# PATTERN ATLAS

Dissolving Distinction

Sanne Francissen

# DISSOLVING DISTINCTION

Pattern Atlas

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PATTERN ATLAS

# CITY AS PART OF NATURE

Challenges such as urbanization and climate change effect our urban environments. There is an urge to deal with these challenges and develop climate resilient cities. The natural environment is able to adapt to changing circumstances so developing the urban environment towards a nature inclusive one could contribute to a resilient city.

Three key topics were identified to address the whole scope of a nature inclusive city. Each of the three topics, human connection with nature, healthy ecosystems and climate resilience, consists of a few criteria influencing the key topic.

Firstly, the ecological perspective focusses on the natural systems of the landscape. Creating ecological connectivity, and increasing the biodiversity and amount of open green space help to strengthen the urban ecosystems. Secondly, the human perspective consists of creating a connection, both physically and mentally, with nature in order to make it a part of daily urban life. This includes integrating green in the urban environments and making it accessible for residents in order to improve the quality of life. Thirdly, the climate perspective focusses on tackling issues such as water nuisance, Urban Heat Island effect and risk of flooding. Making the city part of nature means dealing with these issues in order to develop a climate resilient city.

Including each topic to its full potential contributes to an improved quality of urban life. This pattern language consists of design  typologies that contribute to the concept of city as part of nature.



# USING THE ATLAS

The pattern language is a method in which problem solution descriptions are developed, called patterns, to suggest guidelines for creating place (Hendriquez et al., 2013; Park, 2015). The pattern language approach is developed by Christopher Alexander and can be used as a tool in urban planning and design (Alexander, 1977). The individual patterns describe a spatial problem and a possible solution to this problem. Together, the patterns, that all have the same format,  make up a language that can be used in multiple ways. It is a way of collecting and organizing data that can be used in different projects and situations.

The developed pattern language on a city as part of nature can be found in this pattern atlas, and is part of the master graduation thesis Dissolving Distinction. This atlas consists of a set of 28 patterns, all related to this research objective, and pattern fields, which explain the relationships between the patterns. The pattern field can be organized in multiple ways, which will be elaborated upon in the next few pages.

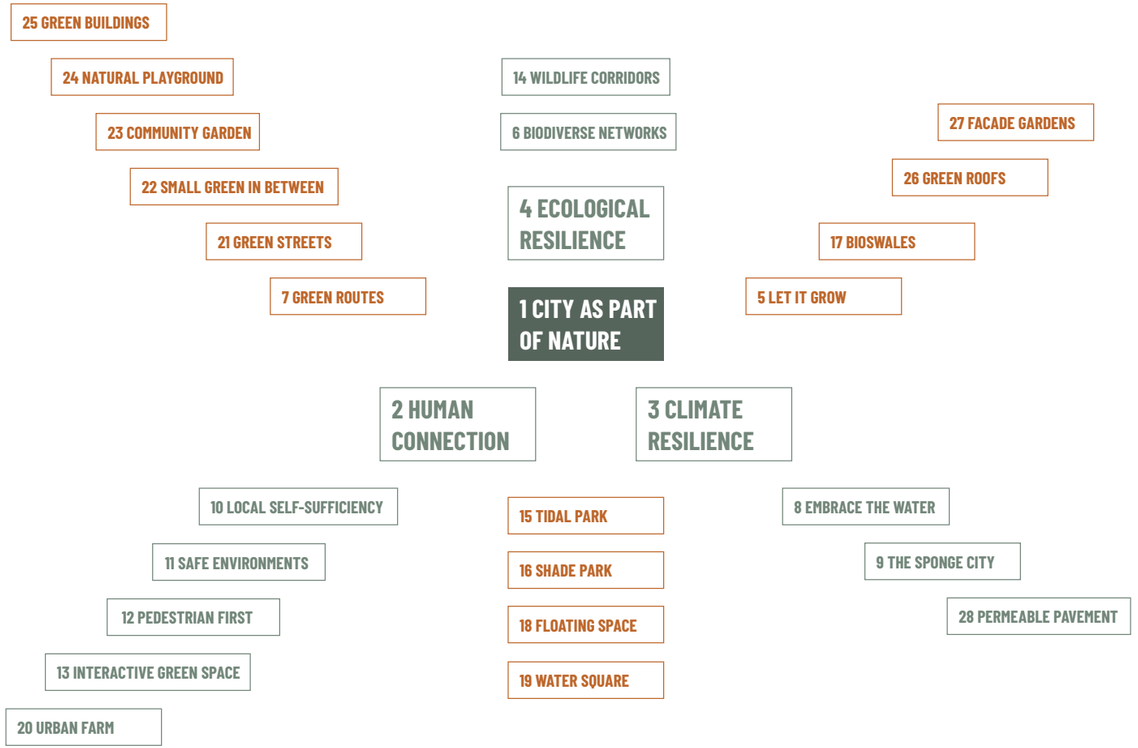
Each individual pattern consists of a few elements among which the framework that is developed during the research. This framework is filled based upon own estimations, in order to highlight the main focus and influence of the pattern.
The development of the patterns is based upon own research on relevant topics for the graduation thesis. However, other pattern languages by De Roode (2021), Van Dorst (2013) have been an inspiration for these topics.

# PATTERN FIELD

## ORGANIZED BY THEME

There are multiple ways to organize the patterns and explain their relationships. One way is to organize them by theme.

As elaborated upon in the previous pages, the city as part of nature consists of three main topics. There are multiple patterns that align mainly with one of these main themes, shown in green. The other patterns touch upon multiple themes and cannot explicitly be classified at one of the main themes. Therefore, these are classified in orange, meaning that they fit within both of the themes.

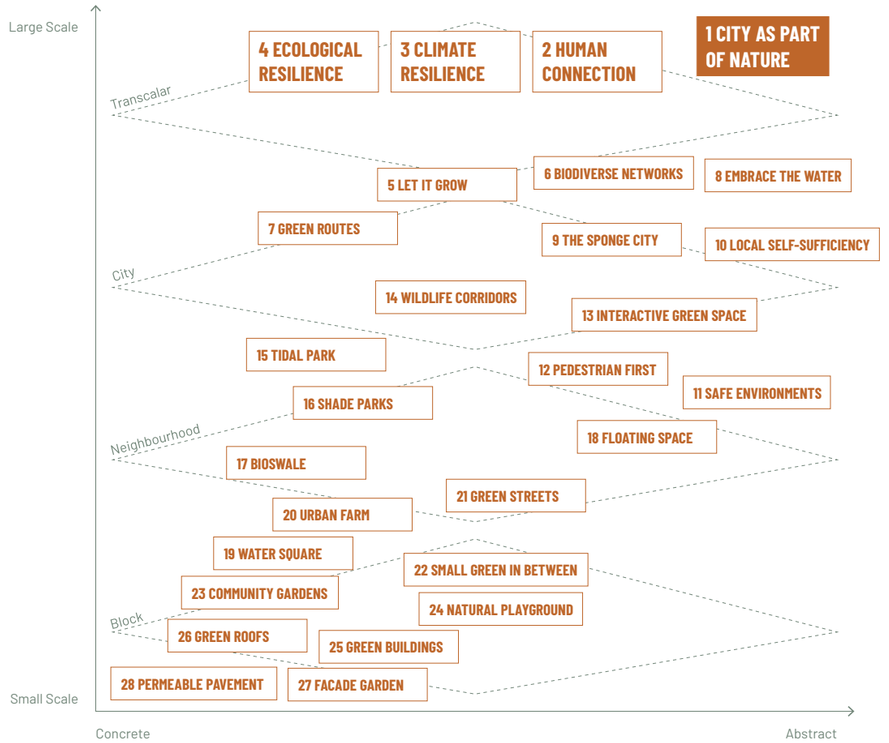


# PATTERN FIELD

## ORGANIZED BY SCALE AND ABSTRACTNESS

Another way to organize the patterns is by the extent to which they are concrete or abstract, and by the scale on which they operate.

