Rewilding Cities: Exploring Opportunities for Rewilding the Built Environment through Nature-Inclusive Design

With the residential neighbourhood Boerhaavewijk as a case study in the Netherlands

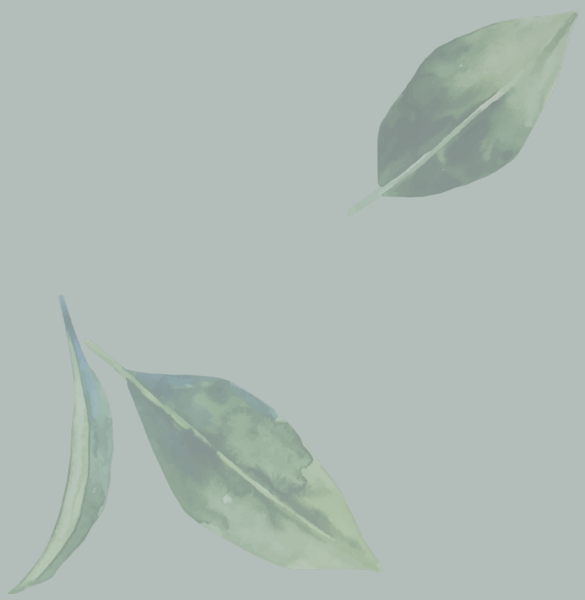
Faculty of Architecture & the Built Environment,
Delft University of Technology

RESEARCH PLAN

Architectural Engineering Studio
Design Tutor: Anne Snijders
Research Tutor: Nico Tillie

Annekee Groeninx van Zoelen
4445929

CONTENT



ARGUMENTATIONS OF CHOICE OF THE STUDIO

The wider scope of the Architectural Engineering studio to seek innovative and inspiring architectural solutions to environmental and societal issues, while leading your own research is what appealed to me a lot. In addition, the directions that can be taken within this studio to explore one's own role as an architect in facing today's challenges is why I choose aE. I want to expand my skills in the interconnected research-design approach and here, this opportunity is offered. I also really appreciate the freedom and flexibility to define one's own problem and context based on one's personal fascination in this studio. My personal fascination arose while reading David Attenborough's book *A Life on Our Planet*. He describes how humanity has taken the Earth out of balance and how nature needs to 'rewild' to stabilise our planet. "How can we encourage a return of the wild and bring back some stability to the Earth?" (Attenborough & Hughes, 2020). This is a question from Attenborough that has been floating through my mind for months, leaving me wondering: how exactly do we do this in the built environment? This is what drives me, to explore opportunities to apply Attenborough's rewilding concept in our built world.

KEYWORDS

Rewilding, Biodiversity, Nature-Inclusive Design, Bio-Corridor, Urban Ecology, Ecosystem, Species, Boerhaavewijk, Haarlem

GLOSSARY OF KEY TERMS

Rewilding: Restoration by letting go, allowing nature to take the driving seat (Tree & Schlosser, 2019). Allowing green spaces to develop without human intervention (Phillips, 2022). It serves as a form of large-scale biological and ecological restoration to regain functional and resilient ecosystems (Noss, 1992; Noss & Cooperrider, 1994). The term is mainly used regarding the reintroduction of species of wildlife, insects, birds and flora and fauna that have been displaced or eradicated. The term is now widely used, although its meaning has become varied with wider use. It retains its original meaning while also being used to describe restoration in general, recovery of Pleistocene species and, in some cases, urban greenways (Pettorelli et al., 2019). Thus, on the one hand, there is 'ecological rewilding' relating to biophysical nature; rewilding of water, land and wildlife. And on the other hand, 'human rewilding' relates mainly to personal, social or cultural dimensions, such as urban rewilding. Ecological rewilding has historically driven the rewilding movement. Human rewilding is not about reinforcing the strict separation between humans and nature, but about interweaving those spheres, especially giving space to natural processes in the context of the current, all-controlling, human dominance on Earth (Arts et al., 2022).

Biodiversity: The variety of living species on Earth or in a particular habitat, including plants, animals, bacteria, and fungi. While Earth's biodiversity is so rich that many species have yet to be discovered, many species are being threatened with extinction due to human activities, putting the Earth's magnificent biodiversity at risk (Biodiversity | National Geographic Society, n.d.).

Nature-Inclusive Design: The objective of the plan or project includes nature protection measures. It must be clear from the project proposal that this extra measure is really going to be implemented as part of the project. Thus, it implies that social, economic and nature conservation objectives are integrated in one project (Nature Inclusive Design Defenition, n.d.). Architectural and spatial interventions are incorporated to accommodate flora and fauna in the design process. Nature-inclusive design is not just beneficial for the natural environment, the flora and fauna also provide ecosystem services that humans benefit from (WHO Europe, 2016).

Bio-Corridor: A biological corridor is an area of habitat connecting wildlife populations separated by human activities or structures (such as roads, development, or logging). This allows an exchange of individuals between populations, which may help prevent the negative effects of inbreeding and reduced genetic diversity (via genetic drift) that often occur within isolated populations. Corridors may also help facilitate the re-establishment of populations that have been reduced or eliminated due to random events (such as fires or disease) (Biological Corridor, n.d.).

INTRODUCTION

"Over the years, we lost our balance.
We moved from being a part of nature to being apart from nature."

(Attenborough & Hughes, 2022)

We live in a climate change-affected world where cities account for sixty to eighty per cent of global greenhouse gas emissions and by 2050, they must find a way to accommodate more people, provide a higher quality of life, and mitigate the consequences of climate change (Lehmann, 2021). Individuals, governments, and companies are working harder to reduce their emissions. This is urgent, as biodiversity continues to decrease and weather conditions become more extreme. Urban ecosystems are under pressure because they must resist longer and more frequent droughts, as well as rising temperatures, air pollution, and water scarcity (IPCC, 2018). The following section provides an introduction to these larger-scale climate change consequences and some common deficiencies in neighbourhoods regarding green space within the context of this project.

