Management, valuation and evaluation of urban greenspace and trees in relation to resilience;

The importance of ecosystem services in the built environment and how they are maintained and cared for.

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Management, valuation and evaluation of urban greenspace and trees in relation to resilience;
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Skötsel, värdering och uppföljning av stadsgrönska och träd ur ett resiliensperspektiv;
*Ekosystemtjänster betydelse i bebygg miljö, hur de uppmärksammas och underhålls.*

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Abstract

Managing worldwide urbanization and housing shortage in cities through a resilient development is an immense issue of today. This study states the risk with urban densification, at the expense of greenspace, which is crucial to maintain vital ecosystem services. The nonlinear response to disturbance in ecosystems, need to be emphasized both in planning and practice, to avoid degradation and collapse. Despite general promotion of densification as a tool to decrease negative urban impact on surrounding landscape, as to mitigate climate change, current strategies of compacting cities are argued to endanger future resilience. In this work, it is stressed that valuation of greenery in urban areas should include the recognition of uncertainty, safeguarding the availability of all forms of ecosystem services in a changing future. Applying a framework of social-ecological resilience, a case-study of Stockholm regarding valuation of greenery and ecosystem services in planning and exploitation, as in continuous management, has been carried out. A wide range of actors within the fields of green management, planning and exploitation have been interviewed. When compared with expressed visions in comprehensive plans and policies, results from interviews show severe gaps between planning and practice. Foresight planning in relation to adaptive governance, to enhance social-ecologic interactions, is suggested a tool to improve implementation and acknowledgement of ecosystem services in urban development and design. Further, enhanced cross-learning and knowledge exchange in the social-ecological system, should be improved through interaction and recognition of the variety of stakeholders and multi-functional green areas to strengthen social-ecological resilience in the urban context.

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**Abbreviations used in study:**
- ES - Ecosystem services
- GAF - Green Area Factor
- RUFS - Regional development plan of Stockholm
- SER - Social Ecological Resilience
- SES - Social Ecological System
- UES - Urban Ecosystem services
1. Introduction

Facing the challenge of rapid world-wide urbanisation (United Nations, 2018), not the least, regarding severe urban impact on both local and remote environment in relation to land-use and climate, prerequisites for future resilience in urban contexts are of relevance to investigate (Barthel, et al., 2013). As a response to environmental degradation and climate related problems there is an increasing knowledge and understanding of the need for incorporating ecosystem services (ES) in urban planning (Andersson, et al., 2014; Maes, et al., 2015). In a changing climate with more extreme weathers and increasing risk of flooding, as of heatwaves and periods of drought, the adaptability and transformative capacity to cope with disturbance, shock and change will be increasingly important (Resilience Alliance, 2010; Berkes, et al., 2003; Folke, et al., 2010). Simultaneously growing populations in urban areas stresses the need to deal with housing shortage, currently the formal strategy is by densification, which risks to decrease greenspace related to resilience (Andersson, et al., 2014; Maes, et al., 2015). Arguing negative effects from urban sprawl, as transport patterns of increased private car-use and dispersed housing that entail a lavish land-use spoiling resources, the environmental promotion for densification and in-fills aims to reduce car-use through decreased sprawl and improved accessibility (Handy, 2005). A proximity to various services and increased use of public transports is regarded a tool for climate mitigation (Kyttä, et al., 2013; Iacono, et al., 2008). Still policies to achieve sustainable cities through densification, as the environmental and social benefits, are questioned because of loss of greenspace, ES and life-quality and urban resilience (Haaland & Konijnendijk van den Bosch, 2015; Faehnle, et al., 2015; Demuzere, et al., 2014). Ahern (2011) and Holling and Meffe (1996) claims that what constitutes a sustainable city has been revised from the aim of creating static sustainability based on fail-safe planning towards resilience, i.e. a structure or system that is able to change, or safe-to-fail as Ahern expresses it. From an understanding of how everything in an ecosystem is linked together and how different decisions and developments affect each other in the larger picture, there should be an overall aim in planning to constantly scale in-and-out, comprehending the whole social-ecological system (SES) (Ahern, 2011; Walker & Salt, 2006). Here management of existing greenery, enhancement and acknowledgment of ES are strategic tools to improve resilience and to enhance the capacity to adapt and transform to future changes (Faehnle, et al., 2015; Schewenius, et al., 2014).

The project is based on the knowledge of the role ES play in the built environment, their linkages to biodiversity and green connectivity, to social impact on health and wellbeing, as preconditioning for social-ecological resilience (SER) (Resilience Alliance, 2010; Folke, 2006; Maes, et al., 2015; Millennium Ecosystem Assessment, 2005). Building on the preunderstanding of benefits from ES in the urban context, the main focus of the study has been on if ES are maintained and how resilience is enhanced in planning and practice.

There has been a descriptive aim with the study, contributing to an understanding of how ongoing densification and greenspace-management in Stockholm is likely to affect resilience. How ES related to greenery and trees are valuated in the city-structure and if and how evaluation of trees and greenspace management is carried out in relation to densification projects and existing developments. Looking at the relation and coherence between plans and practice, there has also been an aim contributing to a prescriptive suggestion of what aspects in planning and management needs to be considered and improved to make practice reflect visions in plans, hence supporting a resilience based urban development.
Research questions used for the study were:

- **How do valuation and management of various green structures affect important ES and resilience in a densifying city?**
- **How are strategies and visions regarding ES and green structures in comprehensive plans and environmental policies communicated and implemented in urban developments and practical greenspace management?**
- **How are monitoring and evaluation of urban green structure management carried out in relation to urban development?**
- **What impact will ongoing densification processes have on resilience in relation to ES, green structures and climate change?**

To answer these questions, a qualitative case-study on planning for- and management of greenery has been carried out in the municipality of Stockholm, Sweden, presented below.

### 1.1. Ecosystem services in the built environment

*ES* are most commonly divided into four different groups; provisioning, regulating, cultural and supporting (Millennium Ecosystem Assessment, 2005). Provisioning *ES* defines different material services as food, freshwater, fuel, fibre etc. Regulating *ES*, which are of particular interest for this study, defines regulating services as climate-, water- and human-disease regulation, water and air purification, storm control and pollination among others. Cultural *ES* are non-material and socially related services from the ecosystem of high relevance for the study of an urban context where many people live close together with a limited access to greenery and nature. Cultural *ES* are important features of the identity of an area, including aesthetic and cultural values as educational and recreational purposes (Millennium Ecosystem Assessment, 2005; Haase, et al., 2014; Haaland & Konijnendijk van den Bosch, 2015). *ES* are also strongly related to learning processes and recognition of values of nature and ecosystem, as the ability to interact and identify oneself in a social-ecological system, which is reflected in SER theory (Berkes, et al., 2003). Supporting *ES* are the base for all other services; soil formation, primary production and cycling of nutrients (Millennium Ecosystem Assessment, 2005). Haaland and Konijnendijk van den Bosch (2015) stresses that a fundamental part of urban resilience is the access to multiple *ES* and hence a biodiverse and vivid ecosystem.

There is an increasing understanding of the importance to integrate *ES* in planning through various forms of greenspace, preserving and enhancing biodiversity, in urban areas (Andersson, et al., 2014; Faehnle, et al., 2015). Colding et al (2006) emphasizes that creating nature reserves in connection to urban areas is not enough maintaining biodiversity and *ES*. Assessment of many different nature reserves in Europe, shows how nature reserves often are degrading over time, due to insufficient maintenance. Management is discovered to be of high importance preserving biodiversity in urban areas. The main reason for poor management found by Colding et al (2006), was due to unwillingness of paying costs for maintaining a high quality in the reserves. A variation in types of greenspace in urban areas, not overlooking smaller green areas in planning, as engagement of different stakeholders, is likely to strengthen local knowledge and contribution to *ES* in cities. Acknowledging a decentralised management through allotment gardens, city farming and private gardens, is also regarded to improve resilience (Colding, et al., 2006). The more people that move to urban areas, the more urgent the issue of maintaining urban *ES* become. Here the importance of UES (urban ecosystem services) through trees are generally underestimated, why often caretaking of urban trees is under prioritized and neglected (Konijnendijk, et al., 2005). Urban forests have a long...
1.2. Theoretical framework

The investigation was carried out using a theoretical framework and analytical tool of social ecological resilience. Living in a time of rapid environmental change, with increasing global threats as severe ecologic degradation, loss of biodiversity, social turbulence and inequity as the overarching presence of climate change, the need of a resilient thinking is crucial, keeping within planetary boundaries (Rockström, et al., 2009; Schewenius, et al., 2014).

1.2.1. The concept of social-ecological resilience in planning

A resilient planning includes the acknowledging and identification of different disturbances that the urban social-ecological system (SES) might face in the future. Creating a capacity to handle and respond to changes includes incorporating awareness of uncertainty, in policies (Ahern, 2011; Walker & Salt, 2006). The adaptability and transformability to outer change and disturbance, is far more important than trying to create a fixed stability, since an inflexible system risks to collapse or shift to another state or regime when exposed to shock or changing conditions (Ahern, 2011; Walker & Salt, 2006). Folke (2006) stresses the importance not only of adaptability to change, but the capacity of using periods of disturbance for renewal, re-thinking urban systems or policies, as "window of opportunities", which then might become an innovative way of managing change in the SES. The ability of social change, is central in SER and can be strengthen by smaller-scale social transformations, creating opportunities of cross-learning in the SES. Transformative capacity is otherwise considered a rather radical event, when a system is transformed into another domain of stability, caused by the former becoming unsustainable (Folke, et al., 2010).
The non-linearity in ecosystem dynamics, implies that an awareness of possible tipping points between different domains need to be considered in planning and development, where also spatial and temporal scales should be in focus, not forcing the system cross critical thresholds (Folke, 2006; Folke, et al., 2010; Barthel, et al., 2013). An ecosystem is constantly undergoing slow changes in between different rather stable states within the same functional domain, although when disturbances causing these changes appear too often or at too large scale, they risk causing a regime-shift, where capacity to maintain functions get lost (Barthel, et al., 2013; Walker & Salt, 2006). Transferred to UES in complex social-ecological systems of interactions within planning, development and practical management, the capacity e.g. of green-structures to maintain cultural and regulating functions, depends on how social-ecological infrastructures are connected, simultaneously enhanced and acknowledged (McPhearson, et al., 2014).