The overarching themes are operating on a transcalar level and are not explicitly concrete. As visible in the graph, there is a trend going from the top right, abstract on a large scale, to the bottom left, concrete on small scale. As the patterns operate on a smaller scale, they get more concrete.

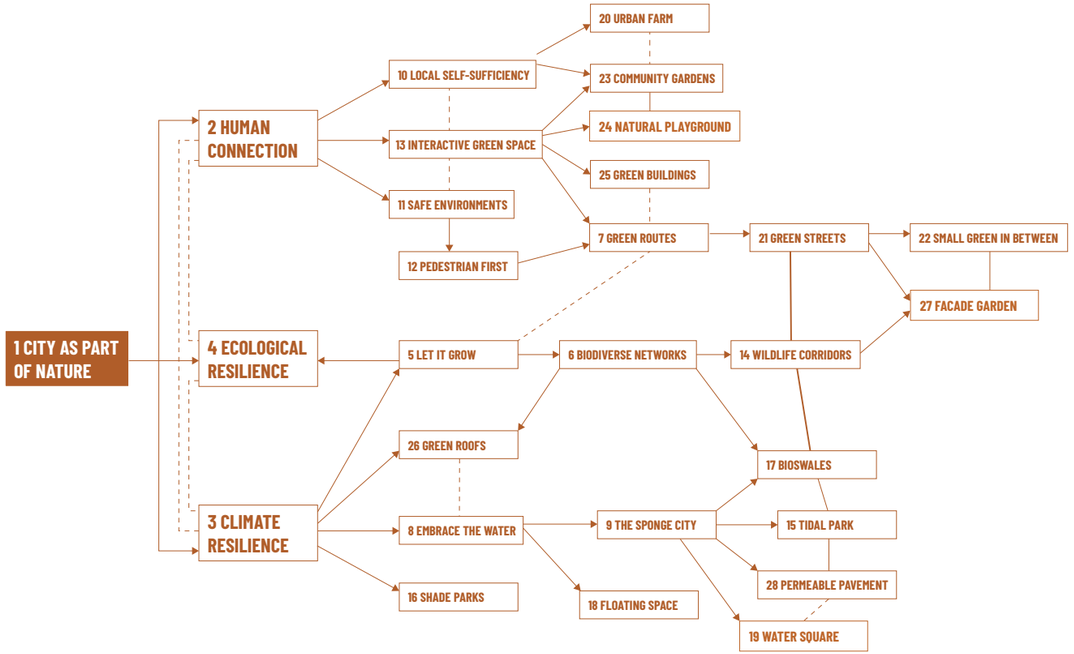


# PATTERN FIELD

## ORGANIZED BY MUTUAL RELATIONS

Finally, there are different relationships between the individual patterns, as shown in the figure on the right.

Most of the patterns can be organized by scale: the overarching themes contain of multiple layers of small scale patterns. Here, the distinction between the three main themes is visible again. Besides this, some patterns are complementary or solve problems that overlap and coexist on the same level.




contains smaller scale patterns
patterns are complementary
solve problems that overlap and coexist on the same level

# CONTENTS

# 1 CITY AS PART OF NATURE

*The urban environment must be considered part of nature in order to create healthy urban ecosystems.*

## THEORETICAL BACK-UP

Urbanization is causing environmental challenges in cities, and in order develop urban sustainability, one should consider the bigger landscape and global context. Humans can be considered part of the urban ecosystems as ecosystem engineers in order to create healthy natural systems within the city (Wu, 2008).

## PRACTICAL IMPLICATION

Within the design of the urban environment the city must be viewed as an ecosystem. Considering both social and environmental needs could result in strong blue- green structures, habitable environments for flora and fauna and reduction of gray structures.


**SOURCES**

Wu, J. (2008b). Making the Case for Landscape Ecology: An Effective Approach to Urban Sustainability. Landscape Journal, 27(1), 41–50. https://doi.org/10.3368/lj.27.1.41

Holmes, D. (2021, 13 september). Mandaworks & Updis wins Jiangyin Xiakewan Science City Master Plan Competition. World Landscape Architecture. https://worldlandscapearchitect.com/mandaworks-updis-wins-jiangyin-xiakewan-science-city-master-plan-competition/#.YV7bsaCxVQJ



**CONTAINS**

Social Resilience, Ecological Resilience, Climate Resilience

# 2 SOCIAL RESILIENCE

*Creating a connection between human and nature increases the urban quality of life for human and nature.*



## THEORETICAL BACK-UP

Increasing the feeling of connection with nature could lead to pro-environmental behavior among people and it also contributes to the vitality and life satisfaction (Withburn et al., 2019). Creating a connection between human and nature therefore is beneficial for human and environmental wellbeing (Withburn et al., 2019).

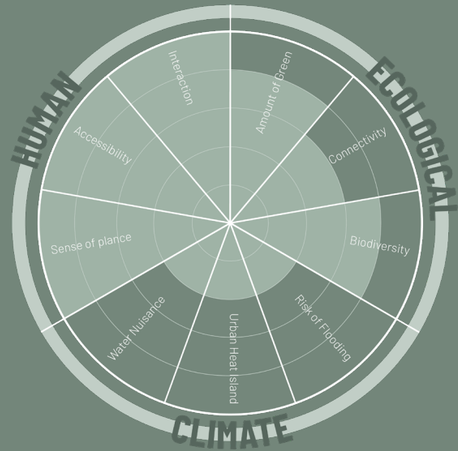
## PRACTICAL IMPLICATION

In order to create a connection between human and nature, long term or repeated exposure to the natural environment is required (Vining et al., 2008; Whitburn et al., 2019). This could be achieved by increasing the amount of accessible green space within the urban environment and adding program to it, providing interaction and a sense of place.

**SOURCES**

Vining, J., Merrick, M. S., & Price, E. A. (2008). The Distinction between Humans and Nature: Human Perceptions of Connectedness to Nature and Elements of the Natural and Unnatural. Human Ecology Review, 15(1), 1–11. http://www.jstor.org/stable/24707479

Whitburn, J., Linklater, W., & Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. Conservation Biology, 34(1), 180–193. https://doi.org/10.1111/cobi.13381




## EMBEDDED IN

City as Part of Nature

## CONTAINS

Local self-sufficiency, interactive green space, safe environments

# 3 CLIMATE RESILIENT CITY

*Moving towards a climate resilient city will limit the negative effects of climate change and urbanization.*

## THEORETICAL BACK-UP

Cities are facing multiple challenges as a result of climate change and urbanization, such as the loss of biodiversity, risk of flooding and Urban heat island effect. (Doherty, et al., 2016). By creating a city that is climate resilient, these effect will be reduced, leading to an improved quality of urban life.

## PRACTICAL IMPLICATION

There is a long list of practical implications that contribute to a climate resilient city. Among others are comprehensive interventions such as, creating a strong green-blue network, improving flood risk management and urban agriculture.


**SOURCES**

Doherty, M., Klima, K., & Hellmann, J. J. (2016). Climate change in the urban environment: Advancing, measuring and achieving resiliency. Environmental Science & Policy, 66, 310–313. https://doi.org/10.1016/j.envsci.2016.09.001

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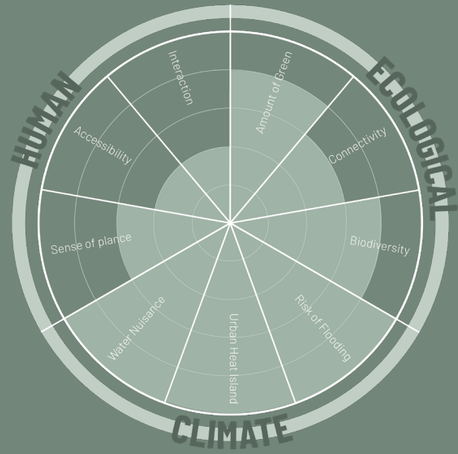



**EMBEDDED IN**

City as Part of Nature

**CONTAINS**

Embrace the Water, Let it Grow, Green Roofs, Shade Parks

# 4 ECOLOGICAL RESILIENCE

*Developing healthy ecosystems in the urban environment is essential in order to benefit from the ecosystem services.*

## THEORETICAL BACK-UP

Healthy ecosystems consist of a rich biodiversity, which provides many ecosystem services contributing to human security, resiliency, healthy and freedom of choice and actions (Elmqvist et al., 2013; Jansson, 2012). It is important to develop ecological resilience within the urban environment, to provide ecosystem services.

