1980s and the cost to support the unemployed population hit the city's finance hard in the early 1990s (Dannestam 2009:114). The financial crisis caused a shift in resident demography; about 30,000 residents moved out, and immigrants came in (Nilsson 2016:13 see Dannestam 2009:114). Moreover, the attempt to replace unemployed staff from declined Kockums shipyard to the Saab car factory failed (Anderberg 2015:214). The City of Malmö's investment of replacing a manufacturing industry with another and similar manufacturing industry was unsuccessful.

When the manufacturing industry stopped supporting the city economically, the City of Malmö had to shift the direction, introducing the future visions of a "city of knowledge" (Nilsson 2016:15 see Dannestam 2009:121), a "city of experience" (ibid.) and a "creative city" (ibid.) into the *Comprehensive Plan* for Malmö 2000 for the recovery from the crisis. IT, trading and service (Nilsson 2016:15 see Greiff 2008:27), such as marketing, product development, information and communication (Nilsson 2016:15), which were trendy industries at that time, gradually replaced the previously active industries until the 1980s.

5.2 Brownfields' Situation and the Significance in the Post-Industrial City of Malmö

5.2.1 The City of Malmö's Objective on the Comprehensive Plan

Many Swedish cities have established a policy to be compact yet environmentally friendly. According to The Report of The National Board of Housing, *Building and Planning and Ecosystem Services: Do Ecosystem Services Receive Sufficient Support in Planning and Building Law?*, issued by the City Planning Office at the City of Malmö, MS, municipalities and regions are responsible for "sustainable urban development" (Hanson et al. 2016:5) in Sweden. Many municipalities aim at being a "dense and green" (Hanson et al. 2016:7) city as a general strategy for efficient land use (Hanson et al. 2016:20). Densification intends to protect unexploited and valuable land in the countryside and suburban areas (Hanson et al. 2016:7, 20), and the provision of green spaces satisfy demanded recreational needs (Hanson et al. 2016:15).

MS is not an exception. Malmö's *Comprehensive Plan* from 2018 aims to be a "socially, economically and environmentally sustainable city" (Malmö stad 2018:11). Malmö plans to be dense and green under the field of "build for neighbourhood" (Malmö stad 2018:14) for one of three target areas of "a close, dense, green and functional city" (ibid.), which targets to enhance the access to green spaces by integrating the parks to the housings (Malmö stad 2018:15).

Economic profitability also became the motivation for the idea of densification. The Housing Expo Bo01 since 1998 in the Västra Hamnen area aims to appeal to developers and earn high-income residents' tax in Malmö rather than letting them be a part of the growing population of the outskirts (Anderberg 2015:216).

Although densification was partly encouraged with economic benefits, MS took the idea to Malmö's *Comprehensive Plan* (Malmö stad 2018) carefully considering ecosystem services, ES. Densification may sacrifice the blue-green infrastructure (Hanson et al. 2016:7) of the city, which "is an approach to urban flood resilience" (Lamond and Everett 2019:1) suggested by the Professor in Real Estate and Climate Risk at the University of the West of England Jessica Lamond and the Doctor in the Department of Architecture and Built Environment at the same university Glyn Everett in their article *Sustainable Blue-Green Infrastructure: A Social Practice Approach to Understanding Community Preferences and Stewardship*.

Hence, the materials of the sealed surface, increased by densification, may contaminate the soil and groundwater beneath. One of the concerns raised by MS is that the hard surface area increases with densification (Malmö stad 2018:54), which affects stormwater management (ibid.). The soil drains excess water, an important ecosystem service in a city. Another potential concern is that these sealed surfaces may worsen the water quality below the Environmental Quality Standards of water (Malmö stad 2018:75). The research *Contaminants in Soil as a Result of Leaching from Asphalt*, by Ross Sadler at Queensland Health Scientific Services, Chris Delamont and Peter White at Southeast Queensland Electricity Board and Des Connell, the Dean of School of Australian Environmental Studies, indicates that asphalt contaminates sealed soil beneath (Sadler et al. 2008:71) and pollutes groundwater (Malmö stad 2018:75).

For these potential effects on the environment, The Swedish National Board of Housing, Building and Planning demands municipalities balance densification and green-blue infrastructure (Hanson et al. 2016:5). The Planning and Building Act, PBL, moderates land and water management and construction in ES (Boverket 2020). PBL, the law, ensures municipalities consider how their plan will affect ES (ibid.).

5.2.2 Recognition and Risk Classification of Contaminated Areas

The Environmental Administration of the City of Malmö, MS, took the initiative to record contaminated areas of closed industries before introducing MIFO, the inventory methodology, on the national scale in the 1990s. MS used to have its original version of the database, equivalent to MIFO, until 2009, when the EBH support started to operate. Then, the County Administration Board of Scania took over Malmö's database (Persson & Lindqvist 2018:26).

Table 4. The Number of Risk-Classified Contaminated Areas in Malmö.

Risk Class	Number of Classified Contaminated Areas
1	38
2	340
3	295
4	131

There are 1414 detected contaminated sites, of which 804 received classification (Figure 17) and are on the list. MS recorded and classified 509 of them. The number of sites for each risk class is as follows: 1 = 38 sites, 2 = 340 sites, 3 = 295 sites, and 4 = 131 sites (Persson & Lindqvist 2018:26). The distribution pattern of the risk class is similar to the distribution of Scanian classified contaminated sites. The same as the Scanian situation can apply to the situation in Malmö that risk class 3, the second most significant group in number, might be unseen because it is not a national and regional priority for remediation.

5.3 Case Study Analysis: Ongoing Redevelopment of Brownfields

Västra hamnen

Figure 17. Structural Plan for Future Development. (Malmö City Planning Office 2015:10)

Västra Hamnen, the Western Harbour has been transitioning to a dense urban district from an industrial port and is a Swedish precedent of sustainable urban development since 2001. As a counteraction to the economic crisis, the development plan of Västra Hamnen was raised (Anderberg 2015:214). According to the document of the City of Malmö, MS, *Västra Hamnen 2031: ett hållbart och gott liv för alla*, there has been the agreement Västra Hamnen 2031 for which the City Planning Office, SBK, the Real Estate Office, the Environmental Administration and Centre District Administration of MS have been cooperating (Malmö stad 2013:6). The agreement intends to develop the area for housing and offices primarily by inviting new inhabitants with Bo01, started in 2001 (ibid.) with funding from the Swedish Government and the E.U. (Baltic Urban Lab n.d.).

