Mainstreaming Nature-based Solutions

The Impact of Societal Dynamics on Risk and Adaptation Perspectives of Pluvial Floods in Malmö

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Abstract: Cities around the world are not only facing the impacts of climate change but are also increasingly charged with the responsibility to adapt. The city of Malmö in Sweden, facing the consequences of ever-so-present pluvial floods, has set an objective to increase the use of multifunctional Nature-based Solutions (NBS) in its urban stormwater planning. Nevertheless, despite evidence pointing at the effectiveness of, and the largely positive perception around the solutions, the efforts to mainstream NBS are progressing slowly. This thesis takes an exploratory grounded-theory approach to expand the conventional understanding of hindrances to mainstreaming. With the mixed methods of semi-qualitative interviews and document analysis, three main aspects are addressed: (1) different stakeholders' perceptions of NBS, (2) obstacles that are hindering their mainstreaming, and (3) best practices that could facilitate the process. The results show that technical, institutional, and socio-political challenges are creating a societal lock-in from which it is difficult to proceed with a simple top-down management approach. Moving forward, the need for better cross-sectoral and interdisciplinary cooperation is identified, alongside stronger private stakeholder engagement. These findings add complexity to the debates pertaining to cities' capacity to take action in the face of climate change and declining biodiversity. Further, it provides a grounded take on the realities and limits of NBS on practitioner level arguing that whilst the solutions offer various co-benefits, the actual realisation thereof remains a challenge.

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Acknowledgements

This thesis is a result of an earnest eagerness to find ways our societies can adapt to climate change through the appreciation and restoration of biodiversity. However, as cities have become more and more estranged from nature, it is a daunting task to reintroduce and recreate what was once lost. There are many skills that need to be learned, and new values that must come to the forefront if this mindset is to become mainstream. As we have discovered, however, balancing the needs, demands, and risk-perceptions of complex urban fabrics and their multiple different stakeholders is not a simple task. Therefore, this work presents itself as a modest addition to a growing body of literature that recognises these very premises.

This was made possible with the help of numerous inspiring discussions, a very enjoyable, close cooperation between the two authors, and steadfast guidance and supervision. First of all, we would like to thank our thesis supervisor at Lund University, Mo Hamza, who gave us the creative freedom and encouraged us to proceed with this exploratory topic, but also helped us find our red threads when they were missing. Next, we are grateful to Martin Vysoký, at Edge, who took the time to introduce us to Nature-based Solutions in Malmö and steered us toward our case study and research questions. Further, we would like to give thanks to Nina Steiner at VA SYD, who helped us establish a network of research participants, and who does inspiring work to engage private stakeholders in the city. We are also grateful to researchers at RISE, Mårten Västerdal, Kerstin Eriksson and Maja Miltell, for connecting us with their network and bouncing ideas back-and-forth. Finally, we would like to thank all the other individuals who were willing and eager to participate in our study, and whose experiences and knowledge we try our best to represent.

With the submission of this paper, we are finishing our Master of Disaster Risk Management and Climate Change Adaptation at Lund University. Being able to study this program has been a true pleasure and privilege. It has showed us that the challenges ahead of us are enormous - and so is the potential of the solutions we have available. What it takes are engaged individuals to lead and facilitate their implementation. As we are leaving Lund University, we are grateful for everything we learned these past two years, and eager to put the many skills we gained into practice.

Summary

The double challenge of climate change (CC) and biodiversity decline have led to worldwide calls for mainstreaming Nature-based Solutions (NBS). The strong promotion of NBS have, however, also led to several academic accounts questioning to what extent current NBS-mainstreaming efforts are democratic, participatory or effective in terms of risk-mitigation. Further, there is a research gap regarding the role of local actors vis-a-vis NBS, and an on-going discussion around cities' ability to successfully engage in climate change adaptation (CCA) given their limited sphere of influence. The thesis addresses these questions by examining the city of Malmö, in Sweden.

In Malmö, a type of NBS - urban Blue-Green Solutions (BGS) - are understood as a way to manage local pluvial flood-risk. In Augustenborg, a neighbourhood in Malmö, a high density of well-integrated BGS was implemented more than twenty years ago. In 2014 when the city suffered from a heavy cloudburst, Augustenborg successfully withstood the event, while other areas of the city, without BGS, were heavily inundated, proving the effectiveness of BGS. Meanwhile, other areas are at high and increasing risk of suffering from similar events in the future. Among the contributing risk-factors are the local environmental and climatic conditions, intense urbanisation and densification, and an insufficient pipe drainage infrastructure, while the tense situation is severely aggravated by CC. Despite these worrying prospects and a world famous successful NBS project in the heart of the city, no comparable project has been implemented since Augustenborg. Efforts to mainstream NBS - that means integrating a great volume of BGS across the city, to form a locally effective complement to the existing drainage system - are only progressing slowly. This led to the formulation of three research areas: (1) what is the current understanding and perception of, and expectation toward BGS/NBS on the local implementation level; (2) what is the role of the societal context and the private sector; (3) what are the best known practices to overcome hindrances to mainstreaming.

The thesis used Corbin and Strauss's (2008) grounded theory as the main guiding framework, coupled with a deductive-inductive-deductive research strategy, and a mixed methods approach, consisting of 22 semi-structured interviews and a document analysis of 28 complementary data sources. The data sample includes civil-servants and politicians, representing the public municipal-regional sector, and consultants and developers, representing the private sector, as well as key-informants. The complementary data sources represent documents gathered through the interviewees as well as through the researchers' own investigation. These datasets were analysed by coding them into conceptual models, using the NVivo-software, which informed both the Conceptual Framework as well as the Results.

Regarding the first research area, it is shown that the perception of NBS and BGS is generally positive. The multitude of co-benefits they can provide are seen as a promising avenue for mainstreaming. However, the overly positive frame and lack of strategic overview may lead to hasty implementations, which may lead to maladaptation given differing expectations, perceptions and knowledge-levels. While BGS are capable of significantly reducing flood-risk, they cannot be seen as a bulletproof solution. There is a need to deepen actors' understandings of NBS and BGS, while giving more consideration to social justice aspects, if BGS are to be successfully mainstreamed.

In terms of the second research area, it was found that there are five categories of hindrances which inhibit the above-described mainstreaming: (1) An unsuitable legal framework; (2) inert institutions; (3) the novelty of NBS and BGS; (4) a lack of private property owner's engagement (PPOs); and (5) unfavourable political dynamics. These hindrances were exemplified to illustrate how their complex interplay can impact the end-result of a BGS project in Malmö. In the discussion, these hindrances are conceptualised as a societal lock-in where the different problem areas are hindering each other's solutions. It becomes clear however, that full reliance on a top-down management of BGS might not be able to yield the desired results.

The analysis of the third research area resulted in a model, conceptualising the mainstreaming process. Approach, design and implementation were linked with the need for capacity development, both within the municipality and in terms of private stakeholder engagement. In the discussion, it is argued that private stakeholder engagement is crucial for mainstreaming BGS. Further, it is emphasised that while most of the literature focuses on understanding top-down management of BGS, promising bottom-up trends, started by the private sector, receive little attention. This was identified as an interesting avenue for future research.

The discussion advances a comprehensive account of NBS and BGS, calling for further investigation of their effects on societies and ecosystems. It appears that the understanding of benefits (and disservices) of BGS are often covered in positivistic frames, promoting multifunctionality and cost-effectiveness. This thesis suggests, however, that despite the overwhelming positivity, mainstreaming still lags behind. Relatedly, the importance of extensively defining and conceptualising mainstreaming is shown, to measure the actual magnitude of mainstreaming, in contrast to e.g. merely looking at the quantity of solutions. Finally, this thesis provides a piece into the puzzle of assessing cities' capacity for CCA. As this study shows, their sphere of influence is limited, and reliant both on higher-level authorities as well as the private sector. This finding calls for more research on how such challenges can be overcome by ambitious local actors, both from the public and the private side, who aim to mainstream BGS, but who are stuck in the complex societal dynamics illustrated in this research.

Table of Contents

Word count: 19747

Glossary

BGGS Blue-Green-Grey-Solution
BGS Blue-Green-Solution
BGCL the Blue-Green City Lab
CCA Climate Change Adaptation
CC Climate Change
F&G Fastighets- och Gatukontoret (the Real-Estate and Street Department)
FK Fastighetskontoret (a predecessor of F&G)
GIS Geographical Information-Systems
GK Gatukontoret (a predecessor of F&G)
GP Green Party Malmö
EC the European Commission
ETOS Stadskontorets enhet för trygghet och säkerhet (the City Office for Safety and Security)
EU the European Union
IPCC the Intergovernmental Panel on Climate Change
IPBES the Intergovernmental Platform on Biodiversity and Ecosystem Services
IFRC the International Federation of the Red Cross
IUCN the International Union for Conservation of Nature
LU Lund University
MEL Monitoring, Evaluation and Learning
MF Miljöförvaltningen (the Environmental Department)
MSB Myndigheten för Samhällsskydd och Beredskap (the Swedish Civil Contingency Agency)
MU Malmö University
NBS Nature-based Solutions
NEKA Nationella Expertrådet för Klimatanpassning (the National Expert Council on Climate Adaptation)
PPO Private Property Owner
RfW Tillsammans gör vi platts för vattnet (Together we make Room for Water-programme)
SCM Stormwater Control Measure
SBK Stadsbyggnadskontoret (the City-Building Department)
SEF Serviceförvaltningen (the Internal Services Department)
SF Svensk Försäkring (the Swedish Insurance)
SGRI the Scandinavian Green Roof Institute
SMHI the Swedish Meteorological and Hydrological Institute
SV Svenskt Vatten (Swedish Water)
SWM Stormwater Management
UN the United Nations
VA SYD Vatten och Avlopp Syd (Regional Water and Sewage Authority)
WA White Architects

1. Introduction

The transgression of planetary boundaries, such as anthropogenic climate change (CC) and loss of biodiversity, is posing an active threat to the stability and well-being of human societies, and that of other species (Becker, 2014). These two challenges are interlinked and influence each other directly and indirectly resulting in layers of complex and compounding hazards (Naturvårdsverket, 2021). These hazards include, but are not limited to: freshwater scarcity, droughts and heatwaves, sea-level rise and storm-surges, forest-fires, pollution, pest-infestations, food-insecurity, and economic destabilisation (Gramstad, Löfgren, 2021; Fridell, Sixtensson, 2020; IPCC, 2022; NEKA, 2022; SF, 2015; Sörensen et al., 2016). Therefore, it is a matter of extreme urgency to develop strategies for risk-reduction, while simultaneously establishing a dialogue about the protection and prioritisation of different assets in society.

Nature-based Solutions (NBS) - the employment of ecosystem functions (Maćkiewicz, Asuero, 2021) - have gained attention in global policy-making as a strategy to address the above-mentioned challenges (IPCC, 2022). It is argued that thanks to their multifunctionality, the operationalisation of NBS results in the creation of more resilient and sustainable societies (Naturvårdsverket, 2021). This suggests a need for mainstreaming: embedding the solutions into urban systems so that "they reconfigure the flow of power, resources and materials and gain momentum to transform mainstream institutions, infrastructures, and social norms" (Xie et al., 2022:122). Meanwhile, however, despite the prevalent idea of NBS as a master key to all locks, several voices address their maladaptive[1] potential (Seddon et al., 2020; Xie et al., 2022). Xie and others (2022), for instance, argue that the push to mainstream is happening without defining explicitly what it entails, and how challenges can be addressed. Meanwhile, Enzi and others (2017) identify that often mainstreaming is only considered from the perspective of international or state actors, and not from that of local implementation. Relatedly, due to their limited sphere of influence, local level CC-action-planning is often not able to consider both mitigation and adaptation standpoints simultaneously leading to counterintuitive strategies (Göpfert et al., 2019). Finally, often it is assumed that NBS projects are inherently democratic and participatory without actual evidence to support this claim (Osaka et al., 2021).

From this starting point, the present Master Thesis adopts an exploratory approach, informed by grounded theory, to understand how NBS are perceived on the local implementation-level, what the realities of city-level cooperation are regarding targeting multiple benefits, and how a societally beneficial form of mainstreaming can be achieved. With this agenda, this thesis looks at the urban fabric in Malmö City, Sweden, zooming in on attempts to mainstream urban Blue-Green Solutions (BGS) for local stormwater management (SWM).

[1] A measure, which has the intention of being adaptive, but ends up bringing adverse impact or consequences. Xie and others (2021), for instance, argue that occasionally NBS may not lead to more biodiversity but augments monocultures.

1.1. Research Context and Purpose: Urban Pluvial Floods and City-scale Adaptation

Due to CC, cities around the world are facing increasing pluvial flood-risks - floods caused by heavy precipitation that overburden the drainage-systems (IPCC, 2022). Malmö City (from now on referred simply as "Malmö"), the regional capital of the Scania-county located in Southern Sweden, is no exception. Malmö has been exposed to several pluvial flood-events in recent years, including an extreme flood in 2014 (Sörensen, 2018). It is predicted that the consequent costs for individuals and society will increase significantly in the near and far future (Cloudburst-plan, 2017; Fridell, Sixtensson, 2020). Therefore, Malmö has set a target to be a Climate-Resilient City by 2045[2], developed a Cloudburst-plan[3], and is committed to the 2030 Sustainable Development agenda (Miljönämnden, 2021).

Most urban areas face similar challenges as Malmö, given their reliance on conventional centralised stormwater management (SWM) systems, which entrusts pipe-infrastructure to lead water away from the city (Senes et al., 2021). This, next to heavy land-use modifications, makes cities particularly exposed to pluvial floods: Once overburdened, underground pipe-networks are likely to flood streets and basements (Sörensen, 2018; Fridell, Sixtensson, 2020). It is increasingly argued that attempts to control water by upgrading pipe-bound infrastructure, is an unrealistic goal (Haghighatafshar, 2019a; Wihlborg et al., 2019; Sörensen et al., 2016). According to current estimations, Malmö lacks space for one million cubic metres of stormwater before meeting its stormwater management targets - too much to accommodate in underground pipe-systems[4]. To address this challenge, a sub-type of NBS, that is Blue-Green Solutions (BGS) is being presented as a local solution to increase the resilience of the SWM-system and reduce flood-risk (Cloudburst-plan, 2017).

Cities can be seen as an ideal candidate to drive the mainstreaming of NBS or BGS. Namely, they play a key role in adaptation as they possess significant decision-making power in terms of day-to-day planning (Wamsler, 2014; Kjaerum, 2018). Additionally, in Sweden, upgrades of the drainage-system are the responsibility of the municipality, and by extension the regional water authority. Furthermore, municipalities ("kommuner") have significant legal responsibility and autonomy for adaptation (Andersson, 2020; von Bahr, Ivarsson, 2020). This coincides with the observation by Kjaerum (2018) who argues that the importance and influence of local governments increases, as they are closer to citizens, whose trust toward national governments recedes.

[2] This is a statement from a civil servant working for the municipality (Civil-Servant-3 - See the Methods section).

[3] A plan commissioned by Malmö municipal council on how Malmö should prepare for future cloudbursts with lessons learned from the 2014 cloudburst event.

[4] This is a statement from a civil servant working for the municipality (Civil-Servant-3 - See the Methods section).

At the same time, the discussion around what local responsibility of CCA should look like is only aspiring, and many argue that private sector should have a role to play as well (Persson et al., 2021). In Sweden, the current autonomous role of municipalities has resulted in varying levels of preparedness, where larger and wealthier municipalities tend to make larger investments (SF, 2015). However, there are de facto limitations to municipal influence. For instance, the Malmö municipality owns and manages only 30% of the land, meaning that 70% remain privately owned. This makes Malmö an interesting case for exploring how mainstreaming materialises in an environment marked by societally complex dynamics and a multi-stakeholder playfield.

1.2. Nature-based pluvial Flood-Risk-Mitigation in Malmö: Research Gaps and Questions

The basic idea behind BGS for pluvial flood-risk-mitigation is to decentralise the system from which floods emerge, by connecting blue-green infrastructure with grey SWM-solutions (Cloudburst-plan, 2017). Malmö is well-known internationally in this realm thanks to a BGS-project in Augustenborg - the Eco-City - which was implemented toward the end of the 1990's (Månsson, Bengt, 2021). The district used to experience frequent pluvial floods, which were addressed by implementing a high density and volume of BGS. When put to the stress-test during the 2014 floods, they performed exceptionally well (Sörensen, 2018; Haghighatafshar et al., 2018b).

Despite these performance indicators, no projects of similar scope and success have been completed to-date (Graham, 2021). The on-going fascination toward Augustenborg says "a lot about how little has been achieved internationally since they were implemented" (ibid.:35). This an interesting observation given that mainstreaming is generally seen as an increasing quantity of solutions over time (Xie et al., 2022). In the absence of clear evidence of mainstreaming, it should be asked if NBS are actually seen as beneficial or desirable, and therefore:

1. What is the understanding, expectation, and perception of Nature-based Solutions (NBS) and the resulting co-benefits, in the context of stormwater management (SWM) with Blue-Green Solutions (BGS) by practitioners and other stakeholders in the city of Malmö?

As proposed earlier, cities may encounter hindrances when implementing CCA-measures due to their limited scope of influence and capacity. During the authors first field visit in the early orientation phase of the research, a lack of cooperation between public and private actors was discovered[5], which was thereafter confirmed by a literature search. While there are

[5] The authors visited some raingardens which were not connected to the roofs of the neighbouring private buildings, even though it was very obvious that the designer had planned to do so, since there was a small ditch leading from the

extensive accounts on the constraints imposed by legal and institutional frameworks and inertia, they are mainly focused on the role of municipalities and policy-makers (Sörensen et al., 2016; Wihlborg et al.,2019; Becker, 2021). Meanwhile, Sörensen (2018) argues that political conflicts over urban space hinder mainstreaming. This gives motivation to investigate the relationship between public and private actors, which led to the question:

2. What is the societal and institutional context of mainstreaming BGS for SWM in Malmö, specifically in terms of private stakeholders' roles and the hindrances affecting public-private cooperation?

Finally, it has been argued that CCA requires efforts from both the public and the private sector in order to be truly effective (Wamsler et al., 2014). Thus, more and better cross-sectoral and public-private cooperation is needed (Maćkiewicza, Asuero, 2021; Mercer et al. 2012; Wamsler et al., 2014). There are, however, challenges to these new partnerships given the hindrances imposed by the societal context. To contribute to this discussion with best-practice examples, the third research question was formulated as follows:

3. In the context of Malmö, what approaches could be suitable to facilitate public-public and public-private cooperation in order to achieve wider mainstreaming of BGS for sustainable SWM?

1.3. Thesis Structure

The following thesis is structured with the purpose of answering the aforementioned research questions. **Chapter 2 - Background** elaborates on the selection of Malmö as research case and accounts of pluvial floods from a risk-perspective. The expected consequences, likelihood and uncertainties are addressed, followed by a consideration of BGS as risk-mitigation strategy. **Chapter 3 - Methodology** introduces the research approach - grounded theory - followed by a motivation of the mixed methods - semi-structured interviews and document analysis - research strategy. Further, this chapter introduces the relationship of two data sets and the process of data analysis.

Chapter 4 - Conceptual Framework clarifies definitions and relationships of key concepts: Nature-based Solutions (NBS), Blue-Green Solutions (BGS), and Mainstreaming. This chapter follows the methodology section as it was largely informed by the research process and the understandings and formulations gathered from participants - thereby, partially answering the first research question. **Chapter 5 - Results I** presents the findings to the second research

rainwater-downpipe over the walkway into the raingarden. However, the downpipe had not been opened to release the water but was still leading it down into the sewer-system. This observation inspired the authors to further investigate public-private cooperation, as the stormwater management capacity of this raingarden, and hence its effectiveness in mitigating pluvial flood risk could easily be multiplied by simple connecting the downpipe with the raingarden.

question - hindrances to mainstreaming - which are categorised as follows: (1) the legal framework; (2) the institutional framework; (3) novelty of BGS; (4) engagement of private property owners; and (5) political dynamics. **Chapter 6 - Exemplifying Study** relates these findings to a specific field-site in Malmö, the Monbijougatan-raingardens.

Chapter 7 - Results II addresses the final research question on suitable approaches through a data analysis synthesis, from participant's perspective. A model including approach, design, and implementation, is proposed, followed by a section on capacity development that was framed as necessary for successfully applying the model. **Chapter 8 - Discussion** re-addresses all three research questions to discuss their implications and generalisations on a higher-level. Finally, **Chapter 9 - Conclusion** summarises key aspects of this thesis and addresses strengths, shortcomings, and limitations.

2. Background: Predictors of Pluvial Flood-Risk and Blue-Green Solutions as Adaptive Measures

This chapter introduces pluvial floods in Malmö through a risk-perspective - a combination of expected consequences, the likelihood of occurrence, and related uncertainties (Sörensen et al., 2016). This is done by elaborating upon prior risk-assessments conducted in Malmö. Assessing risk transparently is crucial given that risk is always a subjective evaluation (Hansen et al., 2013), and there should be well-grounded reasons for framing something as a risk as mitigation requires the investment of societal resources (Berndtsson et al., 2019). As will be shown, pluvial floods threaten individuals as well as societies at large. Meanwhile, BGS are capable of addressing multiple hazards while bringing multiple benefits at once. This chapter first considers the expected consequences of pluvial floods in Malmö; then elaborates on three risk-predictors: (1) the urban climate and environment; (2) urbanisation, densification and infrastructure; and (3) climate change; and, finally, introduces BGS as a way to mitigate the risk.

2.1. Expected Consequences of Pluvial Floods in Malmö

Pluvial floods - the most common flood-type in Malmö - can be defined as an overload of the natural or built drainage-system due to an extreme or heavy rainfall (Sörensen et al., 2016; Sörensen, 2018). The consequences differ depending on the size of the overload as evident by Figure 1, or due to cascading disruptions exacerbating damage (Berndtsson et al., 2019; Sörensen, 2018). The 2014 cloudburst-event[6] in Malmö accounted for 60% of the estimated

[6] In Swedish: Skyfall. SMHI defines a cloudburst as 50 mm of rain in under one hour or 1 mm of rain per minute (Olsson, 2020). Cloudbursts are geographically contained and rapidly-developing events, which makes their occurrence difficult to predict. The most recent cloudburst in Malmö took place on the 31st of August in 2014. Due to its duration, this was a 100-year rain event - and the heaviest one recorded in 50 years (Olsson & Hanson, 2018; Sörensen, 2018).

annual flood-damage-costs in all of Sweden (Sörensen, 2018), which was one billion Swedish Crowns[7] in total (SF, 2015). Beyond insurance-costs, flooding poses a risk to urban critical infrastructure, vital societal functions and public health (Sörensen et al., 2016; Arvidsson et al., 2015). Meanwhile, on an individual level, basement floodings lead to significant costs for private property owners (PPOs) (Cloudburst-plan, 2017; Sörensen, 2018). Given its magnitude, the 2014-flood can be conceptualised as a city-wide hazard, giving an idea of what consequences can be expected from future cloudbursts (Sörensen, 2018). When and how pluvial flood takes place, however, and who is exposed, is determined by various interplaying factors considered in the next three sections.

[7] Conversion: rounded up approximately € 109,000,000 with a 2015 Exchange Rates.