## PRACTICAL IMPLICATION

Creating ecological networks within the city, consisting of core areas, ecological corridors and buffer zones, stimulates ecological resilience as it protects biodiversity in an urban area (Nor et al., 2017). This could be realized through greening the urban environment, connecting the green spaces.


**SOURCES**

Elmqvist, T., Fragkias, M., Goodness, J., Güneralp, B., Marcotullio, P. J., McDonald, R., I., Parnell, S., Schewenius, M., Sendstad, M., Seto, K. C., & Wilkinson, C. (2013). Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment (2013th ed.). Springer.

Jansson, S. (2013). Reaching for a sustainable, resilient urban future using the lens of ecosystem services. Ecological Economics, 86, 285–291. https://doi.org/10.1016/j.ecolecon.2012.06.013

Nor, A. N. M., Corstanje, R., Harris, J. A., Grafius, D. R., & Siriwardena, G. M. (2017). Ecological connectivity networks in rapidly expanding cities. Heliyon, 3(6), e00325. https://doi.org/10.1016/j.heliyon.2017.e00325



**EMBEDDED IN**
City as Part of Nature

**CONTAINS**
Let it Grow

# 5 LET IT GROW

*Extensive green structures within the city improves the liveability for all users.*

## THEORETICAL BACK-UP

Urbanization has led to the lack of urban green spaces in the city. Bringing back nature within the city has multiple benefits such as human well-being and an increasing biodiversity. Besides this, it contributes to the climate adaptive city.

## PRACTICAL IMPLICATION

Urban green structures can developed spontaneously, as well as through design. They can occur in many forms of greenery, both accessible and non-accessible, such as green streets, rooftop parks and communal gardens.


**SOURCES**

Heidt V., Neef M. (2008) Benefits of Urban Green Space for Improving Urban Climate. In: Carreiro M.M., Song YC., Wu J. (eds) Ecology, Planning, and Management of Urban Forests. Springer, New York, NY. https://doi-org.tudelft.idm.oclc.org/10.1007/978-0-387-71425-7_6

S. (2018, 13 mei). Between Floods: Resiliency & Urban Regeneration - Sasaki. Medium. https://medium.com/@SasakiDesign/between-floods-resiliency-urban-regeneration-a4f2242d3239#.gpygsjs1z



## EMBEDDED IN

Ecological Resilience

## CONTAINS

Biodiverse Network, Green Routes

# 6 BIODIVERSE NETWORKS

*By creating a habitable environment within the urban structure for flora and fauna, biodiversity increases..*

## THEORETICAL BACK-UP

The richness and diversity of species in the city are good indicators for the condition and quality of the urban nature and ecosystems. Creating a habitable environment for flora and fauna, and connecting these through wildlife corridors enhances biodiversity and creates a resilient natural ecosystem (Fontana et al., 2011).

## PRACTICAL IMPLICATION

Creating an habitable environment in the city could be done by creating a diverse green structure. In order to enhance biodiversity, the right conditions for settlement should be provided, consisting of provision of food, place for sleep, shelters and possibility for reproduction (Vollaard et al., 2017).


**SOURCES**

Carrington, D. (2020, 3 februari). City bees: allotments and gardens can help arrest decline – study. The Guardian. https://www.theguardian.com/environment/2019/jan/14/city-bees-allotments-gardens-help-arrest-decline-study

Fontana, S., Sattler, T., Bontadina, F., & Moretti, M. (2011). How to manage the urban green to improve bird diversity and community structure. Landscape and Urban Planning, 101(3), 278–285. https://doi.org/10.1016/j.landurbplan.2011.02.033

Vollaard, P., Vink, J., & de Zwarte, N. (2017). Making Urban Nature (Bilingual ed.). nai010 publishers.



**EMBEDDED IN**

Let it Grow

**CONTAINS**

Green Roofs, Bioswales, Wildlife Corridors

# 7 GREEN ROUTES

*Green routes support the connection between human and nature as well as ecological resilience.*

## THEORETICAL BACK-UP

Developing routes through the city that consist of natural components increase the exposure towards nature leading towards an increased feeling of connection (Whitburn et al., 2019). Besides this, green routes consist of infrastructures that are often linear, providing opportunities to create linear biotopes and connections between green patches (Vollaard et al., 2017).

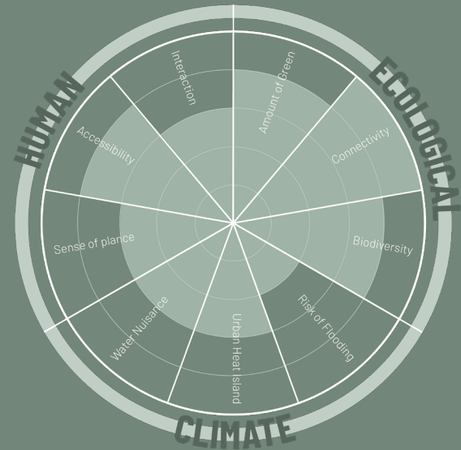
## PRACTICAL IMPLICATION

Within the urban environment open space can be rare. Using exciting infrastructure could be transformed into green routes. Especially when reducing car mobility in dense urban areas and replacing this with slow mobility, space occurs to develop attractive green infrastructures.


**SOURCES**

Vollaard, P., Vink, J., & de Zwarte, N. (2017). Making Urban Nature (Bilingual ed.). nai010 publishers.

Whitburn, J., Linklater, W., & Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. Conservation Biology, 34(1), 180–193. https://doi.org/10.1111/cobi.13381


## EMBEDDED IN

Interactive Green Space, Pedestrian First

## CONTAINS

Green Streets

# 8 EMBRACE THE WATER

*Turn the water from threat into opportunity by working with it, rather than against it.*

## THEORETICAL BACK-UP

Many cities face the challenges of rising water levels and the risk of flooding, as well as risk of drought as a result of a changing climate. By embracing the water within the city, opportunities arise to control the risk of flooding and manage the water usage while using the water as a design element (Ashley et al., 2013).

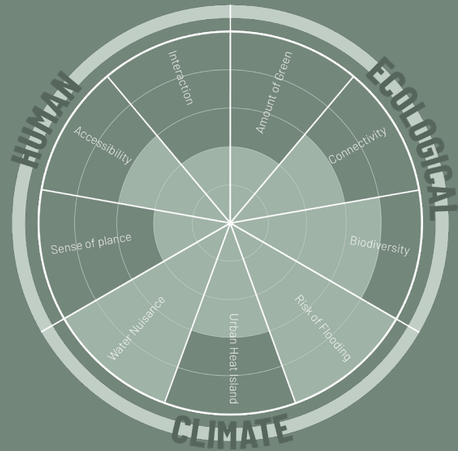
## PRACTICAL IMPLICATION

Letting the water into the city could result in opportunities to create a performative waterfront, tidal parks, and water buffers that reduce the risks of flooding while adding value and quality to the public space of a city.