Figure 18 illustrates that development takes in the whole area. The redevelopment has started with two phases. The first phase was the housing expo Bo01 (Anderberg 2015:216), and the second phase was the realisation of the Bo01 area and the HSB Turning Torso Tower as a new landmark of the city replacement to the Kockums shipyard crane (Anderberg 2015:224). The Housing Expo Bo01 - City of Tomorrow took place in the previous Saab Car Factory from 1988 to 1991 (Anderberg 2015:214).

Malmö SBK documents the management of contaminated soil on site. Most areas of Västra Hamnen is reclaimed, filled with excavation residue (Malmö City Planning Office 2015:15) and partly sand from 1970s to 1980s (Miljöförvaltningen Malmö stad 1993:5, 9, 10, 13). Prior to MIFO on a national scale, MS conducted a land survey in Västra Hamnen based on interviews (Miljöförvaltningen Malmö stad 1993:6). According to the soil survey report *Markundersökning i Västra hamnen, Malmö: Delrapport 1 f d Kockumsområdet*, the area has a big risk in general (Miljöförvaltningen Malmö stad 1993:14); however, the result was updated by MIFO later.

Bo01 expo preparation removed 10,000 tonnes of contaminated soil, of which 3/4 came back on site and 1/4 went through chemical and biological remediation (Malmö City Planning Office 2015:15). The soil contamination level in some areas was low; hence, the new layer covered the existing soil (ibid.). Moreover, the newly introduced canal is pumped up and does not go through contaminated soil (ibid.). Phytoremediation could have been introduced instead of topping up new soil if the area did not await immediate transformation or were awaiting to be a part of green spaces, pedestrian walks or streets.

In 2022, it is hard to find vacant land in Västra Hamnen, which was evident a few years ago. In the current situation, in Aoki's words, many of the fields are under the transformation into amusement parks (Aoki 2019:28) in the cycle of building, demolishing and transforming, and vacant lands receive a determined function and become authorized spaces. The disappearance of urban voids or terrain vagues from the area means normalization (Stavrides 2020:263), which does not support autonomous, voluntary and independent spatial use.

Nyhamnen

The mixed-use urban development project Nyhamnen, The New Harbour, sums up SEK 3.2 billion in the public sector consisting of developing streets, parks, squares, wharves by further reclamation of the sea, bridges, a canal and contaminated site remediation and demolition (Malmö stad 2019:63). A potential constraint for Nyhamnen development is remediation costs (Malmö stad 2019:52).

Located to the North of and being close to Malmö Central Station, Nyhamnen developed with the railway, ferries and boats, such as migration and the gateway to the world and bathing culture (Malmö stad 2021d). Food storage and trading were also widely present activities (Malmö stad 2019:5). The future identity creation of Nyhamnen addresses these historical site usage (ibid.).

Figure 18. Soil Pollutions. (Malmö stad 2019:49)

The map *MIFO Inventory* (Phase 1) suggests land contamination in many parts of the area, essentially a moderate risk (Figure 19). It indicates that phytoremediation is applicable in many parts of the area based solely on this map. Physically rooting to the site history, phytoremediation may allow the gradual formation of a new identity over time. After the MIFO inventory and before the redevelopment takes place, further soil investigation occurs.

Nyhamnen's *Comprehensive Plan* states the contamination risk assessment from the environmental, health, technical and economic perspectives (Malmö stad 2019:49). Thus, there is a plan to arrange remediation measures based on future land use before starting the remediation process (ibid.), which explains the absence of the detail of remediation in the plan.

The urban development articles of the City of Malmö, MS, *130 års hamnhistoria undersöks på djupet* features Hyhamnen's soil examination. The first sampling round started in November 2021, taking samples from about 63 ha in the Nyhamnen area, conducted by a consulting company working for MS to create a survey (Malmö stad 2021a). The planned release of the result will be in spring 2022, which will be a part of the future planning of the area (ibid.). The project manager Jan Johansson at the Real Estate and Street Office at MS, thinks that the Nyhamnen project is an opportunity to apply geotechnics for "urban construction and elevation" (ibid.).

According to Johansson, land reclamation took place from 1860 to 1990, and the residue from the 1930s of the previously existing thermal power plant in the area became a part of it (Malmö stad 2021a).

The remediation method is dependent on the result of the contamination investigation; however, MIFO map illustrates the potential of phytoremediation. The local condition of strong coastal wind and salty air by the coast concerns the plants and their performance.

5.4 GIS Analysis

Previously mentioned in the section Phytoremediation of Brownfields, one of the limitations and characteristics of phytoremediation is its applicability on up to moderately contaminated soil (Svenska Geotekniska Föreningen 2019). Therefore, GIS map analysis explored sites up to moderate contamination in Malmö.

5.4.1 Method

EBH_Potentiellt_fororenade_omraden, a dataset of the County Administrative Board, was used to find out contaminated sites in Malmö. Thus, reclassification of EBH risk classification made the map easier to read, A/1-2 significant to high risk, B/3 moderate risk and C/4 minor risk (Table 4). Targets for phytoremediation are B and C. This map does not include contaminated sites without risk classification and sites for KM/sensitive land use and MKM/less sensitive land use.

Table 5. Classification for the GIS Map According to MIFO/EBH Risk Classification.

Classification for GIS map	MIFO/EBH Classification	Risk level
A	1	Significant risk
	2	High risk
B	3	Moderate risk
C	4	Minor risk

Moreover, the contaminated sites on the map are within the targeted development areas of the City of Malmö on its *Comprehensive Plan* from 2018, which are Targeted Areas for Business in the Areas for Development of Västra Hamnen, Nyhamnen and Hyllie, Group 1 of Protected Business Areas of North Port, East Port, Central Port, Frihamnen and Oljehamnen, Group 2 of Toftanäs, Bulltofta and Valdemarsro, Group 3 of Elisedal, Fosieby and Hindby (Malmö stad 2018:68). Other listed areas for development based on the types of business, Innerstaden, Centrum, Emilstorp, Norra Grängesbergsgatan, Svågertorp, Along Ystadsvägen, Lockarp, Furtuna and Hemgården, Almvik, Glostorp, Marklunda, Sege, Ingvalla (Malmö stad 2018:69), are included. Existing Residential Areas were also listed; however, they were excluded for the map due to their ambiguous definition.

In addition, the result excludes housing properties and churches due to their improbability to be the targets of remediation in the upcoming years.