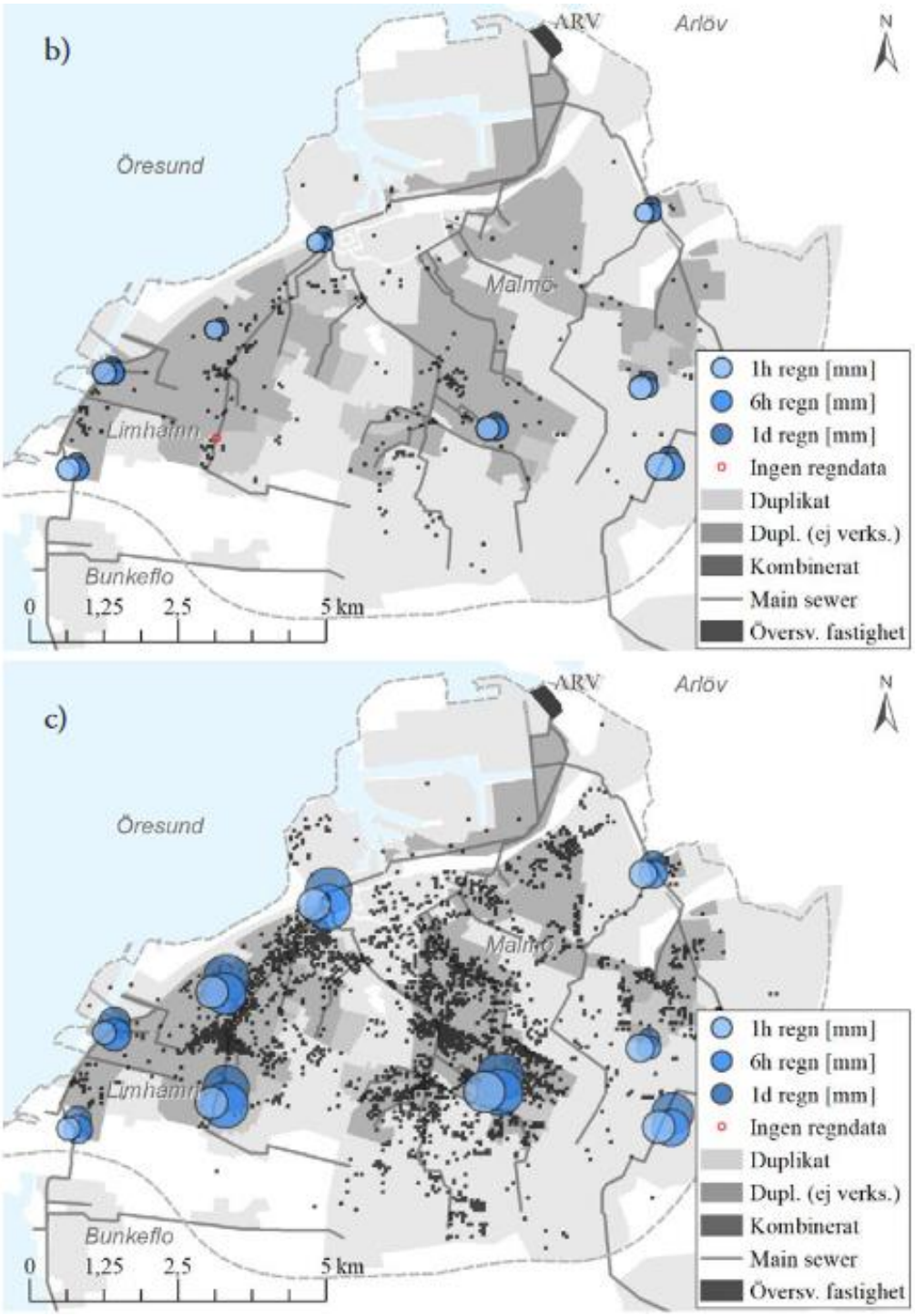

Figure 1 *illustrates the difference between the two most extreme flood-events in the past two decades: 2010 (b) and 2014 (c). In 2010 VA SYD (The regional Water and Sewage Authority) received 210 and Länsförsäkringar Skåne (the County Insurer in Scania) 148 appeals and notifications, whereas in 2014 the numbers were 2109 and 2649 respectively. Adapted from Sörensen (2018:213-4).*

2.2. Urban Climate and Environment

Malmö is a coastal city that is frequently exposed to extreme rains, especially from June to August (Cloudburst-plan, 2017; VA SYD, 2021). This leads to a higher likelihood of urban pluvial flooding as the event is triggered by precipitation (IPCC, 2022). However, flood-events

are not unison in their onset patterns (Cloudburst-plan, 2017). While a series of subsequent rain events is a more common flood-trigger (SF, 2015), the 2014-flood was a consequence of a single extreme cloudburst (Sörensen, 2018). The rain event type, combined with the local environment can predict some risk-characteristics: Subsequent rain events leading to ground saturation[8] lead to more evenly distributed city-exposure, while single cloudbursts expose some areas more heavily than others (ibid.).

Given this interaction of climate and urban environment, there is significant model uncertainty[9] for flood-prediction (Cloudburst-plan, 2017). Stormwater has a gravity flow, which means it follows topographically-determined paths. In urban areas like Malmö, however, the topography is only one factor of pluvial flood-risk (Sörensen, 2018). As can be seen in Figure 1, the flooded properties (black dots) are concentrated around the main sewer-network. This concurs with GIS-modelling showing that most floods occur within a 100-metre radius from the main network (Sörensen, 2018). Therefore, it is not sufficient to look at surface features, but also their interplay with the drainage-system and the (im)pervious surfaces in strategic locations of the catchment area (SF, 2015).

2.3. Urbanisation, Densification and Infrastructure

Malmö is the fastest growing city in Sweden with a population of 350 000, projected to reach 500 000 by 2050 (Miljönämnden, 2021). It intends to accommodate future inhabitants by growing inward through densification.[10] This leads to an increasing amount of impervious surfaces in the city (Boverket, 2016; Naturvårdsverket, 2021; Sörensen et al., 2016). Meanwhile, the dependence on centralised SWM is increasing as more areas are paved and connected to the pipe-system, which in most cases still combines sewer and stormwater into one (Sörensen, 2018; Wihlborg et al., 2019). Yet, this system is unable to meet the contemporary demands as the quantity of water entering the system increases due to population growth and larger surface catchment (Olsson, Hanson, 2018): It was estimated that approximately 40% of the pipe-system today does not have the capacity to withstand a

[8] Ground saturation should be understood here as the declining capacity of the ground to infiltrate stormwater over time as the area is exposed to subsequent rain events. Ground saturation is, to be sure, not a universal quality, but depends on the type of ground in question and a complex interplay of factors. For example, it is argued that given the prevalence of moraine rocks in Malmö, infiltration is negligible (Olsson, 2020). Elsewhere, however, it is argued that the locally low concentrations of clay may in fact increase infiltration (Informant-3,4 - see the Methods section). This points to the difficulty of modelling pluvial floods.

[9] In here, model uncertainty can include both epistemic uncertainty and aleatory uncertainty. Respectively, according to Der Kiureghian and Ditlevsen (2008) most engineering problems would include both the challenge of lack of available knowledge, and the factor of intrinsic randomness of a phenomenon.

[10] The densification-policy follows from a combination of reasons: the possibility of providing resources more efficiently (Boverket, 2016); a national interest to preserve agricultural lands as they nest some of the country's best remaining topsoils (Civil-Servant-3 - See the Methods section); and protection of the marine ecosystems of the Öresund-bay (ibid.).

10-year rain event.[11] Particularly vulnerable are districts where the waste- and stormwater-systems are combined[12] - that is one third of the city's drainage-network (Olsson, 2020; Sörensen, 2018).

As argued previously, the proximity to the main sewer-channels is a major contributor to individual risk. This is shown in Figure 2, depicting the impacts of a simulated storm. The dark nodes, which represent flooding, are not distributed equally, but dependent on their geographic location in the sub-catchment (Haghighatafshar, 2019b). This implies that pluvial flood-risk threatens specific parts of the city - districts located downstream in the sewer-network - even if the whole city is equally exposed to rain (Haghighatafshar, 2019a). Given the densification and socio-economic growth, high-tech infrastructure and other assets accumulate "downtown" increasing the number of assets that are exposed to the hazard (Berndtsson et al., 2019; NEKA, 2022; Sörensen et al., 2016). This trend coincides with CC, which is augmenting the likelihood of flooding.

[11] 10 or 100-year rain is a statistical way of expressing the likelihood of an occurrence of a certain type of a rain event. 10-year rains have a 10 percent probability of occurring in a given location in a year, while the probably for a 100-year rain is 1 percent. Climate Change is, however, also impacting the characteristics of rain events, and what is now known as a 10-year rain event is anticipated to have 10 percent higher volume of precipitation by 2050, and 25 percent higher volume by 2100 (Olsson, 2020).

[12] In this context, combined refers to the sewage and stormwater being led through the same system. A duplicate system would be one where two different pipe-networks exist. It has been seen in the past that the characteristics of the rain event determine how well different systems are able to cope (Sörensen, 2018).

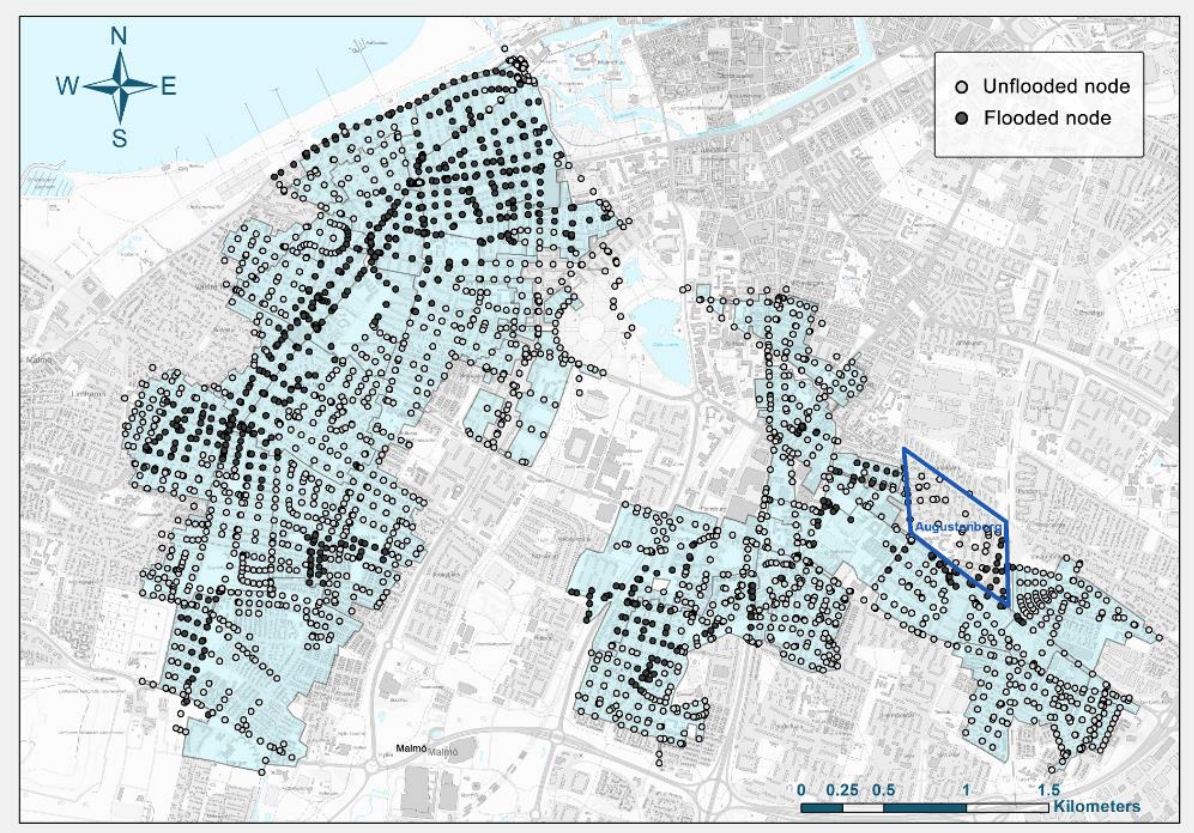

Figure 2 *illustrates the sub-catchments (light-blue) in the city of Malmö and the areas that would flood in a model storm scenario with a recurrence interval of 10 years. The filled markers represent flooded manholes leading to basement flooding, in total 779, whereas the unfilled nodes represent the unflooded manholes. The risk-map was retrieved from Haghighatafshar and others (2019b).*

2.4. Climate Change

Urban floods will increase in conjunction with the rise of global average surface temperatures (IPCC, 2022). One known cause-and-effect is the increasing aptitude of air to amass water when it gets warmer (SMHI, SV, 2020). In Sweden, the average temperature is expected to be 3-5 degrees warmer by 2080[13] provided that the current emission rates persist, while the emissions released to-day will stay in the atmosphere for millennia causing long-lasting changes in the climate system (Gramstad, Löfgren, 2021). This warming will cause more extreme precipitation and an increased amount of such events (Cloudburst-plan, 2017; Naturvårdsverket, 2021; Olsson, 2020; SOU:42, 2017).

Given the correlation of temperatures and precipitation intensity, it can be estimated what kind of rain events Malmö should prepare for (SMHI, SV, 2020). In Sweden, this planning tool is known as the “climate factor”,[14] anticipating a 20% increase in intensity until 2050 and 30-

[13] Relative to the median of years 1960-90.

[14] In Swedish: klimatfaktor. A number of city planners interviewed for this thesis mentioned 1.2 as the climate factor guiding their work in the current moment, that is, factoring a 0.2 increase into normal calculations. In the guiding document, SMHI and SV (2020) highlight that this is a first-generation estimate with flaws, which is why they continue to

40% increase in the second half of the century (ibid.). Accurate predictions on change, and recurrence intervals, are difficult due to limitations in extrapolating current data (Sörensen et al., 2016). As the climate ceases to be stationary, the previously known rules to rainfall change, which creates significant epistemic uncertainty.[15]

2.5. Pluvial Flood-Risk-Mitigation with Blue-Green Solutions

While risks threaten to cause a deviation from societies preferred future development, they can be influenced by risk-mitigation (Sörensen et al., 2016). Risk-mitigation can entail either addressing root-causes of risk[16] or vulnerabilities[17] of the system to minimise disturbances and reduce consequences and costs if, and when, hazards strike (Coppola, 2015; Sörensen et al., 2016). In case of pluvial floods, only some root-causes can be addressed on the city-level. Whilst CC cannot be mitigated only locally, reduction of urban population growth is currently not a salient political choice (Boverket, 2016). This leaves Malmö with the possibility of addressing pluvial flood-risk through upgrades in the pipe-network (Olsson, 2020; SOU:42, 2017; Sörensen et al., 2016), which can be seen as climate change adaptation (CCA).

Meanwhile, there are concerns[18] that counting on technical upgrades is an insufficient strategy (Brink, 2018; Cloudburst-plan, 2017; Gramstad, Löfgren, 2021; Olsson, 2020). This has led to calls for a paradigm shift in planning, introducing BGS for SWM (Sörensen et al., 2016; Wihlborg et al., 2019). The city of Malmö has recognized this strategy on paper and is committed to implement both grey and blue-green measures to reduce flood-risks (Cloudburst-plan, 2017). In short, BGS is seen as having potential insofar they unburden the drainage-system by increasing permeable surfaces where water can infiltrate, be retained, evapotranspire or slowly divert (Sörensen, 2018). Despite the recorded success of such risk-mitigation (Haghighatafshar et al., 2018b; Sörensen, 2018), and the acknowledgement of co-benefits,[19] Figure 3 shows that apart from Augustenborg, no high intensity of BGS have been implemented elsewhere in the city. Hence, this thesis will investigate how well the benefits of mainstreaming BGS are understood among implementers; what hinders the introduction of more BGS; and finally, how this knowledge-action gap could be bridged.

work in order to provide better guidelines for planning.

[15] Informant-6 (See the Methods section). Epistemic uncertainty is a type of uncertainty resulting from a lack of knowledge.

[16] For example, climate change, densification, state of the pipe-network.

[17] For example, exposure of assets and societal preparedness.

[18] While the pipes are being enlarged to allow more water to flow through, there is an on-going competition for space underground as well as a number of technical design challenges. Furthermore, as underground pipe-systems are very inflexible, continuous upgrades would be needed, which is simply too expensive to be realistic (Olsson, 2020).

[19] E.g. temperature regulation and better air quality (Fridell, Sixtensson, 2020).

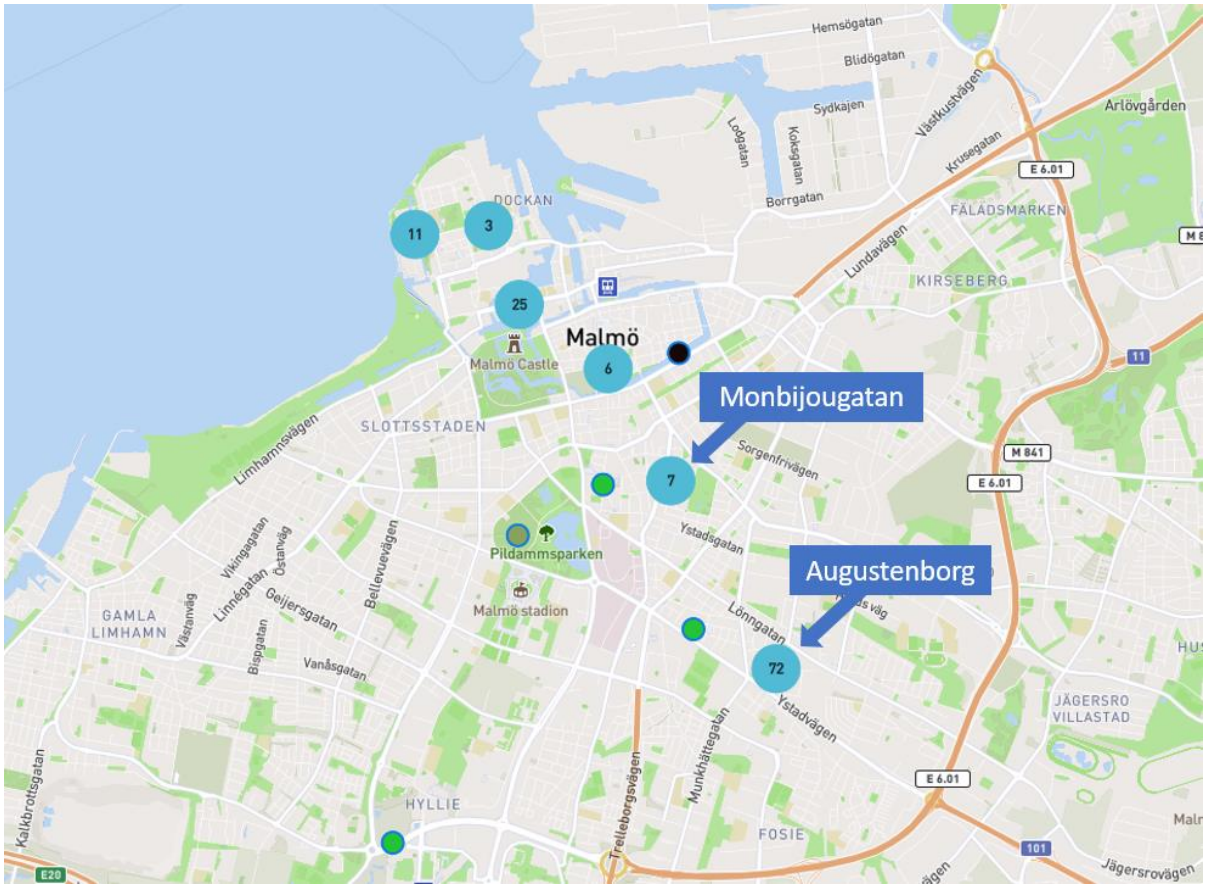

Figure 3 *illustrates water-related climate adaptation projects in Malmö and shows that only Augustenborg has a significant concentration of solutions present day. It should be noted that the map is likely to represent only some of the on-going projects, yet, it gives an indication of concentrations of solutions in the city. Retrieved from Climate Scan (n.d.) and adapted by the authors.*

3. Methodology

Given the novelty and exploratory character of this research, grounded theory was seen as a suitable research approach. The reason for doing exploratory research is to adapt the approach and conceptual tools to the researcher's learning process (Blumer, 1969). Grounded theory provides a structure to inform a systematic data-collection and analysis of qualitative data to generate a theory (Creswell, 2013; Corbin, Strauss, 2008). Previous research has used grounded theory similarly, studying why planners have or have not integrated NBS within flood-risk-management (Brillinger et al., 2021). This chapter explains research strategy, mixed methods approach, data-sampling and data-analysis. Appendices I-IV complement this section with the interview guideline and lists of data-sources.

3.1. Research Approach and Strategy

In the absence of an existing theory in relation to public-private cooperation around NBS mainstreaming, a deductive-inductive-deductive research strategy was adopted to allow unexpected themes to emerge from the data (Blaikie, 2010; Creswell, 2013). In the first

deductive phase, informed assumptions were formulated while researchers familiarised themselves with existing literature, case studies, and made preliminary field inquiries. This phase was helpful in detecting initial research gaps, and most importantly, understanding the importance of private stakeholder engagement for BGS. In the inductive phase, the researchers refrained from engaging with further explanatory literature to distance themselves from theory, merely engaging with the interview-data and the documents received from participants. This allowed the researchers to recognize patterns in the data, emerging from the codes. Finally, to increase the reliability of the sample, deduction was reintroduced, now more targeted, following patterns identified in the inductive phase, by complementing the gathered insights with other scientific literature.

3.2. Mixed Methods: Semi-Structured Interviews and Document Analysis

This thesis uses mixed-methods, combining semi-structured interviews with a document analysis. The interviews followed a fixed guideline (see Appendix I), but had a spontaneous structure. According to Corbin and Strauss (2008), loosening the structure of an interview is useful to generate greater quantities of data. Furthermore, it allowed adjustments to the role and expertise of interviewees and a natural conversation-flow, while still keeping a checklist of themes. As can be seen in Appendix I the questions were somewhat adjusted to fit both NBS-practitioners and those with little prior experience with the solutions. The five parts of the interview consisted of: (1) perception of CC and other societal risks in the interviewee's occupation; (2) interviewee's understanding of role, functions and benefits of NBS/BGS; (3) on-going processes and/or cases in relation to NBS/BGS and/or private stakeholder engagement; (4) challenges faced; (5) and ways forward. The guideline also incorporated questions about subjective values, which were meant to encourage interviewees to reflect on their assumptions and perceptions.

The sampling and data collection took place between January and April 2022, which included 21 interviews. An average interview lasted for one hour, conducted either in English or Swedish, or a mix of the two languages. Both researchers took the role of an interviewer asking questions in turns. Most of the interviews were recorded and transcribed. However, in four key-informant interviews, which took place in the early orientation phase of the research before the interview guide was developed, only notes were taken. All of the interviewees were informed about their right to decline their consent of being part of the research and the quoted parts were run by them prior to the publication for full transparency. The researchers did not perceive any substantive reason to quote the interviewees by name and opted to use IDs to affiliated organisation and role stated in Appendix II. This reference style (e.g. Informant-1) is used in Chapters 4-7.

This thesis focuses on the analysis of interview data, while being supplemented by a document analysis of complementary data sources, including 28 documents[20]: primary, secondary data, and grey literature (see Appendix III). These data sources are referenced with square brackets and a number in Chapters 4-7 (e.g. [1]). The integration of these documents served three goals: Firstly, Corbin and Strauss (2008) stress the importance of understanding meaning behind words when conducting research. As interviews can be heavily influenced by contextual factors and time, extrapolating words from an interview context may cause misrepresentations. Thus, the document analysis contributed to the process of attaining an emic perspective (Creswell, 2013), confirming meanings beyond participants' own words. Secondly, it was noticed that the interview data sample is sparsely representing PPOs[21]. Some of the analysed documents were therefore specifically chosen to shed light on PPOs' perspectives. Thirdly, the document analysis made triangulation possible, and documents and interviews were used dialogically to cross-confirm or refute statements (Bowen, 2009). Most commonly, documents were utilised to add details to unclear interview statements or interviews were contrasted with older sources to detect changes in attitudes or realities.