**SOURCES**

Ashley, R., Lundy, L., Ward, S., Shaffer, P., Walker, L., Morgan, C., Saul, A., Wong, T., & Moore, S. (2013). Water-sensitive urban design: opportunities for the UK. Proceedings of the Institution of Civil Engineers - Municipal Engineer, 166(2), 65–76. https://doi.org/10.1680/muen.12.00046

Kuller, M., Bach, P. M., Ramirez-Lovering, D., & Deletic, A. (2017). Framing water sensitive urban design as part of the urban form: A critical review of tools for best planning practice. Environmental Modelling & Software, 96, 265–282. https://doi.org/10.1016/j.envsoft.2017.07.003


**EMBEDDED IN**

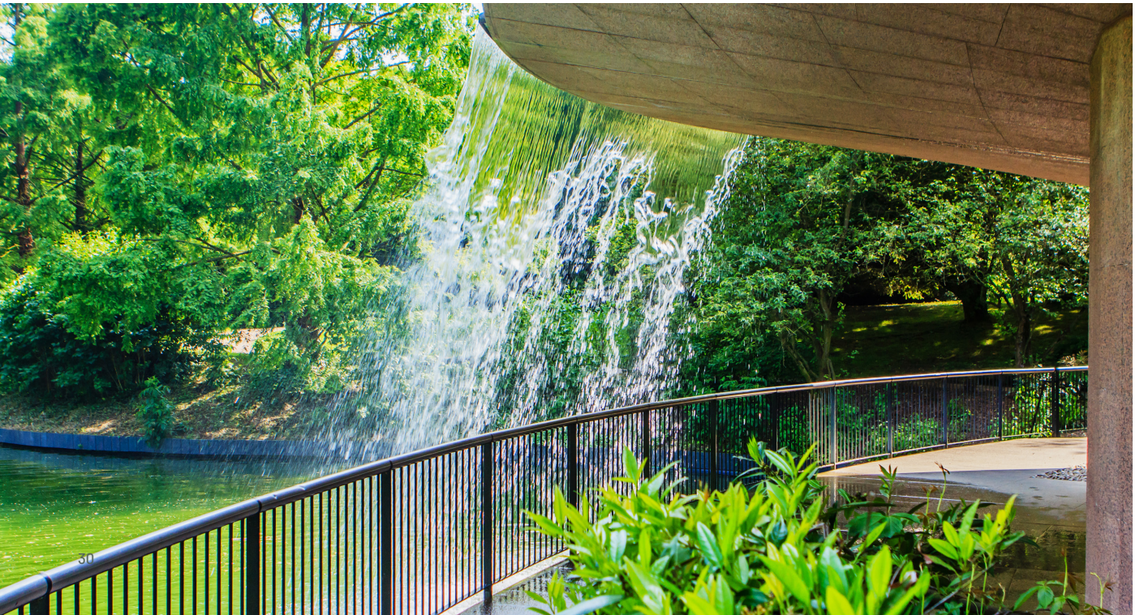
Climate Resilience

**CONTAINS**

The Sponge City

# 9 SPONGE CITY

*Creating a city that can absorb, store, purify and release water will improve the water management in the the city.*



## THEORETICAL BACK-UP

The concept of the Sponge City focuses on urban water-resource management, urban flood and climate risk mitigation, ecological enhancement and social well being and would contribute to a resilient urban landscape (Li et al., 2017). The main goals are to reuse storm water as a resource, mitigate urban flood and improve the water quality (Nguyen et al., 2019).

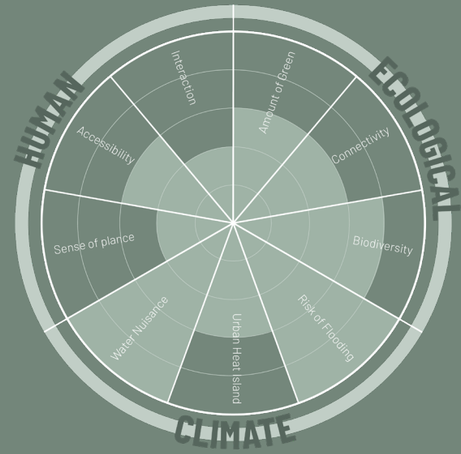
## PRACTICAL IMPLICATION

Developing the city as a sponge results in a system that is absorbing, storing, purifying and releasing water when necessary. This could be implemented through permeable pavement (absorbing), water squares (storing) and bioswales (purifying).


**SOURCES**

Li, H., Ding, L., Ren, M., Li, C., & Wang, H. (2017). Sponge city construction in China: A survey of the challenges and opportunities. Water, 9(9), 594.

Nguyen, T. T., Ngo, H. H., Guo, W., Wang, X. C., Ren, N., Li, G., Ding, J., & Liang, H. (2019). Implementation of a specific urban water management - Sponge City. Science of The Total Environment, 652, 147–162. https://doi.org/10.1016/j.scitotenv.2018.10.168


## EMBEDDED IN

Embrace the Water

## CONTAINS

Bioswales, Permeable Pavement, Tidal Parks, Water Square

# 10 LOCAL SELF-SUFFICIENCY

*Urban agriculture contributes to the food security on local scale and create awareness of the origin of food.*

## THEORETICAL BACK-UP

Our food is produced around the whole world and follows a complex process. This leads to a gap between what we eat and its origin. Local food production is not very common in dense cities, but could be a way to simplify the production process and create awareness of how our food is produced.

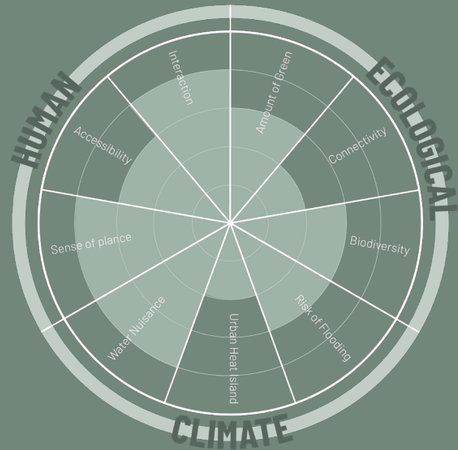
## PRACTICAL IMPLICATION

Urban agriculture could occur in different settings in the city, from gardens to rooftops, and the locally produced food could be sold in local stores, or even at the place of production. Seeing where food is produced could create awareness and lead to a positive change in the consuming behavior.


**SOURCES**

Brown, K. H., & Jameton, A. L. (2000). Public Health Implications of Urban Agriculture. Journal of Public Health Policy, 21(1), 20–39. https://doi.org/10.2307/3343472

Pearson, L. J., Pearson, L., & Pearson, C. J. (2010). Sustainable urban agriculture: stocktake and opportunities. International Journal of Agricultural Sustainability, 8(1–2), 7–19. https://doi.org/10.3763/ijas.2009.0468


**EMBEDDED IN**

Social Resilience

**CONTAINS**

Community Gardens, Urban Farm

# 11 SAFE ENVIRONMENT

*Creating a safe urban environment contributes to the human quality of life.*

## THEORETICAL BACK-UP

An important condition for human wellbeing, quality of life and good health is feeling safe. Green spaces in the living environment can influence the feeling of safety positively in most situations, but also negatively when enclosed within the dense urban environment (Maas et al., 2009). Besides this, urban environments with a lot of traffic, lead to pedestrian casualties, decreasing the safety (Petch & Henson, 2000).

## PRACTICAL IMPLICATION

Designing the urban environment from the perspective of safety could be interpreted in different ways. Using green space to enhance the feeling of safety, but making sure it is not counter productive by avoiding enclosed green. Also focusing on slow mobility instead of car mobility contributes to physical safety in the public space.


**SOURCES**

Maas, J., Spreeuwenberg, P., van Winsum-Westra, M., Verheij, R. A., Vries, S., & Groenewegen, P. P. (2009). Is Green Space in the Living Environment Associated with People's Feelings of Social Safety? Environment and Planning A: Economy and Space, 41(7), 1763–1777. https://doi.org/10.1068/a4196

Petch, R., & Henson, R. (2000). Child road safety in the urban environment. Journal of Transport Geography, 8(3), 197–211. https://doi.org/10.1016/s0966-6923(00)00006-5



**EMBEDDED IN**
Social Resilience

**CONTAINS**
Pedestrian First

# 12 PEDESTRIAN FIRST

*Promoting slow mobility in the urban environment to improve the quality of public space.*

## THEORETICAL BACK-UP

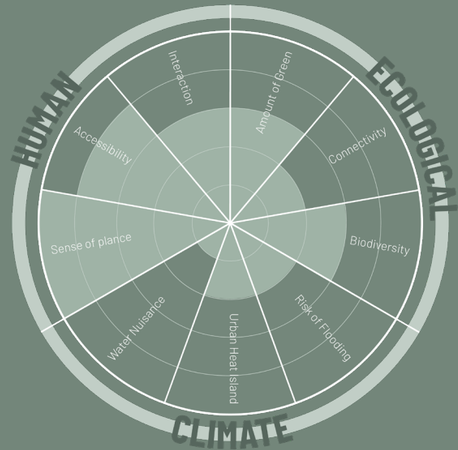
By reducing the car traffic in the urban environment, there could be a shift towards slow mobility. This is beneficial for the urban environment, as slow mobility contributes to road safety and reduces traffic congestion and the level of noise and air pollution (La Rocca, 2010).