5.4.2 Result

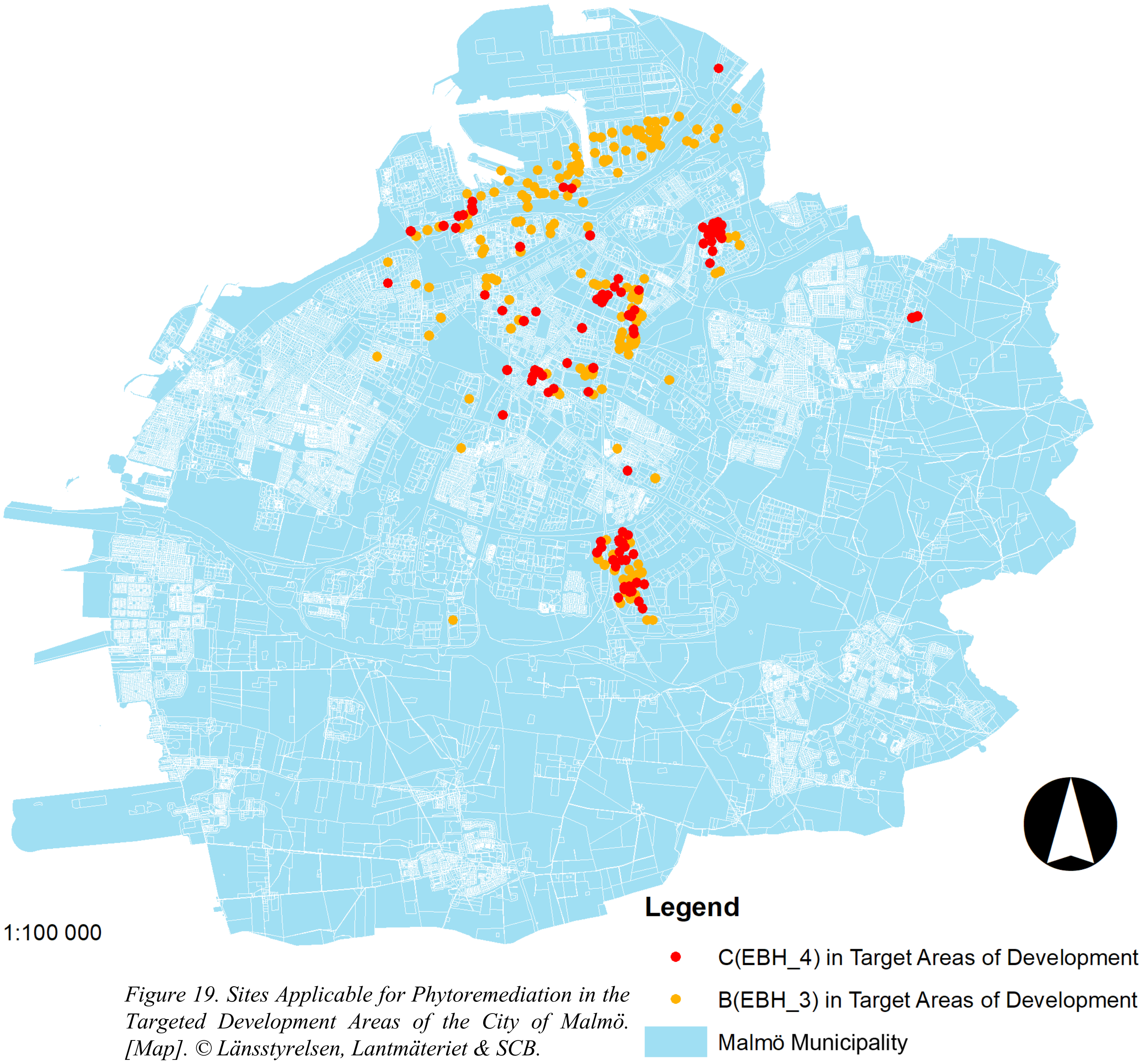

Figure 19. Sites Applicable for Phytoremediation in the Targeted Development Areas of the City of Malmö. [Map]. © Länsstyrelsen, Lantmäteriet & SCB.

The map (Figure 20) indicates 140 sites with category B/3 Moderate risk and 63 sites with C/4 Minor risk. Further manual categorisation classified the result relatively into areas with several to many suitable sites, 3< sites, and areas with a few sites, 1-3 sites. It was classified into more detailed city areas to find more specific locations, smaller than those described in the City of Malmö, MS, on its Comprehensive Plan from 2018.

The found areas with more than 3 sites for both B and C are Bulltofta, Emilstorp, Fosieby industriområde and Värnhem. The area with more than 3 sites for B and 1 to 3 sites for C is Annelund. The areas with 1 to 3 sites for both B and C are Gamla staden, Norra sofielund and Södra sofielund.

In terms of the category B, areas with more than 3 sites are Frihamnen, Inre hamnen, Mellersta Hamnen and Östra Hamnen. The areas with 1 to 3 sites are Gröndal, Hindby, Kronborg, Malmöhus, Nattentorp, Sege industriområde and Slussen. Regarding category C, the area with more than 3 sites is Norra sorgenfri. The areas with 1 to 3 sites are Spillingen, Fortuna Hemgården, Möllevången and Ribersborg.

Generally, the level of contamination, types of contamination and phytoremediation plan indicates the process's duration. For this reason, category C usually takes a shorter remediation time than B for the level of contamination.

If MS acknowledges phytoremediation as an applicable remediation method, the areas with more than three sites suggest potential target areas. However, the data does not include the size, details and types of contaminants, and planning shall address these elements for the application.

Regarding the ongoing project of Nyhamnen, composed of Frihamnen and Inre Hamnen, as mentioned above in the case study, the plan will be made based on further site contamination investigation there. This map indicates that phytoremediation is suitable in many parts of the port with moderate contamination.

6. Discussion

This thesis investigated the possibility of phytoremediation application to brownfields in the post-industrial city Malmö and the brownfields' intermediate community use. Literature studies, GIS mapping and an interview investigated the central research question *Is phytoremediation applicable to the brownfields in Malmö? Hence, is there a space for community development by preserving elements for shaping the site's identity in the intermediate use of brownfields during the application of phytoremediation?* It has been analysing brownfields, contaminated sites often due to former industrial occupation, from ecological, spatial, sociological and economic standpoints, their situation in Malmö and their intermediate use while waiting for transformation and under the application of phytoremediation as cases.

Is phytoremediation applicable to the brownfields in Malmö?

GIS analysis of recorded and risk classified brownfields on A Methodology for Inventory of Contaminated Areas detected many potential sites for phytoremediation in Malmö, categorised as 3. Minor to 4. Moderate risks.

On the other hand, current Swedish measurement focuses on the remediation of the brownfields with 1. Significant to 2. High risks, motivated by subsidy allocation. The prioritisation of brownfields classified into the categories 1. and 2. with their given opportunity of subsidy application lead brownfields of the risk class 3 and 4 to be either neglected or transformed without remediation, postponing the contamination issue of the site.