3.3. Theoretical Sampling and Data Saturation

In grounded theory, theoretical sampling, data saturation and analysis are interrelated: researchers may decide to stop sampling as no new codes emerge, while instances within a code keep increasing (Saunders et al., 2018). Interviewees were asked to refer to actors they considered important in relation to the research topic, which progressively led to the creation of a stakeholder map, which can be found in Appendix IV. The purpose was to get a contribution from all relevant stakeholder groups. Civil-servants and politicians represent the public municipal-regional sector, whereas consultants and developers represent the private sector. Informants consist of both public and private-level actors, but are not directly engaged with implementation in Malmö. Their contribution was, therefore, useful in understanding the general context.

Non-probability sampling (Blaikie, 2010), was used to reach out to different stakeholders who were contacted via email or referred and connected by a network of contacts that the researchers built. Approximately 40 persons were contacted out of which 22 agreed to participate. Simultaneously, the sampling of complementary data sources happened organically[22]. The dataset is deemed sufficiently saturated as new interviews did not result in

[20] Among others these include PowerPoint presentations, an email exchange, a survey, Master-theses, project proposals and reports and peer-reviewed articles.

[21] This was due to the limited data collection period and the inductive research process, where the importance of these actors was discovered later in the process.

[22] Many of the interviewees referred back to projects they had worked on, organisations they were affiliated with, or otherwise important documents for their work, and the researchers requested if those documents could be shared. Some

the creation of new codes, but merely solidified results, adding further examples. This was seen as sufficient as the codes are the pillars of the created model.

3.3. Data Analysis with Codes

In grounded research, analysis is understood as coding: transforming raw data into conceptual models (Corbin, Strauss, 2008). In this context codes describe concepts derived in the process of coding data (ibid.), whereas categories refer to clusters of codes. During the analysis, excerpts were picked from interview transcripts or complementary data sources and clustered into codes and categories using the NVivo-software. Brillinger and others (2021) distinguish between substantive and theoretical coding, which illustrates the iterative character of grounded research. Substantive coding can be seen aligned here with the inductive research phase and theoretical coding with the final deductive phase. As illustrated in Figure 4, the first phase consisted of open and selective coding where excerpts were gathered and combined, and the main categories selected. To test these categories and codes, theoretical coding was introduced where existing theoretical frameworks were contrasted with the findings. This allowed the incorporation of findings from previous studies into the data sample. This phase led to a new substantive coding phase where the language of the categories and codes were adjusted, and their differences refined.

additional data sources were added when the context of interview statements were looked up on the Internet after interviews.

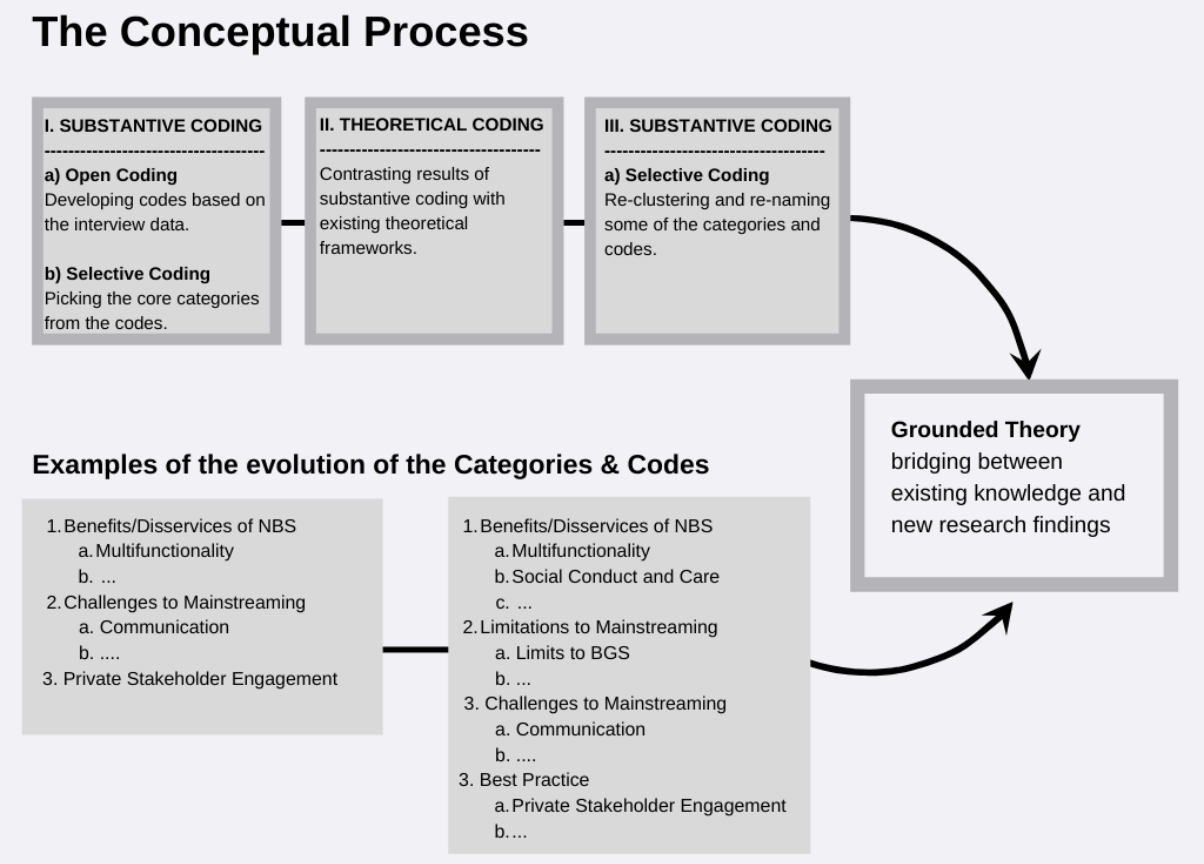

Figure 4 *portrays the process of coding in this thesis research. This figure was created by the authors, but inspired by the work of Brillinger and others (2021).*

A couple of notes should be made about the analysis process. Firstly, the narrative of the results is led by the interviews, since complementary data did not inform the creation of categories or codes, but only provided additional depth. Secondly, to increase the robustness of the results, and to avoid misrepresentations, the interview participants were given the chance to see and comment on their contribution, which increases confidence in that part of the analysis. Finally, the researchers worked with half of the data each, albeit in close cooperation and constant interaction regarding the refinement of categories and codes. In the end the two separate NVivo-files were merged to represent all data. The accuracy of results could have been improved by rotating data between researchers, yet, in the interest of time, the focus was placed on gaining a broad outlook.

The data analysis fed into three parts: the conceptual framework (Chapter 4), hindrances to mainstreaming (Chapters 5 and 6) and approaches to mainstreaming (Chapter 7). In Chapter 4, it played a key role in defining the conceptual limits of the project and informed the description of the relationship between NBS and BGS-concepts to match the perception and understanding on the ground. Chapter 5 is a write-out of the challenges and limitations categories. These categories were further applied in Chapter 6 to illustrate, how general problems play out in relation to data gathered of an exemplifying study of a particular BGS in the city of Malmö. Finally, Chapter 7 corresponds to the elaboration on best practice in the

data, but also capturing more broadly the suitable approaches that can facilitate mainstreaming. In the next four chapters, datasets are referenced using code-names and numbers as indicated in the appendices.

4. Conceptual Framework

This conceptual framework was developed with the help of data analysis. The researchers started off with a concept of Nature-based Solutions (NBS), but complemented this with Blue-Green Solutions (BGS), a more prevalent term in the Swedish planning context [23].[23] BGS has an explicit water component ("blue") embedded into the concept, which is why it is more suitable in terms of understanding stormwater management (SWM). This section first introduces NBS as an umbrella term, and BGS as its sub-category, and then moves on to discuss mainstreaming Blue-Green-Systems and Climate Change Adaptation (CCA).

4.1. Nature-Based Solutions

The European Commission (EC; 2015) has a widely-cited definition for NBS describing them as entities that are "inspired by, supported by, or copied from nature, and range from directly utilising natural system processes to engineering solutions emulating nature". They are framed as being able to generate human welfare and address societal challenges related to climate change and biodiversity decline by protecting, developing or creating ecosystems [6]. NBS is most of all gaining momentum among international organisations[24], which conceptualise it as a vehicle to climate change mitigation and adaptation (Cohen-Shacham et al., 2019; Dhyani, Karki, Gupta, 2020). For instance UNEP and IUCN (2021) frame NBS as a pathway to cut emissions by 2030[25] - a goal recognized by practitioners in Malmö.

A central element of NBS is the idea that they are multifunctional, and thus, cost-effective as argued, for instance, by Naturvårdsverket (the Swedish Environment Protection Agency, 2021). Scholarly literature distinguishes slightly between multiple benefits (or: co-benefits) and multifunctionality (Pineda-Pinto et al., 2022). Co-benefits is simply a list of different functions of NBS leading to positive outcomes with regards to more than one challenge.[26]

[23] The concepts are differentiated in Swedish as "Naturbaserade lösningar" (i.e. NBS) and Blågröna lösningar (i.e. BGS). Whilst the data had mentions of both, the interviewees seemed to have more familiarity with, and most of the documents analysed referred to the latter.

[24] Among others: the UN, IUCN, IFRC, IPCC, World Bank, and the EC.

[25] More specifically, they are seen as a way to cut 30% of all the emission targets, which speaks of the drive with which the organisations envision their mainstreaming.

[26] For example, a single solution such as a green roof can be seen as increasing climate resilience; cooling cities and dealing with the heat island effect; conserving and restoring biodiversity; and contributing to better human-health and well-being (Pineda-Pinto et al., 2022).

Meanwhile, multifunctionality is used to highlight the comparative advantage of NBS; the idea that they are vested with the ability to produce multiple benefits simultaneously, unlike grey mono-solutions (ibid.) [24]. Multifunctionality is seen as an asset especially in an urban context where there is little available space to solve challenges [20].

Pineda-Pinto and others (2022) argue that often multifunctionality is measured with a tangible focus on functions and performance as quantification of these aspects is easier. For instance, two measurable performance indicators of raingardens could be the quantity of water they retain and the amount of pollution they capture. Meanwhile, there are a number of intangible benefits that could be included into the concept of multifunctionality, that is, more socially relevant aspects to which it is more difficult to assign a specific value (Pineda-Pinto et al., 2022; Developer-2). This category would include aspects such as aesthetics, public health, and spaces for gathering and recreation, which tend to be neglected in NBS-studies (Mottaghi et al., 2020). Finally, values of ecology are increasingly juxtaposed with technical and social benefits to highlight the fact that conservation needs to be accounted for if NBS is to provide a solution for both CC and biodiversity decline (Maller, 2021).[27] This implies broadening the focus to understand the importance of biodiversity preservation and appreciation. In order to contextualise the specific local benefits, Figure 5 was created based on the remarked benefits observed in the data sample. They were categorised as technical, social and ecological and the frequency of mentions is added to illustrate the prevalence of the discourse.

[27] There is a tendency to tailor NBS to fit human needs, which is also present in Malmö. During a field visit, it was explained that foreign species of trees were chosen for urban greenery as they grow leaves relatively late in spring, to grant sun-hungry citizens every bit of sunshine before the trees will cast shadows and cool the area in summer. While providing social benefits, from the biodiversity perspective, a local species might have made a better contribution to the urban ecosystem.

Frequency	Technical Benefits	Social Benefits	Ecological Benefits
High (9+)	• Improving Water Quality through Purification • Increasing capacity of the local drainage system & Unburdening • Retention of stormwater & Regulation of surface flooding • Temperature regulation & Creating Microclimates	• Aesthetics • Public Health*	• Increasing & Preserving Biodiversity
Medium (4-8)		• Cost-efficiency** • Economic gains*** • Noise reduction • Pleasant neighbourhoods • Recreation & Play • Safer traffic environment	
Low (1-3)	• Carbon Capture • Water resilience during droughts	• Community-building • Cooler streets and infrastructure • Cultural Heritage • Energy Production • Food Production • Political Gains**** • Protection of infrastructure • Reputation	• Closer connection with nature & New norms of social conduct • Education***** • Resource Efficiency

Note by the authors: The categorisation should not be seen as fixed as there are benefits which could be categorised under several headings. Instead the technical category should be seen as aspects that are easily measurable, as opposed to social benefits which are more intangible and subjective. The ecological benefits are benefits that do not primarily benefit the human but ecology.

*This was presented in the data loosely as having impacts to both physical and psychological health.
**In terms of having to invest resources into one solution only and not several ones.
***Somewhat contestable as a social benefit given that the gains might concentrate to few.
****For politicians whose electoral support increases after having invested into better life quality for citizens.
*****Leading to an augmented understanding of the importance of biodiversity, and more actions to protect and preserve.

Figure 5 *summarises the different benefits that emerged from the data categorised on technical, social and ecological benefits and shows the frequency of their mentions from high to low.*

This discourse around benefits is important to explore. NBS tends to be portrayed as a way to harness ecosystem-services to obtain co-benefits for both nature and people as well as addressing societal challenges in multiple ways (Albert et al., 2019; Cohen-Shacham et al., 2016). Meanwhile, it is rarely clarified in which circumstances the benefits would emerge and how they are distributed, and in which circumstances NBS can lead to disservices (Toxopeus et al., 2020; Sekulova & Anguelovski, 2017; Informant-6). Understanding disservices may, however, be as important as understanding the benefits if mainstreaming of the solutions is to be achieved.

4.2. Urban Blue-Green Solutions

In other instances, divergent but mostly similar concepts are used as an umbrella term to refer to NBS, including Ecosystem-based Adaptation, Ecosystem Services and Blue-Green Solutions (BGS) (Brink, 2018; Wihlborg et al., 2019;[6]). However, to have an understanding of both the wider application of solutions, and solutions tailored to a specific challenge such as stormwater management, BGS is conceptualised as a sub-category of NBS.[28] The term has recently gained popularity in research and practice [10] describing the interactive relationship between water and vegetation - the blue and the green (Haghighatafshar, 2019a; Sörensen, 2018). BGS entered the Swedish planning context in the 1970s to fix challenges in water pollution, and has also been referred to as local treatment of stormwater or open stormwater management[29] (Civil-Servant-1; Informant-6; Sörensen, 2018). Many BGS are also intrinsically connected with the urban grey, and therefore, sometimes referred to as Blue-Green-Grey Solutions (BGGS)[30] (Consultant-1&4; Civil-Servant-2;[12]).

The qualities of BGS in SWM are receiving increasing attention. The BG(G)S-systems in Augustenborg include green-roofs, lawns, permeable parking-spots, dikes, canals and dams. Other solutions that are commonly used in Malmö are raingardens - vegetation-beds with enhanced SWM properties through the application of features like structural soil (see Figure 6) [17]. All of these solutions address SWM through infiltration, retention, purification, evapotranspiration and slow diversion (Sörensen, 2018; Fridell, Sixtensson, 2020). Haghighatafshar et al. (2018b) have shown that a successful implementation of the solutions can reduce peak flows by slowing down runoff, thereby unburdening the entire downstream sewer-network and significantly reducing flood-risk. Their co-benefits in Malmö are also recognised and mapped out to include at least water purification, temperature regulation and improved air quality, next to increasing attractiveness of the city (Fridell, Sixtensson, 2020).

[28] According to Naturvårdverket, NBS has a broad range of applications in protection, sustainable management and (re)creation of a whole or parts of an ecosystem [6]. They need not to be explicitly linked to water aspects, but can, for instance, aim to increase the quantity of pollinators in a given area. Therefore, NBS has a greater scope in comparison with BGS, which helps to zoom into the relationship between water and vegetation.

[29] In other contexts it is also referred to as sustainable urban drainage-systems (SUDS), water-sensitive urban design, low-impact development, and sponge cities (Sörensen, 2018; Wihlborg et al., 2019).

[30] Considering the relationship with urban grey is important, as BGGS currently have at best a net-zero impact, since carbon intensive materials like steel and concrete are frequently utilised (Consultant-1). Net zero refers to a climate change policy which implies that the total emissions from a project are neutral. There might be project phases where emissions are released, but in the case of BGGS, trees and vegetation capture carbon over their life cycle.

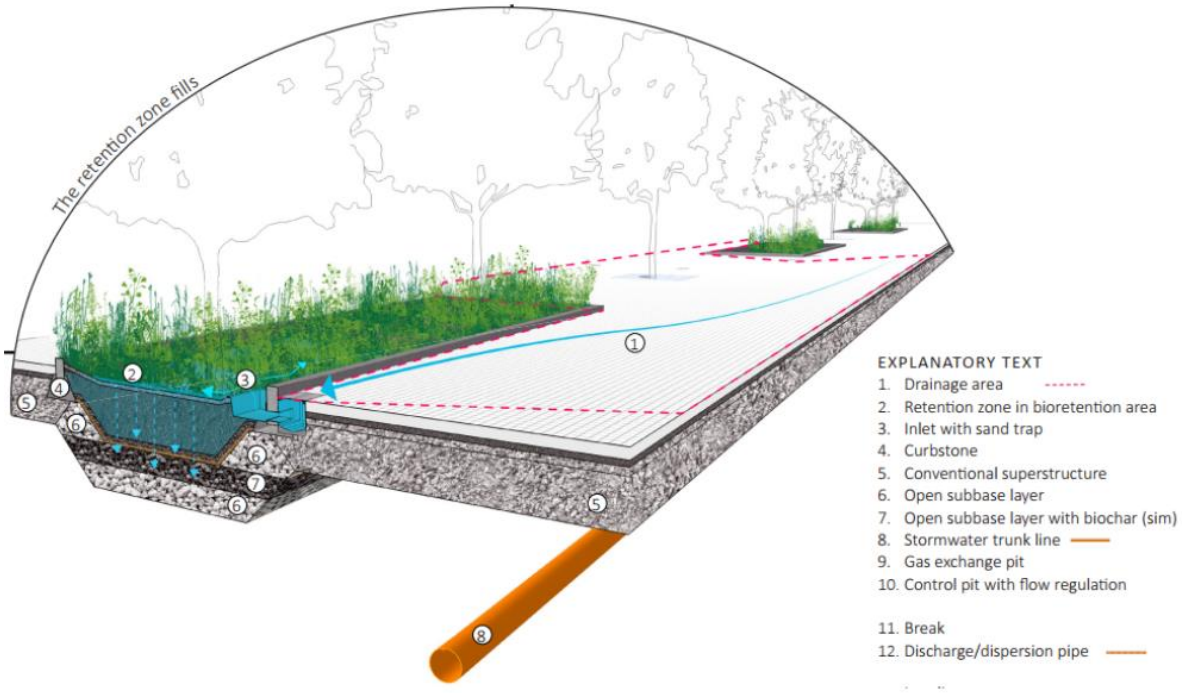

Figure 6 *shows an illustration of a raingarden which receives water from the drainage area, and retains and infiltrates it in the beds (blue downward facing arrows). Retrieved from Fridell et al. (2020).*

4.3. Mainstreaming Blue-Green Solutions

Xie and others (2022:126) argue that many conceptualizations of NBS-mainstreaming have focused on scaling-up solutions with top-down policies rather than acknowledging that "diverse interventions across different sectors led by a multiplicity of actors" are needed. For this reason, this thesis is based on the conceptualization of Wamsler (2014), who sees mainstreaming of urban planning for risk-reduction and adaptation as a cross-cutting issue. This conceptualization puts the planning process as the entry point for influencing risk-factors, considering both hard and soft characteristics of the urban fabric, making sure that all stakeholders, public and private, are equipped to engage, coordinate, and implement the desired measures.

From the point of view of mainstreaming BGS in Malmö, this is crucial. It has been discovered that replicating the BGS-system in Augustenborg is difficult precisely because of the variety of actors involved [8][31]. The goal of mainstreaming BGS in SWM would be to change the current centralised pipe-bound system, which is unable to address future needs, by complementing it or partially substituting it by a blue-green stormwater-system (Wihlborg et al., 2019; Civil-Servant-5). In order to be successful, however, not only the quantity, but also, the density, quality, and interconnectedness need to be considered, as illustrated in Figure 7 (Haghighatafshar et al., 2018a; Sörensen, 2018). Arguably, Malmö is somewhere between

[31] Augustenborg is entirely owned by one stakeholder - the municipality-owned corporation MKB. Meanwhile, 70% of the land in Malmö is privately owned, and on one site there can be a tenfold of small and large property owners.

the micro- and mesoscales, mostly thanks to the integrated solutions in Augustenborg. Creating more of integrated BGS would provide various co-benefits and maximise system effectiveness (Sörensen, 2018) elevating solutions to a sponge-city (macro) scale (Civil-Servant-3). Increasing amounts of land should be then incorporated to make this possible, including some of the 70% of the land in Malmö owned by private property owners.

Meanwhile, beyond flood-risk-mitigation, another aspect of mainstreaming should be considered, namely, adaptation. During the research process it became clear that even macro-scale mainstreaming of a decentralised blue-green-system together with the pipe-system may not suffice in eradicating the flood-risk (Civil-Servant-4; Informant-6). Wamsler and others (2017:258) define adaptation mainstreaming as "the inclusion of adaptation considerations into all sector policy and practice". This implies shifting from prevention (mitigation) and resistance (dismissal/denial) into "a broader systems framework in which the different stakeholders learn to live and cope with an ever-changing, and sometimes risky, environment" (ibid.:270). This concurs with arguments made by several interviewees, namely, that there is a need to shift how water is seen in Swedish society - both as a precious resource (VS-Civil-Servant-2; Civil-Servant-4;[9]) but also by increasing acceptance of the fact that it cannot always be controlled, and the risks may not be always eradicated (Informant-6; VS-Civil-Servant-1).

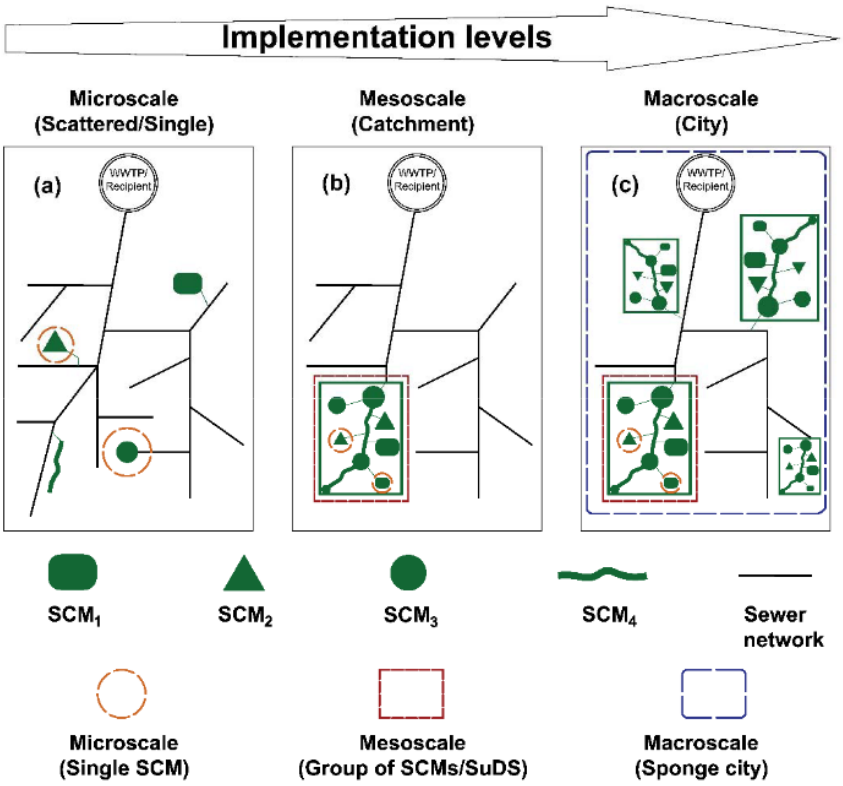

Figure 7 *illustrates blue-green stormwater control measures (SCM) on micro-, meso-, and macroscale. Microscale refers to scattered implementation with individual functions, whereas mesoscale are integrated solutions in an urban catchment, and the macroscale their implementation at a city-scale. Retrieved from Haghighatafshar et al. (2018a).*

5. Results I - Hindrances to Mainstreaming

The Results section comprises of two parts: Hindrances to Mainstreaming and Modelling Mainstreaming. In-between the two, an exemplifying study of a specific project in Malmö is visited, namely, raingardens on Monbijougatan which were purposed to mitigate flood risk in the city district. The purpose of this study is to contextualise the contents of the first results section, which focuses on elaborating on the obstacles and challenges when mainstreaming NBS and BGS in Malmö, identified in the interviews and document analysis. This is presented in five clusters: (1) the legal framework; (2) the institutional framework; (3) the novelty of NBS and BGS; (4) the engagement of private property owners (PPOs); (5) political dynamics.