Extreme Weather Conditions
Climate change calls for measures to cope with more extreme weather conditions and water management issues. Recent research on extreme weather and climate change, published by the Annual Review of Public Health, highlights that extreme weather and climate events, including floods, heat waves, and cyclones, worldwide are a direct result of climate variability (Ebi et al., 2021). Europe is also impacted and several Western European nations experienced heat waves in 2019, which led to record-breaking temperatures that occasionally reach above 40 degrees Celsius for as many as four days straight in June and July (Painter et al., 2021). The summer of 2022 was the third-warmest summer in the Netherlands since 1901, according to the KNMI (2022). "The image of this summer fits with that of the changing climate: sunny and warm summers with an erratic precipitation pattern in which droughts and wet summers alternate", states the KNMI (2022). Studies on Extreme Event Attribution (EEA) indicate that anthropogenic climate change has increased temperatures by 1.2 -3.0 °C and at least three to ten times the chance of severe events (Painter et al., 2021). The effects of climate change on weather conditions can no longer be ignored and designers must respond to this.

Biodiversity Loss
One sign of an ecosystem's health and resilience is its biodiversity. The diversity of genes, species, and ecosystems are three key elements of this broad concept. Despite the discovery of new species and a variety of international agreements to protect endangered species and biotopes, biodiversity is nevertheless declining on a global scale in all three accounts (Vink & Vollaard, 2017).

Climate change harms biodiversity and this worldwide loss of biodiversity, also according to the Intergovernmental Platform on Biodiversity and Ecosystems Services (IPBES, 2019), is shown in figure 1. The Living Planet Index is a measure of the state of the world's biological diversity based on population trends of vertebrate species from terrestrial, freshwater, and marine habitats. Climate change also has a negative impact on biodiversity in residential neighbourhoods, according to research from the University of Nevada Las Vegas on *renaturalization and rewilding as strategies to strengthen urban resilience* (Lehmann, 2021).

Instead of decreasing the surface of natural areas across the world, the degree of natural areas needs to strongly increase in order to stabilise biodiversity, according to the British biologist David Attenborough, and a sustainable balance in biodiversity is needed to stabilise the planet (2020). Urban regreening initiatives, however, enable "repairing" and restoring some of the harm done to ecosystems while boosting urban resili-

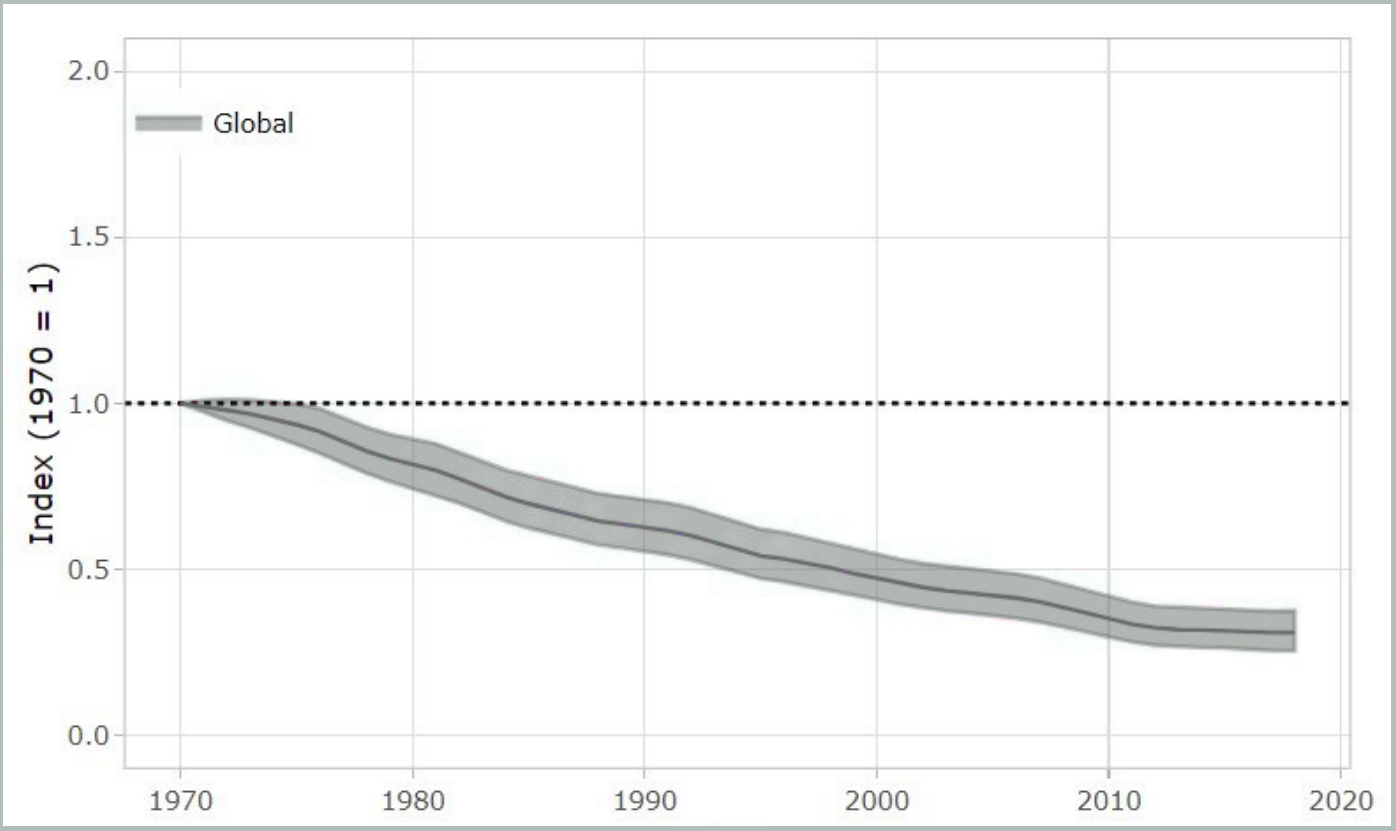


Figure 1: Global Living Planet Index (LPI) (WWF & ZSL, 2022)