Future global sustainability and resilience is dependent on the development of urban areas Ahern (2011) argues, relating to the forecast that 70% of the world population will be living in cities 2050, facing already more than half of all humans living in cities. McPhearson et al (2015) claims that we need to discuss the multidisciplinary concept of resilience starting from the understanding of "resilience of what to what" adding the aspect of "for whom", particularly in an urban context. Stressing the important relation to- and valuation of urban ES to promote and enhance urban resilience, McPhearson et al (2015) makes a distinction between insurance value and option value in valuation. The insurance value includes maintenance of ES regardless disturbance and uncertainty of management, whereas option values reflect the flexibility regarding usage and multi functionality of greenspace over time. The overall lack of consideration and valuation of greenspace in today’s planning and exploitation projects, threatens to lock cities into developments that significantly reduces the capacity to deal with future change. Faehnle et al (2015) claim that urban ES should be treated differently depending on specific spatial and temporal condition at stake in a place or planning project, acknowledging social structures and attitudes. That is, what characterizes a specific place and what role does it play in different SES? The aim with this approach is to include different social interactions, culture and activity that affects how and by whom, the greenspace will be used. Although spatial typological analyses generally have been used to define ecological aspects in a landscape, there is a possibility to expand the use to an understanding of what type of ES is provided and what social-ecological dependencies might affect it, in a certain space and time (Faehnle, et al., 2015). Depending on what perspective you use, trade-offs from ES in various areas will be defined differently, e.g. forests close to schools gives the opportunity of nature-experience, wellbeing, air quality and interaction that school children benefit from. Although from a strict city-planning perspective, it might seem more beneficial to build in the forested area producing a larger amount of housing or social services. Faehnle et al (2015) advocates a strategy of using different scales in relation to each other, to create a wider understanding of how different scales are affected by a specific planning or development.

1.2.2. The resilience of and from urban ecosystem services

The need of greenery, particularly connectivity in between larger green structures within and in proximity to cities, is of most importance to acknowledge in planning and exploitation projects, as a strategy towards resilience (Andersson, et al., 2014). McPhearson et al (2014) emphasises how urban green-structures are not only important from their provision of regulating ES and mitigation and adaptation to climate change, they play an important role for human wellbeing, both on a physical and psychological level, improving the local environment and availability to ES. Regulating ES, reducing risks, that compacted cities are particularly vulnerable to, as heat-islands or events of flooding, are most commonly addressed in urban planning. We face an increasing importance maintaining all forms of ES in urban areas, not the least from the aspect of global change. Today's
supply-patterns may fail and the need of self-sufficiency increase, i.e. to ensure long-term water and food supply for the urban population and a healthy, resilient environment (McPhearson, et al., 2015). There is an observed relation between management and resilient ecosystems, why organisational structures and governance are important parts in maintaining SER (Colding, et al., 2006; McPhearson, et al., 2015). The resilience of ES themselves also needs to be attended, not the least since there are large uncertainties about how ecosystems will respond to disturbances as climate change. A high biodiversity and multiple kinds of UES is considered crucial to enhance and safeguard ES over time. Aspects maintaining a diverse ecosystem i.e. good connectivity, should be given priority in planning, hence safeguarding maintained provision of services needed also for urban and social resilience (McPhearson, et al., 2015).

In a case-study of a boreal city, correlating to the spatial structure of Stockholm, with a rather dense inner core spreading out to less compacted areas integrated with nature, dominantly old forests, Faehnle, et al (2015) found a pattern of how different ES are experienced in relation to their spatial placement. The connectivity and interrelation that still exist between wooden areas are often central for production of ES. Different ES as noise-reduction, clean air and shadow during warm periods is perceived in proximity to the forest or park, whereas flood reduction can be most evident downslope or further down in the watershed (Faehnle, et al., 2015; McPhearson, et al., 2015). Isolation of greenery is a reoccurring issue in the urban context, which needs to be considered in planning. To maintain a heterogenic and biodiverse nature urban areas are dependent on functioning connectivity and the mixture of different land-use patterns as parks, allotment- and private gardens as of forested areas and nature reserves both within and outside the city. Smaller patches of greenery, if functionally designed in relation to other greenspace, might play a central role maintaining connectivity through an urban landscape (Andersson, et al., 2014; Borgström, et al., 2012).

Proximity to greenspace in cities tends to make housing more attractive. Green areas appeal to exploitation, often with the result of degradation of the greenspace that attracted exploitation, due to reduced size and by losing important connections to surrounding greenery (Andersson, et al., 2014; Borgström, et al., 2012). Considering how densification of urban areas reduce greenery of high value, not only from a perspective of dwellers health and wellbeing, but regarding capacity to cope with environmental issues and climate change, a SER-thinking is needed in planning (Schewenius, et al., 2014).

1.2.3. The complexity of governance in social-ecological systems

ES, particularly non-disaster related, repeatedly fail to be acknowledged in planning, even so in documents and policies expressing an intention of enhancing resilience (McPhearson, et al., 2015). Stressing the poor knowledge on how policies regarding UES, when comprised in planning documents, are transferred to practice, McPhearson et al (2015) suggest a need of improved understanding of resilience in relation not only to external, but internal drivers of change. The human capacity to restore and enhance resilience and ES should not be neglected but displayed- creating a feeling of ability to change, rather than a human self-recognition as purely negative from an environmental standpoint (Tidball & Stedman, 2012). This coincides with Ostrom's work on governance structures (1990), where she criticizes ideas of uniform top-down management and privatisation as solutions for sustainability, arguing that contrary the tragedy of commons theory, the valuation and institutions around a common resource might be the most sustainable way to maintain a resource or ecosystem. Her ideas derive from the general knowledge and understanding of how a common dependency on a resource and hence valuation and cautious management of the same, often goes hand in hand (Ostrom, 1990). Tidball & Stedman (2012) claim that focus should be put on interactions that creates virtuous cycles, to visualize citizen stewardship that improves resilience, as
which management processes in the urban SES that needs to be prioritized (Tidball & Stedman, 2012). To enhance learning in a SES, both exchange of knowledge and evaluation of strategies and methods needs to be a continuous process (Hauge Simonsen, et al., updated 2017).

Although urbanisation is a threat of environmental degradation, Barthel et al (2013) stress how cities at the same time can function as the gate towards alternative ways of living and problem solving, as knowledge exchange through social interactions. The ability to learn, social transformation and acknowledging and incorporation of innovations, is a crucial part in resilient urban development. Resilience thinking in relation to governance structures can strengthen both social and ecological systems through stewardship and participation in management (Marcus & Colding, 2014; Andersson, et al., 2014). People living in cities need a physical contact with ES, reconnecting to- and getting an insight in our dependency of the biosphere, changing the perception and overuse of natural resources (Andersson, et al., 2014). We need to acknowledge the interdependency between social and ecologic systems, placing us as urban citizens within the ecosystem we inhabit and to stress how our behaviour and needs, not only are dependent on ecosystems around us, but will affect them and ourselves as beings in those ecosystems (Folke, et al., 2010; Rockström, et al., 2009).

2. Research approach and methodology

2.1. Case study and mixed methods approach

To get an insight into future resilience, both densification processes in relation to greenspace and ES, and continuous management of existing greenery and parks was of interest to investigate, analysing results from the theoretical framework. Attention on management is likely to give an understanding of valuation and acknowledgement of green-structures, parks and trees in planning and decision making. The importance of greenspace reflected in budgets for personnel and time, as functioning organisational structures will affect quality of greenspace, hence ES provided, influencing urban resilience (Faehnle, et al., 2015; Haase, et al., 2014; Andersson, et al., 2014).

Main methods used in this investigation were literature and document reviews and qualitative interviews. The study was developed to investigate how strategies, knowledge and visions in comprehensive planning are communicated and forwarded through exploitation processes and how they correspond with completed developments and practical management. From the extensive process and number of stakeholders, aspects and considerations involved in urban planning and development, the mix-methods case study approach was decided most appropriate. The mixed methods approach was chosen to be able to combine information from literature and documents with information regarding practical experience (Yin, 2006). Gathering data through meeting and interviewing stakeholders involved in processes of planning, exploitation, valuation and management of greenery was a crucial part of the investigation. Yin (2006) describes a case study as an empirical investigation of an ongoing phenomenon in a current context, where borders between context and phenomenon is not completely clear and where data from varying sources are analysed from a theoretical framework based on earlier research. The aim with this case study has been to contribute to existing knowledge and research regarding resilient urban development, looking at green structures in relation to densification. SER theory was used as a framework and analytic tool to analyse results (Teorell & Svensson, 2007). The method was chosen from an intention to investigate results from- and how decisions on densification of the case study area Stockholm are taken. By whom are decisions made, on what grounds and from what larger considerations of land-use in
relation to expressed visions of a resilient urban development in the comprehensive plan (Yin, 2006; Stockholm stad, 2017a). Regarding the complexity of resilience in an urban context (Barthel, et al., 2013), there has been an aim to improve understanding of how it is affected by various social- and political aspects and trends, by organisational structures, group dynamics and individual attitudes and knowledge, to increase insight of possible barriers for implementation of environmental strategies in developments.

Stockholm is one of many expanding cities facing growing populations and housing shortage. The city was chosen as a case study area because of intense development, using densification as the main strategy (Stockholm stad, 2017a). To investigate the impact of densification on greenery and ES, Stockholm municipality was regarded representative for densification processes and how they are related to valuation of various green-structures. Unlike Stockholm, many European cities have already exploited most of their green structures, now needing to invest large amounts to restore them (Egerö, 2018). Densification strategies in Stockholm are argued to simultaneously enhance green structures (Stockholm stad, 2017a) making them of interest to study. Figure one visualizes the amount of ongoing developments in the municipality. Are compacted urban areas compatible with improved ES, or is ongoing development in Stockholm a threat to future resilience? Although all cities have specific pre-conditions, many interactions and valuation procedures that occur in planning and exploitation processes, are likely to be comparative among Western cities (Peck, et al., 2009; Campbell, et al., 2014). Another area of interest is continuous management of greenspace and how it affects provision of ES. Stockholm that is promoted as a green and environmental city on the leading edge makes a relevant case (Stockholm stad, 2017), with high environmental ambitions and considerations in documents as A Greener Stockholm (Stockholm stad, 2016a), the Environmental programme (Stockholm stad, 2017) and the comprehensive plan Stockholm is Growing (Stockholm stad, 2017a).

2.2. Description of case study area

Stockholm, as many boreal cities, has large green structures, where the green wedges, see figure 2, are of particular importance, giving a unique urban resource of high biodiversity, ES and capacity to adapt to climate change (Faehnle, et al., 2015). The region comprehends many of Sweden's ecologically most valuable and biodiverse natural forests and habitats for many endangered species.
(Andersson, et al., 2014; Maes, et al., 2015; Rydberg & Falck, 2000). Although large areas are currently protected, there is a huge interest in decreasing this protection to make exploitation available. With a growing population and demand for new housing, land in the region is of high economic value for exploitation (Borgström, et al., 2012; Rothman, 2018; Terä, 2018).