5.1. Legal Framework

5.1.1. Unsuitable Legislation for Managing Pluvial Flooding

Swedish municipalities are legally obliged to protect human lives, health, property, and the environment by taking "preventive measures against accidents" (LSO, 2003:778). Yet, the current legal framework is very complex, which makes preparing for pluvial floods difficult (Civil-Servant-3). There is no single legislative act concerned with pluvial flooding, but the municipal responsibility for SWM is linked with that for sewer- and drinking water (VS-Civil-Servant-1).[32] Legislation, however, does not articulate clear limits to the discharge a municipality is expected to manage [20]. In practice, an interviewee claimed that the municipality is responsible for managing precipitation of 10-year rain events (Civil-Servant-3).[33]

However, the current state of the pipe-network is not capable of coping with events even lighter than a 10-year rain, which leads to frequent occurrence of basement flooding. Meanwhile, property owners can claim compensation for flood-damages regardless of their insurance coverage (Civil-Servant-3;[16]). This means, given a 10-year rain event, the municipality is liable for managing 100% rainwater, while only being able to install solutions on 30% of the city's land[34] (Civil-Servant-4). Combined with the fact that the municipality has no legal means of coercing private actors to reduce discharge or manage stormwater locally,

[32] SWM was merely fitted into the existing framework of the Act of Public Water Services (LAV, 2006)[20]. There is legislation concerned with flooding in general, such as the 2007 EU Flood Directive, but it only demands risk-mapping for riverine floods and storm-surges [24]. In the absence of external incentives, the Swedish Government has not incorporated any special legislation for pluvial floods [20].

[33] According to Civil-Servant-3 this responsibility could include even 30-year rains in the city centre of Malmö. It entails flooding both on public and private land caused by the failure of the drainage system to cope.

[34] This is an estimate based on the fact that 70% of the land in Malmö is privately owned and of the remaining 30%, 17% are the street-network.

this was identified as a central challenge (VS-Civil–Servant-1&2; Civil-Servant-4&5; Consultant-2&4; Developer-1&2;[2]).

Nearly all interviewees reported significant confusion and uncertainty around the responsibility for risk-reduction and adaptation, which is echoed by several complementary data sources [2;22;25]. This confusion creates passiveness and finger-pointing as no party recognizes an obligation to act or has the capacity to do so (Civil-Servant-4; Consultant-2). To change the legal framework, several legal acts have to be revised simultaneously and in accordance (VS-Civil-Servant-1&2; Civil-Servant-5). The interviewees referred to the politics around the issue complicated, time-consuming and frustrating.[35] From the perspective of political salience[36], it seems unlikely that a legislation which shifts municipal responsibility onto civilians would pass (Politician-1&2). In recent years little progress has been made despite ongoing efforts (VS-Civil-Servant-2; Civil-Servant-4&5).

5.1.2. Determining the level of Climate-Risk

A major challenge in creating a robust legal framework is that it remains undecided what climate scenarios[37] to prepare for (Civil-Servant-3). It is unclear which risks are perceived (un)acceptable [20], and making final decisions is challenging as climate science and recommendations change constantly (Consultant-2). Furthermore, there is not enough knowledge about climate-risks to determine suitable investment levels, which complicates cost-benefit analyses [2]. Municipalities have significant autonomy when it comes to considerations of risk and vulnerability[38] [4]. This discretion is limited, however, as regional authorities have the power to cancel plans which are considered too risky. According to Politician-1, inflowing information tends to be contradictory, forcing the municipality into a lock-in. The need for clearer national guidelines seems, therefore, pressing.

[35] Civil-Servant 5, for instance, did not see a need for "yet another" policy-guiding document from the state when the legislation is too complex to understand even for lawyers. The Cloudburst-plan for example was developed to clarify roles and responsibility questions and to strategize solutions for water that cannot be processed through the normal sewage-network (Civil-Servant-1;[9]). However, said document stays quite vague, merely summarising the current legal framework, but without clarifying uncertainties. Furthermore, Civil-Servant-1 claims that VA SYD has reinterpreted the legislation in a way that makes catchment planning even more challenging than it was before.

[36] The ideals of a strong welfare-providing state as well as fear of losing elections would seem to stand in the way of such a change in policy.

[37] In this context: the different warming scenarios by the IPCC.

[38] The legislative acts that demand this include, the Act on Municipalities' and County Councils' Measures before and in the Event of Extraordinary Events in Peacetime (2006:544) and the Planning and Building Act (PBL2010:900). 50% of municipalities have conducted a comprehensive risk-analysis, 3/10 of municipalities have assessed extreme weather events and 6/10 have assessed municipal vulnerabilities and estimated damages to the built environment [4].

5.2. Institutional Framework

Several obstacles to mainstreaming and implementing BGS seem to originate from the municipality's organisational structure, and its mode of cooperation with other public and private organisations and authorities (see the Stakeholder Map in Appendix IV). These challenges emerge in connection to the legal framework and include: (1) siloed working structures within and between organisations; (2) staff turnover and resulting challenges; and (3), issues related to limited resources and capacity. They all contribute to (4) institutional inertia.

5.2.1. Siloes

As BGS require cross-sectoral and interdisciplinary knowledge and competencies, the lack of such work-structures poses challenges to mainstreaming (Consultant-2;[15;27]).[39] Consultant-2 argued that cross-departmental and multidisciplinary teams facilitate mutual learning and encourage a creative work environment.[40] However, currently there are no such cross-departmental working groups at the municipality (Civil-Servant-2). Instead, cooperation between departments only happens around limited projects (Civil-Servant-1), or exclusively in the planning phase, which sometimes leads to maladaptation or accidents[41] (Civil-Servant-3;[15]). Developer-1 described the municipal structure as very functionalistic:

The different departments "have one issue each, while the solutions are usually in between [...] but they all have their different goals, and different politicians that lead them and different directors, different budgets, and they are supposed to come together and collaborate but they do not have the same job or the same task going into that meeting. [...] They come with a rucksack of limitations of what they can do and what their task is going into it." (Developer-1)

This finding was echoed by Consultant-1, who thought that there was too much specialisation and not enough generalist knowledge. This can lead to double-work when different departments look at the same issue from different side, which is not only problematic in terms of resource efficiency, but also disregards strategic approaches (Civil-Servant-1). No municipal

[39] BiodiverCity project, a pilot series of BGS, which was initiated in Malmö in 2012, as a cooperation between several private developers and public actors, emphasised the need for cross-disciplinary cooperation and the engagement of multiple stakeholders, since the lack of such a flexible work structure appears to be a major challenge.

[40] Consultant-2 said that their consultancy had come up with a proposal on how the municipal work-structure could be reformed to be better suited for tackling such interdisciplinary issues. The suggested changes, they explained, would entail cross-department multi-disciplinary teams to facilitate mutual learning and create a creative and enjoyable work environment to mitigate staff turnover. However, they lamented that the suggestions were not listened to and that there is a lack of willingness to adapt the organisational framework to the task.

[41] During the BGCL pilot projects, the maintenance team from F&G was not warned that scientific measurements were being taken at a site - this led to the test instruments being destroyed (Civil-Servant-3).

department is responsible for having a holistic overview (Developer-1), which might be inherited from the lack of strategic overview at higher policy-levels [22] as described previously. Top-down approaches do not seem to leave room to come together, look at the problem and then think about what has to happen to solve it (Developer-1). Furthermore, even if there is good communication and cooperation, clashes occur due to complexity (Civil-Servant-1) and because of conflicting agenda-setting from municipal committees (Civil-Servant-3)[42].

5.2.2. Staff Turnover

The workload and time-pressure that civil-servants are working under was described as being quite high (VS-Civil-Servant-2; Developer-1; Consultant-2; Politician-1). There is a tendency of "brain-drain" where qualified personnel leave or exchange between municipal departments (Civil-Servant-1&3; VS-Civil-Servant-1&2; Consultant-2&4). This complicates the establishment of a continuous innovative work environment (Civil-Servant-1&3). Consultant-2 explained that pockets of progressive, collaborative, and creative working-culture would emerge around individuals, which would then collapse when they leave. The interviewee deemed that in a siloed work structure synergies are only born occasionally. Consequently, there are severe challenges with monitoring, evaluation and learning (MEL) and project follow-up.

5.2.3. Limited Resources

Limited resources - in terms of time, finances and knowledge - are another major hindrance to mainstreaming BGS, mainly framed as challenge of balancing different demands apart from pluvial flood-risk. As municipal budgets are limited, many civil-servants are hesitant to lobby vehemently for the implementation of expensive SWM-solutions, while other issues, and especially socio-economic ones, are seen as more imminent, compared to the long recurrence-intervals of cloudbursts (Civil-Servant-2&4; VS-Civil-Servant-2). One such example is the mandate to plan and build new apartments to accommodate the growth of the city - a plan with a tight deadline due to conditionally released governmental funding[43] (VS-Civil-Servant-2, Civil-Servant-4, Politician-1&2).

Especially retrofitting BGS into existing areas is seen as disproportionately expensive, and planners are challenged to find easy, smart and cost-efficient solutions (Consultant-1&2; Civil-

[42] For example, there are occasions when BGS measures planned in one department have been opposed by another (Informant-2) [15], and examples of civil servants not being able to work creatively with progressive developers with new solutions due to having to follow specific regulations and requirements (Civil-Servant-5).

[43] This funding is part of the *Storstadspaket*, a plan to develop Malmö's public transport infrastructure, and it is tied to the condition of apartments being created in a timely manner. (VS-Civil-Servant-2).

Servant-4). Meanwhile, uncertainties around CC create unfavourable conditions for big investments (Civil-Servant-4&5; Politician-1). Since most departments work with a number of topics, of which SWM is but one, there are few positions with this specific focus. There is a limited capacity, which is further reduced by the aforementioned turnover and brain-drain (VS-Civil-Servant-2; Civil-Servant-4). Therefore, relevant knowledge is not distributed well across the organisation (Civil-Servant-1).

5.2.3. Inertia

Tightly limited mandates of civil-servants and the resulting siloed work environment make it difficult to move forward with progressive approaches. Informant-6 explained that complicated bureaucracy hinders adaptive decision-making capacity: Planners tend to focus on what was done before, while CCA and SWM are new issues (Civil-Servant-2&4). With civil-servants working at full capacity, attempts to introduce new progressive approaches to the municipal work-structure get quickly traded out for business-as-usual (Consultant-2). Furthermore, a lot of interesting and promising ideas are not put into practice, due to complex legal concerns[44] (Civil-Servant-2&4).

The interplay of these factors creates a rigid institutional framework, making it difficult to adapt to upcoming challenges - a problem which is further exacerbated by quickly changing climate science. Consultant-2 estimated that there is “a 30 year lag in the system” because science is always ten years behind reality, the legal system ten years behind science, and practise[45] ten years behind the legal system. This friction is visible in the interaction with country-authorities: regulations and guidelines change faster than planning processes are rolled out causing stagnation as municipal plans are rejected as non-compliant. However, although this slows the system down and reduces adaptability, it also ensures the compliance to democratic principles, as argued by Civil-Servant-3 and Civil-Servant-5.

[44] Among others, the following story was mentioned: One of the objectives of the so-called “Grönare Möllan” project, was to greenify the city district of Möllevång, Malmö, which had the lowest tree-coverage per-capita in the city. The idea was to donate trees to private stakeholders for planting, yet, the initiative was turned down by a court decision, which argued that the municipality was showing favourable treatment to individuals, which is not allowed by law. The law of non-discrimination is known to sometimes hinder the implementation of CCA measures [4;11].

[45] One municipal detailed plan can give space for a couple of thousand cubic metres of water only (Civil-Servant-3), which means that 5000 of such plans would be needed to reach the goal of a resilient city by 2045.

5.3. Novelty of NBS and BGS

Participants frequently mentioned the novelty of NBS as a challenge. Apart from Augustenborg, BGS for SWM are somewhat new occurrence in Malmö.[46] Currently there are few civil-servants with extensive knowledge about NBS and BGS, mostly due to personal interests or through leadership-driven guidelines (Civil-Servant-1&2&3&5). Some municipal workers were described as fearful of adopting new solutions, preferably choosing more familiar approaches (Civil-Servant-2&4&5; Consultant-1; Informant-6).

Meanwhile, certain private companies and consultancies (e.g. SWECO, Edges, SGRI, WA) who are considered experts on solutions, are contracted by developers and municipalities with insufficient in-house knowledge. Civil-Servant-3 argued that this is ideal as the work-quality tends to be best in public-private collaborations. However, it also creates challenges: Working with external consultants can make the project more difficult due to tough price negotiations (Civil-Servant-2). Therefore consultants try to come up with cheaper options to meet the municipal budget (Consultant-1).

However, according to Consultant-1, even experts working with solutions everyday are sometimes unsure how exactly they should be implemented. The prevailing attitude is that trial-and-error processes are needed, to adjust solutions to the local context (Consultant-1&3&4; Developer-1&2). Furthermore, conflicting perceptions of BGS' potential show that co-benefits are not always understood well. Especially long-term, there are many uncertain parameters which make establishing an overarching strategy very difficult (Informant-6).

In addition, Consultant-1&3 mentioned that BGS-maintenance is currently neglected as maintenance workers are not sufficiently informed how the solutions should be upkept. This concurs with the finding that maintenance tends to be systematically underestimated (Consultant-3;[26]). This is seen as a major issue, as maintenance is of crucial importance in terms of the functionality and the life-cycle of BGS, in order to, for example, sustain species diversity [6] or securing flood-risk-mitigating qualities, as clogged pipes can severely impact their performance (Consultant-1). However, according to Civil-Servant-2, maintenance is seen as a question of details, and usually not an essential part of a project.

From the point of view of some PPO and civil-servants, retention of water close to the property or on the streets is menacing due to its ability to cause damage to infrastructure (Civil-Servant-2; Consultant-1). More generally, knowledge uncertainty is impeding wider BGS support from the private sector, as PPOs want investment security (Informant-8). These fears should not be belittled: NBS are not immune to being maladaptive if they are not

[46] Civil-Servant-1 recalls hearing about solutions like green-walls and roofs for the first time around 2009-10 through an US-American-expert, whilst Civil-Servant-2 learned the term during the "Grönare Möllan" project 3-4 years ago.

implemented well. The underlying challenge here may, in fact, be that MEL plans are only in the process of being developed[47].

5.4. Engagement of Private Property Owners

As described earlier, the legal framework pushes SWM-responsibility onto the municipality, which lacks the capacity to tackle risks on its own. For instance, according to models, measures on public land, such as lowering parks, will not suffice to handle a cloudburst (Civil-Servant-4). Many interviewees agreed that private property owners (PPOs) must be engaged in SWM and implementation of BGS (VS-Civil-Servant-1&2; Civil-Servant-4&5; Politician-1&2; Consultant-1&2&3&4; Informant-1&3&4&5&6). However, without a legal framework to coerce private stakeholder action, the engagement is currently purely voluntary.

5.4.1. Private Stakeholders' Responsibility for Incurred Damages

For private stakeholders, participation is not only a contribution to city-wide flood-risk mitigation, but a question of self-protection. According to current law, PPOs are more responsible for flood-damages than generally assumed [13;19]. There is a 10-year period, after building begins, during which compensation can be sought from the municipality if damages occur due to water leakages [11;22]. Once this time lapses, PPOs are responsible for stormwater damages on private land, unless demonstrably caused by unfulfilled responsibilities of public actors[48]. There has been discussions if the municipality could be made more liable, but this seems impossible, not least due to the magnitude of demands it would subsequently receive [22].

According to Consultant-4, responsibility discussions have evolved only recently, which explains the lagging awareness. Few interviewees had exact knowledge on whether the municipality or private individuals would need to pay for the damages caused by different pluvial flood-scenarios. Another layer of complexity is added by insurances. Currently, almost all Swedish PPOs have insurance that covers flood-damages (Informant-1). There is a possibility, however, that insurers withdraw their protection as a reaction to heightening flood-risk. Informant-1 explains that risks need to be sudden and accidental - no compensation is given for damages caused by foreseeable events. As floods become more frequent, some insurances are already withdrawing from insuring some Scania seaside-properties against floods.

[47] For instance, in the case of BGCL there were questions about what should even be tested in terms of BGS (Civil-Servant-3).

[48] Such a case would be e.g. a flood in the basement that was caused by water coming from the public pipe-system, in case this happened during a rain with an intensity of, or less than a 10-year event. Consequences of rain stronger than a 10-year event go at the expense of PPOs.

Sweden has a history of strong social protection, which translates into a lack of willingness to act, as private stakeholders expect public actors to take measures (Informant-6;[13;19]). However, this relationship is changing (Consultant-4). This seems to be showing in VA SYD's stakeholder engagement campaign "Tillsammans gör vi plats för vattnet" (from now on: RfW)[49] which targets 26 000 villa owners in Malmö, encouraging them to disconnect their pipes from the public network [9]. This caused tensions, as manifested in a questionnaire in which VA SYD asked private villa owners about their willingness to manage stormwater on their own property. One respondent stated to have no intention of investing in their pipe-system as "VA SYD is not carrying their responsibility" [18]. Furthermore, the paradigm-change is not well understood: "Historically [private] people were not allowed to do certain things that they are now asked for" (Consultant-4).

Despite initial success of VA SYD's communication campaign it seems that the "low-hanging fruits have been picked": Engagement has become tougher over time, which can be partially attributed to the Covid-19 pandemic (VS-Civil-Servant-1). It appears that soft measures like communication alone are not enough - a legal framework with coercive power is necessary (Civil-Servant-4; VS-Civil-Servant-2; Consultant-1&2; Informant-1&6). On the political side however, the intention is to maintain high levels of public social protection and not transfer responsibility onto private individuals (Politician-1&2; Informant-1;[20]).

5.4.2. Lack of Incentives and Knowledge

While most interview participants agreed on the need for private engagement, the way to facilitate engagement and implementation of measures is less clear. Firstly, mitigating action cannot always guarantee full flood-prevention, since the urban water-pipe-network, as well as climate-scenarios are highly complex and difficult to model (Informant-6). In many cases it is not even clear where floods come from exactly, which complicates the implementation of suitable measures (Consultant-2; Informant-6). Meanwhile, there is no doubt that the challenge is collective and needs to be tackled on multiple fronts, preferably upstream and on catchment-scale (Informant-6; VS-Civil-Servant-2; Civil-Servant-3).

In the absence of a coercive framework to action, some PPOs take more measures than others. According to Consultant-2 there is a lack of incentives[50] for PPOs to engage, although this was somewhat countered by the statement of Informant-2, who reasoned that PPOs have an intrinsic motivation to care for their investments. Furthermore, tensions can arise when some PPOs engage more than others, as sustainability-trends and peer-pressure incentivise action (ibid.). From this perspective, knowledge is lacking on solutions and slowness in

[49] Together we make room for water

[50] Municipalities offer few financial incentives (Informant-1), which is seen as a decisive factor hindering the engagement of PPOs (Informant-8).

initiative-taking that hinders action [2;13;19]. Meanwhile, it should be noted that even though PPOs are often considered a homogenous group, they diverge in their ability to act (Informant-2). Clear indicators of adaptive capacity[51] are possession of ample land or property, size and finances of the corporation, and the amount of in-house knowledge (VS-Civil-Servant-1; Consultant-3). No evidence could be found that these factors - socio-economic status, capacity to prepare or flood-vulnerability - are considered when BGS are being planned.

Meanwhile, some property- or land-owners are commercially-drivers, whilst others emphasise social values. Developer-2, who works in a joint project of Lund Cathedral and White Architects (WA), building a new residential area Råängen, Brunnshög, Lund, see that commercially motivated PPOs might feel less committed and responsible long-term than, for example, the Cathedral, which has always been an important local actor in Lund. They elaborated that commercial developers might have fewer incentives to think about adaptation and long-term sustainability. Meanwhile, the municipalities support for private developers can be affected by financial considerations[52].

Several interviewees mentioned that communication between municipality and private people is poor (Informant-2&7; Consultant-2; Politician-2), as there are few opportunities and structures that foster dialogue [17;2] and no one is responsible for the task. Politician-2 argues that this lack of good dialogue leads to people not knowing about BGS. Informant-2 furthermore explains that from the perspective of PPOs, messaging is sometimes confusing as different public authorities give conflicting responses[53]. The complicated bureaucracy of what is allowed, and what is not, causes hesitation among PPOs [17]. From a legal perspective, this is warranted, as PPOs are responsible for damages to other properties caused by poorly implemented adaptation measures [11].

[51] Adaptive capacity should be here understood in line with McLeod and others (2015:35): "The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences."

[52] Developer-2 explains that municipalities tend to prioritise developments on public land over such on private land, as the sale of public land to developers provides the city revenues with which the construction of necessary infrastructure - which the municipality is responsible for - can be funded. With developments on private land this initial investment capital is missing, which means that the support of developments of private land is more expensive for the municipality.

[53] An example was given where a PPO who wished to install a green-roof was turned down by one city department, whilst being encouraged by another department.

5.5. Political Dynamics

5.5.1. Political Dynamics of Blue-Green Stormwater Management

According to Politician-2, all big parties in Malmö's government see CC, and more particularly flooding, as a risk. Nearly all interviewees mentioned the 2014 floods in Malmö and Copenhagen as an imprinting experience that brought CC onto their agenda.[54] This led to the creation of the Cloudburst-plan (2017), which aims to build capacity for the next cloudburst event by applying both NBS, BGS and grey solutions, to reduce damages and disturbances, prioritising lives and critical infrastructure [20].

Interviewees reported that NBS and BGS are gaining increasing attention, reflecting in the quantity of implemented measures (Civil-Servant-3)[55]. At the same time, however, most projects are ad-hoc and come with a limited short-term funding (Consultant-2). Moreover, it appears that the technical side, and short-term measurable financial benefits, are still highlighted over social or ecological ones and the investments in long-term resilience [16]. According to Developer-1 planners see a division between "nice-to-have's", like greenery and BGS, and "must-have's", like electrical and digital infrastructure - placing the focus on the latter, despite the former being equally important in the long-term and for sustainability. This tendency is reinforced by the novelty of solutions, lack of knowledge surrounding their effectiveness, and a consequence of not knowing how to quantitatively express intangible aspects, such as recreational benefits, aesthetics or multifunctionality[56] (Civil-Servant-4; Consultant-2).

Malmö's stormwater preparedness flagship project is an expensive grey stormwater-tunnel (Politician-1; Civil-Servant-4) - not BGS. Interestingly, the same level of risk-reduction could be achieved, at a lower cost, by implementing BGS, yet, this would require the involvement of private land (Civil-Servant-4). There is however, a lack of political will to place coercive demands on PPOs, as they would infringe with the private sphere (Politician-2).[57] This concurs

[54] They were even mentioned by civil-servants in the city of Gothenburg and Lund as a fundamental reason for them to augment preparedness locally.