ence. Attenborough states "[…] the rewilding of the world will suck enormous amounts of carbon from the air and lock it away in the expanding wilderness […] this nature-based solution would be the ultimate win-win - carbon storage and biodiversity gain all in one" (2020). Rewilding provides significant opportunities to increase biodiversity, develop self-sustaining ecosystems, and mitigate climate change (Lehmann, 2021).

Deficiencies in Neighbourhoods

The goal of rewilding the planet is in contrast with global urbanisation, which continues to increase, but at the same time in many cities worldwide, the quality of life has declined over recent years (Lehmann, 2021). Neighbourhoods often show a lack of green connectivity, such as park connectors or bio-corridors, both internally and with the surrounding region. They also tend to have an excessively paved surface, which is counterproductive for nature development and water management. Being in a green environment is beneficial for mental health. Kondo et al. found evidence of a positive link between urban green space and mood, attention, and physical activity (2018). Nevertheless, the existing green in neighbourhoods tends to be primarily artificial landscaping, such as lawns, sports fields, and private gardens.

Furthermore, post-war reconstruction quarters are generally lacking density, mixed-use, and amenities within walking distance. It is therefore desirable to suspend building in greenfield areas and reduce built footprints while simultaneously building denser. Existing buildings need to be renovated sustainably to become emission-free. Good urban design and planning can make a profound positive contribution to solving the problems related to climate change and societal challenges (Lehmann, 2021).

Context

There are many residential neighbourhoods in the Netherlands. According to the Central Bureau of Statistics, the Netherlands has as many as 2,500 residential districts in 2020 (Woonplaatsen in Nederland 2020, 2020). In Schalkwijk, Haarlem, Boerhaavewijk is one of those typical 1960s reconstruction neighbourhoods, this location is shown in figure 2 on the following page. It is characterised by a spacious layout, long sightlines, and wide distances. The district has a strongly inward-looking character, as shown in figure 5: there are clear boundaries and the building blocks create separate areas within the