Figure 2. Map over Green wedges (light green) and connectivity (arrows- where dark arrows stand for weak connections), in Stockholm region. Source (Boverket, 2016).

Stockholm comprehensive plan expresses a strong focus on new development and densification, planning to increase the number of housing with 140 000 dwellings in the next 15 years and to reach 1 million residents in the inner-city within a few years (Stockholm stad, 2017a). Stockholm municipality is one of 26 municipalities in a larger urban region. The comprehensive plan comprises the development of the 14 City Districts within Stockholm municipality. Whereas the regional development plan for Stockholm (RUFS) (Stockholms läns landsting, 2018), includes the whole region. The intense development is meant to take place through densification of identified focus
areas, through linking city parts together and by in-fills in already existing housing areas. Another aim is to further densify the inner-city areas and merge them together with the closest "outer-city" areas, increasing attractiveness of the city core by creating a dense city structure (Stockholm stad, 2017a). There is an outspoken aim in the comprehensive plan to create a more "city-like" structure, creating a vivid city-life with high accessibility to culture and services, see figure 3 (Stockholm stad, 2017a).

Figure 3. Map from comprehensive plan showing city development, where pink striped areas shows main and light pink complementary development, pink arrows strategic connections for developments, light green areas possible developments, dark striped green area nature reserves and green arrows ecologic connections that needs to strengthened (Stockholm stad, 2017a).

In combination with densification, parks and green structures are explained to be enhanced by planning for ES, as in the pilot project the Royal Seaport (Stockholm stad, 2016b). Considering that this development takes up a very little part of the major densification and number of ongoing developments in the city, an understanding of how densification processes generally function is of high value for a future prospect of resilience. From the perspective of existing research on urban ES
and resilience (Faehnle, et al., 2015) (McPhearson, et al., 2015) (Folke, et al., 2010), it has been an ambition to investigate likely gaps between visions and practice in Stockholm. Is the altering of land-use to the expressed extent possible, without risking degradation and loss of ES and hence resilience? How are challenges as increasing population, economic interests, political aims, social trends and wellbeing handled in relation to ecological and environmental issues, not the least in the light of a changing climate? In relation, it is worth noting that the concept resilience is mentioned only once in the 182p long comprehensive plan, here in relation to green-solutions. The word resilient is used three times, once in a table simply explaining the concept with no mention of how, twice in relation to energy-use in relation to growing population and climate change (Stockholm stad, 2017a), In the green-programme Greener Stockholm neither resilience nor resilient is mentioned at all (Stockholm stad, 2016a).

Substantial research is made on ES, biodiversity and resilience in the Stockholm area, why there is an existing knowledge of the importance- and vulnerability of the green wedges and other green structures that are likely to be affected by densification (Andersson, et al., 2014; Barthel, et al., 2013; Borgström, et al., 2006), giving a good background for further investigation. As a city with an environmental self-esteem, Stockholm municipality would be expected to act as forerunner, planning and developing a resilient city, why the interest in investigating practice in relation to visions is of extra relevance also from a general perspective: what is needed for implementation of strategies to take place and what is likely to become barriers?

2.2.1. Historical background of parks and management in Stockholm

Stockholm has a long history of city-planning including parks and conserving greenery in central areas (Asker, 1986). 1866 a new city-plan for Stockholm was admitted; the Lindhagen plan, developing a modern city with large boulevards and square city-blocks, which formed the stone-city of today. The structure was compacted and dense, though included alleys and many of the large parks, that are still the most important in Stockholm. From 1880 until the1930-ies parks as Vanadislunden, Kronobergsparken, Tegnerlunden, Tantolunden, Vitabergsparken and many other were founded from this plan, often on hills which were difficult to use for housing. 1869 Alfred Medin became the first city-gardener and was followed by dedicated city-gardeners within the Park Administration under the Street Administration until 1979. One of the most famous city-gardener was the landscape architect Holger Blom, from 1938-1971, who was of large importance implementing a functionalist view and architecture of parks and green areas in Stockholm, which should be accessible and enhance city-life for everyone. From 1940 until 1970 park-areal increased significantly in relation to new development of housing in outer city districts, during a period where much of the management could also be rationalized through new methods and machines. Despite rationalization and simplified management between 1940 and 1970, Asker describes how budgets for green-management and parks are increasing significantly, keeping a high standard on municipal greenspace (Asker, 1986). During the 70-ies the organisation was restructured, when Holger Blom resigned 1971, he was not replaced and the Park Administration was separated from the Street Administration 1979, although still responsible for all park- and green management in the city (Stockholm stad, 2017). 1992 the Park Administration was moved to the new Street and Property Administration and a year later in-house personnel was replaced by various entrepreneurs. The new administration had to procure entrepreneurs for management of parks, snow clearance, emptying garbage and similar in public spaces. When a few years later, 2005, the Street and Property Administration was divided into the Land Administration and Traffic Administration, management of urban parks was divided over a range of central municipal administrations and the14 different district administrations. The District Administrations had main responsibility for parks and procurement of entrepreneurs for practical management (Stockholm stad, 2017). The Land
Administration changed name to the Exploitation Administration 2007, to note the prime responsibility of exploitation and development rather than management of municipal land. Half of new built housing shall be rental apartments, where the developer leases land- and half condominiums, where land is sold off. The number is set for the whole city and the variation between detail plans is large (Björkefall, 2018; Åberg, 2018; Obermüller, 2018).

To focus the study, the inner-city district Kungsholmen was chosen representative of varying styles of developments in Stockholm, with both old and dense city structures on the east side and the semi-dense lamellar housing from the garden city-era (Stockholm stad, 2017) together with new developments partly still under planning and construction, in the western part (Stockholm stad, 2017b). Kungsholmen will be losing a substantial amount of greenspace through densification (Stockholm stad, 2017b) and the ongoing developments are representative for most development projects in the municipality (Stockholm stad, 2017a). Narrowing down the study area Kungsholmen City District Administration was used as a reference case of how greenery and trees are addressed in already dense, vs greener and less dense city structures undergoing densification, comprising the complexity of various urban developments. Because of the spread of information and examples given by the various respondents, the focus on Kungsholmen was diminished during the process, besides the selection of informants in relation to park management. The larger focus on Kungsholmen is based on interviewing the Park Engineer and landscape architect responsible for this area and the procured entrepreneur for Kungsholmen and Östermalm (Figure 9). Interviews regarding specific densification projects was also carried out for Kungsholmen. Overall two main focus-areas has been identified: Urban developments in central, already dense areas, where the main issue concern runoff management, risk of heat islands and general lack of ES from greenery and on developments in relation to the green wedges, nature reserves and other large green structures.

2.2.2. Strategies for greenspace and ES in planning

According to the Environmental Programme (Stockholm stad, 2016) and the green-plan Greener Stockholm (Stockholm stad, 2016a), accessibility to greenspace will be increased through improved management and restoration of existing parks in relation to development of new parks. Multi-functional parks will be developed in connection to new solutions as green roofs and walls, to meet future need of ES and greenery in relation to a growing population and climate change (Stockholm stad, 2016a). By ensuring connectivity between existing parks and greenery e.g. through street-trees, biodiversity and ES will be maintained, despite intense exploitation (Stockholm stad, 2017a). Green structures are argued to be improved by strengthening the ecologically most important green areas and to form management strategies towards multi-functionality and general enhancement of ES (Stockholm stad, 2017d). The comprehensive plan gives an overview of responsible administrations for management and a description of visions to keep a qualitative greenery in and around the city. Although, it does not comprehend a description of how this functions in practise, as valuation of connectivity in relation to exploitation, or how often EIA is carried out and leading to abolishment of development. Still, acknowledgement of urban greenspace, ES and the need of connectivity to maintain biodiversity in the municipality, can give important signals for local detail plans.
2.3. Methods for valuation and management of greenery and trees

2.3.1 I-Tree and the Alnarp model

Valuating trees in Stockholm different tools and models are used. The monetary Alnarp model (Arbor Konsult AB, 2018) is often used valuing trees that have been injured or taken down. Other models are used for valuing various functions and ES related to trees in the period of 20 years. Values regarded are ecological and biological, currently a focus on dead wood to increase habitat for species dependent on disappearing landscape features, often result in valuation of dead trees higher than on vital trees (Sjöberg, 2018). An international valuation tool the I-Tree project is currently being adapted to Swedish types of trees. I-Tree is modelling a monetary value of trees from all their functions and services in relation to climate mitigation and adaptation. The summer 2018 an investigation of height and size of tree-crowns will be executed in Stockholm to make calculations on ES related to volume of urban trees (Sjöberg, 2018). The aim of the I-Tree model is to improve valuation of urban trees and to make benefits from trees in urban areas easier to communicate and visualize. All ES related to a specific type of tree in relation to its age and size will be defined and measured, a system that internationally has been very successful (i-Tree org, 2006).

2.3.2. Green area factor

Green area factor (GAF) for local area is a tool required in building permits in Stockholm since august 2017. The aim is to improve green-structures and ES in the city. The GAF tool is a planning tool originally developed in Germany, to include social values, biodiversity and a capacity of climate adaptation in urban areas (Stockholm stad, 2015). GAF first started to be initiated in developments in Stockholm, as part of the C/O City-project in the Royal Seaport. GAF is based on the ecological functionality of greenspace and is not related to larger connectivity of green-structures. Giving a simplified overview, the use of GAF from a perspective of urban climate adaptation is related to the need of greenery and ES to handle flooding in relation to extreme weathers as well as hot and dry periods with risk of heat islands and drought-stress in urban areas, reducing negative effects of too large hardened surfaces. Different GAF factors are used to measure functionality and enhancement of ES where GAF =1 is used when <50% of the local area is built, GAF =0.6 is used when 50-70% of the area is used for buildings and GAF =0.4 when >70% of the area is built (Stockholm stad, 2015). Figure 4. below shows a simplified calculation model. Different GAF are used for different areas, where GAF =0.6 is recommended for housing and GAF =0.4 for commercial or office-buildings. The achievable GAF may still differ between projects depending on area available in detail plan (Nilsson, 2018). GAF is not only related to surface, but to aspects as depth of plant-beds, preservation of nature and the size of trees in the project. GAF for public area is currently under development for Stockholm in relation to the C/O City project and WSP (Nilsson, 2018), with the outspoken aim of improving multi-functionality and ES in public blue- and green areas (Stockholm stad: C/O City, 2015).

![GAF calculation in relation to space. Image source: C/O City (Stockholm stad, 2015)](image)
There is currently no set GAF for public area in Stockholm (Egerö, 2018; Nilsson, 2018).