## PRACTICAL IMPLICATION

Promoting alternatives for car mobility, by developing an extensive public transport network and creating attractive routes for pedestrians and cyclists by changing the street profiles in a way that pedestrians and cyclists feel safe. Besides, car mobility could be discouraged by reducing the maximum speed and accessible roads for cars.


**SOURCES**

La Rocca, R. (2010). Soft Mobility and Urban Transformation. TeMA - Journal of Land Use, Mobility and Environment, 2. https://doi.org/10.6092/1970-9870/125


**EMBEDDED IN**
Safe Environments

**CONTAINS**
Green Routes

# 13 INTERACTIVE GREEN SPACE

*Promoting the connection between human and nature by creating interactive green space.*

## THEORETICAL BACK-UP

Decreasing the interaction between human and the natural environment may contribute to the feeling of disconnectedness to nature (Vining et al., 2008). It is important to stimulate this interaction, as a connection between human and nature is beneficial for human and environmental wellbeing (Withburn et al., 2019).

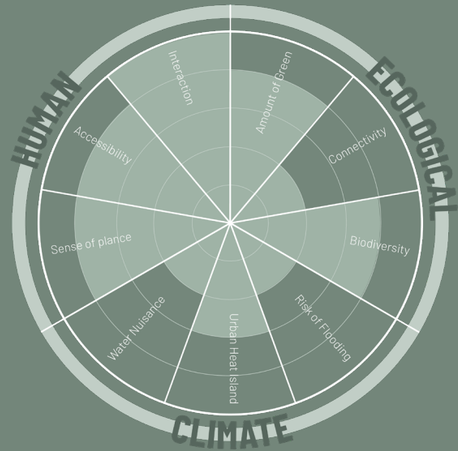
## PRACTICAL IMPLICATION

Interaction with the natural environment could be stimulated by adding program to the green spaces. This could be done by developing green routes and green buildings, but also by implementing community gardens and natural playgrounds.


**SOURCES**

Vining, J., Merrick, M. S., & Price, E. A. (2008). The Distinction between Humans and Nature: Human Perceptions of Connectedness to Nature and Elements of the Natural and Unnatural. Human Ecology Review, 15(1), 1–11. http://www.jstor.org/stable/24707479

Whitburn, J., Linklater, W., & Abrahamse, W. (2019). Meta-analysis of human connection to nature and proenvironmental behavior. Conservation Biology, 34(1), 180–193. https://doi.org/10.1111/cobi.13381


**EMBEDDED IN**

Social Resilience

**CONTAINS**

Green Buildings, Green Routes, Community Garden, Natural Playground

# 14 WILDLIFE CORRIDORS

*Wildlife corridors are essential to create healthy urban ecosystems.*

## THEORETICAL BACK-UP

Urban green space plays a crucial role in preserving biodiversity in the city. However, as a result of urbanization, fragmentation of the natural landscape has increased causing decreased connectivity and isolation of habitats. In order to conserve biodiversity, connectivity between urban green spaces is essential (Nor et al., 2017).

## PRACTICAL IMPLICATION

Connectivity between urban green spaces could be achieved through wildlife corridors. This could be implemented by greening the existing infrastructures or new corridors such as bioswales.


**SOURCES**

Nor, A. N. M., Corstanje, R., Harris, J. A., Grafius, D. R., & Siriwardena, G. M. (2017). Ecological connectivity networks in rapidly expanding cities. Heliyon, 3(6), e00325. https://doi.org/10.1016/j.heliyon.2017.e00325



**EMBEDDED IN**

Biodiverse Networks

**CONTAINS**

Green Streets, Bioswales

# 15 TIDAL PARK

*A tidal park along a river contributes to developing a city as part of nature.*

## THEORETICAL BACK-UP

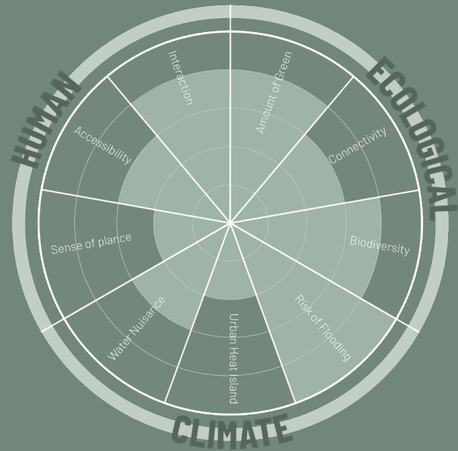
Developing a tidal park along the river quays in a city has multiple positive consequences improving the quality of urban life. First of all, it contributes to water safety, water quality and nature values (Tillie, 2019). Second of all, it could host recreational green space for people and strengthen the connection between human and nature (Tillie, 2019).

## PRACTICAL IMPLICATION

In urban environments where a river flows through the city, the connection between the river and city could be increased by developing a tidal park. Making it accessible for people and part of a route contributes to recreational values, while it enhances ecological values.


**SOURCES**

Tillie, N. (2019). From Urban Green Structure to Tidal River in Rotterdam: Testing Grounds for Urban Ecology. Nature Driven Urbanism, 111–130. https://doi.org/10.1007/978-3-030-26717-9_6


**EMBEDDED IN**

Sponge City

# 16 SHADE PARK

*In the paved environment of the city, shade parks reduce the urban heat island effect.*

## THEORETICAL BACK-UP

In urban environments heat stress occurs as a result of excessive heat released by heat sources such as vehicles, and the high amount of urban structures with heat-absorbing materials (Jabareen, 2013; Rizwan et al., 2008). Increasing the amount of vegetated area in the city contributes to the mitigation of the urban heat island effect (Rizwan et al., 2008).

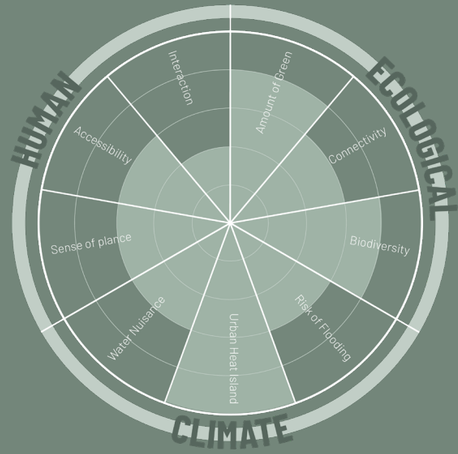
## PRACTICAL IMPLICATION

In order to deal with the urban heat island effect, nature should be included in the urban environment. This could be done in multiple ways, such as groups of trees that provide shade for both buildings as urban infrastructures.


**SOURCES**

Jabareen, Y. (2013). Planning the resilient city: Concepts and strategies for coping with climate change and environmental risk. Cities, 31, 220–229. https://doi.org/10.1016/j.cities.2012.05.004

Rizwan, A. M., Dennis, L. Y., & Liu, C. (2008). A review on the generation, determination and mitigation of Urban Heat Island. Journal of Environmental Sciences, 20(1), 120–128. https://doi.org/10.1016/s1001-0742(08)60019-4


**EMBEDDED IN**

Climate Resilience

# 17 BIOSWALE

*The negative effects of surface runoff can be reduced by bioswales.*

## THEORETICAL BACK-UP

As a result of impervious land cover in urban environments, surface runoff causes multiple problems, such as flooding, water pollution and destroyed habitat (Xiao & McPherson, 2011). A bioswale is a "low-gradient, open channel possessing a dense cover of vegetation through which all surface runoff is directed" (Groves & Hammer, 1999, pV) and helps to mitigate the nuisance of surface run off.