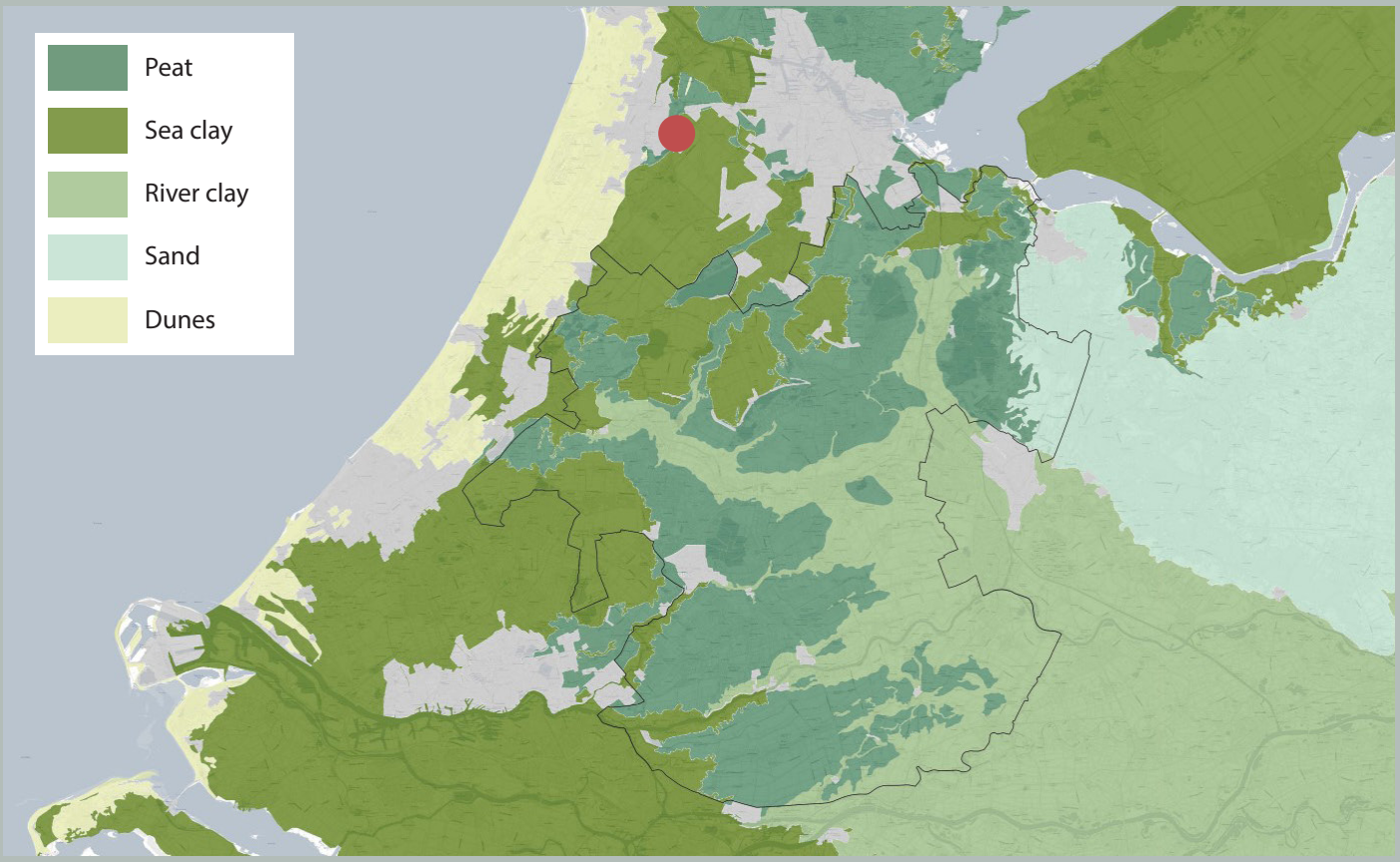


Figure 2: Soil map (Köbben, 2021)

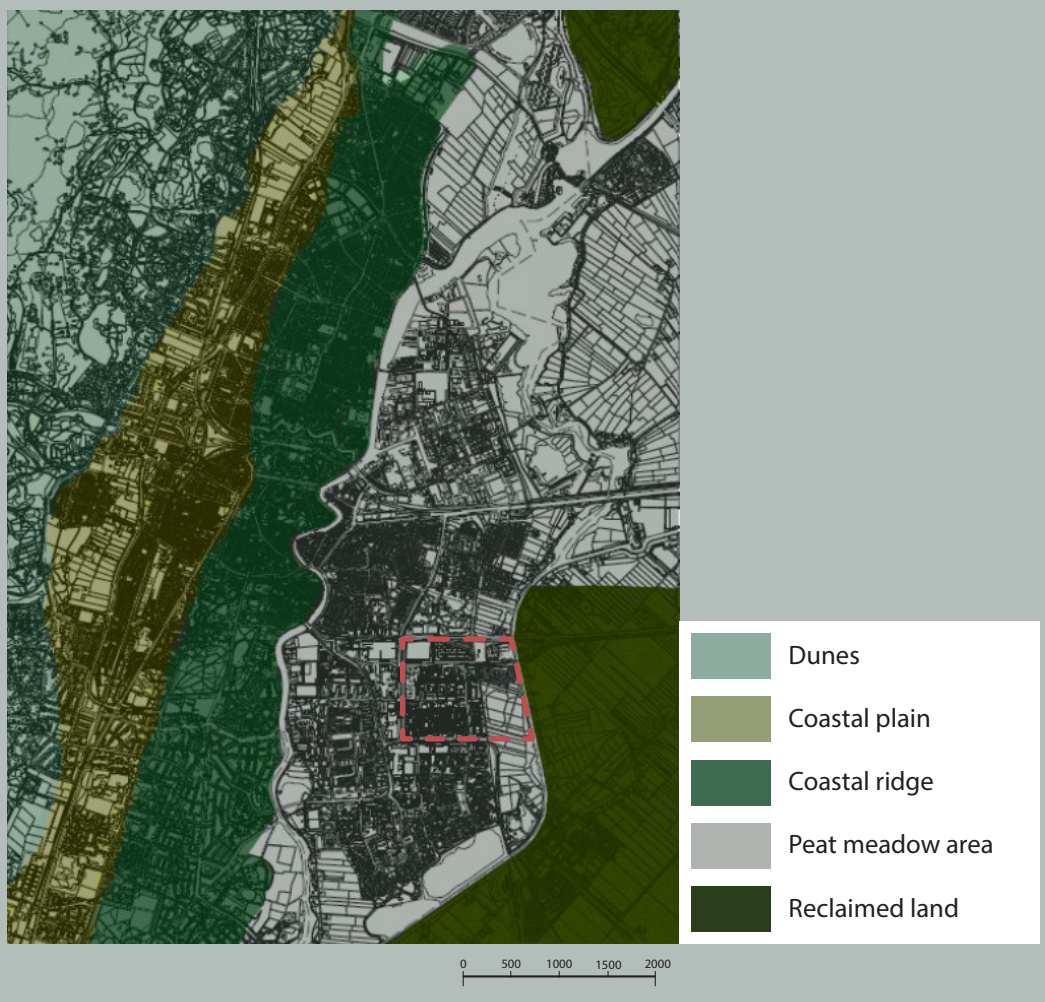


Figure 3: Landscape zones Haarlem (drawn by author)

Figure 4: Green and water structure Schalkwijk, Boerhaavewijk in red dotted line (drawn by author)