### 2.3.3. Ecologic compensation

Ecologic compensation as prescribed by the Environmental Act, should be used when there is a risk to decrease or harm biodiversity and negatively affect ecosystem, when exploitation in vulnerable areas is unavoidable (Naturvårdsverket, 2015). It should compensate for natural values, which can include different species or habitats, or different functions and services provided by the ecosystem. A natural value can also be a cultural or aesthetic value for visitors. Compensation is made through an action that strengthens lost, or other ecological values or habitat within the same area or somewhere else. In Stockholm requirements are to compensate within the development area where loss occur (Rothman, 2018; Pehrsson, 2018). Recreation or protection of another green-area or improved natural-care and management can also constitute compensation (Naturvårdsverket, 2016). Ecologic compensation is connected to the polluter pay principle and the larger EU legislation and strategies to halt biodiversity-loss (European Commission, 2016). The tool called *hierarchy of needs* based on recommendations in the Environmental Act, should be applied in issues of ecological compensation, where an aim of first avoiding, then restricting and first as the last way out try to compensate for ecological loss (Naturvårdsverket, 2015). The Environmental Act has rather strict requirements regarding ecologic compensation in relation to dispense from protection, exploiting in Natura 2000 and Nature reserves, i.e. absence of other possible solutions or pressing societal needs for exploitation (Naturvårdsverket, 2015). In 2015 an investigation was made by the Swedish Environmental Protection agency of how ecologic compensation was fulfilled in different projects in relation to prescriptions in the environmental Act. The report concludes that minor exploitations in protected areas are very seldom compensated (1-2%) as are not formally protected green-areas. The most commonly compensated green-areas are those with protected and/or endangered biotopes, where in 82% of the cases given dispense from protection, compensation was required (Naturvårdsverket, 2015).

### 2.4. Data collection and analyses

#### 2.4.1. Structure and organization of greenspace management

Municipals in Sweden have a planning monopoly and own the right to make detail plans and decide over land use. On a national level decisions regarding densification and greenery are primarily regulated by the National Board of Housing, Building and Planning (Boverket, 2018) and the *Plan and building Act* in combination with the Swedish Environmental Protection Agency, that is responsible for guiding and supporting other authorities and organisations in their work with and taking part in development of the *Environmental Act* (Naturvårdsverket, 2017). On regional level the political Stockholm County Council is responsible for the regional plan RUFS (Stockholms läns landsting, 2018). The regional administration the County Administrative Board of Stockholm is responsible for foundation material for comprehensive- and detail plans, as for monitoring that municipal detail plans are coherent with and do not contradict municipal and regional comprehensive plans. It is also responsible for controlling that detail plans do not break environmental-, safety- or other restrictions regarding building and development (Länsstyrelsen Stockholm, 2018). For the Stockholm municipal organisation of green management see Table 1 below.
To deepen the preunderstanding of the subject, framing research questions and prepare interviews, substantial literature and documents were reviewed. Literature included previous research on resilience, urban ES, urban forestry and trees, climate adaptation and mitigation through greenspace, strategies and environmental considerations in relation to planning and densification. Whereas document reviews included various international, governmental, regional and particularly municipal planning documents and legislation. Recommendations, visions, programmes, procurements and webpages were also reviewed in relation to literature and outcome from interviews (Teorell & Svensson, 2007).

In relation to literature- and document reviews, main method for data-collection was qualitative interviews. These were of significant relevance for the study, to get an understanding of how visions from comprehensive plans are forwarded through detail plans to practice. Interviews were also important to understand management procedures and procurement (Teorell & Svensson, 2007; Yin, 2006). The identification of different key-informants, particularly within responsible authorities and

### Table 1: Organisation, responsibility and division of green- and park-management within the municipality. Administrations are placed in order of main importance and/or involvement in green management, rather than on how decisions are taken. Source: (Stockholm stad, 2018)

<table>
<thead>
<tr>
<th>Municipal actors and authorities involved in green-and park management</th>
<th>The City Council (Stockholm stad, 2018) is the highest political, decision-making authority and municipal decisions are taken after consultation with the specialized authorities/departments, that has a proportional allocation of political parties represented in the City Council. Under each Authority an Administration functions as advisory and executive organisations. The 14 City District Administrations, The Traffic Administration, The Exploitation Administration, The City Planning Administration, The Environmental Administration, The Property Administration, The Sports Administration, Stockholm Water, external entrepreneurs (Stockholms stad, 2017c).</th>
</tr>
</thead>
</table>
| **Division of responsibility for green structures and management** | **The District Administrations** The District Administrations are responsible for general management of most parks and greenspace, except for the largest central parks in the city. Most park-entrepreneurs are hired by the District Administrations for various management and snow-clearance in parks. Other involved actors are various constructors and consultants, either private or municipal, in relation to exploitation projects and greenspace.  
**Traffic Administration** Some of the city-central parks are managed by The Traffic Administration, that is also responsible for all trees in the streets  
**Exploitation Administration** The Exploitation Administration functions as the city’s landowner and is responsible for developing or selling out land for exploitation, that might consist of green structures. The Exploitation Administration is also responsible for development of new parks.  
**City Planning Administration** The City Planning Administration is responsible for detail plans regulating how and where development will take place, both regarding buildings and greenery.  
**Environmental Administration** The Environmental Administration takes part in decisions when valuable land is expropriated and carry out evaluations and EIA when required, it also functions as a referee before detail plans are approved.  
**Property Administration** The Property Administration has responsibility for properties outside the municipality as for nature reserves and Natura 2000 areas.  
**Sports Administration** The Sports Administration is responsible for sport-fields.  
**Stockholm Water** Stockholm Water is involved in greenery and bio-filters for runoff water treatment around the city. |

### 2.4.2. Literature reviews and identification of key-informants

To deepen the preunderstanding of the subject, framing research questions and prepare interviews, substantial literature and documents were reviewed. Literature included previous research on resilience, urban ES, urban forestry and trees, climate adaptation and mitigation through greenspace, strategies and environmental considerations in relation to planning and densification. Whereas document reviews included various international, governmental, regional and particularly municipal planning documents and legislation. Recommendations, visions, programmes, procurements and webpages were also reviewed in relation to literature and outcome from interviews (Teorell & Svensson, 2007).
administrations in the municipality and among City District Administrations and their different procured entrepreneurs, was an important part of the investigation. Widening the study further, to get a comprehensive framing of the subject, key-informants outside the municipality were identified. At national level regarding the Plan and Building Act and in relation to comprehensive planning on regional level. Other identified informants were external actors as constructors and consultants, with different perspectives on planning, exploitation and management procedures (Repsstad, 1988, 2007; Yin, 2006). The aim has been to cover a diversity of professions involved in green management (see figure 5 and table 3), ecological valuation, exploitation and densification projects, to get a pervasive understanding of the complex processes that are involved. The selection of key informants aimed to include actors from all sectors within green management, exploitation and planning. Why respondents comprise planners, landscape architects and project managers from different municipal developments, municipal politicians involved in development strategies and municipal environmental issues, various environmental experts at different municipal authorities and administrations working with plans, strategies, ecological compensation, climate adaptation, ES and greenspace on different levels and areas. External actors and entrepreneurs of interest to interview were people working with practical management of parks and greenery. The municipal consultative arborist and expert on management and valuation of trees, also procured in relation to construction works, was interviewed. Other respondents were representatives from construction companies both private and municipal, as from green consultants and pilot projects. Interviews on a national level was carried out with a key-informant regarding the Report on how to work with the Plan and Building Act in relation to ES (Boverket, 2016). On regional level key-informants regarding comprehensive planning, climate adaptation and the Report on Green infrastructure (Länsstyrelsen Stockholm, 2018) in the Stockholm region, were interviewed. A semi-structured, qualitative method was used for interviews, to create a freer structure, where the respondent could develop aspects of the matter, in a discussion-like context as little steered and formalized as possible. This method improved possibilities to take in the complexity of the processes at stake, getting a deeper and more nuanced understanding of the topic, than if following a strict set of questions (Repsstad, 1988, 2007). The semi structure also gave the opportunity to get important information that was not particularly asked for, i.e. insight knowledge and aspects not thought or aware of as important, why the collected data often exceeded the material asked for. The prepared questions differed slightly between the respondents depending on their role and profession and were used as a backup, to make sure that all aspects were covered, rather than as a standardized questionnaire, although all congruent with the main set of questions (see appendix 2) (Repsstad, 1988, 2007). For further information, division over organisation and profession of informants see Figure 5. below and appendix 1.

The decision was taken not to include interviews with the Stockholm County Council since understanding of standpoints of the regional plan RUFS, that primarily deals with developments and infrastructure, was regarded as sufficiently covered through reading the plan and by interviews with planners at the County Administrative Board of Stockholm. As was the Sport Administration, with its limited responsibility of Sport fields excluded, although two major projects including sport-fields are brought up in the study. Here the decision was built on the knowledge of political decisions and the Exploitation- and City Planning Administrations being responsible for building permits and detail plans, why the ability of the Sport Administration to affect decisions in the actual case was perceived as rather limited (Stockholm stad, 2018). The reason for not interviewing personnel at the Property Administration was built on their prime green-focus on nature reserves and municipal land outside the municipal borders (Stockholm stad, 2017), which is of interest in the investigation although from a perspective that was regarded as covered by other respondents.
2.4.3. Analytical framework and procedure

Based on the pre-knowledge from literature reviews, perception and apprehension of ongoing densification and loss of green-structures, the scope of the study was specified through formulation of analytical questions derived from the theoretical framework of SER. These were to specify the research questions and formulate empirical/interview questions. During the process of interviewing informants and reviewing literature some aspects related to SER in an urban context, as in the case-
study, reoccurred as important issues for a resilience based urban development and were therefore used as themes to structure the results (see appendix 2). Five main themes were identified:

"Strategies concerning climate change and environmental degradation", dealing with issues of comprehensive strategies for climate adaptation in Stockholm and to what extent they are related to greenspace. E.g. are future climatic and environmental issues as flooding, poor air-quality and noise pollution primarily dealt with technically or by ES?

"Knowledge, communication and organisational scales", regarding how knowledge and information is communicated between comprehensive and detail plans, during development as within the extended organisation. How is responsibility for implementation of decisions regarding greenspace in relation to management and exploitation divided?

"Valuation of greenspace", looking at valuation and acknowledgement of the importance of greenspace, green structures and trees in urban life, planning and practice. How are budgets, time and expertise, set for management? How is different type of land-use valued and what decisions and considerations are steering valuation of greenery in relation to densification?