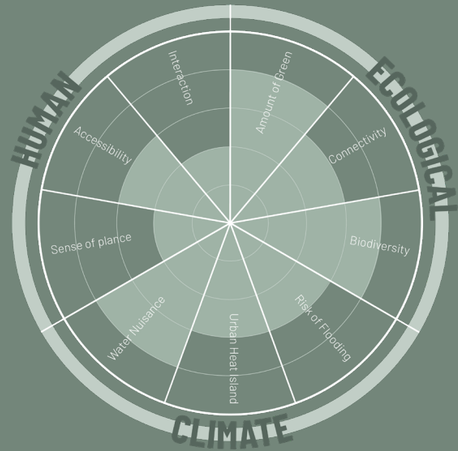
## PRACTICAL IMPLICATION

Locations in the urban environment with a lot of paved area, such as infrastructures, parking lots and squares, are the most vulnerable for surface runoff nuisance. These places offer the opportunity to implement a bioswale, especially alongside urban infrastructures there is often space available.


**SOURCES**

Groves, W. W., & Hammer, P. E. (1999). Analysis of bioswale efficiency for treating surface runoff (Doctoral dissertation, M. E. S. M.), University of California, Santa Barbara).

Xiao, Q., & McPherson, E. G. (2011). Performance of engineered soil and trees in a parking lot bioswale. Urban Water Journal, 8(4), 241–253. https://doi.org/10.1080/1573062x.2011.596213


**EMBEDDED IN**

Sponge City, Biodiverse Networks

**CONTAINS**

Wildlife Corridors

# 18 FLOATING SPACE

*Creating floating urban space results in resilient living.*

## THEORETICAL BACK-UP

The rising sea level increases the risks of flooding in the urban environment. Using the water surface to develop urban space creates opportunities for resilient living, as it addresses issues such as natural disasters, energy shortage, environmental damage and social problems (Moon, 2015).

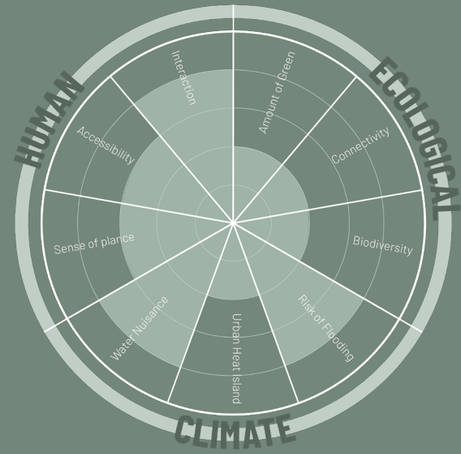
## PRACTICAL IMPLICATION

Floating space could occur in the form of public space, such as a public buildings or parks, as well as in the form of a residential neighborhood.


**SOURCES**

Gendall, J. (2020, 15 mei). How U.S. Cities Can Learn From Amsterdam in Becoming More Sustainable. Architectural Digest. https://www.architecturaldigest.com/story/how-us-cities-can-learn-from-amsterdam-becoming-more-sustainable?epik=dj0yJnU9aEZham82Sm9iczdaR0dEUUdHRWQtWWdWX1FJQzN2VEomcD0wJm49c1lMT2FTTjV4RFY0bnNrRGpkZEwyZyZ0PUFBQUFBR0ZTN01N

Moon, C. (2015). A Study on the Floating House for New Resilient Living. Journal of the Korean Housing Association, 26(5), 97-104. https://doi.org/10.6107/jkha.2015.26.5.097


## EMBEDDED IN

Embrace the Water

# 19 WATER SQUARE

*A water square offers a solution to water nuisance in cities.*

## THEORETICAL BACK-UP

As a result of climate change there is more extreme precipitation, and in combination with the large paved areas in urban environments, water nuisance can occur. Therefore, there is a need to temporarily store the rainwater, before distributing it into the soil, open water or sewage system (Wijbenga - van Nieuwenhuizen & Bonte, 2019).

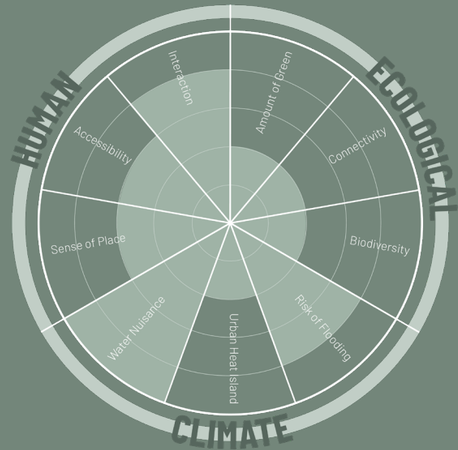
## PRACTICAL IMPLICATION

Water squares offer the possibility to temporarily store rainwater in the public space. The square is a lower located open space that could be used as a playground or sports field in situations in which there is not excessive rainwater. During periods of heavy precipitation, the water can be temporarily stored in the square.


**SOURCES**

Boer, F., Jorritsma, J., & Van Peijpe, D. (2010). De Urbanisten and the wondrous water square. 010 Publishers.

Wijbenga - Van Nieuwenhuizen, B., Bonte, A., Gemeente Rotterdam, Waterschap Hollandse Delta, Hoogheemraadschap van Delfland, Hoogheemraadschap van Schieland en de Krimpenerwaard, & Evides Waterbedrijf. (2019, February). Rotterdams Weerwoord Urgentiedocument. https://www.rotterdam.nl/wonen-leven/rotterdams-weerwoord/Urgentiedocument-2020_NL.pdf


**EMBEDDED IN**

Sponge City

# 20 URBAN FARM

*Urban farming has social environmental benefits and contributes to a connection with the natural environment.*

## THEORETICAL BACK-UP

Urban farming serves a multi-functional concept, as it is beneficial for more than just local food production. It contributes to a feeling of social cohesion and offers educational purposes, leading to improved interaction with the ecosystems (Poulsen et al., 2017).

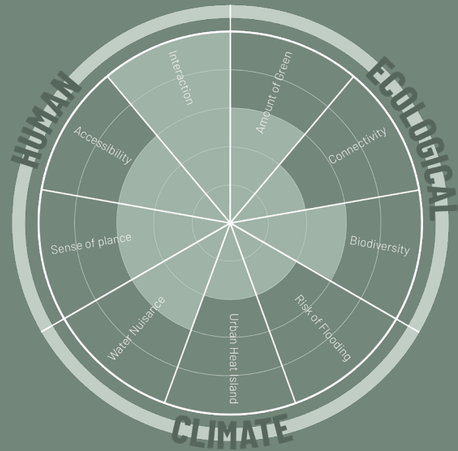
## PRACTICAL IMPLICATION

Developing urban farms could be done in multiple ways and locations. Small public squares in residential neighborhoods could be transformed into urban farms, improving the quality of open space. In denser districts with little open space, unused flat rooftops could be turned into an urban farm.


**SOURCES**

Hui, S. C. (2011). Green roof urban farming for buildings in high-density urban cities. https://www.researchgate.net/profile/Sam-C-M-Hui-2/publication/228933623_Green_roof_urban_farming_for_buildings_in_high-density_urban_cities/links/5416b2460cf2788c4b35df4e/Green-roof-urban-farming-for-buildings-in-high-density-urban-cities.pdf

Poulsen, M. N., Neff, R. A., & Winch, P. J. (2017). The multifunctionality of urban farming: perceived benefits for neighbourhood improvement. Local Environment, 22(11), 1411–1427. https://doi.org/10.1080/13549839.2017.1357686


**EMBEDDED IN**

Local Self-Sufficiency

# 21 GREEN STREETS

*Greening urban infrastructures improves the quality of urban life.*

## THEORETICAL BACK-UP

Greening the infrastructures contributes to the stimulation of using bicycle transport instead of car transport within the urban environment. Urban cycling is beneficial for the urban quality of life and increases the human connection with nature (Nawrath et al. 2019). Besides this, green streets contribute to climate resilient goals and support biodiversity, due to expended habitat (Church, 2015).