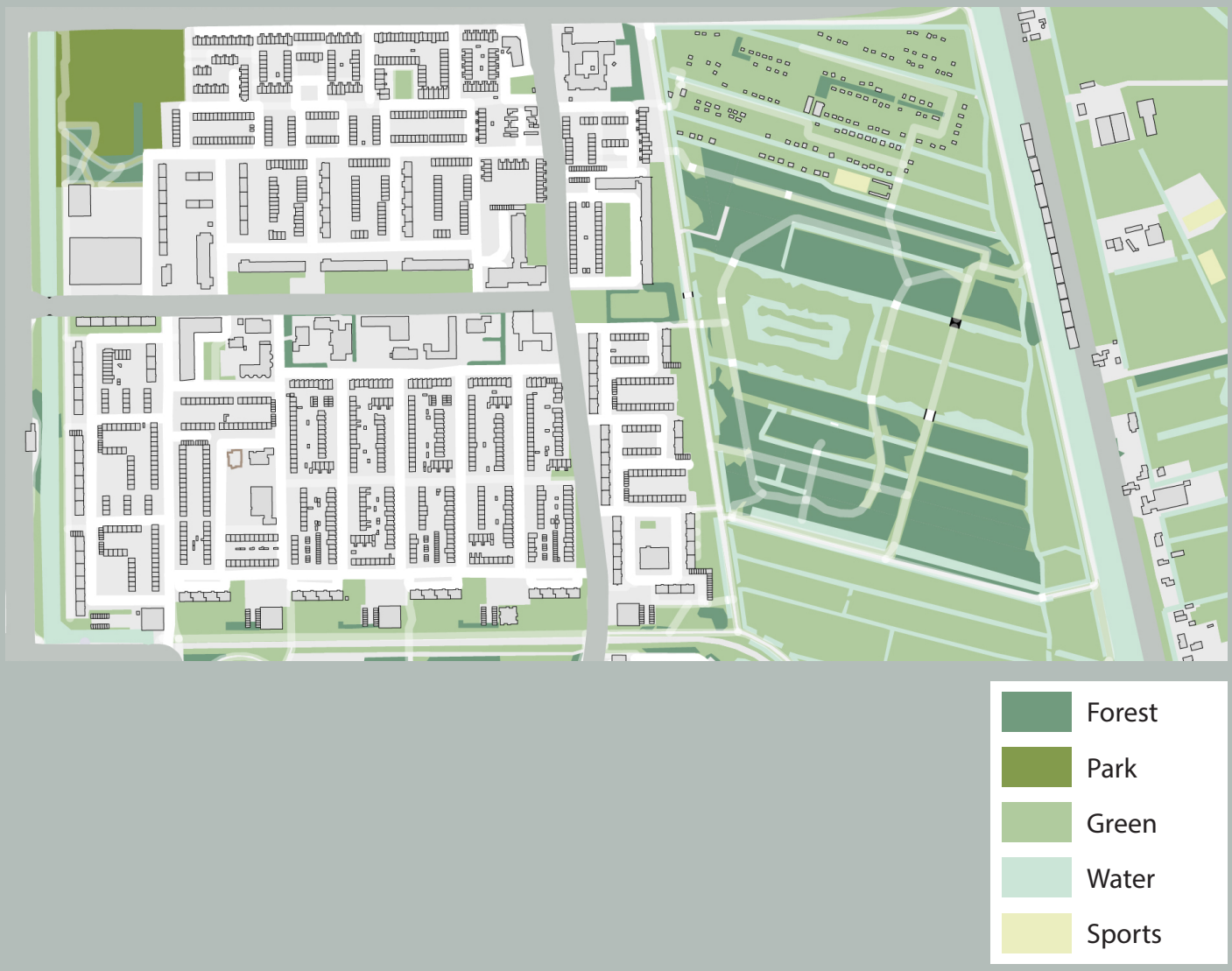


Figure 5: Boerhaavewijk and the Poelpolder (drawn by author)

neighbourhood (Gemeente Bestuur Haarlem, 2018). Figure 3 shows that Boerhaavewijk rests on a peat meadow area and reclaimed land makes up the natural reserve that borders the district's eastern edge. The Poelpolder, in the east of Boerhaavewijk and part of this neighbourhood, is an example of a typical Dutch polder on the outskirts of the city. It establishes a distinct barrier between the city and the surrounding landscape and separates rural from urban. There is a poor connection and a clear boundary between the two areas (see figure 4 & 5). The green and water structure of the surrounding area is shown in figure 4 and it is visible that Boerhaavewijk belongs to the urban fringe of the city of Haarlem.

PROBLEM STATEMENT

There is no overview of requirements for rewilding a residential neighbourhood in the Netherlands through nature-inclusive design.

OBJECTIVE

This graduation project intends to explore how to rewild the built environment through nature-inclusive designs. It aims to define the requirements for rewilding a residential neighbourhood, with Boerhaavewijk as a case study. The outcome of this research will lead to a framework mapping opportunities for rewilding neighbourhoods. Local biodiversity is examined, since it is crucial to learn about the local biodiversity and the various environmental requirements of the species that are currently there for developing a balanced ecology policy (Vink & Vollaard, 2017). Rewilding this area provides an ecological connection between the built zone and its surrounding landscape. A return to nature for selected urban areas can be a powerful way to bring back lost biodiversity to our cities and bring communities closer to nature (Phillips, 2022). The research then explores how nature-inclusive design strategies can be applied to promote this local biodiversity. The requirements and design principles coming from this framework will be implemented in the design project where Boerhaavewijk and its surrounding landscape will be the context of the project, as drawn in figure 6 below.

Figure 6: Objective of the research in a diagram (drawn by author)

Furthermore, the aim of the design project, besides applying the framework to rewild the neighbourhood, will also cover the transition of Boerhaavewijk from a mono-functional neighbourhood into an inclusive, mixed-use neighbourhood. Increasing biodiversity goes hand in hand with increasing liveability, circularity, and climate-adaptation. The developed design strategy aims to create a balance between the natural environment, cultural landscape (i.e. private gardens, allotments, sports fields, water surface, etc.), existing building stock, and mobility infrastructure, like parking and paved surface. This also includes an assessment of the (lack of) density, the mix of uses, local amenities, and public transport, to formulate conditions for a more inclusive living environment. The proposals resulting from the study will also make the neighbourhood more climate-resilient and contribute to increasing biodiversity. Although increased biodiversity is an important and expected outcome, this is an architectural graduation studio and not based on biological studies. The degree of knowledge needed on biodiversity is focused on the current species in Boerhaavewijk and their needs to live and reproduce, which makes it relevant for this project.

OVERALL DESIGN QUESTION

The overall design question for this project consists of two components. Firstly, the thematic research question will directly be implemented in the overall design:

How to apply the requirements for rewilding the built environment through nature-inclusive design in a residential neighbourhood?