Therefore, recognition of phytoremediation as a method is crucial. Due to the ecological, spatial, social and economic benefits, acknowledgement of phytoremediation may display the ways to remediate unprioritised brownfields. At the same time, brownfields' spatial quality, which influences people to interact with the site outside of the social codes, which terrain vagues, urban voids, common spaces, and fields suggest, should be recognised as an alternative public space. However, adding an alternative definition to public space is challenging due to the fixed definition of industrialised capitalistic society's implementation of permanent public space. This situation challenges our society and asks which direction it develops in the post-industrial era.

Phytoremediation, a sustainable method regarding the application cost and the disturbance to soil biodiversity and the inhabiting species compared to other methods applying heavy machinery, cleans deteriorated soil onsite, provides ecosystem services and works on the global environmental issue. Thus, it could be a practical and attractive remediation method for the municipality when combined with intermediate use of the site, such as a park or a community garden for city development.

Regarding the Västra Hamnen project, site remediation could have been done more cheaply and moderately to the environment. Nyhamnen, awaiting the survey of land examination and the detailed plan with undetermined remediation methods, shows a possibility of adopting phytoremediation in many areas. The benefit of phytoremediation aligns with the contamination risk assessment, especially from the environmental and economic perspectives (Malmö stad 2019:49) of the Comprehensive Plan compared to other remediation methods, which disturb the environment to a greater extent and cost significantly more.

Is there a space for community development by preserving elements for shaping the site's identity in the intermediate use of brownfields during the application of phytoremediation?

Site history is discoverable by being in a brownfield, simultaneously forming a collective sense of place, primal scenery, in other words, a concept that Okuno shaped. The use of a field is defined by physically taking space, and the interaction with the space determines the use. These are the common characteristics of vacant lands in the name of fields, terrain vagues, urban voids and common spaces.

The roughness of brownfield is born in the cycle of circulation of the site receiving and losing function, and what is already on the site is the site's identity. Vacant lands are attractive spaces where users have their findings and can take initiation in spatial use by applying their imagination. The experience in vacant lands arises a "nostalgic and warm image" (Ueda et al. 2005:127) that can be shared among citizens and form primal scenery or a sense of place. That eventually shapes the city's identity.

Instead of other methods requiring heavy machinery, phytoremediation gradually removes contaminants over time and transforms the environment. The cases of Gas Works Park undergoing in-situ bioremediation treatment and the Landscape Park Duisburg Nord, with ongoing phytoremediation, enhance the sites' industrial heritage and create a new identity with landscape design during the remediation application. The changing situation of plants, such as application and harvesting, makes the situation temporary, and the temporality attracts visitors.

Hence, the gradual yet constant change of the site's situation in phytoremediation may support space commoning.

While fixed public spaces are allowed to be used by certain groups of the society, common spaces may host marginalised communities, which are not "the legitimate public" (Mitchell 2003:136) yet are also entitled to take space in the city.

Moreover, Vintergatan Urban Garden had realised due to the City of Malmö's involvement in connecting citizens in need of space to the landowner who offers vacant land. The active assistance of the municipality is reassuring aid for a thriving community. Container growing enables urban agriculture on contaminated soil, as seen in the cases of Vintergatan and Allmende-Kontor, which also contributes to creating the identity of space.

Suggestions for Future Research

This research project did not address any cases of common spaces. Case studies of common spaces would strengthen the understanding of the relation among brownfields and common spaces and space-commoning practice.

This thesis touched upon the economic benefit of phytoremediation indirectly, and it can be visualised concretely through calculation.

It will be relevant to evaluate the inventory method of brownfields in Sweden compared to other countries' measures, which this project excluded.

Moreover, it is crucial to comprehend the phytoremediation in detail for the actual application to maximise its effect, which this thesis project did not cover. Since phytoremediation is a site-specific method, an actual plot as a case will be great to learn about the method's complexity in applying plants, which are applicable and suitable plant species and local and varying onsite conditions, such as diverse concentrations of contaminants in different areas, the slant, groundwater conditions, and existing biodiversity.

Thus, phytoremediation and urban agriculture's coexistence and the interaction with brownfields can be analysed.

Finally, the role and stance of Landscape Architecture and designing brownfields, such as based on the urban voids' designing criteria of Lopez-Pineiro, can develop to maintain the harmony between amusement parks and fields (Aoki 2019:28) in Aoki's words.

In conclusion, the phytoremediation of brownfields, where their state generates proactive attitudes of people in the post-industrial environment, exhibits an opportunity for understanding Swedish contaminated areas not only as contaminated lands. The landowner's and municipality's broader understanding of brownfields can expect more examples like Vintergatan City Growing, which received help from the City of Malmö and the landowner Skanska Öresund at their launching and contributed to creating an identity from this particular location. Acknowledging brownfields' state of vacancy without filling them with a fixed function and the phytoremediation method may change the situation and approach to brownfields with minor to moderate risks, often neglected due to the current remediation measure. The recognition of brownfields from ecological, spatial, sociological and economic standpoints may add a new layer of identity in revitalising the post-industrial city of Malmö.

References

Anderberg, S. (2015). Western Harbor in Malmö. In: Nan, S., Reily, J. & Klass, F. (eds) Review 11 - Reinventing Planning: Examples from the Profession, The 51st International Society of City and Regional Planners Congress: Cities Save the World. Let's Reinvent Planning. Oct 19-23, Groningen, Antwerp, Schiphol, Maastricht, Rotterdam, Deventer, Delft/the Hague, Amsterdam, Wageningen & Eindhoven, The Netherlands, Dortmund, Germany & Brussels, Belgium. 210-227 https://isocarp.org/product/2015-isocarp-review-11-rotterdam-nld/

Aoki, J. (2019). Whereabouts of the field. In: Maki, F. & Makabe, T. (eds) Another Utopia - Thinking about the City from "Open Space". 1, Tokyo, Japan: NTT Publishing. 17-29. https://www.nttpub.co.jp/index.html

Aureli, P. V. (2013). The Theology of Tabula Rasa: Walter Benjamin and Architecture in the Age of Precarity. Log. (27), 126. https://www.jstor.org/stable/41765790

Baltic Urban Lab (n.d.). Västra Hamnen Area - Bo01 - Waterfront Regeneration in Malmö. https://www.balticurbanlab.eu/goodpractices/västra-hamnen-area-bo01-waterfront-regeneration-malmö [2022-01-31]

Bartlick, S. (2014). Berlin Voters Claim Tempelhof. https://www.dw.com/en/berlin-voters-claim-tempelhof/a-17663944 [2021-12-17]

Bolan, N.S., Park, J.H., Robinson, B., Naido, R. & Huh, K.Y. (2011). Chapter four - Phytostabilization: A Green Approach to Contaminant Containment. Advance in Agronomy. 145-204. https://doi.org/10.1016/B978-0-12-385538-1.00004-4