"Regulations of greenery, Green area factor and Ecologic compensation", comprising what regulations about greenery are mandatory or recommended to follow in relation to exploitation projects. How does GAF and Ecologic compensation function in practice and how are visions in comprehensive plans reflected in continuous management?

"Monitoring and evaluation", highlighting the importance of learning processes through follow-up. Are long-term consequences considered in decisions and how are recommendations and strategies in planning transferred to constructors and followed up? Who is responsible for evaluation e.g. of runoff management and GAF over time?

To further encode material, each theme was divided into under-categories. For e.g. the theme Valuation of greenspace, sub-categories were based on were valuation related to the study take place; that is in park management related to entrepreneurs, in relation to procedures in continuous management, in exploitation processes and in budgets. The other themes were also divided into sub-categories identified as most reoccurring through interviews and supported by literature. Important features to maintain and enhance SER in an urban context, were used to interpret results: e.g. acknowledgement and management of connectivity in green structures to assure provision of ES and biodiversity (Andersson, et al., 2014), foresight planning and long-term considerations, as communication of knowledge, innovations and adaptive governance structures (Folke, et al., 2010; Ahern, 2011).

3. Results and analyses

Results are presented in five tables divided into different themes, including 3-4 under-categories or aspects considered important. The aspect on the left side corresponds with empirical questions and the analyses is a synthesis of answers given by respondents. In relation to tables, shorter texts further clarify findings.
In the text, each respondent is referred to by their initials, oversight is shown in table 5 below.

**Table 3. Simplified overview of respondents and initials/abbreviations used.**

<table>
<thead>
<tr>
<th>Planning</th>
<th>Process</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwin Björkefall- EB</td>
<td>Emmelie Nilsson- EN</td>
<td>Björn Embren- BE</td>
</tr>
<tr>
<td>Project leader (Expl.Ad.)</td>
<td>Green consultant (WSP/ C/O City)</td>
<td>Expert of Trees (Tr. Adm)</td>
</tr>
<tr>
<td>Ulrika Egerö -UE</td>
<td>Jan Pechan- JP</td>
<td>Anne Heino- AH</td>
</tr>
<tr>
<td>Ecologist/planner (Cl.Pl.Ad.)</td>
<td>Project developer, (Einar Mattson)</td>
<td>land specialist, (Stockholmshem)</td>
</tr>
<tr>
<td>Christian Karlsson- CK</td>
<td>My Peenalu- MyP</td>
<td>Erik Ohlsson- EO</td>
</tr>
<tr>
<td>Landscape architect (Expl.Ad.)</td>
<td>Landscape architect (Ci.Dist.Ad.)</td>
<td>Park-manager entrepreneur (Svevia)</td>
</tr>
<tr>
<td>Cecilia Obermüller- CO</td>
<td>Magnus Rothman- MR</td>
<td>Anders Ohlsson Sjöberg- AOS</td>
</tr>
<tr>
<td>Politician mp (City.Pl.Auth.)</td>
<td>Strategic green-planner (Env.Ad)</td>
<td>Arborist (Arbor consult)</td>
</tr>
<tr>
<td>Mårten Pehrsson- MP</td>
<td>Magnus Sannebro- MS</td>
<td>Helena Åkerlindh- HÅ</td>
</tr>
<tr>
<td>Environm. investigator (Env.Ad)</td>
<td>Climate strategist (Env.Ad)</td>
<td>Park Engineer (Ci.Dist.Ad.)</td>
</tr>
<tr>
<td>Karin von Sydow- KvS</td>
<td>Karin Terä- KT</td>
<td></td>
</tr>
<tr>
<td>Planner (C.Adm.Board Sto)</td>
<td>Green Infrastructure (C.Adm.Board Sto)</td>
<td></td>
</tr>
<tr>
<td>Lennart Tonell- LT</td>
<td>Ulrika Åkerlund- UÅ</td>
<td></td>
</tr>
<tr>
<td>Politician mp (Expl.Auth.)</td>
<td>Specialist ES (Boverket)</td>
<td></td>
</tr>
<tr>
<td>Inger Åberg- IÅ</td>
<td>Landscape architect (Expl.Ad.)</td>
<td></td>
</tr>
</tbody>
</table>

**3.1. Strategies concerning climate change and environmental degradation**

Urban areas are often vulnerable to climate change because of compacted structures, hardened surfaces and large populations. Extensive research highlight the relation between green-structures, ES and resilient cities, why strategies for climate adaptation should comprise greenery (Demuzere, et al., 2014). Does Stockholm have any strategies for climate adaptation or mitigation and do they in that case include an acknowledgement of greenspace? Are climate related issues dealt with
technically or through ES? How foresight are land-use policies and planning in relation to risk of environmental degradation and considering human wellbeing?

### 3.1.1. Strategies in planning regarding land use and risk management

The selling of land for condominiums and trend of building a higher proportion condominiums than rental housing in the inner-city, is an issue regarding control of land-use and climate adaptation, but also from a social perspective of gentrification (AH;CO;CK;LT). The city is working on lowering restrictions for noise in relation to housing, because of difficulties to find land for exploitation that is not close to roads or airports/approach paths (CO;EB;UE). CO means that the Environmental Administration and its ability to protect greenery, is too weak in relation to the Exploitation Administration, referring to differences between developments historically and today: "When the stone-city was built, one made sure to create large parks in between housing, today large areas e.g. Ulysunda, are built without a single park!" (CO). The new development Hagastaden is another area with hardly any greenspace (CO;MP;UE).

Whether pilot projects as the Royal Seaport is bringing new methods into exploitation projects, respondents believe it might increase awareness of issues brought up, although it is a risk of using pilot projects as flag-project to show off rather than a base for general implementation (CO;EN;KvS;LT). The Royal seaport constitutes 2% of what is currently built in the city, why impact as such is rather low (KvS). The political aim of building, overrides climatic issues, prioritising quantity over quality which also affects social issues and wellbeing (CO;KvS;LT).

There is a general issue of low awareness of larger green structures in detail plans. In the best case, planners are concerned about the local environment related to the plan. But there is a high tendency of missing out the larger image of how, even a limited development might spoil the connectivity and vitality of ecological connectedness in a green wedge, causing unreasonably damage in relation to the actual benefits of exploitation (AH;CO;MR). The intense densification on Kungsholmen is an explicit example of separate detail plans with no consideration of larger structures, causing increased fragmentation and degradation of greenery, probably not only in the local areas but in the larger green-structures leading from south of Stockholm to Solna/Sundbyberg and the Järva wedge (MR). Separate and already fragmented greenspace might seem unimportant and insignificant, still from a larger perspective, often irreplaceable to maintain connectivity and vitality of green structures (KT;MR;UE). There is a general lack of understanding and acknowledgement of the strategical importance of green structures in detail plans, to maintain ecological values and biodiversity of the Mälar-region (MR;KT;UE).

There is a lot of different mapping of likely water-flows and risk of flooding in the case of a 100y rain for Stockholm, showing the most vulnerable areas. The municipal aim is to lead excess water to parks where damage from flooding can be reduced and where capacity to take up water is better (MS;MyP). The management of flooding, as the reduction of heat islands is to a large extent dependent of access to greenery. The larger hardened areas water needs to flow over, the more contaminated it will become and the less greenery in urban areas, the more likely to create heat islands with dry and dusty air, which further contaminates water in events of flooding (MS;MyP;KT;KvS). Experience of extreme rainfalls 100y and larger in Malmö and Copenhagen, has proved an extensively higher ability to reduce damage and flooding in areas with greenery and ES, e.g. in the area Augustenborg (SMHI, 2013) in Malmö (MS;KT;KvS).

Many issues regarding green structures and climate adaptation-strategies are raised in the Environmental Programme Greener Stockholm (Stockholm stad, 2016a), although this programme
has less juridical impact than the comprehensive plan and the two documents often contradict each other (UE). For instance, at Kungsholmen in the developments of Fredhäll and Kristineberg, the city is completely aware of reducing and degrading ecological connections- but other considerations has been regarded more important (UE).

Table 4a. Strategies in planning regarding land use and risk management

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies in planning regarding land use and risk management</td>
<td>4a</td>
</tr>
<tr>
<td>General municipal action plan and strategies for climate adaptation for the Stockholm area</td>
<td>Particularly strategies regarding events of flooding and downfall in progress e.g. in Rålambshovsparken to handle excess water from nearby streets (MyP;MS;KT;KvS;MS) Stockholm insufficient regarding greenspace and climate action (AH;AOS;CO;EN;LT;MS;MR;UE). MSB* working on strategies (KT;MS).</td>
</tr>
<tr>
<td>Requirements regarding flood prone areas</td>
<td>Restrictions close to beach and presentation of solutions in flood prone areas, although possible to gain permission (EB;KT;KvS;MS). Too little attention of greenery in relation to future climate issues (AOS;AH;CO;KT;MS;UE).</td>
</tr>
<tr>
<td>Considerations and restrictions regarding flood- or heat sensitive areas in relation to exploitation projects</td>
<td>Increasingly reflected, but no regulations regarding greenery for risk of heat islands (AH;HÅ;MyP;MS;UE) New rules for constructors regarding runoff management: ability to delay up to 20mm rain locally in relation to new buildings (AH;CK;IÅ;MS;MP;UE) Increasing interest in building in flood-prone areas (CO;KT;KvS;MS)</td>
</tr>
<tr>
<td>Considerations of long-term strategies for the achievement of resilience in detail plans through greenery</td>
<td>Tendency in detail plans of local and narrow consideration of particular project area (AOS;IÅ;KT;KvS;LT;MR;MP;UE). Consideration of long term consequences of reduced greenery unusual (AH; AOS; CO; KT; KvS;LT;MR;MS;UE).</td>
</tr>
<tr>
<td>Prioritizations regarding land use in relation to urban planning and climate change</td>
<td>Political aim of intense exploitation and new housing often overrides other concerns (AOS;AH;CO;CK;EN;IÅ;KT;KvS;LT;MR;MS;MP; UE;UÅ). Greenspace often the under-prioritised, partly due to difficulties to measure (AOS; AH;CO;CK;EN;KT;LT;MR;MS;UE).</td>
</tr>
</tbody>
</table>

MSB - Swedish Civil Contingencies Agency (MSB , 2013)

3.1.2. Foresight and adaptive strategies

An increased vulnerability of trees to diseases is likely to be caused by climate change and thin ozone layers. Why a variety of tree-species are recommended to ensure resilience to future loss of certain types (BE; AOS). In relation to the need of greener, particularly from the aspect of a warmer climate, UE refers to an investigation of how greenery affects local climate explaining that temperatures during night are most dependent on larger connected green structures that spread damp and coolness over large areas, whereas day-temperatures are more dependent on local greenery for shadow and storing of water locally (UE).