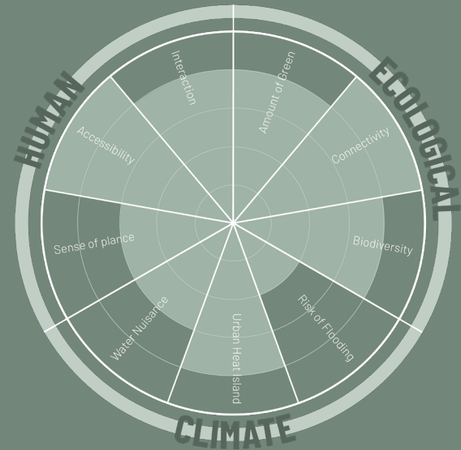
## PRACTICAL IMPLICATION

Developing green streets starts with reducing the amount of paved area and adding vegetation. This could be implemented with rows of trees and vegetated roadsides, but also by adding facade gardens and vegetated building facades.


**SOURCES**

Church, S. P. (2015). Exploring Green Streets and rain gardens as instances of small scale nature and environmental learning tools. Landscape and Urban Planning, 134, 229-240. https://doi.org/10.1016/j.landurbplan.2014.10.021

Nawrath, M., Kowarik, I., & Fischer, L. K. (2019). The influence of green streets on cycling behavior in European cities. Landscape and Urban Planning, 190, 103598. https://doi.org/10.1016/j.landurbplan.2019.103598


**EMBEDDED IN**

Green Routes

**CONTAINS**

Small Green in Between, Wildlife Corridors, Facade Gardens

# 22 SMALL GREEN IN BETWEEN

*Public green spaces do not need to be large in order to be beneficial.*

## THEORETICAL BACK-UP

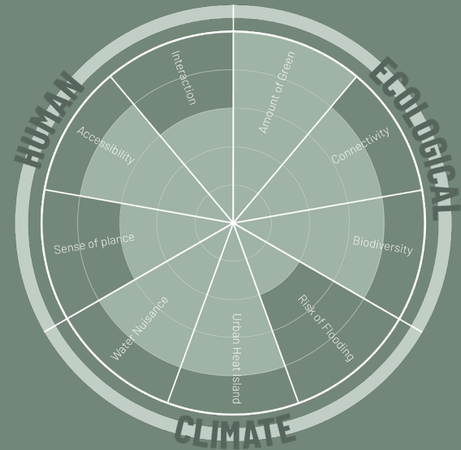
In urban planning and design, nature is often embedded in the city through parks. However, also small sites, can be turned into a public green space that promote quality of life and provide ecosystem services. Besides this, it can be part of the cities' larger green structure (Zhang & Han, 2021).

## PRACTICAL IMPLICATION

Green in between could especially be relevant in high-density cities. The small green oasis can be implemented between buildings or on small empty lots.


**SOURCES**

Zhang, H., & Han, M. (2021). Pocket parks in English and Chinese literature: A review. Urban Forestry & Urban Greening, 61, 127080. https://doi.org/10.1016/j.ufug.2021.127080


**EMBEDDED IN**

Green Streets

# 23 COMMUNITY GARDEN

*Growing your own crops in a community garden has an educational purpose as well as an interactive usage of urban green space.*

## THEORETICAL BACK-UP

Growing up in the city might cause a lack of knowledge on the origin of our food. Through communal gardens, one can learn about the ecosystem services, the production of crops and have social interaction with other citizens (Meconi et al., 2020).

## PRACTICAL IMPLICATION

The communal garden could be implemented in smaller and bigger lots in the city and maintained by the citizens. This creates a shared feeling of responsibility and is an interactive implication of urban green space.


**SOURCES**

Menconi, M., Heland, L., & Grohmann, D. (2020). Learning from the gardeners of the oldest community garden in Seattle: Resilience explained through ecosystem services analysis. Urban Forestry & Urban Greening, 56, 126878. https://doi.org/10.1016/j.ufug.2020.126878

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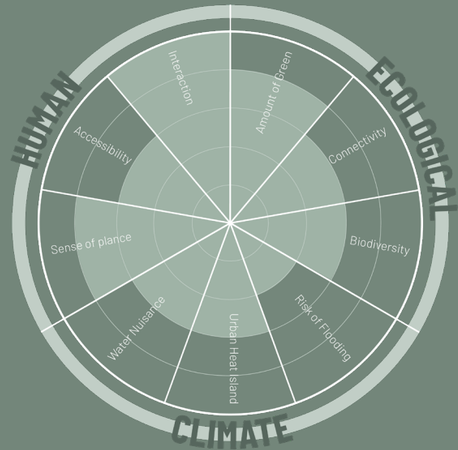


## EMBEDDED IN

Interactive Green Space, Local Self-Sufficiency

# 24 NATURAL PLAYGROUNDS

*A playful interaction with nature could be established in natural playgrounds.*

## THEORETICAL BACK-UP

Connecting with nature is valuable for young people, as it is beneficial for their mental and physical wellbeing, and creates social cohesion (Lapoukhine et al., 2014). Therefore, playing on playgrounds that consist of natural elements, rather than on the traditional man-made playground, is contributing to the development. Besides this, natural playgrounds offer educational purposes and lead to 'greener' citizens (Ethier, 2017).

## PRACTICAL IMPLICATION

Transforming traditional playgrounds into natural playgrounds is a straightforward way to implement this. Another way to achieve a natural playing environment is by "coincidental" playgrounds, in urban parks or other urban green sites, where fallen trees are left on the ground, creating a playing element.


**SOURCES**

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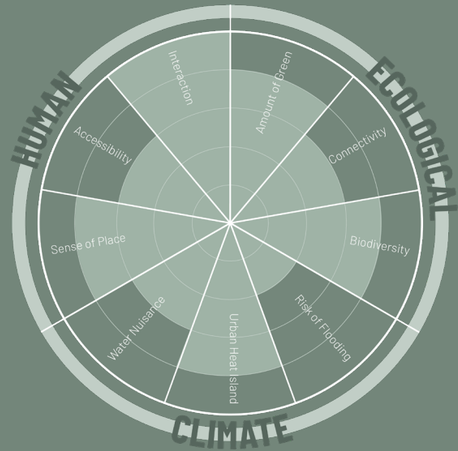
Lopoukhine, N., Wheeler, K., Keenleyside, K., Charles, C., Koss, R., & Nicoll, R. (2014). *Empowering the next generation to connect with nature: a global movement*. PARKS, 20(2), 49–60. https://doi.org/10.2305/iucn.ch.2014.parks-20-2.nl.en


**EMBEDDED IN**

Interactive Green Space

# 25 GREEN BUILDINGS

*Greening buildings contribute to dissolving the distinction between urban and natural.*

## THEORETICAL BACK-UP

Developing buildings that include green facades and roofs have multiple benefits on different scales. Especially on the district scale it is beneficial for urban life, as it contributes to the ecological networks and reduces the effects of climate change, such as UHI and water nuisance (Manso et al., 2021). Besides this, on building scale it has a cooling effect, causing energy savings and an improved urban climate (Feng & Hewage, 2014).

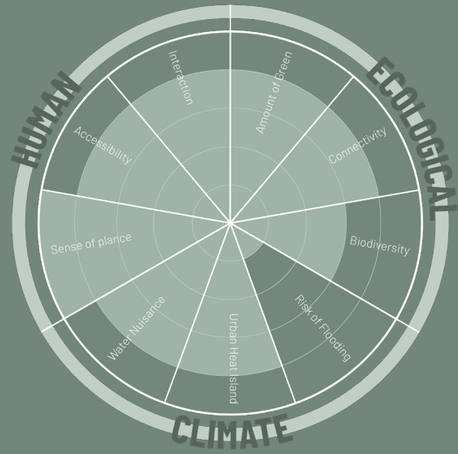
## PRACTICAL IMPLICATION

As green buildings have multiple urban benefits, it is desirable to implement these in high density urban environments. Existing buildings could be transformed by adding vegetation onto the roofs and facades. For new buildings living walls can be constructed, allowing a greater variety of plants.