Boroş & Micle (2015). A Review: Study on Soil Decontamination by Phytoremediation in the Case of Former Industrial Sites. ProEnvironment. 8, 468-475. http://journals.usamvcluj.ro/index.php/promediu/article/view/11727

Borret, K. (1999). The 'Void' as a Productive Concept for Urban Public Space. In: Ghent Urban Studies Team (ed.) The Urban Condition: Space, Community, and Self in the Contemporary Metropolis. Rotterdam: 010 Publishers. 236-251. https://www.nai010.com/en/

Boverket (2020). Ekosystemtjänster i den byggda miljön - vägledning & metod. https://www.boverket.se/sv/PBL-kunskapsbanken/teman/ekosystemtjanster/ [2022-01-21]

Classification for the GIS Map According to MIFO/EBH Risk Classification. [Diagram]. Länsstyrelsen Skåne. Regionalt program för förorenade områden (n.d.b). https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden/regionalt-program-for-fororenade-omraden.html [2021-12-11]

Comparison of USEPA and SGF Remediation Methods. [Table]. United States Environmental Protection Agency. (2019) Cleaning up Brownfield Sites [Fact Sheet]. 560F19181. https://www.epa.gov/brownfields/understanding-brownfields [2021-12-13]; Svenska Geotekniska Föreningen. (2020) Åtgärdsportalen. https://www.atgardsportalen.se [2021-12-13]

Dannestam, T. (2009). Stadspolitik i Malmö: Politikens meningsskapande och materialitet. Lund University. Department of Political Science. https://portal.research.lu.se/sv/publications/stadspolitik-i-malmö-politikens-meningsskapande-och-materialitet

De Poli, M. & Incerti, G. (2014). Gas Works Park. In: Molinari, L. (ed.). An Atlas of Recycled Landscapes. 1, Milano, Italy: Skira Editore S.p.A. 160-163. https://www.skira.net/en/#

Dewey, S. (2020). The Power of Urban Agriculture in Transforming a Community. https://www.clf.org/blog/the-power-of-urban-agriculture-in-transforming-a-community/ [2021-12-18]

Doron, G. (2008). '… Those Marvellous Empty Zones at the Edge of Cities'. In: Dehaene, M. & de Cauter. L. (ed.) Heterotopia and the City: Public Space in a Postcivil Society. 1, London; New York: Routledge. 203-214. https://www.routledge.com/Heterotopia-and-the-City-Public-Space-in-a-Postcivil-Society/Dehaene-Cauter/p/book/9781138975965

Drenning, P., Norrman, J., Chowdhury, S., Rosén, L., Volchoko, Y. & Andersson-Sköld, Y. (2020). Enhancing Ecosystem Services at Urban Brownfield Sites - What Value Does Contaminated Soil Have in the Built Environment? IOP Conference Series: Earth and Environmental Science November 2-4, Gothenburg, Sweden. 1-7 http://doi.org/10.1088/1755-1315/588/5/052008

EBH Support on the County Administration Board. [Diagram]. Naturvårdsverket. 26000 förorenade områden kartlagda och riskklassade (n.d.e). https://www.naturvardsverket.se/amnesomraden/fororenade-omraden/utredning-och-efterbehandling-av-fororenade-omraden-ger-resultat/26-000-fororenade-omraden-kartlagda-och-riskklassade/ [2021-12-20]

Estimated Number of Places in Need of Examinations - Finishing Measures (1999). [Chart]. Naturvårdsverket Förlag. Metodik för inventering av förorenade områden - Bedömningsgrunder för miljökvalitet - Vägledning för insamling av underlagsdata (2002). Värnano: Fälth & Hässler. https://www.lansstyrelsen.se/download/18.840e7ca163033c061f1959d/1526068014016/Rapport_4918_NV.pd

The European Commission (2012). Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - The Implementation of the Soil Thematic Strategy and Ongoing Activities. (Document 52012DC0046). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52012DC0046

European Environment Agency (2010). The European Environment - State and Outlook 2010: Synthesis. Luxemburg: Publications Office of the European Union. https://www.eea.europa.eu/soer

Fritscher, L. (2020). Phobias: Understanding the Collective Unconscious. https://www.verywellmind.com/what-is-the-collective-unconscious-2671571 [2021-12-29]

Gemeinschaftsgarten Allmende-Kontor e.V. (n.d.). Allmende Kontor Chronik. https://www.allmende-kontor.de/der-garten/allmende-kontor-chronik/ [2021-02-24]

Greiff, M. (2008). Från sillamarknad till kommunikation och högskola: Omvandling och förnyelse i Malmö under 700 år. In: Lisberg Jensen, E. & Ouis, P. (eds). Inne och ute i Malmö: Studier av urbana förändringsprocesser. Malmö: Malmö University Publications in Urban Studies. 13-29. https://mau.diva-portal.org/smash/record.jsf?dswid=6782&pid=diva2%3A1405302&c=1&searchType=SIMPLE&language=en&query=&af=%5B%5D&aq=%5B%5B%7B%22localid%22%3A%227234%22%7D%5D%5D&aq2=%5B%5B%5D%5D&aqe=%5B%5D&noOfRows=50&sortOrder=author_sort_asc&sortOrder2=title_sort_asc&onlyFullText=false&sf=all

How Soil in Urban Areas Became a Target in the Sixth EAP [Diagram].

Hunter, P. (2014). Brown is the new green: Brownfield sites often harbour a surprisingly large amount of biodiversity. EMBO reports. 15(12), 1238-1242. https://doi.org/10.15252/embr.201439736

Internationale Bauausstellungen. (n.d.). IBA Fürst-Pückler-Land: Workshop for New Landscapes. https://www.internationale-bauausstellungen.de/en/history/2000-2010-iba-furst-puckler-land-werkstatt-fur-neue-landschaften/ [2021-12-26]

Inventory of polluted areas in Scania. [Map]. Länsstyrelsen Skåne & Lantmäteriet (n.d.:4) [Map]. In: Persson, K. & Lindqvist, M., Inventering av förorenade områden i Skåne. Malmö:Länsstyrelsen Skåne. https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden.html [2021-12-13]

Ji-Elle. (2016). Berlin-Stadtteilgarten Schillerkiez (5). [Photograph]. https://commons.wikimedia.org/wiki/File:Berlin-Stadtteilgarten_Schillerkiez_(5).jpg [2022-03-09]

Joint Research Centre: European Soil Data Centre (2010). European Atlas of Soil Biodiversity. Luxembourg: The Publication Office of the European Union https://esdac.jrc.ec.europa.eu/content/atlas-soil-biodiversity