Several respondents believe there need to be more long term considerations in planning and exploitation than today (AH;CO;MR;MP;UE). Stockholm is behind regarding how we are planning for and valuating greenspace in comparison with the rest of Europe (AH;CO;UÅ). There is a risk that we are building too much and too fast, to have time and ability to oversee the consequences until too late (UE). It is of high importance to start consider greenspace and green-structures in planning and practice far more consequent than today to maintain capacity of climate adaptation (AOS;AH;CK;CO;EN;HÅ;KT;KvS;LT;MR;MS;MyP;MP;UE;UÅ).
The County Administrative Board has the legal requirements to stop a detail plan that for instance risk climate adaptation, but it is extremely uncommon to take place, it is hardly likely that climatic considerations would stop a plan (MR; KvS). To manage climate change we need to start planning for and prepare actions now MS stresses. He means that the new Slussen is built to be capable of handling high water levels in Mälaren, a likely future scenario, although its capacity depends on water-levels in the Baltic being lower, which might not be the case due to sea level rise (MS). Here the MSB is looking at possibilities of creating a sluice at Oxdjupet, blocking off the sea further out, transforming the archipelago to an inland sea, but these projects take many years to plan, why we cannot afford to wait, or it will be too late. Sea-level rise is a concern of freshwater supply in Stockholm, risking to contaminate the lake Mälaren (MS).

"Regarding climate adaptation and the Stockholm inner city, we need to have greenery and greenspace everywhere to manage future disturbances! The most densified parts of the city would need to increase all form of greenery, everywhere it is possible" (UE). Greenspace is also needed to improve life and neighbourhood-qualities for the population (UE). The city should be much better on coordinating mapping of increased risks of flooding with mapping on green-structures, to better grip where densification risk to destroy future capabilities of adaptation (MR; UE), something that is not done today from a climate perspective (MS; UE) There are many ongoing detail plans in the city in areas that are under investigation for ecologic connections, giving the overwhelming risk that many detail plans will be set before investigations are finished, resulting in development that would not have occurred if information had been available earlier (KT; KvS; UE).

Table 4b. Foresight and adaptive strategies.

<table>
<thead>
<tr>
<th>Foresight and adaptive strategies</th>
<th>4b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The size of the greenery needed to maintain resilience and connectivity</strong></td>
<td></td>
</tr>
<tr>
<td>Still undefined but possibly a lot more than in the dense inner city (AH; CO; EN; HÅ; MyP; KT; KvS; MR; MS; UE).</td>
<td></td>
</tr>
<tr>
<td><strong>Considerations of the need of greenery and trees in planning</strong></td>
<td></td>
</tr>
<tr>
<td>Theoretical knowledge in plans, outcome dependent on individuals and when in</td>
<td></td>
</tr>
<tr>
<td>process experts are consulted and various compromises (AOS; AH; CK; EB; IÅ; JP; KvS; MP; UE) General attention to greenery in practice poor and under prioritized (AH; CO; LT; MR; MS) Growing interest (AH; CK; EN; EB; KT; MR).</td>
<td></td>
</tr>
<tr>
<td><strong>Acknowledgement of ecosystem service solutions in planning and management.</strong></td>
<td></td>
</tr>
<tr>
<td>Increasing interest, particularly for flood-management in planning (AH; CO; CK; EB; EN; MyP; MR; MS). In practice little room for green solutions in new dense developments (AOS; AH; HÅ; MyP; EN; JP). Unclear outcome in practice (AH; BE; CK; EN; IÅ; JP; KT; KvS; MyP).</td>
<td></td>
</tr>
<tr>
<td><strong>Foresight and long-term considerations</strong></td>
<td></td>
</tr>
<tr>
<td>Extensive building speed and large amount of new housing risks to override other</td>
<td></td>
</tr>
<tr>
<td>considerations and result in short-sighted decisions (BE; AH; EN; HÅ; MyP; AOS; CK; CO; LT; KT; KvS; LT; MR; MS; UE; UÅ).</td>
<td></td>
</tr>
</tbody>
</table>

3.1.3. Strategies in practical management

From the work with the report on Green infrastructure KT claims a need of interdisciplinary research on urban planning and ideology regarding densification processes and how they are valued, particularly in relation to health, environmental issues and climate change (KT). Today it is a rather aggressive debate on housing and densification, with no considerations regarding the identity of old European urban areas with lower houses and lot of greenery, instead focus is on New York and Singapore (KT). "The ambition is that the green-infrastructure report will increase the understanding of the large natural and ecological values, particularly regarding forest, that exist in Stockholm today, qualities lost in most rural areas because of intense focus on monoculture"
Strategists at the City Planning Administration researches what is a good density in cities although CK means that it most appears to be about current trends, which today is rather dense, the old stone-city-structure, based on political strategies to win next election (CK). In relation, KvS claims that effects we see today of heat-islands and events of flooding in Stockholm, is to a much higher extent related to the large reduction of greenspace and intense densification, than to climate change. "Stockholm is fast getting very much denser and we can already sense the risks with this development" (KvS). She means that the awareness of this is increasing due to visible effects and improved knowledge about climate change. Climate-data has also been improved as tools for applying it (KvS).

### Table 4c. Strategies in practical management

<table>
<thead>
<tr>
<th>Strategies in practical management</th>
<th>4c</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General recommendations for type of runoff management</strong></td>
<td>No general preferences of using ES/ bio-filters rather than technical solutions, constructors choice (AH;CK;EB;IÅ;JP.). Increasing interest of ES solutions (AH;MP).</td>
</tr>
<tr>
<td><strong>Requirements of planting street trees in connection to new developments</strong></td>
<td>Not specified but often part of ecological compensation, high scores in GAF measures (AOS;EB;CK;JP).</td>
</tr>
<tr>
<td><strong>Choice of type of trees in parks and streets</strong></td>
<td>Strong requirements (Tr. Adm.) on large variation of tree species because of increased vulnerability to diseases (BE;HÅ;AOS;MyP).</td>
</tr>
<tr>
<td><strong>Responsibility for placement of buildings in relation to topography, light and greensery.</strong></td>
<td>Ci.Pl. Dist. look at sunlight, topography and likely wind direction when placing building in detail plans (AOS;CK;EB;IÅ;JP).</td>
</tr>
<tr>
<td><strong>Time perspectives in planning and densification</strong></td>
<td>Narrow and short perspective regarding need of greenery (AOS;AH;CO;KT;MS;UE) When valuating trees, looking at prospect of staying fit in 20y onwards (AOS;BE). For developments and climate change the consequences in 100y time (EB;KvS;UE).</td>
</tr>
</tbody>
</table>

### 3.1.4. Summation

Strategies of adaptation to a changing climate, primarily cover flooding and runoff, e.g. new requirements in building permit to manage runoff locally. Regulation do not specify use of ES over technical solutions, this is the choice of the constructor. There are comprehensive plans under process, regarding sea-level rise and the risk of lower areas in Stockholm being flooded, as the concern of keeping the freshwater reservoir Mälaren from being contaminated by brackish water. Although regarding the complexity of these strategies development need to proceed rather fast. No climate strategies are clearly addressing greenspace to improve resilience, particularly not from a land-use perspective. Although mentioned in comprehensive plans, the maintenance of connectivity in green structures to safeguard ES and biodiversity, is insufficiently considered in detail plans. The implementation of strategies, particularly regarding greenery is very random and often poor in exploitation processes. There is a general prioritization of housing and intense development, with uncertain future consequences for connectivity in green structures and maintenance of ES. Climate
related regulations around requests keeping a high mix of types of trees in new developments, to spread risk of future diseases.

3.2. Knowledge, communication and organisational scales

Overall knowledge and communication of information and strategies to enhance and maintain resilience is crucial for a sustainable development. The organisational structure and ability to learn and transfer insight from plans to action are important features to gain resilience in a SES (Barthel, et al., 2013). Applied to the context of Stockholm, how is knowledge and information communicated between comprehensive and detail plans? Does communication and information function in the municipal organisation and in relation to external actors and how does it affect valuation and decisions regarding greenspace in developments and densification processes?

3.2.1. Communication of strategies between different levels of planning

"It is an overall high level of knowledge in strategies and comprehensive plans about ES and the need of green-structures, although a tendency of this knowledge and information being lost and under-prioritised during the development process." (AH). The use of consultants in all projects means that knowledge gets lost between different projects, the passing on information is lacking and good solutions used in one project is not forwarded to another (AH).

Regarding implementation of strategies in projects MP expresses that "Strategically, on a theoretical level Stockholm is managing fairly good, but then we have this black hole called building permit..." The Exploitation Administration is using the tool the banister, regarding aspects to remember and communicate in an exploitation process, where GAF and evaluation processes built on yearly statistics are discussed to be included (MR;MP).

A lack in communication of plans for preserving green-structures between administrations and constructors is common (AOS;CK;JP). When experts come in late in the process, preservation often fail due to inappropriate knowledge among planners about construction processes and particular considerations to preserve trees (AOS;UE). Penalties can be applied on trees or nature being damaged, but it is very rare (CK).
Knowledge and communication regarding connected detail plans, particularly regarding more undefined green-structures and connectivity on different sides of municipal borders is common, which increases risk of fragmentation (UE). When defined wedges, KT claims the municipalities have a responsibility to cooperate regarding detail plans in relation to the green wedges that crosses municipal borders, although it does not always happen.

Many respondents describes how ES, biodiversity and climate adaptation as new issues to consider in planning, why sufficient knowledge and practical experience regarding implementation often is lacking (AH;KT;MP;MS;UE;UÅ). "We are experiencing a period of transition regarding knowledge and future demands of green solutions, therefore we need to be aware that ES take place to function- we cannot go on densifying as today, if we want to be capable of handling future climate change!" (AH). An answer to improve greenspace quality in the future, is to increase cooperation for GAF and compensation between different projects which makes compensation & maintenance difficult (BE;CO;CK;EO;HA;MyP;LT;MR;MP;UE).

There is still not enough knowledge about how green wedges and average urban green structures are affected by reduced connectivity and degradation. Or in the long run how much space is needed to
maintain biodiversity and various ES in the city, why we need to be more cautious when exploiting them (AH;UE;KT;UÅ).