[55] Civil-Servant-1 shared that action was taken e.g. in Söderkullsparken, which was lowered to increase its retention capacity. Civil-Servant-2 observed that BGS are becoming more common, and Civil-Servant-5 notes that while five years ago the focus in stormwater-planning was mostly technical (retention of water in ponds) other aspects are recently gaining more attention.

[56] Several interviewees brought up "Itree" as an interesting tool which could have potential - although also indicating that there is a need for other tools as well. The central challenge here appears to be, however, that while long-term benefits can be shown, this is of little interest for politicians and contractors who work with shorter time spans [Consultant-3; Civil-Servant-3]

[57] Politician-2 shared that their party attempted an initiative in the municipal council to incentivise private stakeholders to engage in sustainable SWM, which was voted down. The majority of the council saw that the municipality should focus on the property that it has and not overstep boundaries.

with Informant-6's observation of the deep divisions between public and private spheres in Sweden, especially regarding the high standing of private property rights. On the other hand, it was deemed that the citizens were accepting of a raise in water fees which was allocated to pluvial flood risk reduction (Politician-1). This concurs with the other findings in the sense that the public authorities are seen as the arm who should respond to the risks, while the PPOs and citizens should contribute through fees and taxes.

Whether or not the resulting speed of transition is rapid enough somewhat split the interviewees, although the majority urgently pressed for more action[58], in fear of future disasters. Furthermore, the political discourse was described as being overly focused on mitigation, not adaptation (Informant-1; Consultant-2). While floods have become a somewhat acknowledged challenge in Malmö, political discussions about other climate-risks such as heatwaves are missing. Beyond the question whether CC is sufficiently discussed in politics, Politician-2 raised concerns that policy goals do not actually translate into action. The political debates would be too far away from the reality of civil-servants: "We have those philosophical discussions and leave it to the civil-servants to make something of it. [...] What they [civil-servants] say does not meet policies and policies do not meet reality" (Politician-2).

5.5.2. Balancing Different Demands

According to a Consultant-2 there is an awareness of the need for CCA, but other demands are prioritised. Several interviewees mentioned the on-going momentum for densifying Malmö by growing inward and emphasised the time pressure to build apartments (Politician-1; VS-Civil-Servant-2). Meanwhile, the city cannot grow outward[59], which creates conflict with the fact that BGS, such as rain gardens and parks, are space-intensive. Informant-5 argued that densification seems to have more weight today, compared with CCA: Currently building apartments and enabling affordable living is prioritised over flood-risk-mitigation and sparing space for BGS. Hence, the amount of sustainably managed water is dictated by the available space, not by the need for SWM [12].

[58] Informant-1 expressed great concern, referring to the IPCC's recent risk-assessments. Svensk Försäkring is engaged in national-level lobbying, hoping that insuring people and companies will remain possible in the future, while fearing that it might not. Politician-2 deems the perception of urgency among other parties far too low, stating that decorated speeches and responsibility-evasion dominate CC debates. VS-Civil-Servant-2 and Consultant-2 expressed great concerns regarding upcoming cloudbursts. Informant-2 stated that sustainability is high on property owners' agenda, with attention to potential consequences for properties. The greatest exception was Politician-1 who claimed to witness an accelerating pace of successful action.

[59] The agricultural land surrounding Malmö is considered to be some of the best topsoil in Europe and thus has a great significance for food security (Politician-1&2; Civil-Servant-3; Developer-1&2).

Furthermore, there are needs for different types of land-use and urban infrastructure[60] - both below and above surface - which contribute to a competition between different actors and city departments (Informant-7; Civil-Servant-4; VS-Civil-Servant-2; Politician-1;[15]). Civil-Servant-4 described the struggle to weigh different tangible and intangible demands[61] and present a balanced perspective to politicians, not focusing too much on single issues. Even civil-servants, who are professionally focussing on water-related issues, mentioned that sometimes resources might be better used for other hazards, as cloudbursts are simply just so rare (Civil-Servant-4; VS-Civil-Servant-2;[14]).

6. Exemplifying Study - Monbijougatan Raingardens

The aforementioned hindrances to mainstreaming NBS and BGS are now exemplified with an exemplifying study of raingardens in Monbijougatan - a street in the Möllevång-city district in Malmö, known for having little pre-existing greenery [21]. Raingardens have become increasingly popular in the Swedish context thanks to the multiple benefits they provide (City-Planner-5;[21]). In 2015, three large raingardens, located between a primary school and residential buildings were built as a pilot project [21]. They were initiated by two city planners at F&G in Malmö who had a personal interest in NBS, in other words, there was little top-down management involved (Civil-Servant-1). The project was supported by external developers, designers, and VA SYD, who were consulted for their know-how as F&G had not implemented such a system before (ibid.).

6.1. Siloed Work Structure leading to Faulty Implementation

While the planning team itself was interdisciplinary, and had knowledge about stormwater, this did not carry through to the implementation process, leading to mistakes with the construction of the inlets (Picture 1). The lack of a slope towards the inlet does not account for water's gravity flow, which significantly reduces their SWM capacity, as water falling onto the street is barely entering the raingardens (Civil-Servant-3; Consultant-4). The challenge seems to have emerged from the lack of a precedent, poor communication, diverging goals, and risk-perceptions (Civil-Servant-1; Consultant-4). According to Consultant-4, civil-servants feared that cars would drive into the gardens, which motivated the implementers to divert from the drawings and make the inlets smaller than planned. While there would have been

[60] City authorities, and partially property owners, are expected to provide a range of services, including recycling facilities, electricity, sewage-system, health-care services, spaces for business, public transport, fibre-optic-cables and so forth (Politician-1; Developer-1). Furthermore, cities have been built to accommodate certain lifestyles. Therefore things like parking spots in the near proximity of apartments are highly valued (Politician-1).

[61] The list of necessary considerations is long: Next to tangible services, there are intangible values, which were highly regarded by the interviewees, for example, education, security and crime prevention, social justice, energy transition, enjoyable street-life, unemployment issues and reduction of segregation, or in other words, socio-economic sustainability.

solutions to mitigate this hazard, the knowledge did not spread from one actor to another pointing toward insufficient communication and coordination at the institutional level (ibid.).

6.2. Lacking Private Stakeholder Engagement

Due to their size, the raingardens would have the ability to take in water from a catchment area three times as large, yet, the actual catchment of the raingardens is a lot smaller than planned (Civil-Servant-3; Consultant-4). Initially, it was suggested that the adjacent buildings could be connected to the raingardens and, thus, disconnected from the public water-system, which would have maximised the solutions' benefits (Consultant-4). However, during a field visit it was observed that these connections were not made (see Picture 1). The reason for this relates to SEF's wish to not have open water flows on the street as this might be a hazard for residents when water freezes (Civil-Servant-3; VS-Civil-Servant-1&2). This challenge was solved by VA SYD (VS-Civil-Servant-1&2), when more raingardens were implemented on the same street, by the installation of vaults that can be closed in case temperatures fall below zero. Such retrofitting was not observed in the first gardens and to the present day, there remains an unexploited opportunity to unburden the drainage-system. Even if such a solution would be retrofitted, however, there is no guarantee that the private stakeholders would open the vaults when it rains, as there is no system to follow-up on the guidelines (VS-Civil-Servant-1&2; Civil-Servant-3).

Picture 1 *shows an inlet (on the left) without a sand-trap to keep sediment out of the raingarden, and an insufficient gradient hindering water catchment. Furthermore, the downpipe of the building (on the right) has not been connected to the raingarden. Picture taken by researchers.*

6.3. Different Demands Influencing the Final Design

Different stakeholders had different perceptions about what the primary purpose of the raingardens is. A report argues that managing stormwater and reducing the load on the pipe-network is the main objective [21]. Conversely, Consultant-4 stated that there were no specific targets for water purification nor stormwater treatment - the designers were simply asked to "do what they can". No interviewee mentioned that pluvial flood-risk-mapping or a broader catchment-level analysis under consideration of the pipe-network was conducted prior to the raingarden-planning.

Meanwhile, a number of other reasons for creating the gardens were named. An analysis that pointed at Möllevång city district having the least greenery per capita in Malmö sparked municipal efforts to increase vegetation [7].[62] The increase in greenery was also seen as positively correlated with addressing social issues in the area and increasing its general attractiveness (Politician-2). Furthermore, it was on the city's agenda to slow down traffic and create a safer environment for children (Consultant-4;[21]). A report also proposes that the solution targets heatwave risk-mitigation [21]. All of these different demands manifest in the

[62] Later on greenification in the area has been addressed through so-called "Grönare Möllan" -project (Civil-Servant-1&2;[7]).

final design of the raingardens, which are larger than necessary from a SWM perspective. They are well-perceived, thanks to their green aesthetic (Civil-Servant-2). However, they ended up being more expensive than originally intended due to complications during the implementation (Consultant-2). This poses the question if resources could have been saved in the process if SWM would have simply been bypassed as a target.

6.4. Implications of Design Flaws, Unclear Responsibilities and Institutional Inertia

The vegetation in the raingardens has been suffering from a lack of water, which results from the combination of faulty inlets, oversized design, and smaller-than-optimal catchment area. Therefore only few of the initially planted species are still growing today [21]. Consultant-3 referred to the raingardens as “grassy”, while Consultant-2 called them “messy”, implying that they are losing their aesthetic appeal and becoming sinks for rubbish. The interviewees had little information about ongoing maintenance, nor did they know of efforts to fix the flaws. Picture 2 shows how sand has accumulated in the raingarden due to poor maintenance. Consultant-4 argues that the municipality has not acted after having been informed about the construction mistakes, not because they are expensive or laboursome fixes, but because no one is assigned for the task. Furthermore, there are no designated funds to cover the sort of maintenance work. This seems to be coupled with losses in institutional memory due to the high staff-turnover after the project, which seems to have made the purpose and responsibility-division of the project even blurrier (Civil-Servant-1; Civil-Servant-3).

Picture 2 *shows the sand has already ended up in the raingarden, due to the lack of a sand trap. Picture taken by researchers.*

6.5. Lessons Learnt

Apart from SWM-experts, who inspect their area of expertise closely, Monbijougatan-raingardens are mostly seen through a lens of positivity. As Picture 3 shows, there is no reason why this should not be the case. This manifests the ease with which such projects are celebrated and seen as tokens of a resilient-green city, even if they do not satisfy basic SWM demands. Practitioners fear, however, that the raingardens pose a threat to the perception of NBS in Malmö if they prove dysfunctional in case of a flood (Civil-Servant-3; Consultant-3). Given a flood event, lay-people may end up thinking that raingardens on the whole do not perform, even if the underlying reason is a design flaw. In the case of new solutions such as raingardens, trust is easily lost (Consultant-1). Maladaptation and the declining aesthetic value might make further mainstreaming of and trust-building toward the solutions difficult. In a similar line of thought, Consultant-1 stated that "it is impossible to make Climate Change Adaptation that is not beautiful" meaning that public trust cannot be won otherwise. As the lack of good examples is seen as impeding new projects [26] addressing the challenges identified and stepping up maintenance efforts on Monbijougatan is crucial.

That being said, the first raingardens on Monbijougatan were a pilot project, and lessons have been learnt since their implementation. The raingardens implemented later on, on the same street, have an improved design and implementation, and a matching size for the catchment which includes adjacent private properties (Consultant-4). While no MEL was established in the first project (Civil-Servant-1), it was introduced to later versions of raingardens in the city (Civil-Servant-3). The same goes for private stakeholder engagement - a task that was taken up by VA SYD's civil-servants when the second round of raingardens were initiated (VS-Civil-Servant-2). The lack of institutional memory is increasingly recognized as a severe problem and different mapping tools were introduced during the Blue-Green-City-Lab-project to address the issue of knowledge-sharing (Civil-Servant-3). The hope is that this will make it possible to better address mistakes (ibid.).

Despite challenges, Monbijougatan-raingardens should not be seen as a failure, but as an important and exploratory part of the process of creating more integrated BGS in Malmö. Its shortcomings have been able to shed light onto what knowledge is still lacking when it comes to achieving SWM with BGS. For instance, while there is no clear idea who should be responsible for driving BGS and private stakeholder engagement, the fact that the civil servants and VA SYD respectively have assumed these roles, shows that such vacuums can be filled by active individuals. This might point at a gradual shift and a deepening understanding of the potential of raingardens and other BGS as risk-mitigation and adaptation measures in Malmö.

Picture 3 *exemplifies the existence of other benefits in the absence of others: while the goals of SWM may not have been achieved, they slow down traffic and bring greenery to the area. The mistakes in the construction are hardly noticeable for a lay person. Picture taken by researchers.*

7. Results II - Modelling Mainstreaming

The second Results section introduces the ideas of the data samples in terms of modelling mainstreaming. The section is structured in accordance with a mainstreaming model (Figure 8), created by the authors, which helps categorise the data: A holistic approach towards BGS-projects is followed by a synergistic design, and implemented cross-sectorally. The displayed model emphasises the need for flexible and adaptable processes and structures through Monitoring, Evaluation, and Learning (MEL), as well as Capacity Development (CD), both within the public sector, and in terms of engaging the private sector. The following data presentation is structured in resemblance to the different phases of the model: (1) Holistic Approach; (2) Designing Multifunctionality and Synergies; (3) Implementation within Existing Structures and Processes; (4) Capacity Development to Facilitate Mainstreaming.

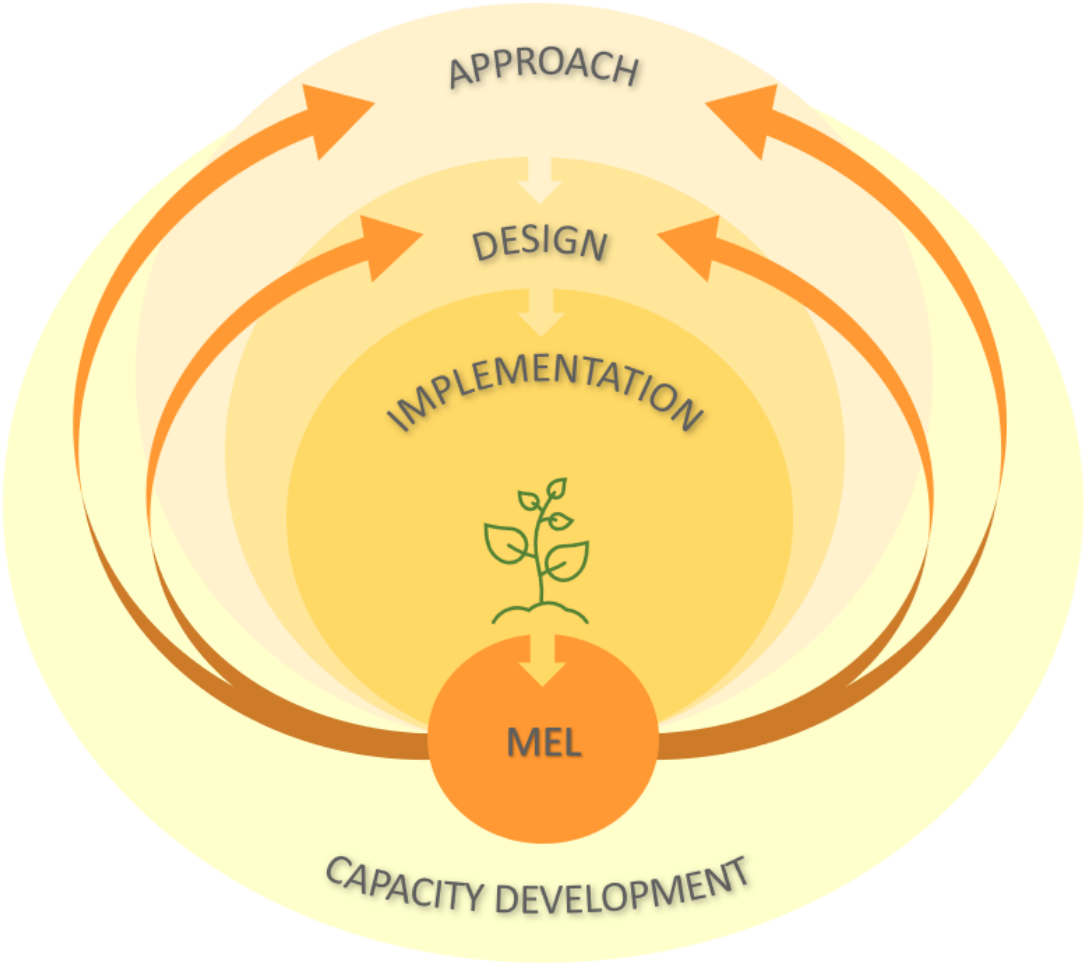

Figure 8 *shows a visualisation of a mainstreaming model that helps categorise and conceptualise the gathered data, and is used to structure the presentation of the results.*

7.1. Holistic Approach

7.1.1. Understanding Vulnerabilities

Several sources emphasised (Informant-1;[2;4;20]), the municipality's and private actors' need for better knowledge about how locally occurring hazards impose different risks on infrastructure and assets. Some interviewees (Civil-Servant-4; Politician-2; Consultant-2, Informant-3&4) argued for the importance of recognizing citizen's differential vulnerabilities[63] and adaptive capacity. Even if a cloudburst's impact-area cannot be predicted, properties that are located downstream may be more exposed for topographical reasons. Such vulnerability-assessments are necessary to make informed decisions about which risk-mitigating measures are to be implemented, where, and how. Several sources

[63] Vulnerability describes the combination of exposure and susceptibility to harm [16].

(Civil-Servant-4, Consultant-2&4, Informant-6;[20]) highlight the need for better scenario-modelling to see how floods develop at specific locations by showing where the water is coming from, where it flows and what is happening both upstream and downstream. Furthermore, it was deemed relevant to assess cascading effects of hazardous events to clarify how different critical infrastructure is interdependent [24]. Since the same geographical location can be affected by multiple different risks, several participants recommended opting for multi-hazard solutions (VS-Civil-Servant-1&2; Civil-Servant-3&4&5; Consultant-1&2&3&4).

7.1.2. Catchment-Area Focus and Localised Solutions

Pluvial flood-risk exceeds detailed-planning[64] boundaries, which is why there is a need to consider the whole (sub)catchment area and its topography in BGS-planning (VS-Civil-Servant-2). Measures should be implemented both upstream and downstream to retain water and slow down runoff [20;16]. In Malmö, however, there is often no space to implement measures in affected downstream areas, which is why greater efforts are needed upstream (Civil-Servant-4;[20]). To understand the catchment-area, better drainage-system models are needed, to assist decision-makers with setting more specific targets and finding strategic locations for solutions to optimise their impact (Informant-6). This is crucial from the perspectives of maximising socio-economic benefits and cost-efficiency [17;20]. Finally, BGS should not be tested in laboratory-conditions but in the urban environment to get accurate results (Civil-Servant-3). There is no way to directly copy solutions from city to city or from neighbourhood to neighbourhood. They need to be tailored to the local context, due to the complex human-environment interactions (Informant-7) and physical realities, such as grounds' differing infiltration-capacity depending on the soil-type (Informant-3&4;[21]).[65]

7.1.3. Cross-sectoral and Multi-disciplinary Mobilisation

To achieve a holistic approach, one needs to incorporate a multitude of perspectives and needs through stakeholder engagement [20;24;27;28]. This is best achieved by working in cross-institutional cooperation and cross-disciplinary teams, that include both private and public actors (Civil-Servant-3), while focussing on MEL [28]. These teams should include natural scientists (environmental experts, BGS-experts); urban designers (architects, technicians and engineers) (Consultant-4); and social scientists who can provide expertise on the socio-cultural and economic context (Informant-7). Inclusion of citizens into scientific

[64] A detailed plan is a document in physical urban planning which determines how an area in the municipality can be built-up and how land- and water areas can be used.

[65] PPOs disconnecting their downpipes and leading water into their gardens could in specific contexts, depending for example on the local soil-type, lead to maladaptation and heighten the risk of flooding, if local conditions are not accounted for in the design.

endeavours, or grassroots experiences through participatory approaches was also highlighted as a way to incorporate more diverse and local understandings of benefits and disservices of BGS (Informant-7; [15;24]). Informant-2, for instance, argued that ultimately PPOs know their own property best.

The majority of interviewees pointed at seeking a variety of allies with other municipal departments, external consultants, developers, private companies, universities, and independent research projects (Civil-Servant-1&2&3; Politician-1; Consultant-1&2&3; Informant-5&6&8). Further, the incorporation of new scientific findings and innovations is seen as crucial for knowledge exchange and attracting future investments [4;27]. Consultant-1 explained that other countries and cities can serve as inspiration: Studying front-runner cities and learning from experiences that were made elsewhere, instead of waiting for homegrown mistakes to occur, is seen as an opportunity to save time, energy and resources supported by complementary data [24].

7.2. Designing Multifunctionality and Synergies

7.2.1. Flexibility and Adaptability

Multifunctionality was mentioned multiple times as being particularly important in dense urban areas, to avoid conflicts around space[66] (VS-Civil-Servant-2; Civil-Servant-1&2&3&4; Consultant-1&2&3&4; Informant-6&7;[20;24]). One interviewee portrayed it as finding "simple win-win solutions" (Consultant-2) and another one as "positive spirals to achieve wider societal impact" (Consultant-1). Beyond space, cost-effectiveness came up, as costs can be shared when different departments see their needs met[67] and co-finance solutions (Civil-Servant-4; Consultant-1). Learning to connect benefits was therefore considered very important [20;24].

Whilst planning ahead of CC may drive one to try and consider all possible scenarios, Civil-Servant-3 and Politician-1 deemed planning according to worst-case scenarios inhibiting. Instead, interviewees and complementary data sources recommended an adaptive planning-mindset. This entails avoiding plans which create lock-ins and choosing adaptable and revisable solutions to account for changing needs over time (Developer-1&2;[20;16;17]). Planning for revisability comes with costs, however (Developer-1), but so does planning for worst-case scenarios (Civil-Servant-3). Multifunctionality was seen as a way to address the

[66] Car-parking is considered a "political hot-potato" (Politician-1), which can cause conflict in certain areas. But also parking opportunities for bikes can be a critical question [17].

[67] SWM could be connected with cooling of indoor climates (Informant-6); they could be introduced as parks (Consultant-1); or connected with socio-economic development work, community regeneration, employment opportunities, public health, crime prevention and energy use (Consultant-2).

changing demands of the urban fabric and the uncertainty regarding climate impacts (Civil-Servant-4;[24]).

Multiple functions do not simply appear, but they need to be planned for and incorporated early on in the process [10]. Monbijougatan-raingardens where greenification was combined with traffic-management and SWM, is a multifunctional solution. Yet, as argued earlier, the actual benefits of the site are poorly defined. It was theorised that the street could have contributed to ecological education [21], but there is no evidence that this is attempted. Similarly, aesthetics do not simply emerge, but are subjective. Participants gave contradictory accounts about the raingardens referring to them as beautiful, or, "messy", "unfinished" and "grassy".

7.2.2. Finding Synergies of Benefits

The "formation of joint priorities and objectives among all stakeholders" is portrayed as an imperative step to better planning [24]. However, it is challenging to address intangible benefits. A promising project is on-going in Lund, "Råängen"[68]. This neighbourhood-to-be is a collaboration between White Architects (WA) and the Lund Cathedral and part of the Brunnshög-development. Right from the beginning of the project, stakeholders were invited to participatory workshops: With the help of artwork and other artefacts they aimed to find a shared vision, expressed in designs and solutions that synergistically fit stakeholders' values and goals (Developer-1&2). Through creating relationships of trust and mutual faith, and discounting monetary values (Civil-Servant-5), the purpose is to develop the courage to introduce new solutions and incorporate values that may seem secondary at first (Developer-1&2). This process is happening dialogically with the municipality too: Lund municipality is involved in the planning process but brings in a more functional planning perspective (Civil-Servant-5). The results of this interaction will be important to study for understanding how value-based adaptive planning can be matched with functionalistic city planning.