Jon, I. (2021). Cities in the Anthropocene - New Ecology and Urban Politics. 1st edn, London: Pluto Press https://www.plutobooks.com/9780745341507/cities-in-the-anthropocene/

Jones, L. & Konick, L. (1984). Park Was Built on Foul Mound of Chemical Soup. Seattle Daily Times, April 22. https://www.seattletimes.com

Kawamoto, S. (2012). Baseball at Harappa: Great Playground for Children of Shōwa Era. In: ¿Cómo le va?. 10, Japan: Conex Eco-Friends Co., Ltd. https://conex-eco.co.jp/showa/47258/

Kuhn, R. (2014). Designing New Landscapes. In: Molinari, L. (ed.). An Atlas of Recycled Landscapes. 1, Milano, Italy: Skira Editore S.p.A. 17-19. https://www.skira.net/en/#

Kurosawa, A. (1947). One Wonderful Sunday [Film]. [2022-02-10]

Lamond, J. & Everett G. (2019). Sustainable Blue-Green Infrastructure: A Social Practice Approach to Understanding Community Preferences and Stewardship. *Landscape and Urban Planning*. 191, 1-10. https://doi.org/10.1016/j.landurbplan.2019.103639

Latz + Partner (n.d.). *NODU: Duisburg Nord Landscape Park*. https://www.latzundpartner.de/en/projekte/postindustrielle-landschaften/landschaftspark-duisburg-nord-de/ [2022-01-18]

Lidgren, J., Hesslekrans, Å., Person, A., Helbig, T., Andersson, S. & Lukac, B. (2015). *MEST_plan*. Malmö: Stadsbyggnadskontoret Malmö stad. https://malmo.se/Miljo-och-klimat/Miljo--och-klimatprojekt/MEST.html

Lopez-Pineiro, S. (2020). *A Glossary of Urban Voids*. Berlin: Jovis Verlag GmbH. https://www.jovis.de/en/books/details/product/a-glossary-of-urban-voids.html

Länsstyrelsen Skåne (n.d.a). *Förorenade områden*. https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden.html [2021-11-01]

Länsstyrelsen Skåne (n.d.b). *Regionalt program för förorenade områden*. https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden/regionalt-program-for-fororenade-omraden.html [2021-12-11]

Länsstyrelsen Örebro (2017). Förorenad mark vid gamla handelsträdgårdar: information till fastighetsägare och boende. [Pamphlet]. 10. Örebro: Länsstyrelsen Örebro. http://extra.lansstyrelsen.se/ebh/Sv/Pages/Broschyrer-och-faktablad.aspx [2022-02-18]

Maki. F. (2019). General Remarks: Draw a Dream from "Open Space". In: Maki, F. & Makabe, T. (eds) *Another Utopia - Thinking about the City from "Open Space"*. 1, Tokyo, Japan: NTT Publishing. 241-257. https://www.nttpub.co.jp/index.html

Malmö City Planning Office (2015). *Västra Hamnen: Current Urban Development.* Malmö: Malmö stad. https://malmo.se/Stadsutveckling/Stadsutvecklingsomraden/Vastra-Hamnen/Samlade-skrifter-om-Vastra-Hamnen.html

Malmö stad (2013). *Västra Hamnen 2031: ett hållbart och gott liv för alla*. Malmö: Malmö stad. https://malmo.se/Stadsutveckling/Stadsutvecklingsomraden/Vastra-Hamnen.html

Malmö stad (2018). *Översiktsplan för Malmö: Planstrategi*. Malmö: Malmö stad. https://malmo.se/Stadsutveckling/Tema/Oversiktsplanering/Oversiktsplan-for-Malmo.html

Malmö stad (2019). *Översiktsplan för Nyhamnen: Fördjupning av Översiktsplan för Malmö*. Malmö: Malmö stad. https://malmo.se/Stadsutveckling/Stadsutvecklingsomraden/Nyhamnen.html

Malmö stad (2021a). *130 års hamnhistoria undersöks på djupet*. https://malmo.se/Aktuellt/Artiklar-Malmo-stad/2021-11-10-130-ars-hamnhistoria-undersoks-pa-djupet.html [2021-02-02]

Malmö stad (2021b). *Markföroreningar*. https://malmo.se/For-foretag-och-verksamheter/Miljo--och-halsoskydd/Markfororeningar.html [2021-12-11]

Malmö stad (2021c). *Marksanering*. https://malmo.miljobarometern.se/kemikalier-och-miljogifter/fororening-med-miljofarliga-amnen/marksanering/ [2021-12-13]

Malmö stad (2021d). *Nyhamnens historia*. https://malmo.se/Stadsutveckling/Stadsutvecklingsomraden/Nyhamnen/Nyhamnens-historia.html [2021-02-02]

Malmö stad (2021e). *Taxor och avgifter inom miljö- och hälsoskydd och livsmedelskontroll*. https://malmo.se/For-foretag-och-verksamheter/Miljo--och-halsoskydd/Taxor-och-avgifter-inom-miljo--och-halsoskydd-och-livsmedelskontroll.html [2021-12-12]

Map of EBH Classification of Contaminated Areas in Nyhamnen and Vintergatan Urban Garden's Location. [Map]. Lantmäteriet. *GSD-Fastighetskartan vektor* (2019) [Geodata]; Länsstyrelsen. *LST Potentiellt förorenade områden externt (EBH)* (2020) [Geodata] https://ext-geodatakatalog.lansstyrelsen.se/GeodataKatalogen/GetMetaDataById?id=e5f8c5ca-62a9-41d6-900c-43f2837a8757; SCB. *Tatorter_1980_2020.gpkg* (1984) [Geodata]. https://www.scb.se/vara-tjanster/oppna-data/oppna-geodata/tatorter/

MIFO Risk Classification. [Diagram]. Naturvårdsverket. *Inventering av förorenade områden* (n.d.b). https://www.naturvardsverket.se/vagledning-och-stod/fororenade-omraden/inventering-av-fororenade-omraden/ [2021-12-10]

Miljödepartmentet (2020). *Regleringsbrev för budgetåret 2021 avseende Naturvårdsverket*. (M2020/02056). Stockholm:Regeringen. https://www-esv-se.translate.goog/statsliggaren/regleringsbrev/?rbid=21348&_x_tr_sl=sv&_x_tr_tl=en&_x_tr_hl=sv

Miljöförvaltningen Malmö stad (1993). *Markundersökning i Västra hamnen, Malmö: Delrapport 1 f d Kockumsområdet*. Malmö: Malmö stad. https://malmo.se/Miljo-och-klimat/Miljo--och-klimatmal/Miljolaget-i-Malmo/Miljorapporter/Mark.html?folder=19.663ce4af1240ed89c73800091843#

Mitchell, D. (2003). *The Right to the City: Social Justice and the Fight for Public Space*. London: The Guilford Press.