Table 5b. Communication of green-strategies, vulnerability and importance.

| Communication of sensitive areas, green wedges and biodiversity in exploitation projects | If earlier protected. Might adjust exploitation area rather than lead to abandonment of project, new housing prioritized (AOS;AH;CK;IÅ; KT;LT;MR;MP;UE) Not enough attention payed to importance of ecologic connectivity (AH;CO;KT;KvS;MR;MS;UE). |
| Communication and information of the strategical importance of greeneries in urban areas | Organisational fragmentation decreases communication and building of knowledge. Transitional period when knowledge of importance is growing, strategies under progress (BE;AH;CK;HÅ;MyP;MR) Too low awareness of importance (BE;AH;CO;MyP;KT;KvS;LT;MR;MS;MP; UE;UÅ). |
| Communication and information about the need of ES in planning and developments. | Organisational fragmentation decreases communication and building of knowledge (BE;AH;AOS;MR ).Growing interest and knowledge (BE;AH;EN;MyP;KT;MR). Important to increase (BE;AH;AOS;CO; EN;HÅ; MyP;HÅ;KT;KvS;MR;MS;UE;UÅ). |

3.2.3. Knowledge and communication of strategies about greenspace and management

Even practical arrangements as how landscape architects are placed in the Administrative-building, affect communication and information exchange. Previously all landscape architects at the Exploitation Administration and Traffic Administration worked in the same building, making it easy to update information and communicate strategies, when now placed in different buildings there are no spontaneous meetings which affects communication (CK). With the change to open-landscape-office, respondents believe more people will work from home, further decreasing communication (MS).

There is an issue with communication in relation to long-time neglected management of nature reserves and other recreational natural areas, where bush-wood has not been cleared for many years, why they have grown into large trees shadowing and crowding out other species as meadow flowers, that are dependent on the cultural semi-opened forests that were common in the traditional farmer-landscape with grazing animals. Here the public needs to be better informed of why the municipality is taking down trees and clearing the forest, not to be upset over destruction or worried that it is about exploitation. If people were informed that the clearing of vegetation is part of management procedures to increase and restore biodiversity, they would possibly have a more positive attitude to management (AOS; BE; MR).

Some City Districts has large problems with condominiums along waterfronts, complaining over trees blocking the view. Why seemingly becoming more common to trim trees harder and to take down large trees, as a response to complaints and to reduce risk of people harming trees (AOS). AOS means that when there are arguments about trees in relation to condominiums, in the end the trees are often taken down, as in the alder carr in proximity to the environmental City District Royal Seaport, that was removed after protests from condominiums, still in an area promoted for working with- and enhancing ES (AOS).
3.2.4. Summation

There is a responsibility of communicating detail plans that affects green wedges between concerned municipalities, although this is not always done. Transfer of strategies from comprehensive plans to detail plans is varying, since the latter tend to have a very local focus. The area-programmes are meant to reduce this issue, zooming in from the comprehensive plan to a focus area of related detail plans. Communication between different actors and administrations is often insufficient, partly because of fragmented organisation and lack of time and personnel. In general, there are some parts that function well, as communication between the City Planning Administration and Exploitation Administration, but then there are gaps where information and strategies gets lost. When it comes to communicating information about function and management of GAF and bio-filters for runoff over time, there is a significant risk of failure. There is also often a lack of understanding management procedures when planning/constructing parks, GAF and greenspace.

3.3. Valuation of greenspace

Green structures, trees and parks in urban areas are of fundamental importance for provision of ES. Valuation of greenery, including sufficient budgets and competence for management, as acknowledgement in planning and development, not to decrease ecological connections and biodiversity, is therefore central to achieve SER (Haase, et al., 2014; Andersson, et al., 2014). To
what extent are green connections considered in intense development and densification processes in Stockholm? How is management attended and valued and what prioritizations are made regarding land-use and future needs?

3.3.1. Park management and entrepreneurs

"The current organisation for green management in Stockholm is a mere catastrophe, that does not function at all!" (BE). Pointing at the low valuation of greenspace management BE exemplifies how Södermalm with approximately 130 000 residents, has one person responsible for administration of management, still being of the same size as a smaller city (BE). In comparison most cities in Sweden have a unitary Park Administration with a comprehensive organisation and vision for park management, aspects that risks to get lost in the fragmented organisation in Stockholm (BE;MR;UE).

The City Districts of Kungsholmen, Östermalm and Norrmalm are cooperating for management of green structures, to improve knowledge-exchange and information between the areas, strengthen communication and to support each other, as getting access to larger resources when sharing (HÅ;MyP). Kungsholmen has introduced city-farming the last years, an effort to make residents able to actively take part in decisions and management of their neighbourhood greenery. MyP and HÅ stresses an issue of responsibility in some of the city-farming projects. Meaning there is a need of dedicated persons to organize and run the project over time. City-farming also involves aspects regarding work-effort in relation to harvesting and possible damage, related to the abundance of people using city-greenery, although in general outcome has been positive (MyP;HÅ). Part of the project is to make people more comfortable in parks, lifting the issue of safety of greenspace from clearing of bushes and more light-to increased attendance of people and ongoing activities (HÅ).

HÅ and other respondents, believes the safety issue is more about feeling safe, than a real case of unsafety (HÅ;MyP;MR). MR means that the ongoing discussion of unsafety in relation to greenery has become a form of promotion of densification, making it is easier to justify exploitation on green areas, ",...one does even defend densification as an act of increasing safety, when there in fact is a poor relation between unsafety and greenspace "(MR).

Regarding management of trees and the use of arborists, EO explains that Svevia makes most trimming of dead branches and other care-taking of trees as trimming or taking down. Only in exceptional cases when trees are in a tricky place or a whole alley needs to be replaced- they call for arborists (EO;HÅ). Whereas BE and AOS describes problems related to entrepreneurs with insufficient knowledge harming trees in the city. The Traffic Administration solely use procured arborists for managing trees in streets, although it is still common that City District Administrations engage already procured park-entrepreneurs for managing trees (AOS;EB;HÅ;EO). Earlier the municipality had reoccurring events and projects for education of park-managers, something that has gone missing with the use of external entrepreneurs for management (BE).
3.3.2. Valuation and procedures regarding greenery & trees in streets and continuous management

Describing the uniqueness of Stockholm with its rich old pine and oak forests, that does not exist anywhere else AOS claims that "To combine this valuable nature with the intense exploitation of today is a vulnerable action! In the end, it is not only about green- but what type of greenery and how we are managing it!"

Often valuation of greenery in relation to exploitation is rather casual, because of vague requirements and formulations, in relation water quality is much easier to measure and monitor, with clearer requirements in the Building Act and building permits (KT;MR;MS;UE). The discussion of what is meant with sustainability in relation to management and greenery needs to be highlighted and renewed (AOS;AH). AOS raises the issue of important research being denied of economic reasons, strictly related to market based interest and valuation. He compares the modest research made on the bug causing the Elm-disease with the abundance made on the bug causing disease on Fir, because of economic production-value related to the latter (AOS).

City District Administrations cannot refuse exploitation, HÅ and MyP explains how inner-city districts are trying to make functions and values of different greenspace more distinct, to keep them from exploitation. Whereas surrounding municipalities and outer city districts are trying to create nature reserves. "The valuation of greenery is very low in relation to exploitation projects, but still so important for the citizens!" (MyP). Many respondents refer the outcome of decisions taken, e.g. ecological considerations in a project, as highly dependent on individuals, whom is actually part in the project group (AH;CK;EB;MP;MS;UE). Or as MP expresses it: "Valuation of greenery in relation to exploitation, as to preserve existing trees or not, is to a large extent dependent on the project leader and group dynamic. For example, some project managers are landscape architects with insight and interest in greenery... and some are not..." The result of the plan is also dependent on the ability of the project leader to withstand influence and requirements e.g. from constructors, that will try to reduce preservation and ecological considerations as far as possible to reduce costs and make building easier (AOS;BE;MP;CK).
The concept of multi-functional parks and greenspace is highlighted in today's planning. Although there is a risk among planners to believe that this means you can reduce size of greenery and replace it with multi-functionality in another place (MyP;HÅ;MR). Although multi-functionality is needed, that does not mean you can compromise on size that is vital to enhance ES (AH;EN;HÅ;MyP;MR).

There are very specific type of greenery and soil/gravel constructions used for bio-filters to function properly, making construction expensive, still maintenance is often poor (AH). AH is concerned by the current snow clearance, meaning that unlike the earlier in-house staff with precise knowledge of when and how to clear snow and use salt, different entrepreneurs and under-entrepreneurs used today, lack this routine and knowledge resulting in an over-usage of salt and destroyed greenery (AH). Both BE and AOS agrees on insufficient methods and a too intense use of salt during wintertime, harming street trees and greenery as affecting the ecosystem.

Table 6b. Valuation and procedures regarding greenery & trees in streets in continuous management.

<table>
<thead>
<tr>
<th>Valuation and procedures regarding greenery &amp; trees in streets in continuous management 6b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitality of street trees</td>
</tr>
<tr>
<td>Many trees are injured or dying because of root damages from constructions and compaction, wrong treatment or by being injured e.g. by vehicles (AOS;AH;BE;EO;HÅ;MyP).</td>
</tr>
<tr>
<td>Considerations and consequences of multifunctional greenspace</td>
</tr>
<tr>
<td>Multi-functionality increasingly highlighted as solution (HÅ;KT;MyP;MR;MP). Ordinary grass most multifunctional (HÅ;MyP;MR). Risk of interpretation that size and abundance of greenspace can be compromised through multifunctional parks (HÅ;MyP;MR;MP).</td>
</tr>
<tr>
<td>Consequences for damaging trees and greenery</td>
</tr>
<tr>
<td>Regulations on penalties in relation to constructions, difficulties in proving guilt, particularly regarding deliberate injuring of existing trees by private persons and condominiums (AOS;BE;EO;HÅ;CK;EO;JP).</td>
</tr>
<tr>
<td>Valuation of street trees in relation to bike lanes and other constructions</td>
</tr>
<tr>
<td>Earlier cautiousness regarding street trees but in relation to political aim of improving bike lanes, trees are often taken down (AOS;BE).</td>
</tr>
<tr>
<td>Greenery and trees in relation to snow-clearance and de-icing with salt,</td>
</tr>
<tr>
<td>Little space for managing snow-clearance in streets, why trees gets harmed and greenspace areas are used for snow-storage (AOS; AH; BE; EO). Far too much salt is used for de-icing (AOS;AH;BE).</td>
</tr>
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</table>

3.3.3. Exploitation and densification processes

When making an investigation of ecological connections in the inner-city it was found that the only remaining connectivity was in Djurgården and the north west of Kungsholmen, unfortunately development plans for Stadshagen, Kristineberg and Fredhäll in the latter area, were already in place when the investigation was finished and the municipality cannot withdraw a detail plan after establishment, or penalties are fined, why densification will continue (UE).

There are constant compromises in planning and development processes (AH;EB;CK;CO;EN;IÅ;MP;MR;LT;UE), e.g. the City Planning Administration want constructors to reduce impact on green structures and constructors wants to reduce costs, as UG expresses it: "When buildings are done no-one is satisfied."