7.3. Implementation within existing Structures and Processes

According to several interviewees and complementary data sources, the easiest way to implement more BGS is to integrate them into existing processes and activities at every opportunity. A clear example of this would be creating BGS when maintenance work is done on the roads or when old housing areas are renovated and retrofitted (VS-Civil-Servant-2; Consultant-2&4). Such integration is taking place already: At F&G, BGS are being standardised into project task descriptions (Civil-Servant-2); a new residential area might become a testbed

[68] The central idea behind Råängen is to create a sustainable community that can live on for 1000 years - not only in terms of its technical performance, but social welfare too (Developer-1&2).

for BGS (Civil-Servant-3); and VA SYD makes use of maintenance of pipes on streets to encourage citizens to disconnect their downpipes (VS-Civil-Servant-1).

Early incorporation is seen as an opportunity to save resources [20], but there are challenges as well, especially when it comes to BGS-retrofitting works (Consultant-2; Civil-Servant-4). Furthermore, two interviewees argued that when BGS are merely incorporated ad hoc, strategic overview necessary for functional solutions is missing (Consultant-2), which can in the worst-case scenario, lead to maladaptation and heightened flood-risk (Informant-6). Therefore, capacity development within organisations and the private sector appears as a key to moving forward.

7.4. Capacity Development to Facilitate Mainstreaming

Capacity-development is required both among the public and private stakeholders. This means not only building human resources, but also enhancing the actors' understanding of systemic barriers to detect areas in which capacity development is most needed. The following chapter will firstly address institutional capacities and then leads over to private stakeholders capacities to attain a broader understanding of societal dynamics.

7.4.1. Public Institutions

It was pointed out by all interviewees that municipalities play a key role in CCA and the implementation of NBS and BGS through their function as strategic city planners and their legal responsibilities. Hence, institutional capacities of local public actors are a crucial limiting factor. The following subheadings (a,b,c) detail the capacity needs identified in interviews and complementary data sources, and proposals for how those capacities could be developed.

a) Public-public Cooperation

The need for better cooperation and coordination between authorities, departments and other municipal or regional actors was stressed by the majority of interviewees (VS-Civil-Servant-1&2; Civil-Servant-2&3&4&5, Politician-1&2, Consultant-2&3&4: Developer-1&2; Informant-2). On a base-level, communication was deemed good by civil-servants, guided by documents steering collaboration (Civil-Servant-1&3). The problems were seen as emerging mainly from being bound by policy and conflicting political goals (Civil-Servant-3). There are clear opportunity to-be-ceased by identifying common goals for BGS, and co-financing solutions (Consultant-1;[21]).[69] Currently, such collaborations happen solely organically (Civil-

[69] There are several opportunities to secure funding for the implementation of NBS and BGS. Civil-Servant-5 elaborates that it is possible to find subsidies to support the integration of BGS in new development areas. MSB is also providing financial support for flood-risk-reduction. Other financing mechanisms would entail using tax-money, or counting on the

Servant-1). For the purposes of mainstreaming, two interviewees argued such collaborations should be institutionalised (Consultant-2; Informant-6). The former argued for re-thinking the organisational culture altogether to foster creativity, fun, and innovation (Consultant-2).

Fun was identified as an important motivator by Civil-Servant-1, who stated that "good things happen when we work together". Holistic flood-risk-management was described as being born into a "permanent organisational culture of collaboration and collective learning" (Consultant-2), or strong communication, good relationships, mutual learning and shared vision between colleagues, teams, departments, organisations and communities [24]. In this regard a few approaches were suggested: reducing specialisation but increasing generalisation to enhance mutual understanding (Consultant-1), weekly meetings with different departments (Civil-Servant-5) or incorporating in-house consultants who can create bridges between different knowledge bubbles (Civil-Servant-2).

b) Knowledge and Learning

To address the hindrances around the lack of knowledge about risks, and the novelty of BGS, it is required to facilitate knowledge-distribution and the creation of new knowledge through scientific inquiries and MEL. There is a lot of existing knowledge, but the main challenge revolves around gathering, ordering and distributing it top-down, bottom-up and horizontally, making it available for all relevant stakeholders beyond the "bluegreen-bubble" (cf. Consultant-3;[28]).[70] Several ways which are expected to facilitate the necessary knowledge distribution and mutual learning were suggested[71]. Furthermore, documentation and consistent updates on knowledge were seen as key aspects for long-lasting institutional memory (Civil-Servant-3; Consultant-2).

Besides measures to facilitate a better distribution of the existing knowledge, the need for new knowledge creation was also mentioned. One often-mentioned topic was the lack of knowledge on BGS-maintenance. It was seen as crucial to incorporate maintenance workers early on to create a feasible maintenance plan (Consultant-1&3&4; [28]), and to have the consultants stay longer in the projects to support the municipal maintenance (Consultant-1). Better methods were deemed necessary to quantify risks and benefits of NBS and BGS, to

solvency of housing cooperatives and PPOs [11]. Where these options do not suffice it might be necessary to opt for more progressive and innovative approaches. Insurances are for example exploring opportunities to incentivise municipalities [25].

[70] The specific knowledge gap identified was physical properties and dynamic movements of water, as well as a systems perspective on urban ecosystems (Consultant-2&3&4; Informant-6).

[71] These include a platform for collaboration among different urban actors to share ideas, insights and experiences [28]; technical handbooks and workshops about solutions (Civil-Servant-1&2; Consultant-1&3); reports to advise municipalities and decision-makers [2;4;25]; and open access integrated spatial data infrastructures and Geographical Information Systems (GIS)-data, whilst sensitive information should only be available to planners and officials [24].

have a stronger argument for investments into risk-mitigation (Civil-Servant-4&5; Consultant-3;[2]).

Furthermore, a need for better MEL was mentioned by most participants and many complementary data sources. Besides the importance of capturing learning from previous projects, further research into the effects, contributions, and perceived benefits of NBS and BGS to cities and their various inhabitants, was deemed essential (Civil-Servant-2&5, Consultant-1&2; Informant-7). Meanwhile, there were several calls to have the courage to try out promising and interesting but untested approaches and "dare to fail", while making sure that there is an opportunity to reassess, learn and fix potential mistakes (Civil-Servant-2&4&5; Consultant-1; Developer-1&2; Informant-7;[27;24]).

c) Guidelines and Legal Framework

An update of the Planning and Building Act in 2018 sharpened municipal responsibility for strategic planning over risks, mandating them to consider different climate scenarios [4;6;11;22]. Navigating in the cross-fire of climate adaptation and other municipal responsibilities has led the public authorities to occasionally use grey zones and creatively stretch the regulations whenever deemed necessary to accommodate unusual problems, solutions and projects (Civil-Servant-5; Informant-3&4; VS-Civil-Servant-1). For instance, as private stakeholder participation remains uncharted territory, VA SYD has taken the initiative to engage individuals without being legally mandated to do so.

All civil-servants agreed that the current legislation and guidelines should be revised by higher political levels, to provide better conditions to tackle the present and upcoming challenges. Some hope was put into a new governmental report expected to be issued in 2023 (Civil-Servant-5). Demands related to choosing an IPCC-scenario according to which plans should be drafted (Civil-Servant-3; Politician-1), regulations, which would clarify responsibilities, and stricter norms from Svenskt Vatten[72] for retrofitting areas (Civil-Servant-5; Informant-5). Several sources (Civil-Servant-4; Politician-1; Informant-1;[2]) mentioned a need for national level guidelines, and county-wide plans. This can be important when it comes to questions of funding, a long-term strategy, or to streamlining the guidelines of different local authorities.

It was considered that, on a regional level, suitability assessment and consequence analysis should be stricter and have a longer-term outlook (Informant-3&4;[25]). On the municipal level, a clearer division of roles and tasks was requested with a fair distribution of responsibilities between municipal authorities and PPOs (Civil-Servant-4; VS-Civil-Servant-1&2; Consultant-2). Furthermore, increasing the mandatory percentage of greenery in new development areas, and including NBS, was highlighted (VS-Civil-Servant-2; Civil-Servant-4)

[72] The roof organisation of the different regional VA-organisations.

next to individualised property risk-analyses (Informant-1)[73]. Finally, prioritisation of developers with green ambitions was seen as a possibility to aim for more sustainable development (Politician-1&2).

7.4.2. Private Stakeholder Engagement

All interviewees, as well as several complementary data sources, recognised that the engagement of private stakeholders is of great importance. It was proposed that a three-way approach between national, local and private stakeholders should be institutionalised (Civil-Servant-4; Consultant-2). Regarding which private stakeholders should be engaged, however, few gave resolved answers. The Cloudburst-plan [20] indicates that all PPOs should engage, while VS-Civil-Servant-1 saw the largest PPOs as the most important group, due to their scope of influence. However, individual engagement may not have much effect if there is no critical mass in strategic locations (Informant-3&4&6). The following sections summarise approaches for private stakeholder engagement. The first two sections assume citizens as passive recipients who are coerced or invited to participate, while the last section elaborates on citizen-driven action.

a) Coercive Top-down Engagement

In the interviews one coercive measure was mentioned that successfully increased the implementation of BGS in Sweden. In Stockholm, city officials adopted a regulative framework in 2016, the "åtgärdsnivå", which demands PPOs to manage up to 20mm of rainwater on their property. Consequently, the quantity of BGS increased significantly, since they constitute the most cost-effective way to fulfil the regulations' requirements (Consultant-1). When Malmö-based actors were asked if a similar regulation could be implemented in Malmö, it appeared that the regulation is in fact non-compliant with national legislation[74] (VS-Civil-Servant;[1]). As the regulation would not hold in court, the city of Stockholm has continued expanding the public pipe-system anyhow (ibid.).

An improved legal framework was described in terms of legal demands that force PPOs to lessen the discharge of water (VS-Civil-Servant-1&2; Civil-Servant-4;[2]), fines for individuals that disrupt BGS[75] (Consultant-1), and more municipal control over areas that are not its property [11]. The likelihood of rapid changes was seen as moderate by some (Civil-Servant-4&5), but low by most (Informant-3&4&5; VS-Civil-Servant-1&2; Politician-2) participants.

[73] Informant-1 explained that they have an ongoing project with rise, the resilience declaration, which aims at every property having a risk-analysis that insurances can use as well as property owners themselves, banks, municipalities etc. to see what they need to do to minimise the risk of flooding for example.

[74] More specifically, national legislation, which hands out the responsibility to manage stormwater to municipalities.

[75] The example given by the interviewee related to trash getting stuck in the BGS stopping the flow of water.

Arguably, coercing private actors to adapt is not a politically salient choice (Informant-6; Politician-1), although there might be legal ways to do it.[76]

b) Voluntary Top-down Engagement

Next to, and in the absence of, coercive engagement strategies, there seems to be a strong drive to encourage private stakeholders to implement BGS through solicitation. A commonly shared understanding is that the sooner engagement takes place,[77] the better the chances for long-term buy-in (Informant-2; Civil-Servant-2; Consultant-1;[8]). Apart from Råängen in Lund, interviewees did not mention any examples where engagement happened early on in projects, but only after plans were finalised. In general, only Augustenborg, Monbijougatan, "Grönare Möllan" and RfW-programme came up as tangible examples of voluntary top-down engagement in Malmö. Nevertheless, three groups of incentives for private engagement could be identified: financial, sharing risk-knowledge and emotive incentives.

i) Financial Incentives

Both direct and indirect financial incentives could be identified. When it comes to the direct financial incentives, public subsidies made it easier for PPOs to implement BGS (Informant-2). An example of such subsidy are 2500 Swedish Crowns[78] offered to PPOs per disconnected downpipe in the RfW-program. VS-Cvil-Servant-1&2 claimed that this subsidy has been received well and it was brought up in many interviews, including by informants from Gothenburg (3&4).[79] Despite being well-appreciated, other complementary financial incentives were seen as necessary (Civil-Servant-2). As part of the BGCL-project, there has been an attempt to create self-sustaining finance models for BGS (Civil-Servant-3). Two other, non-tested ideas are lowering water fees in proportion to retained or purified water (Consultant-1), and finding creative ways to share costs between PPOs (Informant-3&4;[8;11]).

When it comes to indirect financial incentives, the most commonly mentioned aspect was the increase in property-value thanks to risk-reduction, and the aesthetic and reputational benefits from BGS (Informant-2; Civil-Servant-5; Consultant-1&2;[15]). Furthermore, cheaper solutions are hypothesised to facilitate implementation [27]. Finally, insurance markets were

[76] This might be done through legal stipulations that show that any other development would put municipal values under danger, and when proven that the intended actions are in the best public interest [11;4].

[77] This is however very challenging in new-development areas, as citizens only get the chance to buy property or move in as tenants after plans have been finalised [28].

[78] The conversion is approximately € 240.

[79] The reader should be aware that Gothenburg is not part of the VA SYD authority, but the reputation of RfW-program is far-spread.

mentioned as a possible pathway. Their effect was theorised as revolving around the fear of losing insurance-coverage (Informant-2;[4]), or gaining discounts on premiums per implemented BGS (Consultant-2). Informant-1, however, implied that this is not a likely option, due to incompatibility with the current market and the business model.

ii) Risk-Knowledge Incentives

According to VS-Civil-Servant-1 private stakeholder engagement revolves around "the money but also the knowledge". Knowledge correlates with citizens' preferences for future cityscapes[80] (Informant-7), and could increase the likelihood that stakeholders want to implement BGS. In line with the Cloudburst-plan [20], knowledge-sharing should increase both the capacity to understand the risk of cloudbursts, and present risk-mitigating solutions.

When it comes to understanding risks, the 2014-floods arguably brought preparedness onto PPO's agenda and clarified the urgency (Informant-2). The knowledge that property is at risk is a powerful incentive to invest in risk-reduction (ibid.). This, however, may not have an impact on PPOs who are not in a risk-zone. A great variety of tools are currently being developed to improve risk-communication, using platforms like (participatory) GIS-applications, social-media, as well as virtual- and augmented-reality [9;24]. Disaster-recovery phases were also brought up as important opportunities to gain momentum for spreading risk-awareness (VS-Civil-Servant-2).

When it comes to understanding solutions - and BGS in particular - green-roofs, which are perceived as cheap and easy to implement, are becoming a standard (Consultant-2; Informant-2). The need link challenges and solutions has been identified by several expert-instances[81] who offer guidance and education to private stakeholders (VS-Civil-Servant-1; Consultant-3, Civil-Servant-3;[27]). Further, the SODA project[82] intends to continue on this path and create basic educational material for PPOs (Consultant-3; Informant-8). However, beyond mere technical know-how, there might be further need to share knowledge about BGS's legal, social, economic and environmental aspects ([17]; Informant-7).

iii) Emotive Incentives

Consultant-2 argued that not all private stakeholders necessarily need to be informed about the intricacies of risks and solutions. All interviewees mentioned approaches which are not

[80] In other words, if citizens are aware of a certain solution the likelihood that they would like to see them implemented in their future neighbourhood increases.

[81] VA SYD, BGCL, SGRI

[82] A RISE research project focused on assisting societal transformation towards more sustainable stormwater management with a special focus on development districts.

connected to financial or risk-related incentives. Instead, they aim at engaging the emotional side of stakeholders rather than the rational-logical side, and include communication of other benefits, appealing to social conscience, and eye-level engagement.

It was argued that PPOs should not see BGS-implementation as a burden (Informant-2; Civil-Servant-2) but perceive them as desirable (Informant-3&4). Since BGS should be able to meet PPOs' demands, communication of other benefits can be useful, if technical- and risk-aspects catch little interest [27]. The appreciation of beauty was mentioned several times (Consultant-1&2&4). Beyond aesthetics, other important benefits included connection to hobbies, such as gardening (VS-Civil-Servant-1&2) and intrinsic appreciation of greenery (Civil-Servant-2). For PPOs, benefits that relate to property protection, or increasing property value, are likely to be highly relevant (Informant-2).

Beyond individual benefits, social conscience came up several times. All participants seemed to share a concern for sustainable development of their city and neighbourhood. Social duty also motivates action among PPOs and can cause irritation if certain stakeholders neglect their responsibilities toward others (Informant-2). One example of a land-owner with a strong social responsibility-perception is Lund Cathedral, who aims to create a sustainable neighbourhood, where BGS play a key role (Developer-2). A similar story is that of Augustenborg, where social goals of neighbourhood development were combined with BGS [8].

The third incentive for engagement is enhanced communication, ideally on eye-level. It is crucial to listen to stakeholder's concerns and find common solutions [17]; different needs should be recognized (Informant-7; Developer-2); and a space for participation created (Developer-2; [27;24;17]). The language used, should be adapted to planners and implementers, or lay citizen groups (Politician-2). While the first group tends to respond to more logically-formatted information, the latter may receive emotional framings better (Politician-2; Informants-3&4; VS-Civil-Servant-2; Consultant-2). Thus, sharing goals and tangible benefits might more easily convince private stakeholders (Politician-2; Developer-2;[8]), especially if combined with forging closer relationships (Informant-2; Developer-1) and using reciprocal language (VS-Civil-Servant-2). Finally, art was proposed as a way to bridge between science and citizens (Developer-1&2; VS-Civil-Servant-1&2; Informant-3&4;[9]) and creatively using diverse communication-channels was recommended (VS-Civil-Servant-2; Developer-1; Informants-3&4;[9]).

c) Bottom-up Engagement

According to Consultant-2, under current societal circumstances, nothing will be imposed on the private sector if not self-demanded. This highlights the importance of sharpening the focus on on-going bottom-up processes. Both politicians argued that election results are the

biggest incentive from a municipal decision-making standpoint, which is why grassroot change is important. Similarly, Informant-5 argued that politicians have a crisis-focus, and that the values in society at large play a big role. Consequently, the growing public attention on BGS can impact politicians' future prioritizations and decisions.

Knowledge on BGS does not only spread top-down, but many examples were provided on how it disseminates horizontally. Neighbours tell neighbours about positive experiences with disconnecting downpipes (VS-Civil-Servant-1), colleagues tell colleagues about successful projects at F&G (Civil-Servant-2), other municipalities get inspired by RfW (VS-Civil-Servant-1), and cities look for innovative solutions elsewhere (Consultant-1). There are signs of an emerging trend: current development projects incorporate much more greenery than a few years ago (Informant-2), and F&G is standardising BGS (Civil-Servant-2). The novelty of solutions is seen as attractive and competition in the private sector can trigger rapid adopters (Informant-2; Consultant-1).

Furthermore, bottom-up engagement is considered important for incorporating stakeholders' needs (Informant-7;[17]). However, there is an identified lack of technical and political capacities among the private sector to meaningfully partake in decision-making (Politician-2). This discrepancy may become significant especially considering the fact that role-divisions in terms of who should lead private stakeholder engagement are very unclear. When asked who should be responsible for engaging the private stakeholders, few respondents elaborated. One opinion was that the task belongs to project leaders and communicators (Civil-Servant-2), while Civil-Servant-1 considered VA-SYD most suited for the task. Moreover, the question of how costs should be distributed is only aspiring (Civil-Servant-4). While the care for one's own neighbourhood can enhance civil efforts (Civil-Servant-1;[17]), it was feared that municipal contribution could lag behind private investments (Informant-2).

8. Discussion

8.1. Perception of and Expectations towards NBS

This thesis started off with the intention to discover how NBS are perceived today and if they are seen as beneficial for SWM. The results gathered confirm what has been argued elsewhere (Barton, 2016; Wamsler et al., 2014): BGS are gaining prominence in Swedish urban planning - even though no second Augustenborg has been created. Evidence points at municipal efforts to standardise their implementation in newly built areas and in retrofitting works such as Grönare Möllan and Monbijougatan-raingardens. Meanwhile, private sector representatives showed high confidence in the market providing cheaper solutions in the near future, which would facilitate mainstreaming. What seems to be driving this momentum is a

sense of urgency for CCA and increased risk-perception of floods since the 2014-cloudburst: public financing toward SWM has increased, and there is a general openness towards new innovations even if there are sides to NBS which are still unknown.

One key factor for this positive perception, mentioned by nearly all interviewees, seems to be the multifunctionality of NBS and BGS. Monbijougatan-raingardens was chosen as an illustrative example where a single solution could simultaneously achieve both risk-reduction and socio-ecological benefits. Thus, if well-implemented, it could be a complex answer to a complex set of challenges. Yet, this example also confirms what is argued by Wynberg and others (2021), namely, that multifunctionality tends to be co-opted by single actors focussing on their own activities, instead of actively creating synergies between different values in the city. This confirms the findings of Mottaghi and others (2020): The complex affordances[83] of BGS are still not well-understood. Some interviewees argued that cost-efficiency of solutions could be achieved through multifunctionality by pooling funds from different municipal departments. However, if synergies are not sought between different actors with different interests, this seems unlikely to happen and some co-benefits and synergies remain underexplored.[84]

On the topic of co-benefits, Naturvårdsverket (2021) advises to consider human welfare and biodiversity as factors whenever implementing NBS. This thesis provides evidence that sometimes social benefits are more available compared to ecological or technical ones. In Monbijougatan for example - unlike literature elsewhere proposes, such as Wamsler et al., (2020a), the social benefits of traffic management trumped the more technical goals of flood-risk-reduction. Meanwhile, creating safer traffic environments is still significantly more tangible than, for instance, measuring aesthetics. This builds upon the argument that decision-makers tend to focus on developing the hard- instead of soft-capacities (Hagelsteen, Becker, 2019; Wamsler et al., 2020a). Figure 5, however, shown in the Conceptual Framework shows that there is an emerging discourse around intangible socio-ecological benefits that could be reaped. This is important seeing that NBS have a tendency to commodify nature (Wynberg et al., 2021) which does not lead to the desired mainstreaming this thesis proposes. In the data sample, however, there was a tendency to have more precise goals for technical benefits, whereas the social and ecological benefits were defined rather loosely. There is a need to amplify this discourse from the perspective of on-going paradigm shifts among NBS-scholars. Namely, Maćkiewicza and Asuero (2021) argue that solutions without social benefits, and that harm ecological integrity, should no longer qualify as NBS, but that NBS should increasingly be seen as a holistic and synergistic measure.

[83] By affordances, the authors of the paper refer to the possibilities of action that an environment offers to an actor.

[84] For example potential opportunities of combining NBS and BGS with urban food-production were not mentioned by any participants, even though the risk of losing food-security was unrelatedly brought up several times, and is emphasised in literature [2].

Addressing the debate on framing NBS as universally beneficial (Osaka et al., 2021), this thesis showed that incorrect implementation and maintenance can easily lead to poor performance, or even cause disservices, which is overlooked due to the lack of MEL. While this was exemplified by Monbijougatan-raingardens, the issue is not limited to Malmö (Consultant-1). Although the understanding that BGS and grey-SWM are different as interventions is increasing - as can be seen in the calls for education and capacity-development - the discourse on disservices is still limited. Mottaghi and others (2020) argue that disservices are, however, somewhat inevitable: "[T]he introduction of a certain technological infrastructure like blue-green infrastructure, might at first look innocent, but it brings much more than meets the eye" (ibid.:140). In other words, besides new possibilities, BGS bring along new demands, sensitivities, vulnerabilities, and forms of social conduct, fundamentally transforming what it means to live in a city (ibid.). If NBS are merely seen as a quick sustainability fix (Seddon et al., 2021), maintenance and the longevity of ecosystem conservation will be systematically forgotten. This distracts from the larger issue of unsustainable socio-economic growth, production and consumption, which keeps trumping ecological values. The hasty implementation of BGS that are, without sufficient maintenance, not properly sustained even replicates such unsustainable behaviour. Therefore, even if co-benefits and the resulting positive perception are powerful arguments for mainstreaming NBS, this thesis recommends not advertising them counterfactually as guaranteed win-win solutions.