Mitchell, D. & Van Deusen, R. (2001). Downsview Park: Open Space or Public Space. In: Czerniak, J. (ed.) *Case: Downsview Park Toronto*. Munich; New York; Cambridge MA: Prestal; Harvard University, Graduate School of Design. 102-113. https://www.gsd.harvard.edu/publication/case-downsview-park-toronto/

Naruse, M. (1933). Each Night I Dream [Film]. [2022-02-21]

Naturskyddsföreningen Malmö (n.d.) *Stadsodlingsgruppen*. https://malmo.naturskyddsforeningen.se/intressegrupper/stadsodlingsgruppen/

Naturvårdsverket (2009). Riktvärden för förorenad mark - Modellbeskrivning och vägledning. (5976:03). Bromma: CM Gruppen AB.

Naturvårdsverket (n.d.a). *Det här gick pengarna till 2021*. https://www.naturvardsverket.se/amnesomraden/fororenade-omraden/sa-har-fungerar-bidragen-for-efterbehandling/det-har-gick-pengarna-till-2021/ [2021-11-25]

Naturvårdsverket (n.d.b) *Inventering av förorenade områden*. https://www.naturvardsverket.se/vagledning-och-stod/fororenade-omraden/inventering-av-fororenade-omraden/ [2021-12-10]

Naturvårdsverket (n.d.c) *Riktvärden för förorenad mark*. https://www.naturvardsverket.se/vagledning-och-stod/fororenade-omraden/riktvarden-for-fororenad-mark/ [2021-12-10]

Naturvårdsverket (n.d.d). *Ämnesområde: Förorenade områden*. https://www.naturvardsverket.se/amnesomraden/fororenade-omraden/ [2021-11-25]

Naturvårdsverket (n.d.e). *26000 förorenade områden kartlagda och riskklassade*. https://www.naturvardsverket.se/amnesomraden/fororenade-omraden/utredning-och-efterbehandling-av-fororenade-omraden-ger-resultat/26-000-fororenade-omraden-kartlagda-och-riskklassade/ [2021-12-20]

Naturvårdsverket Förlag. (1999). *Metodik för inventering av förorenade områden - Bedömningsgrunder för miljökvalitet - Vägledning för insamling av underlagsdata*. (Rapport 4918). Värnano: Fälth & Hässler. https://www.lansstyrelsen.se/download/18.840e7ca163033c061f1959d/1526068014016/Rapport_4918_NV.pdf

Nilsson, J. (2016). *Malmös stadsomvandling från industristad till kunskapstad: Arkitekturens roll i förändringsprocessen*. Linköping University. Department of Culture and Communication/History Art and Visual Communication. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1069958&dswid=-5249

The Number of Classified Contaminated Sites in Scania (2021-10-14) on EBH Support. [Diagram]. Länsstyrelsen Skåne. *Regionalt program för förorenade områden* (n.d.b). https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden/regionalt-program-for-fororenade-omraden.html [2021-12-11]

The Number of Risk-Classified Contaminated Areas in Malmö. [Diagram]. Persson, K. & Lindqvist, M. Inventering av förorenade områden i Skåne (2018). https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden.html [2021-12-13]

The Obligation of Payment and Subsidy Application. [Diagram]. Länsstyrelsen Skåne. *Regionalt program för förorenade områden* (n.d.b). https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden/regionalt-program-for-fororenade-omraden.html [2021-12-11]

Okuno, T. (1972). *Primal Scene in Literature - The Illusion of Fields and Caves*. 1st edn, Shueisha

Ozu, Y. (1936). The Only Son [Film]. [2022-02-13]

Persson, K. & Lindqvist, M. (2018). *Inventering av förorenade områden i Skåne*. (2018:31). Malmö:Länsstyrelsen Skåne. https://www.lansstyrelsen.se/skane/miljo-och-vatten/fororenade-omraden.html [2021-12-13]

The Publication Office of the European Union (2010) Map of Soil Biodiversity Potential Threats. [Map]. In: S. Jeffery, C. Gardi, A. Jones, L. Montanarella, L. Marmo, L. Miko, K. Ritz, G. Peres, J. Römbke and W. H. van der Putten (eds.), *European Atlas of Soil Biodiversity*. Luxembourg: European Commission, Publications Office of the European Union. https://esdac.jrc.ec.europa.eu/content/atlas-soil-biodiversity [2022-03-04]

Publications Office of the European Union 2002/C 325 of Treaty Establishing the European Community (Nice Consolidated Version) - Part Three: Community Policies - Title VI: Common Rules on Competition, Taxation and Approximation of Laws - Chapter 3: Approximation of Laws - Article 95 - Article 100a – EC Treaty (Maastricht Consolidated Version) - (12002E095). https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A12002E095

Publications Office of the European Union 2006/0231 of Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - Thematic Strategy for Soil Protection (/* COM/2006/0231 final */). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52006DC0231

Publications Office of the European Union 2011/0244 of Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the

Committee of the Regions: Our Life Insurance, Our Natural Capital: an EU Biodiversity Strategy to 2020 (/* COM/2011/0244 final */). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52011DC0244

Publications Office of the European Union 2011/0571 of Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap to a Resource Efficient Europe (/* COM/2011/0571 final */). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52011DC0571

Ra'ike. (2009). Landschaftspark Duisburg Nord. [Photograph]. https://commons.wikimedia.org/wiki/File:Landschaftspark_Duisburg_Nord.jpg [2022-03-09]

The Riksdag (2017). Riksvisionens rapport om statens förorenade områden - Betänkande 2016/17:MJU19. Vällingby:Elanders Sweden. https://www.riksdagen.se/sv/dokument-lagar/dokument/betankande/_H401MJU19

Riksrevisionen (2021). *Organisation*. https://www.riksrevisionen.se/om-riksrevisionen/sa-styrs-riksrevisionen/organisation.html [2021-12-01]

Robins, J. Henshall, S. & Farr, A. (2013). *The state of brownfields in the Thames Gateway*. Orton Waterville: Buglife. https://www.buglife.org.uk/resources/habitat-hub/brownfield-hub/the-state-of-brownfields-in-the-thames-gateway/

Sadler, R., Delamont, C., White, P & Connell, D. (2008). Contaminants in Soil as a Result of Leaching from Asphalt. *Toxicological and Environmental Chemistry*. 68 (1-2), 71-81. https://doi.org/10.1080/02772249909358646

Sawyer, S. (2020). *Gas Works Park (Seattle)*. https://www.historylink.org/File/20978 [2021-12-20]

The Scales of Brownfield Administration and Management. [Map].