And simultaneously a holistic design strategy for the neighbourhood will be created:

How to transition Boerhaavewijk from a mono-functional neighbourhood into an inclusive, mixed-use neighbourhood?

The overall design question leads to a final design project that consists of a nature-inclusive design leading to a connection between the built zone and its surrounding landscape and creating a more natural environment in Boerhaavewijk.

THEMATIC RESEARCH QUESTION

How to rewild the built environment through nature-inclusive design in a residential neighbourhood?

The thematic research question explores the opportunities for rewilding in a residential neighbourhood. To determine this, the sub-questions are as follows:

- *How to apply the concept of rewilding in the built environment?*
- *What are the requirements for a nature-inclusive design to be an ecological connection between the built zone and its surrounding landscape?*
- *How can rewilding through nature-inclusive design create opportunities for biodiversity in a residential neighbourhood in the Netherlands, with Boerhaavewijk as a case study?*
- *What are the specific species and their requirements in Boerhaavewijk?*

HYPOTHESIS

A study on applying the concept of rewilding to the built environment will lead to a generic framework. The requirements for architecture through nature-inclusive design as an ecological connection are examined on three scale levels: the building level, the habitat level, and the system level (see figure 7). Looking into case studies on nature-inclusive designs on those three levels leads to a framework consisting of architectural interventions, elements, and designs.
A list of the specific species in Boerhaavewijk and their requirements will be made. With this knowledge of the current biodiversity and the framework of architectural interventions, a specific framework and design strategy for a nature-inclusive design to rewild Boerhaavewijk will be created. It is expected that there will be an increase in existing biodiversity through the developed design strategy. Nevertheless, it cannot be proven. However, by adapting to the requirements of current species, by designing for and allowing better places for species to develop, there is a high probability that biodiversity will increase.