Zooming into the SWM-focus of this thesis, it does appear that there is momentum to choose BGS over ordinary green space, which is promising for the goals of flood-risk-reduction. Given that Augustenborg seemingly passed the stress-test of 2014 gives confidence that NBS and BGS can be used to decrease and purify runoff and reduce medium recurrence-interval floods (Haghighatafshar et al., 2018b; Sörensen, 2018). However, evidence was provided that one should move away from implementing a high quantity of ad-hoc solutions and, instead, focus on their density and connectedness - the "treatment train" - as was the case in Augustenborg. This raises many questions around the fact that more and more solutions are incorporated into everyday bureaucracy. In the absence of a strategic overview of where solutions are, and how they are connected, the flood-risk might be barely mitigated, whilst in the worst-case scenario a wrong solution in the wrong place may even increase the flood-risk (Sörensen, 2018).

The identified expertise-gap among practitioners who might be involved in implementing BGS, can lead to arbitrary placement of BGS in the city. Meanwhile, it is unlikely that the challenge can be addressed merely through knowledge-spreading given that existing models are not sophisticated enough to predict what BGS really contribute to cities' hydrology (Sörensen, 2018). This makes good decision-making difficult, as was discovered by Gluckman and Wilsdon (2016) who argue for the importance of good quantifiable scientific data for policy-makers. The 2014-cloudburst provided a good test ground, and it might be necessary to prepare to produce high-quality data during upcoming flood events.

Besides preparedness, there is an alternative discourse brought up by some interviewees: The costs of implementing sufficient measures to eradicate flood-risk entirely are, in fact, too high. This relates back to Coppola's (2015) risk-mitigation definition, as well as the definition of adaptation mainstreaming by Wamsler and others (2017), which were introduced in the Background and Conceptual Framework sections. Societies are filled with risks and the levels of risk-perception determine the extent to which there are attempts to mitigate hazards. As CC cannot be reversed, societies will need to adapt to new risk-levels. Some practitioners, like VA SYD (2021) recognise this and call for a perspective-change, to accept a certain level of flooding in cities. Ideally this would be in areas designed to withstand the inundation.

As riskier societies become the new reality, it needs to be discussed which areas are deemed sensitive and ought to be protected. Traces of this discourse were detected, yet, nothing of the magnitude of the Copenhagen Cloudburst-plan, which prioritises downtown-assets of higher economic value (Sörensen, 2018). A social justice perspective is a chapter that remains unopened, although the authors of this thesis could identify at least two crucial questions: Who should be benefitting from the protection provided by BGS, and their co-benefits,[85] and who should bear the costs of flooding? In the current legislative framework, the municipality cannot implement climate adaptation that benefits some individuals over others. Yet, PPOs do not stand on the same line to begin with, as the risk is not equally distributed in the city, and they have different adaptive capacities depending on their socio-economic status. Little has been written about intersectional vulnerabilities and flood-risk in the context of Malmö although this is a crucial component of risk-aware decision-making. This brings emphasis to arguments made by Fratini and others (2012) who see that management of extreme rains needs to bring the technical domain together with urban resilience and spatial planning to consider socio-cultural, economic and environmental aspects. Studies on risk-perceptions would be a valuable contribution, informing a more holistic and just decision-making process, where more voices are considered (Hansen et al., 2013).

Relating back to the first research question of this paper, it can be summarised that the perception of NBS and BGS is generally positive. The multitude of co-benefits - such as urban safety, sustainability and high life-quality through healthy, inclusive and enjoyable environments - are seen as a promising avenue for their mainstreaming. These values were largely shared by all research participants. Meanwhile, however, from a SWM-perspective, the overly positive frame and lack of strategic overview may lead to hasty implementations, which may lead to maladaptation given differing expectations, perceptions and knowledge-levels. A number of aspiring discourses were identified, which require further considerations

[85] An example of how NBS co-benefits lead to inequalities is presented by Barton (2016) who argues that a strong focus on aesthetics can lead to gentrification that increases an area's property value, leads to higher apartment prices and therefore raises concerns among citizens (Barton, 2016).

if BGS are to be successfully mainstreamed: Namely, deepening understanding co-benefits and disservices, especially the ecological ones, as well as adaptation mainstreaming and social justice.

8.2. Lock-in of Societal Processes

The second research question this thesis concerns the societal context of mainstreaming in order to understand hindrances both from the public and private sector perspectives. The objective here was to expose the complexities related to NBS-governance involving various stakeholders and visions, as described by Maćkiewicza and Asuero (2021). Correspondingly, the findings highlight both technical, socio-organisational and political challenges.[86] It was seen that the latter two weigh heavier, which accords with Wamsler and others (2020b) who emphasise the importance of knowledge, resources, coordination, shared goals, and commitment for mainstreaming. The fact that both Augustenborg and Monbijougatan were projects that came into life only because of particularly engaged and passionate individuals, exemplifies the current reality of mainstreaming in Malmö: Commitment and a holistic vision to this goal simply do not exist in current governance structures.

Generally speaking, there is an expectation that NBS should be implemented top-down (Xie et al., 2022). According to the authors of this thesis this creates a societal lock-in, visualised in Figure 9, resulting from (1) civil-servants' capacity deficit; (2) political unwillingness to change regulations; and (3) citizens' awareness deficit. Similarly to Wihlborg and others (2019), this thesis finds that civil-servants are restricted by tight mandates, siloed work environments, limited resources, and unsuitable legal framework with overly complicated regulations and unclear responsibilities. This results in institutional inertia; a finding that correlates with Becker's (2021) understanding of institutional frameworks. This makes designating resources to new innovations and building capacity around BGS difficult, as clearer guidance and more resources from the political level would be needed.

The interviewees called for clarification of the legal frameworks that guide collaboration and distribute responsibilities around SWM. However, it is difficult to determine what new regulations should look like. In fact, there were certain instances, where the demanded changes could impede each other if not balanced well: For example, while there were many calls for county-wide guidelines to avoid disagreements between different agencies, new lock-ins are just as easily created with too tightly-defined roles and regulations that hinder adaptive planning.

[86] Respectively: suitability and fit of solutions in a pre-built urban space; discussions who should implement them, when, and how; and debates why they should be prioritised over other societal needs.

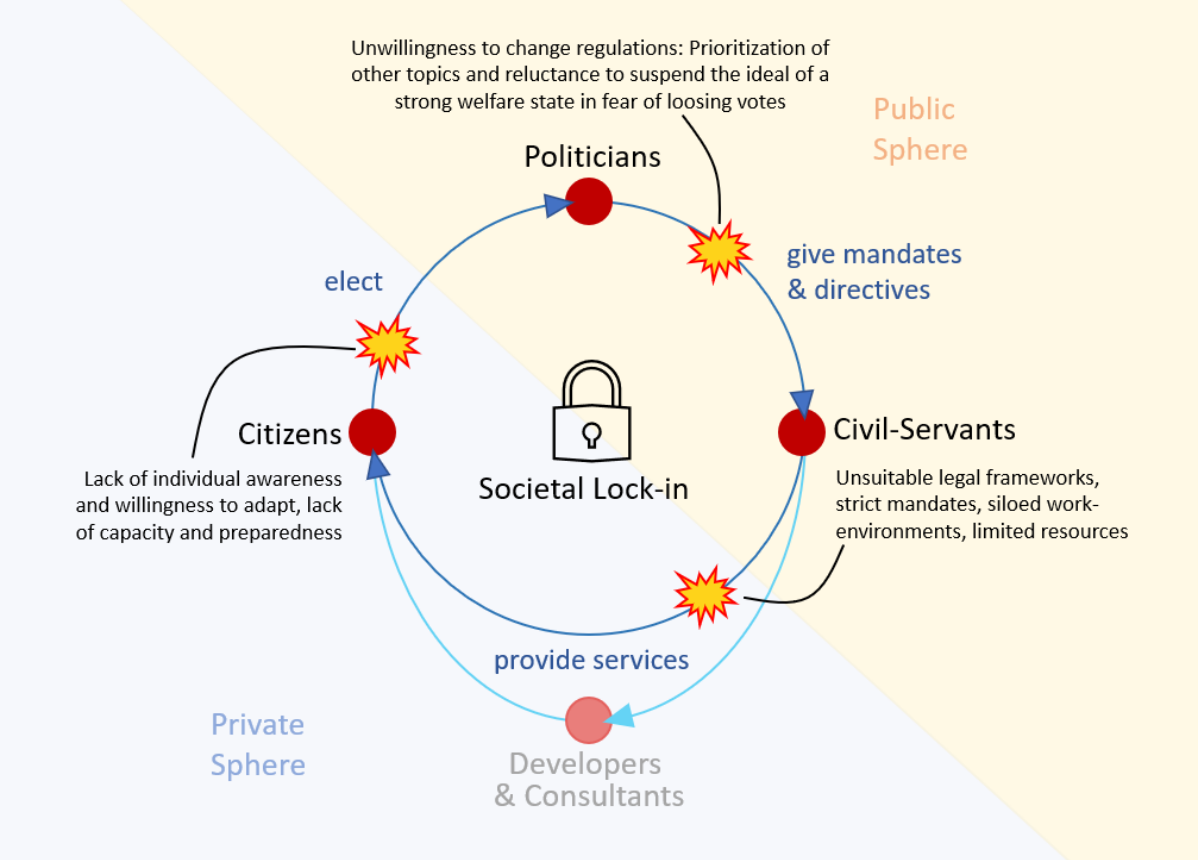

Figure 9 *visualises what is here referred to as a societal lock-in. The explosion signs signify disruptions between actors, which makes mainstreaming BGS difficult, if not impossible.*

As this research has shown, Malmö's public services currently lack the capacity to satisfactorily manage stormwater on public land, as the sphere within which BGS and grey-SWM can be mainstreamed will not suffice. While Malmö has invested in a new stormwater-tunnel project, such solutions are known to come with an enormous price tag (Sörensen, 2018). Retrospectively, this might not be a sensible investment given the long recurrence intervals of cloudbursts. According to experts, risk-reduction could be achieved through the large-scale implementation of well-integrated BGS. However, given that 70% of Malmö's land is privately owned, this cannot be achieved without measures also being implemented on private land as the civil-servants lack the capacity to coerce PPOs engagement.

Therefore, while capacity-development within institutions is of essence to improve the quality of BGS, large-scale mainstreaming depends on political changes, that is amendments of the legal framework increasing the coercive power of the municipality or PPOs obligations. The only example given for such a top-down regulation is the Stockholm water purification requirement. However, while they resulted in BGS-mainstreaming, the municipality still has to invest in back-up pipe-systems. If this were to be more coordinated, the national politics would need to come involved. Based on the interviews, however, these changes are time-intensive, and potentially not salient politically speaking.

Alternatively, PPOs could be encouraged to take action through solicitation as VA SYD is currently attempting. However, the private sector perceives little responsibility in terms of CCA (Persson et al., 2021). Given the long legacy of the Swedish welfare state, the level of individual preparedness is low, although there are initiatives to increase it. At the same time, however, recent legislative acts have only consolidated municipal responsibility for adaptation and SWM. Even though all participants agreed that private stakeholder engagement is necessary, it is not prioritised. The authors see this as a consequence of a culture, where citizens are understood as passive recipients of public services. There are few incentives for municipalities to engage PPOs, as this would change little of the nature of their own liability.

This concurs with more general statements by Maćkiewicza and Asuero (2021) and Xie and others (2022), arguing that governance of NBS, and mainstreaming, needs to happen on a societal scale, and cannot only be considered top-down given the complexity of the issue. This is why in Figure 9 citizens are linked into the loop of societal lock-in. Several interviewees argued that the only way to resolve the challenges would be for the electorate to choose politicians with different agendas. This, however, requires for the citizens to gain extensive understanding, and awareness of risks and possible solutions. Essentially, PPOs would have to demand restrictions of their property rights, which seems an unlikely path of action at best. Yet, unless the topic reaches a higher prioritisation on people's agenda, circumstances are not expected to change.

There is, however, a pathway to change, identified private sector representatives, which may change the picture radically in the future. While municipalities are responsible for SMW, they do not cover damages in case of extreme rain events, but PPOs are liable themselves. Some pessimistic voices in this thesis deem it necessary to wait for the next major cloudburst that attracts public attention and boosts people's willingness to take individual action or demand political change. This correlates with the observation that, generally speaking, a layperson's interest in solutions increases after major floods (VA SYD, 2021). This can be connected with the availability bias in risk perception research, indicating that the consequences of a risk need to be tangible for the perception to increase (Slovic et al., 2007). From the point of view of preparedness, however, waiting for severe damages is not a desirable option. Therefore, it is imperative to "raise citizen awareness of their options and (legal) responsibilities regarding all phases of adaptation, and before hazards strike" (Brink, Wamsler, 2018:94). Apart from that, it must be acknowledged that the implementation of BGS alone is not sufficient, as it was shown that they cannot guarantee complete prevention of floods. Therefore emergency preparedness measures must be considered as well, which ultimately also requires citizens engagement (Kohn et al., 2012).

Relating back to the second research question, the societal context makes mainstreaming of BGS difficult. Change is hindered by municipality's restricted capacities, the improbable rapid

political changes and a culture of non-engagement. There is a societal lock-in caused by a lack of awareness among citizens who see public actors as responsible for flood-risk-management, which results in political hesitation to change the legislation that was created to protect social welfare and private property rights. Without capacity-development and increasing individual preparedness, PPOs will face challenges they are not equipped to handle. This case sheds light to a wider discussion where cities and municipalities are seen as suitable actors to address CCA due to their proximity to citizens (Kjaerum, 2018). It should be asked if they are truly equipped to manage this task, and if not, when this will unravel. Thereby these findings stand in contrast to accounts which solely argue for the need to develop internal municipal capacities.

8.3. Pathways to Facilitate Mainstreaming

The third research question asked how wider mainstreaming of BGS for sustainable SWM could be facilitated. It was highlighted that besides the need to develop institutional capacities, mainstreaming BGS in Malmö can only be achieved through the engagement of all stakeholders, particularly PPOs. According to Bergström and others (2014), complex challenges with multiple involved stakeholders call for the adoption of a systems-perspective that is vary of the local context. While previous research (e.g. Olsson, 2020) argued that changing the legal framework or other enforcement mechanisms should be in the focus, it was found that this may not be the most efficient way to achieve fast BGS-mainstreaming in Malmö. Also, a new legal framework cannot replace a lack of shared vision. Therefore, other pathways should be explored.

The authors consider, aligned with Wamsler and others (2014) and Maćkiewicza and Asuero (2021), that through a cross-disciplinary approach, the capacities of multiple stakeholders can be combined into joint efforts. Furthermore, it is argued that the engagement of local communities in all project phases - from design to evaluation - makes solutions more efficient (Mercer et al., 2012; Seddon et al., 2021). Provided that more strategic goals are brought to forefront, not all PPOs need to implement measures, but only those whose lies at a strategically important location. The authors deem that the level of incentives to participate are relatively high, evident by, for instance, the fact that the majority of approached private stakeholders are, in fact, happy to partake in risk-mitigation. Hence, creating a culture of participation could help reduce pressure at strategic catchment-locations. It is found that inclusion fosters local ownership and empowerment (Mercer et al., 2012; Manruri, Rao, 2004; Kjaerum, 2018; Forsyth, 2013; Seddon et al., 2021) meaning that other social benefits could be reaped as well.

Thinking synergistically helps reaching a wider audience, as theorised by the authors. This is reflected in literature, stating that different backgrounds and sets of knowledge create win-win solutions (Haase, 2021; Frantzeskaki et al., 2018), helping to reduce obstacles to wide-

scale implementation (Dushkova & Haase, 2020). This entails letting go of seeing BGS solely as a SWM-tool, and embracing it as a multifunctional opportunity that can be integrated into city's everyday life (Sörensen, 2018). This thesis found that aesthetics and economic benefits were often-mentioned examples to get private stakeholders on-board. A promising avenue is also framing the solutions through safeguarding one's own property. Thus, maximising benefits, and communicating about them, is expected to increase their acceptance (VA SYD, 2021). To reach this goal, better tools for performance-assessment, both for benefits and disservices, are needed - an aspect echoed by literature (Toxopeus et al., 2020; Sekulova & Anguelovski, 2017).

The question remains, who has the capacity to facilitate and engage private stakeholders in this manner. Municipalities seem to be the obvious answer, since they are close to citizens, as Kjaerum (2018) argues. Similarly, Wamsler et al. (2021) highlight that soft-capacities of municipalities should be trained to improve citizen-municipality interaction. Considering, however, municipalities' work pressure and staff turnover, it is hardly surprising that engagement efforts have been rare and hesitant thus far, being left to final project phases. Targeted investments into soft-capacity building as seen in VA SYD's creation of the RfW-programme, where a designated team has a primary focus on private engagement, might be required.[87] If given as a side-task to a civil servant, private stakeholder engagement runs the risk of becoming a "technocratic compromise" (Wamsler, 2020a:247) and as such "punctual, isolated, and often counterproductive".

It should be highlighted that beyond the need for stakeholder engagement, there is a wider demand to change societal perceptions of water. As argued earlier, our societies are about to become riskier, which requires adjustments of norms. In line with adaptation mainstreaming, normative and cultural incentives are needed to address the "underlying values, beliefs, and worldviews of actors" (Wamsler et al. 2020a:248), as well as their "cognitive/emotional and relational qualities" (ibid.). This is in line with learning to comprehend society-wide risk-perceptions (Hansen et al., 2013), but also addressing concerns of justice ahead of time.

Finally, most of the results have spoken of citizens as passive recipients of services, and not as active stakeholders. This concurs with the findings of Brink and Wamsler (2018) who argue that collaborations with citizens are rarely considered. The pathway to change, however, as illustrated in Figure 10 necessitates a full incorporation of this stakeholder group in all thinking around SWM with BGS. Meanwhile, certain groups of private stakeholders are not passive at all: there are several bottom-up projects of citizens pushing for sustainable change, and taking initiative by implementing measures themselves.[88] Similar developments were

[87] When creating such teams it is however imperative to ensure close cooperation with other departments to avoid the creation of new siloes and to enable adequate private stakeholder engagement throughout all project phases.

[88] An anecdote from an irritated survey respondent who decided to take matters in their own hands (VA SYD, 2021) shows that increasing knowledge among private stakeholders can lead to decentralised change. In the case of Sofielund, citizens

detected among private developers and consultants who are eager to innovate new solutions and follow up with MEL. Yet, adaptive capacity levels of PPOs differ. To guarantee a just transition "a broader view of the target audience is needed, reflecting different housing types, articulacy and level of trust in authorities, to ensure inclusion of the most-vulnerable" (Brink, Wamsler, 2018:94). For a better understanding of the interplay between public top-down and private bottom-up change further research is required.

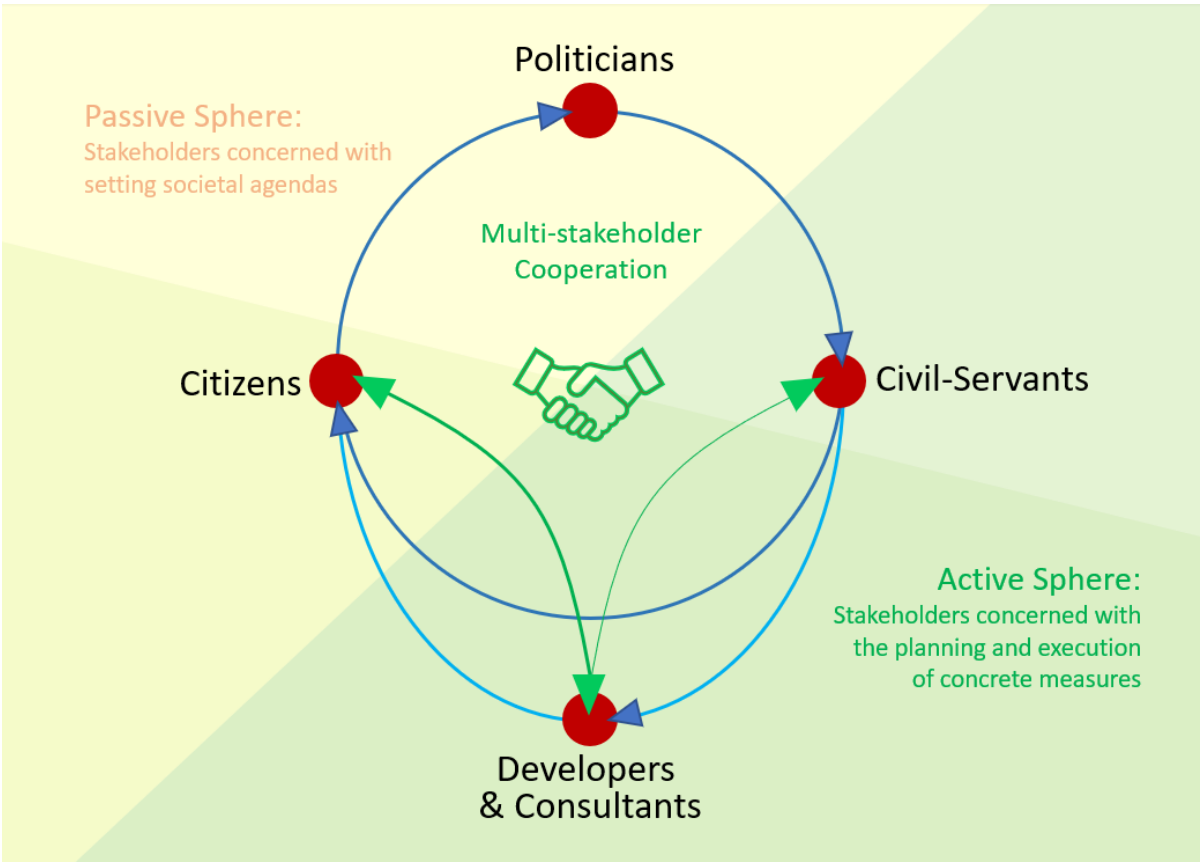

Figure 10 *portrays the optimal way to mainstream BGS in SWM, namely, through active incorporation of private stakeholders.*

To conclude, the literature confirms that successful NBS projects, involving private stakeholders, have proven to stabilise development, generate green business models, and create green job opportunities (Perkins, 2010; Dushkova, Haase, 2020). Furthermore, greater awareness among citizens will ultimately reflect on changes to the political agenda (Bevan & Jennings, 2019) and enhance the chances for amendments of the legal framework. Further, trend and norm creation should not be underestimated. As argued by Eyben and others (2008:203) "[l]ocalized success creates belief and provides safety for individuals, institutions

took action and implemented measures to protect their homes from floods, despite very little knowledge on best practice [17]. In Råängen, a private landowner, Lund Cathedral, has initiated cooperation with developers and consultants that have specialised in BGS, to meet a sustainability vision which far exceeds what the municipality is aiming for. Similarly, there are cases of neighbourhoods who have engaged in close cooperation with VA SYD to retrofit their properties. A VA SYD-study (2021) suggests that citizens' awareness of the pluvial flood-risk increases and that they want to contribute to societal risk-mitigation and adaptation.

and countries to follow suit". Wamsler et al. (2014) claim that strong leadership can make up for a lack of support from legislation or higher-level authorities. Malmö has been inspirational in its approaches to BGS in the past. Nothing is stopping it from continuing on this path in the future.