**SOURCES**

Feng, H., & Hewage, K. (2014). Energy saving performance of green vegetation on LEED certified buildings. Energy and buildings, 75, 281-289.

Manso, M., Teotónio, I., Silva, C. M., & Cruz, C. O. (2021). Green roof and green wall benefits and costs: A review of the quantitative evidence. Renewable and Sustainable Energy Reviews, 135, 110111.


**EMBEDDED IN**

Interactive Green Space, Green Routes

**CONTAINS**

Green Roofs

# 26 GREEN ROOFS

*Environmentally friendly roofs enhances ecological connectivity and biodiversity, while dealing with negative effects of climate change.*

## THEORETICAL BACK-UP

In order to reduce the negative effects of the changing climate, rooftops of buildings can be transformed into environmentally friendly roofs that absorb heat ans store water. These can be implemented in different forms: green and brown roofs includes vegetation that enhances biodiversity, while blue roofs are able to deal with excessive rainwater (Gee, 2021).

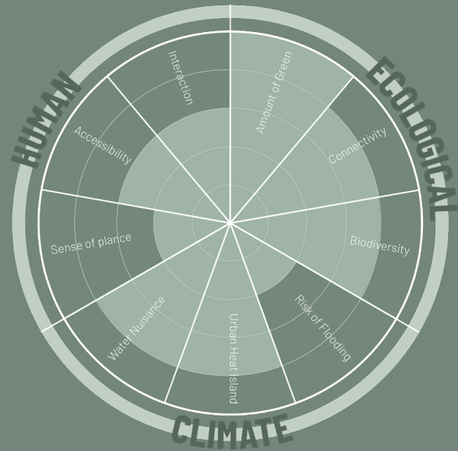
## PRACTICAL IMPLICATION

Environmentally friendly roofs have multiple benefits in relation to a city that is part of nature. It addresses all three aspects as they, besides the environmental and climate benefits, also are able to provide high quality outdoor space. Unused flat roofs are very suitable to be transformed into environmentally friendly roofs.


**SOURCES**

Gee, A. (2021, February 14). Green, blue, brown and white roofs – what are they and why do we need them? Global Center on Adaptation. https://gca.org/green-blue-brown-and-white-roofs-what-are-they-and-why-do-we-need-them/

Manso, M., Teotónio, I., Silva, C. M., & Cruz, C. O. (2021). Green roof and green wall benefits and costs: A review of the quantitative evidence. Renewable and Sustainable Energy Reviews, 135, 110111.


## EMBEDDED IN

Climate Resilience, Biodiverse Networks, Green Buildings

# 27 FACADE GARDENS

*Adding vegetation in front of your facade improves the street scape and contributes to a city that is part of nature.*

## THEORETICAL BACK-UP

Greening the city contribute to the urban quality of life. However, in high density urban environments, little space might be available for vegetation. Developing small scale green patches in front of buildings contribute to the green network and can even form linear biotopes, connecting larger green patches (Gemeente Rotterdam, n.d.; Vollaard et al., 2017).

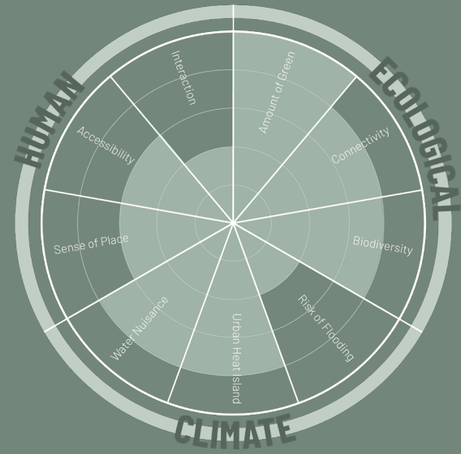
## PRACTICAL IMPLICATION

Facade gardens can be implemented quite easily and require little open space. Stimulating urban residents to create a facade garden in front of their house, and involving neighbors in this, increased the interaction with natural systems while also increasing the social cohesion.


**SOURCES**

Gemeente Rotterdam. (n.d.-b). Geveltuinen | Rotterdam.nl. Retrieved May 25, 2022, from https://www.rotterdam.nl/wonen-leven/geveltuinen/

Vollaard, P., Vink, J., & de Zwarte, N. (2017). Making Urban Nature (Bilingual ed.). nai010 publishers.


## EMBEDDED IN

Climate Resilience, Biodiverse Networks, Green Buildings

# 28 PERMEABLE PAVEMENT

*Impervious surfaces increase the natural infiltration of rainwater and reduces water nuisance in the city.*

## THEORETICAL BACK-UP

As a result of the changing climate, extreme rainfall occurs more often causing water nuisance in cities. Especially in urban environments with a lot of paved area it is necessary that the city is able to absorb store, purify and release precipitation water when necessary (Wijbenga - Van Nieuwenhuizen & Bonte, 2019).

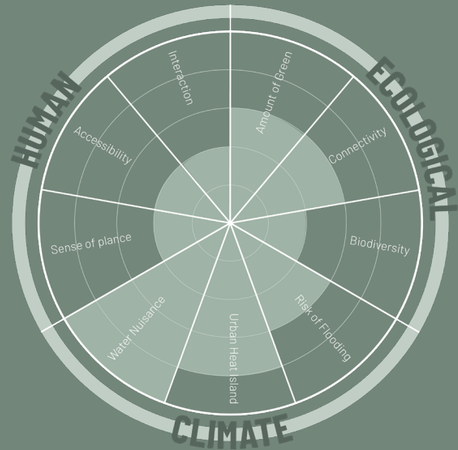
## PRACTICAL IMPLICATION

Reducing the amount of impervious surfaces helps to increase the infiltration capacity of precipitation in urban environments. However it is not possible to get rid of all paved surfaces. Permeable pavements offer a good alternative, that can be implemented in urban streets.


**SOURCES**

Brattebo, B. O., & Booth, D. B. (2003). Long-term stormwater quantity and quality performance of permeable pavement systems. Water research, 37(18), 4369-4376.

Wijbenga - Van Nieuwenhuizen, B., Bonte, A., Gemeente Rotterdam, Waterschap Hollandse Delta, Hoogheemraadschap van Delfland, Hoogheemraadschap van Schieland en de Krimpenerwaard, & Evides Waterbedrijf. (2019, February). Rotterdams Weerwoord Urgentiedocument. https://www.rotterdam.nl/wonen-leven/rotterdams-weerwoord/Urgentiedocument-2020_NL.pdf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Sponge City

# 1 CITY AS PART OF NATURE

2 SOCIAL RESILIENCE

3 CLIMATE RESILIENCE

4 ECOLOGICAL RESILIENCE

5 LET IT GROW

6 BIODIVERSE NETWORK

7 GREEN ROUTES

8 EMBRACE THE WATER

9 SPONGE CITY

10 LOCAL SELF-SUFFICIENCY

11 SAFE ENVIRONMENT

12 PEDESTRIAN FIRST

13 INTERACTIVE GREEN SPACE

14 WILDLIFE CORRIDORS

15 TIDAL PARK

16 SHADE PARK

17 BIOSWALE

18 FLOATING SPACE

19 WATER SQUARE

20 URBAN FARM

21 GREEN STREETS

22 SMALL GREEN IN BETWEEN

23 COMMUNITY GARDEN

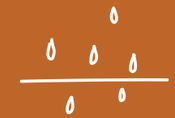
24 NATURAL PLAYGROUND

25 GREEN BUILDINGS

26 GREEN ROOFS

27 FACADE GARDENS

28 PERMEABLE PAVEMENT



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