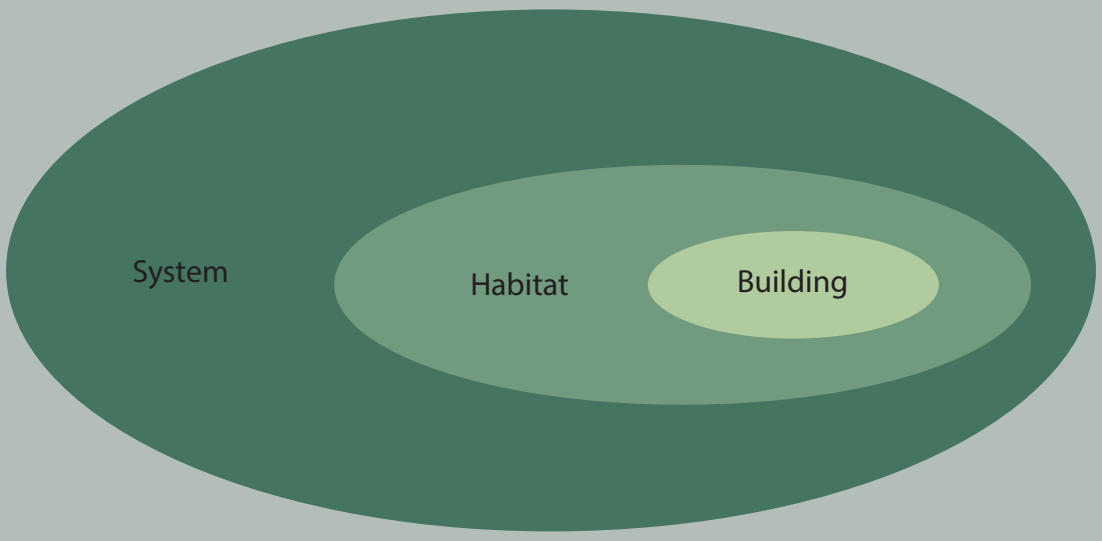


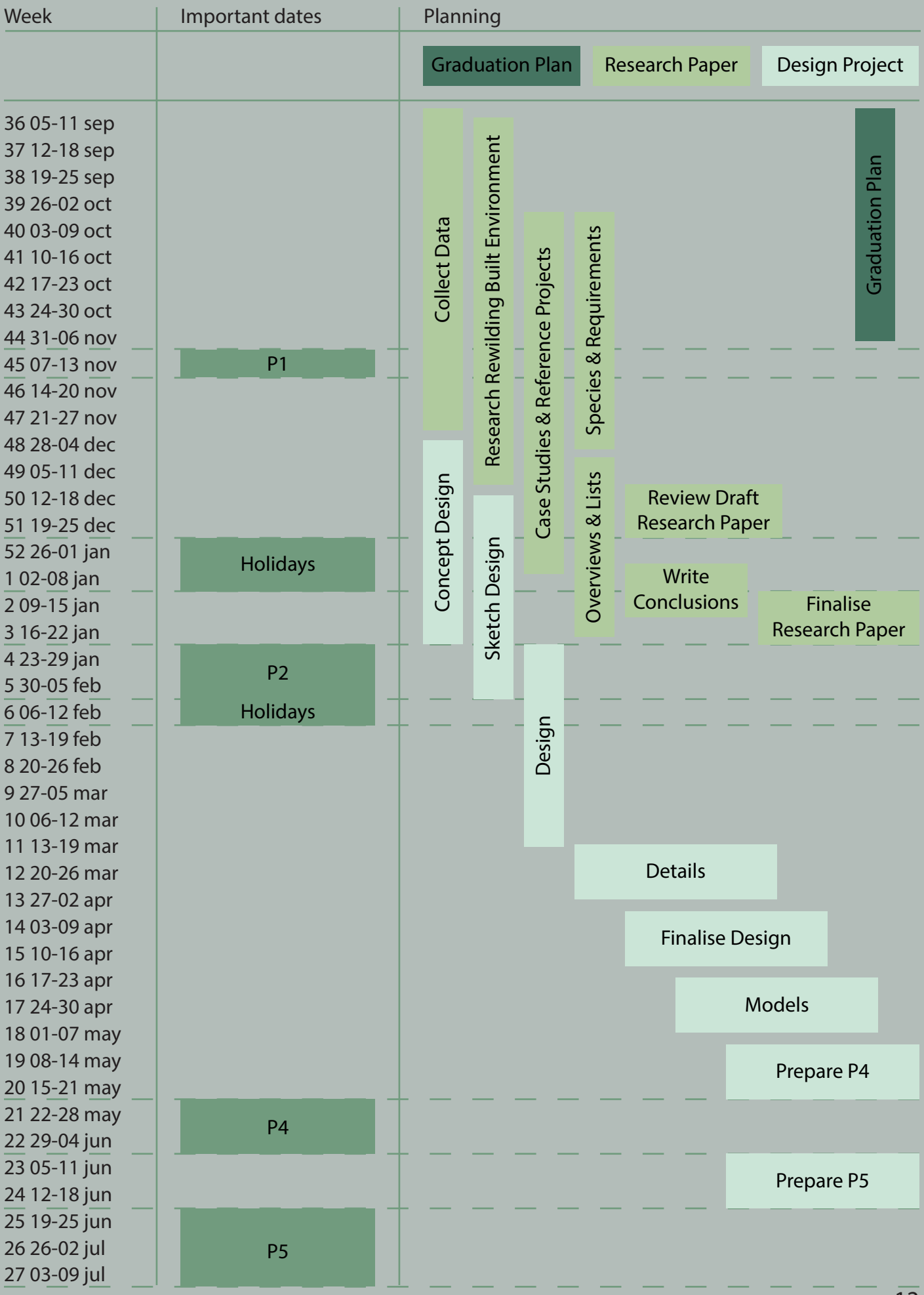
Figure 7: Three scale levels: Building, Habitat, and System (drawn by author)

METHODOLOGIES

The methodologies are presented in the table below.

Sub research question	What data do you need?	How can this data be collected?	How will this data be analysed?	What will be the expected result?
How to apply the concept of rewilding in the built environment?	- Qualitative data on rewilding projects in the built environment	- Literature study - Desktop research - Reference analysis	- Overview of the possibilities and reference projects	- List of interventions to rewild the built environment - Examples of built areas where rewilding has been applied
What are the requirements for a nature-inclusive design to be an ecological connection between the built zone and its surrounding landscape?	- Qualitative data on ecological connections - Nature-inclusive design case studies	- Literature study - Reference analysis	- Overview of reference projects	- List of requirements - Opportunities from case studies on three scale levels (building, habitat, and system level)
How can rewilding through nature-inclusive design create opportunities for biodiversity in a residential neighbourhood in the Netherlands, with Boerhaave-wijk as a case study?	- Qualitative data on nature-inclusive designs in residential neighbourhoods - Examples of nature inclusive designs in residential neighbourhoods	- Literature study - Reference analysis	- Overview of opportunities - Overview of reference projects	- List of opportunities - Examples of nature inclusive designs in residential neighbourhoods
What are the specific species and their requirements in Boerhaavewijk?	- Current species in Boerhaavewijk - Their require-ments to live and reproduce	- Literature study	- Overview of the current species - Overview of their require-ments	- List of specific species and their requirements in Boerhaavewijk

PLANNING


Week
Important dates
Planning
Graduation Plan
Research Paper
Design Project
36 05-11 sep
37 12-18 sep
38 19-25 sep
39 26-02 oct
40 03-09 oct
41 10-16 oct
42 17-23 oct
43 24-30 oct
44 31-06 nov
45 07-13 nov
46 14-20 nov
47 21-27 nov
48 28-04 dec
49 05-11 dec
50 12-18 dec
51 19-25 dec
52 26-01 jan
1 02-08 jan
2 09-15 jan
3 16-22 jan
4 23-29 jan
5 30-05 feb
6 06-12 feb
7 13-19 feb
8 20-26 feb
9 27-05 mar
10 06-12 mar
11 13-19 mar
12 20-26 mar
13 27-02 apr
14 03-09 apr
15 10-16 apr
16 17-23 apr
17 24-30 apr
18 01-07 may
19 08-14 may
20 15-21 may
21 22-28 may
22 29-04 jun
23 05-11 jun
24 12-18 jun
25 19-25 jun
26 26-02 jul
27 03-09 jul
P1
Holidays
P2
Holidays
P4
P5
Collect Data
Research Rewilding Built Environment
Case Studies & Reference Projects
Species & Requirements
Graduation Plan
Concept Design
Sketch Design
Overviews & Lists
Review Draft Research Paper
Write Conclusions
Finalise Research Paper
Design
Details
Finalise Design
Models
Prepare P4
Prepare P5

RELEVANCE

The final design project will be an exploratory study on rewilding the built environment on the scale of a neighbourhood. The findings experienced in this neighbourhood can serve as an example for many other areas in the Netherlands and around the world. The framework can be used for other projects as well, as implementing nature-inclusive designs as a way to rewild neighbourhoods is a global necessity.

LITERATURE

Among many other scientific literature and academic papers, two papers in particular are very useful for this research. These papers are by former students of the Architectural Engineering Graduation Studio at the Faculty of Architecture & the Built Environment, Delft University of Technology. Ciske Buiter's paper *A design strategy for a nature inclusive building studies the current biodiversity in Schalkwijk* (2021). It contains a biotope requirements list that is very useful for this project. In addition, Ella Wildenberg's paper *Nature inclusive design in high-density urban development to support urban biodiversity* is also interesting because it proposes architectural interventions that can be used in nature-inclusive design and urban ecology in the Netherlands (2021). I will use both papers and tie the findings together to achieve highly relevant information for this site specifically.