8.4. Limitations

The authors approached this research with a personal interest in the subject. While the chosen methodology focused on mainstreaming NBS, efforts were made to reduce the researchers' positive bias by paying attention to potential drawbacks and limitations. However, as the research questions had a focus on benefits instead of disservices, the latter received less attention. This shows in the results insofar that the predominant narrative revolves around ways to facilitate mainstreaming, whereas findings pointing at drawbacks and limitations only appear in the discussion as limitations to the research approach. This, however, is not considered a significant limitation by the authors, as, without exception, the data sample pointed at the potential of NBS and BGS. Furthermore, the researchers aimed to reduce personal bias by striving toward an emic perspective (Cresswell, 2013): letting the narrative of the results be led by interviewees and allowing the participants to confirm the statements they had given. The authors believe that opting for a grounded research approach increased internal validity and resulted in a more realistic and balanced picture of NBS. The results add complexity to the positivity around mainstreaming by describing day-to-day challenges encountered by practitioners, and brought in new research findings by describing the state of mainstreaming through the lens of integrated SWM-solutions, as well as emphasised the importance of private stakeholder engagement.

Meanwhile, to recognise and highlight hindrances for mainstreaming, the researchers purposefully chose an exemplifying study - Monbijougatan - where a lot of problems and challenges were encountered. The focus on a single solution may be wrongly interpreted as applying to all projects in Malmö. However, such a conclusion about mainstreaming could be drawn only if various solutions in the city were investigated and compared in similar detail. When it comes to the results in general, the fact that the interviews had a high-level focus, focused only partly on specific projects, and were not limited to stakeholders in Malmö, is seen as increasing the validity of the results and making them, at least, partly applicable to other Swedish municipalities as well. Beyond Sweden, however, extrapolation of results should be done mindfully as the thesis builds upon socio-cultural and legal particularities. The deductive research phases point out, however, that there might be resemblances between different country contexts as well. Further research would, however, be necessary to understand to what extent these findings are unique or universal.

Moreover, in sum, participants showed to have an impressive amount of knowledge and ideas about how mainstreaming could be achieved, as modelled in the second Results section.

However, during data analysis it was discovered that the knowledge was geographically and spatially dispersed, and remains largely theoretical as few participants were able to pinpoint tangible best practice examples. Some ideas mentioned have not been tested in Malmö, or they are currently on-going (such as the development of better hydrological models) which is why another inquiry would be necessary to understand their real-life interaction and applicability. This somewhat limits internal validity, as the evaluation and cross-comparison of these examples fall outside the scope of this work. Further research, preferably on cross-country-scale, is, thus, needed. Finally, while this research lays out many reasons to address pluvial flood-risk, the presented data-sample might be biased by the risk-perception of technical practitioners. It became apparent that other societal needs and hazards, of which some but not all can be directly addressed through the different benefits that NBS provide, are consistently highlighted. It should be concluded, therefore, that this thesis does not offer a full risk-picture, as other hazards are not equally considered.

9. Conclusion

This research provides a fresh angle to the issue of mainstreaming of urban NBS, which correlates with existing findings, but also complements them by including a wider analysis of stakeholders and their perspectives in a concrete setting. This exploratory approach pinpointed the importance of private stakeholder engagement in mainstreaming BGS in Malmö, but also identified system-boundaries, in other words, the absolute limitations of BGS as risk-mitigation tools. Throughout the thesis, it was highlighted that the solutions' various benefits and disservices need to be better modelled and conceptualised, indicating the relevance of further research into BGS performance in complex urban environments. Interrelatedly, a need for quantifiable indicators, and better communication of intangible benefits, is required if mainstreaming is to be achieved across sectors. Generally, it is seen that mainstreaming of NBS can yield a large variety of benefits. However, this study cautions against adopting too simplistic narratives of win-win solutions, as the reality tends to be more complex. Further, it was found, in line with recent NBS-mainstreaming literature, that solutions cannot be found through singular pathways, but must be co-created multi-sectoral and multidisciplinary.

To conclude, the lack of private stakeholder engagement was identified as the main hindrance to mainstreaming BGS as it is the node in the societal lock-in that possesses most potential for progress: Firstly, if engaged in action, the municipal authorities can better implement strategic planning in the whole catchment. Secondly, if their awareness of risks and solutions grows, a stronger CCA-politics may prevail. Finally, in the absence of mainstreaming, information about PPOs' liability and the potential of future damages is key for augmenting individual preparedness. It can be concluded that the value and importance of each stakeholder's contribution needs to be recognised. In other words, problems with democracy can only be solved with more and better democracy.

It is for this precise reason that coercion into action should not be the prioritised course of action, as this may aggravate the problem instead of bringing in solutions. Instead, incentives to voluntary engagement next to augmenting awareness about the importance and functions of water and BGS is key, and should be explored further. As return-to-investment of private stakeholder engagement is less tangible compared to technical projects such as stormwater-tunnels, the ideas of synergies and multifunctionality need to be exploited to create attractive alternatives to the old ways of working. In this thesis perspectives from Capacity Development were utilised to conceptualise the need to bridge gaps between development today and development tomorrow. Although little used in Western urbanised contexts, the authors believe that the systemic perspectives offered by research fields such as Community-based Adaptation, are needed to take distance to the paradigms of a society, that has been enjoying limitless socio-economic growth, but will need to adapt to the boundaries of the new age.

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Appendix I: Interview Guideline

Colour coding & Numbering:

1. PRACTITIONERS
2. OTHER STAKEHOLDERS
3. Both

[Name of the interviewee(s)]

[Organization/Stakeholder group of the interviewee(s)]
[Title/Role of the interviewee(s)]

INTERVIEW STARTS

A short explanation of the interviewees' role and their relevance for our research.

Researchers' introduction

Asking for permission to record and elaborating that the recording will be used both to inform our research process and to capture potential leads. The recording will not be broadcast nor accessible to anyone other than the researchers who will use it to transcribe and check against their notes.

RECORDING STARTS

Clause: This interview is made with the purpose of informing thesis research on mainstreaming NBS in Malmö. To avoid misrepresentations, prior to publishing this piece of work we will refer to you the relevant parts of the thesis for you to confirm that the way that your contribution aligns with your expectations and intentions. You maintain the right to withdraw your consent of being part of this thesis work at all times.

INTRODUCTION

Inform the interviewee(s) about the purpose of our research. Adapt the language to the conversation partner.

- Achieve wider mainstreaming of nature-based solutions, and blue green grey measures
- Grasp what perceptions, understandings and expectations different stakeholders have of nature-based solutions
- Analyse the obstacles that hinder cooperation and implementation
- Identify drivers and incentives that can help overcome the challenges and facilitate cooperation between different private and public stakeholders
- If relevant, specify the case that will be discussed during the interview
    - The NBS/BGG project
    - The "green area"

Let them introduce themselves and their organisation/stakeholder group.

1.1. PRACTITIONERS

1.1.1. What is your educational background?

1.1.2. What is your organisation mainly working with? What is its purpose?

1.1.3. What is/was your role in this project?

2.1. OTHER TYPES OF STAKEHOLDERS

2.1.1. What is your educational background? /What do you work with?

2.1.2.What is your relationship to the project? *(if not clear to the researchers)*

UNDERSTAND:

*Get an understanding of **the case** they are/have been working on and understand **their perspective** on it .*

1.2. PRACTITIONERS

1.2.1. What is/was the aim of the project?

1.2.2. What values are/were driving you?

1.2.3. What expectations are/were driving you?

1.2.4. Who is supposed to benefit from the project?

1.2.5. What do you think are the needs and values of the beneficiaries?

1.2.6. How does the project address these needs and values?

2.2. OTHER STAKEHOLDERS

2.2.1. How concerned are you about flooding in your neighbourhood? Why?

2.2.2. If you were affected by a severe flood, what would you be most concerned/worried about?

2.2.3. Are you aware of the flood mitigation project in your neighbourhood?

- **Yes:**
  - 2.2.3.1.How did you find out about the project?
  - 2.2.3.2. How was it introduced to you?
  - 2.2.3.3. What expectations do you have towards the project?
- **No:** *(the researchers explain the basic function of the project)*

*Understand **the role** of NBS and BGG.*

1.3. PRACTITIONERS

1.3.1. How and when have you encountered NBS and BGG?

1.3.2. How much experience do you have with NBG and BGS?

1.3.3.1 What is your understanding of NBS and BGG?

1.3.3.2 What is their potential?

1.3.4.1. What convinced you of the utility of NBS?
1.3.4.2. Why are you using them?
1.3.4.3. What is their purpose?

1.3.5.1. What kinds of NBS and BGS are you working with?
1.3.5.2. What is their role in this project?

1.3.6. What services are they expected to provide and to whom?
1.3.7. Which services of NBS do you find most important? (rank them)
1.3.8. How do they help fulfil your overall aim?
1.3.9. How do they relate to your values?

If already implemented, or if previous experiences exist:

1.3.9.10. How content are you with the performance of NBS/BGG?
1.3.9.11. What benefits do you perceive?
1.3.9.12. Which characteristic of NBS and BGS makes them most attractive to you?
1.3.9.13. How could their performance be enhanced?

2.3. OTHER STAKEHOLDERS

2.3.1. What is your perception/understanding of the project (green area)? *(or "was", before the researchers explained it)*
2.3.2. Did your perception/understanding of it change over time?

2.3.3.1. What do you think about the green area?
2.3.3.2. How does it relate to your values?

2.3.4.1. What is its purpose?
2.3.4.2. What potential does it have?

2.3.5.1. What services do you perceive or expect from it?
2.3.5.2. What benefits do you perceive?
2.3.5.3. How could its benefits be enhanced?
2.3.5.4. Can you place them in a hierarchical order based on what you personally value the most?

*Understand **the process** of the project:*

1.4. PRACTITIONERS

1.4.1. What type of assessments (values, needs, risks, vulnerability) was the plan initially based on?
1.4.2. Where is the expertise coming from?

- 1.4.3. What types of experts (ekosystemtjänster, climate adaptation, risk & vulnerability experts) did you consult with? What disciplines are they from? (*make notes of contacts*)
  1.4.4. What is their role and level of involvement?
  1.4.5. When and how did you consult with them?
  1.4.6. What did they recommend?
  1.4.7. How did you deal with their recommendations?
  1.4.8. Who is involved in making decisions during the planning stage of the project?
  1.4.9. Who has the final say?
  1.4.10. What types of skills and knowledge could the group of people currently working on the project be enhanced with?

  1.4.11. Who else is involved in the project? What are the stakeholders?
  1.4.12. Who decides who is involved?
  1.4.13. How were the different stakeholders approached? At what stage of the process?
  1.4.14. What was the role and contribution of the different stakeholders?
  1.4.15. What are their responsibilities? Who has/had what mandate?
  1.4.16. What consultation loops were there?
  1.4.17. Who was consulted at what point, for what reason?

*First let them name all **stakeholders and actors** that they come up with by themselves. If certain stakeholders are missing ask specifically:*

1.5. What other stakeholders/actors/players that are/were not involved could/should have been involved?
1.5.1. How are/were private actors involved? Why (not)?
1.5.2. How are/were XYZ involved?
1.5.3. How are/were they approached and engaged?
1.5.4. At what stage of the process?
1.5.5. What is/was their role and contribution?
1.5.6. What is your expectation towards them?

1.6.1. How relevant is private stakeholder engagement for the success of NBS in Malmö/Lund?
1.6.2. What role does private stakeholder engagement play on your organisation's agenda?
1.6.3. What are some best practices for private stakeholder engagement that you know of?
1.6.4. To what extent are these best practices being implemented by your organisation?
1.6.5. What are the challenges with implementing such best practices?

2.4. OTHER STAKEHOLDERS

2.4.1. How were you approached when this project was implemented?
2.4.2. At what stage of the process?
2.4.3. What made you (not) engage?
2.4.4. What was your impression of this approach?
2.4.5. How and when would you have liked to be approached?
2.4.6. Reflecting on it now, would you have liked to be consulted? Why (not)?

2.4.7. What would you have liked to contribute?

*Understand the **challenges:***

1.5. PRACTITIONERS

1.5.1. How successful do you consider the project? Why (not)?
1.5.2. What obstacles do you foresee?/What could go/went wrong?
1.5.3. What challenges are you anticipating/facing?/What challenges did you encounter?
1.5.4. Why is that a challenge/an obstacle?
1.5.5. When did you encounter that challenge/obstacle/problem?
1.5.6. What challenges/obstacles/problems do you foresee when it comes to private stakeholder engagement? *(if not mentioned)*

2.5. OTHER STAKEHOLDERS

2.5.1. What are your concerns?
2.5.2. What problems are there/do you foresee?
2.5.3. Why is that a challenge/an obstacle/a problem?
2.5.4. When did you encounter that challenge/obstacle/problem?

*Understand **the current situation** and potential **ways forward** (RQ1 +RQ3):*

3.1. PRACTITIONERS & OTHER STAKEHOLDERS

3.1.1. How were the challenges dealt with so far?
3.1.2. How are you expecting this challenge/problem/situation to develop in the future?
3.1.3. What will you do about it?
3.1.4. How will/would you tackle the challenges?/How are you dealing with them?/How were they dealt with?
3.1.5. How do you rate your chances of tackling/solving that problem?

3.1.6. Who would have to be involved in that?
3.1.7. How do you think these people would be best approached?
3.1.8. What types of incentives would have to be provided for the relevant actors to come on board?
3.1.9. When you think about the future of the city of XYZ, what aspects do you deem most important for its development?

WRAP UP

Close the interview with recalling potential follow up, such as exchanges of contact details to further informants, and/ or documents and data. Thank the interviewee for their time and ask them whether they want to be invited to a presentation of our research results.

Appendix II: Interview Data Sample

	ID	Occupation	Organization	Date
1	VS-Civil-Servant-1	Communicator	VA SYD	January, 2022
2	VS-Civil-Servant-2	Project Coordinator	VA SYD	February, 2022
3	Civil-Servant-1	Urban Planner	F&G Malmö	March, 2022
4	Civil-Servant-2	Urban Planner	F&G Malmö	March, 2022
5	Civil-Servant-3	Referral Agent	MF Malmö	March, 2022
6	Civil-Servant-4	Planning Strategist	F&G Malmö	March, 2022
7	Civil-Servant-5	Urban Planner	Stadsbyggnadskontoret Lund	March, 2022
8	Politician-1	Politician	Liberal Party Malmö	March, 2022
9	Politician-2	Politician	Green Party Malmö	February, 2022
10	Consultant-1	Consultant	SWECO	March, 2022
11	Consultant-2	Consultant	Urban Island	March, 2022
12	Consultant-3	Consultant	Scandinavian Green Roof Institute	March, 2022
13	Consultant-4	Landscape Architect	Edges	February, 2022
14	Developer-1	Architect	White Architects	February, 2022
15	Developer-2	Project Coordinator	Lund Cathedral	February, 2022
16	Informant-1	Business Representative	Svensk Försäkring	February, 2022
17	Informant-2	Representative of PPOs	Fastighetsägarna Syd	February, 2022
18	Informant-3&4	Civil-Servants	Gothenburg City	February, 2022
19	Informant-5	Researcher	RISE	March, 2022
20	Informant-6	Researcher	Lund University	February, 2022
21	Informant-7	Researcher	Lund University	April, 2022
22	Informant-8	Researcher	RISE	March, 2022

Table 1 shows the title of the interviewee, their affiliated organisation, the month and year when the interview was conducted, and the ID, which is used in the Conceptual Framework and the Results. There was no question about the gender identity of the participants, for which reason they are all referred to in the text with the pronoun “they”. 21 interviews in total were conducted, and in two of the interviews (14/15 and 18) two people were being interviewed simultaneously.

Appendix III: Document Analysis Data Sample

COMPLEMENTARY DATA

ID	Year	Document Name	Author/Affiliation	Brief Description
[1]	2022	Email Thread	VS-Civil-Servant-2	A comment on the possibility of Malmö incorporating a legislative set-up similar to Stockholm's "åtgärdsnivå".
[2]	2022	"Första rapporten från Nationella expertrådet för klimatanpassning" (translation: The first report from the National Expert Council on Climate Adaptation)	the National Expert Council on Climate Adaptation	An expert report on the current status of national climate adaptation measures in Sweden and providing advice to the Swedish government.
[3]	2022	"Naturbaserade lösningar i urbana miljöer Erfarenheter från Blue Green City Lab (Nr C 660)" (translation: Experiences of Urban NBS from the Blue Green City Lab)	Mattson, E. & Holmqvist, J. Publisher: IVL - Svenska Miljöinstitutet	A report presenting results and experiences from the BGCL, which aimed to increase the use and development of urban NBS by investigating hydrological performance and ecosystem services.
[4]	2021	"Klimatanpassning – kostnader och finansiering" (translation: CCA - costs and finances)	Gramstad, O. & Löfgren, C. (Boverket)	A pilot study about costs and finances related to CCA-actions against erosion and flooding in the built environment. A governmental assignment handed over to Boverket.
[5]	2021	"Miljöprogram - Environmental Programme for the City of Malmö 2021–2030"	Miljönämnden (Environmental Committee)	A programme adopted by the Malmö City Council in 2021 to guide the city's efforts in tackling climate change and environmental degradation.
[6]	2021	"Naturbaserade lösningar – ett verktyg för klimatanpassning och andra samhällsutmaningar" (translation: NBS - a tool for climate adaptation and other societal challenges)	Naturvårdsverket	A report with a purpose of spreading information and knowledge about NBS and giving guidance on how they can be planned and executed.
[7]	2021	"Objektsgodkännande underlag Projektnamn: Grönare Möllan (4875)"	F&G	A project proposal regarding greenification of the Möllevång city district in Malmö through the increase of tree coverage as a climate adaptation and drainage solution.

		(translation: Object authorization document)		
[8]	2021	"The Eco-city Augustenborg – experiences and lessons learned" 1. A Book about the Eco-City Augustenborg 2. Ekostaden Augustenborg as a permanent urban laboratory 3. Augustenborg – innovation with a social angle	Publishers: MF, MKB Fastighets AB, SLU Alnarp, the Sustainable Business Hub Persson, B. (SLU Alnarp) & Månsson, M. (MF) Karvonen, A. (KTH) Graham, T. (project manager)	Book chapters about the origin of the Augustenborg project as well as anecdotes about its success.
[9]	2021	"Tillsammans gör vi plats för vattnet 2021" (translation: Together, we will make space for water 2021)	VA SYD	A yearly report on the progress on the programme.
[10]	2020	"Blue-Green Solutions and Everyday Ethicalities Affordances and Matters of Concern in Augustenborg, Malmö"	Mottaghi, M., Kärrholm, M. & Sternudd, C. (LU)	A peer-reviewed journal article which explores the effects BGS has in citizens' lives through the establishment of affordances in the Augustenborg city district in Malmö.
[11]	2020	"Finansieringsmodeller för klimatanpassningsåtgärder" (translation: Finance models for CCA-actions)	von Bahr, E. & Ivarsson, M.	A report commissioned by the regional "Kustsamverkan" (coastal partnership) in Scania and Halland in order to map out potential financing opportunities for erosion and flooding in the area.
[12]	2020	"Livable Streets - A Handbook of Bluegreengrey Systems"	Fridell, K., Thynell, A., Bruhn, F., Fors, J., Sixtensson, S., & Vysoký, M. (Edge) in collaboration with the municipalities of Uppsala, Malmö, Lund, Norrköping, Helsingborg, Nacka, Växjö	A handbook about combining blue-green with the urban gray.

			and Karlskrona.	
[13]	2020	PowerPoint Presentation	VA SYD	A report on the study results in the framework of “Tillsammans gör vi plats för vattnet”
[14]	2020	“Undersökning av incitament för införande av LOD på hyresfastigheter” (translation: A study of incentives to implement BGS in rental properties)	Olsson, S. (LU) In collaboration with VA SYD	A project report of an investigation of small private property owners and the incentives needed to implement more local stormwater management / BGS.
[15]	2020	“Urban Insight: Planning for Climate Adaptation Key actions for resilient and adaptive cities of the future”	SWECO	A report with the aim of guiding acceleration of climate adaptation by providing examples from city case studies.
[16]	2019	Drivers of changing urban flood risk: a framework for action	Berndtsson, R.; Becker, P.; Persson, A.; Aspegren, H.; Haghighatafshar, S.; Jönsson, K. et al. (2019)	
[17]	2018	“BLÅGRÖNA LÖSNINGAR I SOFIELUND - Klimatanpassningsåtgärder i allt tätare städer” (translation: BGS in Sofielund - Climate adaptation measures in ever-denser cities”	Alkan Olsson, J. & Hanson, H. (LU)	A study where small and large property owners have been interviewed in order to identify optimal BGS solutions and visions for the Sofielund city district in Malmö.
[18]	2018	Survey Results	VA SYD	A document of over 40 answered questionnaires aiming to map out levels of knowledge about locally treated stormwater and willingness to partake in disconnecting downpipes in the Rostorp city district in Malmö.
[19]	2017	PowerPoint Presentation	VA SYD	A preliminary project investigation for “Tillsammans gör vi plats för vattnet”
[20]	2017	“Skyfallsplan för Malmö” (translation: Cloudburst-plan for Malmö)	Execution in collaboration with different municipal actors: GK, SBK, MF, FK, ETOS, SEF, and VA SYD.	A plan commissioned by the Malmö municipal council on how the city of Malmö should prepare for future cloudbursts with lessons learned from the cloudburst event of 2014.
[21]	2017	Vegetation för regnbäddar – aspekter att tänka på (translation: Vegetation for Rain gardens - aspects	Danielsson, N.A. (SLU Alnarp)	A degree project with a focus on finding suitable vegetation for the raingardens on Monbijougatan, Malmö.

		to consider)		
[22]	2017	"Vem har ansvaret?" (translation: Who has the responsibility?)	SOU (Statens Offentliga Utredningar) 2017:42	A governmental investigation to analyze how the responsibility is divided between the state, counties, municipalities and individuals to adapt on-going and planned landuse and built environment in the face of the changing climate. A question of special interest was that of sustainable stormwater management.
[23]	2016	"Nature-Based Solutions in Urban Contexts - A Case Study of Malmö, Sweden"	Barton, M. (LU)	A graduate thesis studying NBS in Malmö.
[24]	2016	"Re-Thinking Urban Flood Management—Time for a Regime Shift"	Sörensen, J. (LU), Persson, A. (LU), Sternudd, C. (LU), Aspegren, H. (LU), Nilsson, J. (MU), Nordström, J. (LU), Jönsson, K. (LU), Mottaghi, M. (LU), Becker, P. (LU), Pilesjö, P (LU), Berndtsson, R. (LU) & Mobini, S. (VA SYD).	A peer-reviewed journal article calling for a shift from traditional single-purpose drainage systems into integrated systems in a multifunctional urban environment.
[25]	2015	"Vem tar ansvar för klimatanpassningen? – En översikt ur ett försäkringsperspektiv" (translation: Who takes the responsibility for CCA - an overview from an insurance perspective)	SF	A report by the Swedish Insurance roof organisation, the purpose of which is to educate and push other stakeholders to take urgent CCA action.
[26]	n.d.	"BiodiverCity - Om grön innovation i det urbana rum" (BiodiverCity - Regarding green innovation in the urban space)	the City of Malmö, VINNOVA, EU	A summary report of different green innovations in the city of Malmö.
[27]	n.d.	"Blue Green City Lab"	Leonette, J. & Toft, E. (Malmö stad) Chin, A. & Lanka, J. (AFRY)	A narrative report of the lessons learned during the Blue Green City Lab -project.
[28]	n.d.	"Snapshot - Malmö BiodiverCity"	Naturvation	A project snapshot of NBS and sustainable urban development in Malmö.

Table 2 portrays all the complementary data sources, their ID, author and a short description of content.

Appendix IV: Stakeholder Map