Schulze Bäing, A. & Wong, C. (2012). Brownfield Residential Development: What Happens to the Most Deprived Neighbourhoods in England?. *Urban Studies*. 49(14), 2989-3008. https://doi.org/10.1177/0042098012439108

The Science Communication Unit, University of the West of England, Bristol (2013). Science for Environment Policy - Phytoremediation's Potential for Brownfield Decontamination Assessed. *Science for Environment Policy - Thematic Issue: Brownfield Regeneration*. 39, 16. https://ec.europa.eu/environment/integration/research/newsalert/pdf/39si_en.pdf

Shibaura House (n.d.) *History of Shibaura House*. https://shibaurahouse.jp/?page_id=2160&lang=en [2021-12-29]

Sites Applicable for Phytoremediation in the Targeted Development Areas of the City of Malmö. [Map]. Lantmäteriet. *GSD-Fastighetskartan vektor* (2019) [Geodata]; Länsstyrelsen. *LST Potentiellt förorenade områden externt (EBH)* (2020) [Geodata] https://ext-geodatakatalog.lansstyrelsen.se/GeodataKatalogen/GetMetaDataById?id=e5f8c5ca-62a9-41d6-900c-43f2837a8757; SCB. *Tatorter_1980_2020.gpkg* (1984) [Geodata]. https://www.scb.se/vara-tjanster/oppna-data/oppna-geodata/tatorter/

Skanska Öresund's Plot after the Move of the Community Garden. [Photography].

Solà-Morales, I. d. (1995). Terrain Vague. In: Davidson, C.C. (ed.) *Anyplace*. Cambridge, MA: MIT Press. 119, 122-123. https://www.anycorp.com/store/anyplace

Stadsodling Malmö (n.d.). *Vintergatans Stadsodling*. https://stadsodlingmalmo.se/odlingar/vintergatans-stadsodling/ [2021-12-15]

Statens geologiska undersökning (2021). *Förorenade områden.* https://www.sgu.se/samhallsplanering/fororenade-omraden/ [2021-11-02]

Statens Geotekniska Institut (2020). *Förorenade områden och efterbehandling*. https://www.sgi.se/sv/kunskapscentrum/om-geoteknik-och-miljogeoteknik/geoteknik-och-markmiljo/fororenade-omraden/ [2021-07-23]

Stavrides, S. (2020). *Common Space: The City as Commons*. 2, London, UK: Bloomsbury Publishing Plc. https://www.bloomsbury.com/uk/common-space-9781783603275/

Stilgenbauer, J. (2015). In: Hou, J., Spencer, B., Way, T. & Yocom, K. (eds) *Now Urbanism: The Future is Here*. 1, Abingdon & New York: Routledge. 92-106. https://www.routledge.com/Now-Urbanism-The-Future-City-is-Here/Hou-Spencer-Way-Yocom/p/book/9780415717861

Supervision Process of the City of Malmö. [Diagram]. Malmö stad. Markföroreningar (2021b). https://malmo.se/For-foretag-och-verksamheter/Miljo--och-halsoskydd/Markfororeningar.html [2021-12-11]

Svenska Geotekniska Föreningen (2019). *Fytosanering*. [2021-12-14] https://www.atgardsportalen.se/metoder/jord/in-situ/fytosanering

Svenska Geotekniska Föreningen (2020). *Åtgärdsportalen*. https://www.atgardsportalen.se [2021-12-13]

Swedish National Brownfield Management in Connection to the European Union. [Diagram].

TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB*. Malta: Progress Press. http://teebweb.org/publications/teeb-for/synthesis/

Tokyo Midtown Management Co., Ltd. (n.d.a). *Facilities*. https://www.tokyo-midtown.com/jp/facilities/ [2021-12-29]

Tokyo Midtown Management Co., Ltd. (n.d.b). *History and Development*. https://www.tokyo-midtown.com/jp/about/history/ [2021-12-29]

Tsai, H. (2019). Gas Works Park. [Photograph]. https://www.flickr.com/photos/aya80904/48892344767 [2022-03-09]

United States Environmental Protection Agency (2019). Cleaning up Brownfield Sites. [Fact Sheet]. 560F19181. United States Environmental Protection Agency. https://www.epa.gov/brownfields/understanding-brownfields [2021-12-13]

United States Environmental Protection Agency (2021). Overview of EPA's Brownfields Program. https://www.epa.gov/brownfields/overview-epas-brownfields-program [2021-07-23]

United States General Services Administration (2019). *National Register of Historic Places*. https://www.gsa.gov/real-estate/historic-preservation/historic-building-stewardship/national-register-of-historic-places [2021-12-15]

Vanheusden, B. (2007). Brownfield Redevelopment in the European Union. *Boston College Environmental Affairs Law Review*. 3(34), 559-575/6. https://lawdigitalcommons.bc.edu/ealr/vol34/iss3/6/

Vintergatan Urban Garden. [Photography].

Washington State Department of Ecology, Seattle Department of Parks and Puget Sound Energy (1997). *Gas Works Park Environmental Clean Up - Public Participation Plan*. Washington. https://ecology.wa.gov

Wikipedia (2021). *Roppongi*. https://en.wikipedia.org/wiki/Roppongi [2021-12-29]

Zifan, A. (2016). *Sweden Map of Köppen Climate Classification*. [Map]. https://sv.m.wikipedia.org/wiki/Fil:Sweden_map_of_Köppen_climate_classification.svg [2022-03-08]

Acknowledgements

First and foremost, I want to thank my supervisor, Dr Marie Larsson. Her course Urban Agriculture and Social Interaction became a great inspiration for developing the thesis topic, and this paper would not exist without her special assistance and dedication. Thank you, Jenny Sjölin from Vintergatan Stadsodling, for making time for the interview to illustrate the situation of a community garden in the industrial area in Malmö.

I would like to thank Helena Persson, the Independent Project in Landscape Architecture course leader, for her devotion and support. I would also like to show gratitude to Education Officer Nicklas Karlsson, who helped me as an independent student to be registered on the course to build my own degree. I must also thank my previous classmate Tereza Fenclová for her consultancy for writing a thesis as an independent student.

Thanks to Helen Andersen for her company at home in between intense writing. Most importantly, I could not reach this point without my family. Big thanks to my father, Kenji Chimura, for believing in and supporting me for all these times. I especially want to dedicate this thesis to my mother, Hiroko Chimura, who always wished me academic success and still wishes the same in heaven. Joking around with my younger sister Elina Imafuku helped me through challenging writing days. Finally, special thanks to my partner Lorenz Krauth for his continuous understanding, support, and inspiration for developing my interest in the subject.

Publishing and archiving