BIBLIOGRAPHY

Arts, K., Bakker, L. & Buys, A. (2022). Rewilding in Nederland: Essays over een offensieve natuurstrategie. In knnv uitgeverij (ISBN 978 90 5011 869 9). knnv uitgeverij. https://research.wur.nl/en/publications/rewilding-in-nederland-essays-over-een-offensieve-natuurstrategie

Attenborough, D. & Hughes, J. (2020, 6 October). A Life on Our Planet: My Witness Statement and a Vision for the Future. Grand Central Publishing.

Biodiversity | National Geographic Society. (n.d.). Retrieved 7 November 2022, from https://education.nationalgeographic.org/resource/biodiversity/

Biological Corridor | For UNESCO World Heritage Travellers. (n.d.). Retrieved 7 November 2022, from https://www.worldheritagesite.org/connection/Biological+Corridor

Buiter, C. (2021). A design strategy for a nature inclusive building [Master Thesis]. Delft University of Technology.

Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., Hayes, K., Reid, C. E., Saha, S., Spector, J. & Berry, P. (2021). Extreme Weather and Climate Change: Population Health and Health System Implications. Annual Review of Public Health, 42(1), 293–315. https://doi.org/10.1146/annurev-publhealth-012420-105026

Gemeente Bestuur Haarlem. (2018). Bestemmingsplan “Boerhaavewijk” (ontwerp). In gemeentebestuur.haarlem.nl. https://gemeentebestuur.haarlem.nl/bestuurlijke-stukken/2019788198-2-Bijlage-A-Ontwerpbestemmingsplan-Boerhaavewijk-1.pdf

Lehmann, S. (2021). Growing Biodiverse Urban Futures: Renaturalization and Rewilding as Strategies to Strengthen Urban Resilience. MDPI. (accessed on 20 September 2022, from https://www.mdpi.com/2071-1050/13/5/2932/htm

IPBES (2019) Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Díaz S, Settele J, Brondízio ES, Ngo HT, Guèze M, Agard J, Arneth A, Balvanera P, Brauman KA, Butchart SHM, Chan KMA, Garibaldi LA, Ichii K, Liu J, Subramanian SM, Midgley GF, Miloslavich P, Molnár Z, Obura D, Pfaff A, Polasky S, Purvis A, Razzaque J, Reyers B, Roy Chowdhury R, Shin YJ, Visseren-Hamakers IJ, Willis KJ, Zayas CN (eds). IPBES Secretariat, Bonn, 56 pages

IPCC 2018. Global Warming of 1.5 ◦C. An IPCC Special Report by the Intergovernmental Panel on Climate Change on the Impacts of Global Warming of 1.5 ◦C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Available online: https://www.ipcc.ch/sr15/ (accessed on 31 October 2022).

KNMI - Een van de warmste, zonnigste en droogste zomers. (2022, 31 augustus). https://www.knmi.nl/over-het-knmi/nieuws/zomer-2022

Köbben, R. (2021). The farm of the future [Master Thesis]. Delft University of Technology.

Kondo, M., Fluehr, J., McKeon, T. & Branas, C. (2018). Urban Green Space and Its Impact on Human Health. International Journal of Environmental Research and Public Health, 15(3), 445. https://doi.org/10.3390/ijerph15030445

Nature inclusive design Definition. (n.d.). Law Insider. Retrieved 7 November 2022, from https://www.lawinsider.com/dictionary/nature-inclusive-design

Noss, R. (1992). The Wildlands Project, Land Conservation Strategy. Wild Earth, Special Issue, 1, 10-25.

Noss, R. and Cooperrider, A. (1994). Saving nature's legacy: protecting and restoring biodiversity. Washington, DC: Island Press.

Painter, J., Ettinger, J., Doutreix, M. N., Strauß, N., Wonneberger, A. & Walton, P. (2021). Is it climate change? Coverage by online news sites of the 2019 European summer heatwaves in France, Germany, the Netherlands, and the UK. Climatic Change, 169(1–2). https://dtoi.org/10.1007/s10584-021-03222-w

Pettorelli, N., Durant, S. M. & du Toit, J. T. (Reds.). (2019). Rewilding. Ecoligical Reviews. The Quarterly Review of Biology. https://doi.org/10.1017/9781108560962

Phillips, O. (2022). Cities Gone Wild: Urban Rewilding in Disadvantaged England [Master Thesis]. Lund University.

Tree, I. & Schlosser, E. (2019, 17 september). Wilding: Returning Nature to Our Farm (Illustrated). New York Review Books.

Vink, J. & Vollaard, P. (2017). Stadsnatuur maken / Making urban nature (1ste editie). Macmillan Publishers.

WHO Europe (2016). WHO report shows urban green spaces deliver multiple health benefits. Retrieved from: https://www.euro.who.int/en/health-topics/environment-andhealth/pages/news/news/2016/11/who-report-shows-urban-green-spaces-deliver-multiple-healthbenefits#:~:text=A%20new%20WHO%20report%20summarizing,other%20harmful%20urban%20fact ors%20%E2%80%93%20air

Wildenberg, E. (2021). Nature inclusive design in high-density urban development to support urban biodiversity [Master Thesis]. Delft University of Technology.

Woonplaatsen in Nederland 2020. (2020, 2 oktober). Data overheid. https://data.overheid.nl/dataset/931-woonplaatsen-in-nederland-2020

WWF & ZSL. (2022). Living Planet Inex Latest Results. Living Planet Inex. https://www.livingplanetindex.org/latest_results