Regarding the detail plan for replacing removed football courts from Stadshagen in Fredhällsparken, none of the administrations seem pleased with the solution, although claiming it being politically self-destructive to remove football pitches, why these must be replaced within the city district and placement in a park is the easiest solution (AOS;CK;CO;HÅ;LT;MR;MP;MS;UE). Where to replace or compensate the lost park has not got political attention (CK;CO;HÅ;UE). Many respondents claim inner-city exploitation being far too high (AH;CO;HÅ;KT;MS;MyP). "If reducing the size of the
exploitation in Stadshagen, one could have kept the football court there and thereby also the valuable oak-trees and the park in Fredhäll!" (MyP).

The overriding political goal of building 140 000 new apartments is putting a high pressure on the planning and exploitation offices and many detail plans are pushed forward at a speed that does not allow time to requested considerations (CK;EB;BE;UE). Particularly at the City Planning Administration there is a constant shortage and circulation of staff (BE;CK;UE), putting further pressure on remaining staff. Many planners express a lack of knowledge regarding the project they are planning, because just recently passed on to them, when asked about an interview. CK exemplifies a project he took part in, which during a period of two years changed responsible planner five times. In Stockholm exploitation processes often are initiated by constructors in relation to the Exploitation Administration, despite the original intention of development starting from the City Planning Administration contacting the Exploitation Administration and only later constructors (AOS;CO;CK;EB;LT;UE;UÅ). One reason for opposite order in Stockholm are high economic interest involved in development. This risks speeding up densification and exploitation, also in areas that should not earlier have been used (CO;LT;UE;UÅ). "Today it is always new housing that is considered most valuable- but in future it will possibly be the opposite: that greenspace is the most important!" (AH).

Regarding attitudes among constructors about preserving greenery, JP claims there is no interest in devastating greenery, although often an issue of compromises i.e. the size and placement of building permit and attention to other requirements as availability of natural light in apartments (JP;UÅ). "Where the aim has been to save a large oak tree, it might cause a conflict with daylight issues, because of the plan, that gives no room for saving it in practice." (JP). Knowledge regarding construction practices and the space needed for a full grown tree is often lacking in planning (AOS;BE;CK;JP). When trees that are meant to preserve, stands too close to planned buildings, they are impossible to spare due to damages of roots from construction (AOS;CK;JP). Preserved nature in relation to developments generally increase value of flats, but there is an issue of space, price and possibilities also in relation to other concerns in a development project (AH;JP;UÅ). Relating to an inquiry of constructors by Boverket, there is no problem to preserve existing nature, although construction takes longer time which comes with higher costs, why it depends on the municipality being willing to pay for it (UÅ).
3.3.4. Budgets in relation to greenery

"There is an enormous frustration among management actors today about how things are run and with no budgets to commit work that is asked for and needed" (AH). Insufficient budgets and economic savings on management and maintenance increases costs for delivering service and result in poor condition on the average greenspace and insufficient management in general (AOS; AH; BE; MR; MP; UE). The setting of budgets on this low level derive from when starting to procure external managers instead of in-house personnel. Responsible for procurement had insufficient knowledge about need and procurement-processes and were driven by the major aim of cutting costs (AOS; BE). At the same time lot of site specific knowledge from long practical experience, was lost (AOS; AH; BE; CK; HÅ; UE).

Budgets for management of greenspace need to be reconsidered and improved to maintain new parks as well as the existing greenery (AOS; AH; BE; HÅ; MyP; MR). "The City Districts are given a smaller sum for management each year, but this is not regarded as interesting to invest in, a strategical investment could otherwise be to educate park engineers, landscape architects and entrepreneurs in new methods regarding enhancement of ES, something that particularly entrepreneurs seem to lack knowledge about" (MR). There is no interest in investing in everyday management (AOS; AH; BE; CK; HÅ; MyP; UE). "Budgets are far larger for establishing new parks than for maintenance, the Exploitation Administration sits on money for greenery within projects, that has
too little room for it, whereas the City Administrations hardly has any money at all for management of parks in proximity to new housing, this division is absurd!" (CK).

The fragmented municipal organisation in relation to separated budgets for different areas and responsibilities tends to create barriers and lack of information, where savings in one end is not weighted towards consequences and higher costs in another (AH;EB;AOS;MyP;HÅ). Several respondents mean that it is common to make a political career on cutting costs today, resulting in poor budgets and lack of time and staff for maintenance, which in the long run results in loosing knowledge and experience (AOS;AH;BE;LT). "It is unreasonably that procurements are made as present, if one wants to have a functioning management of greenery." (AOS).

"Economic valuations are of highest importance in exploitation processes: The municipality needs to get money for all extensive infrastructure-projects as Slussen, Bypass Stockholm and the East-bypass... as to cover recent costs for the Northen-bypass, the expansion of the highway Roslagsvägen/E4 and so on..." (LT). Selling off land gives the municipality money directly, whereas leasing out land gives a lower income in direct relation to the project, although a higher amount over time (CK;EB;LT). The Exploitation Administration is actuating in the building of condominiums because of profit, which affects prices on houses (LT;JP). There is an ongoing extensive outselling of all land outside municipal boarders reducing ability of foresight urban planning of the growing city (KT;KvS;LT;MS;UE). "The current selling out of municipal land might become a large issue of responsibility in the future regarding consequences from densifications in relation to climate change. Today the municipality is responsible of consequences of detail plans in 10y, but it is discussed to prolong this period" (MS).

<table>
<thead>
<tr>
<th>Table 6d. Budgets in relation to greenery.</th>
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<tbody>
<tr>
<td><strong>Appropriate budget for green management</strong></td>
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<tr>
<td><strong>Investment in street trees in the municipality</strong></td>
</tr>
<tr>
<td><strong>Budgets and management of greenery and parks in relation to damage, wear and tear</strong></td>
</tr>
<tr>
<td><strong>Budget for greenery in densification processes</strong></td>
</tr>
<tr>
<td><strong>Budgets for densification</strong></td>
</tr>
</tbody>
</table>

**3.3.5 Summation**

There are no general requirements for procurement of entrepreneurs for management of parks. Often the lowest price accepted is decisive, although some City District Administrations require documented earlier experience. Low budgets for management are resulting in negative effects, particularly on long-term maintenance and poor condition of many parks. An ongoing project
improving plant-beds for street trees by skeletal-soil has significantly enhanced condition of trees (see appendix 3). At the same time, street trees are treated less cautiously in relation to construction work, today than earlier, largely because of political aim of improving bike lanes. Valuation of greenery and trees is carried out at different stages of developments; in comprehensive plans on a strategical level, primarily concerning larger green structures and the green wedges. In relation to detail plans and exploitation, often landscape architects at the Exploitation Administration make an initial valuation on site. If regarded needed, experts are requested to make further investigations of nature and trees that might be of interest to preserve. Experts are mainly engaged when the area beforehand is protected, considered vulnerable or of strategic ecological interest. It is rare to preserve single trees or nature-areas in developments, unless they are earlier protected or of ecologic value. To make preservation of greenspace or trees come through in densification or development projects, it needs to be considered early in the planning process.

3.4. Regulations of greenery, Green area factor and Ecologic compensation

To safeguard a sustainable development, various procedures and measures are taken to improve considerations and implementation of environmental action both globally, on EU- national- and local level (Naturvårdsverket, 2017). There are plenty regulations regarding developments and the environment, although formulations in Swedish legislation is often open for interpretation, why the same laws can be implemented differently in different areas (Naturvårdsverket, 2015). What regulations regarding greenery are mandatory or recommended in developments in Stockholm. How is GAF and ecologic compensation implemented?

3.4.1. Laws and regulations in planning and exploitation

There is a growing interest at the City Planning Administration to include information about nature values in exploitation areas trying to consider this in the detail plan, as a tendency to let experts come in earlier in the process which strengthens the case e.g. of keeping existing trees (AOS). Regarding new regulations about GAF in relation to developments JP means that it is hard to say whether new requirements of GAF has any effect, "...generally it is difficult to work with, since measurements and requirements differ a lot, also within municipalities in the Stockholm area". As a constructor, it is very difficult to know how to handle green-issues because of vague directives and requirements. JP believes it would be easier if this was clearly regulated in the Building Act (JP). EN claims that "GAF can be a very good tool for improving greenery, though important to remember that it is not an answer to all greenspace issues- only a tool to improve quality! If you think elsewise you are far out!" (EN). GAF needs to be considered in relation to how houses are built, currently there is a trend not only of denser development but higher, disregarding the issue with no sun reaching down to ground under high houses in the northern hemisphere with low solstice wintertime, affecting both greenery and humans (AH;AOS;MS;MP).

Respondents in the Environmental Administration (MR;MP) and City Planning Administration (UE) experience a larger aim keeping existing nature and trees in developments, than respondents from the Exploitation Administration (EB;CK) and among constructors (AH;JP). The latter describes it as rare to keep existing trees in exploitation projects, unless regarding ecologically valuable or protected nature, since considered to increase costs. Both sides agree on the result often being that trees are lost due to various complications or miscalculations during the process. When trees are to be preserved, there are restrictions included in the building permit about how to act around them, if they are
damaged, penalties can be required for trees on the municipal land- of what happens on private land is less certain- practically the city loses control over land sold out (CK;UÅ).

Table 7a. Laws and regulations in planning and exploitation.

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenspace regulations in the Plan and Building Act and Environmental Act</td>
<td>Vague documents that are open for different interpretations (AH;CK;JP;KvS;LT;MP;UE;UÅ). Generally difficult with valuation of greenery, lacking tools for measurement (AH;CO;CK;JP;KT;KvS;MR). No support for keeping green-structures in development projects (KvS;UE;UÅ).</td>
</tr>
<tr>
<td>ES in the Plan and Building Act (BEST)</td>
<td>Difficult to demand enhancement of ES (KvS;UE;UÅ). The BEST-report is meant as a complement (UÅ). Better procedures in progress (KT;UÅ).</td>
</tr>
<tr>
<td>Awareness of ecological connectivity in planning</td>
<td>General theoretical knowledge, particularly on comprehensive level, poorer in detail plans that have a narrow focus &amp; other considerations to balance (MP;UE;MS;AH;CO;CK;IÅ;KT;KvS;MR;MP;UE).</td>
</tr>
<tr>
<td>Regulations about keeping large trees and green areas in proximity to trafficked roads as buffer-zones</td>
<td>None. Rather the opposite, since areas close to large roads are less used for recreation these are considered of low value (AH;CO;MR;MS;UE), knowledge of problem with noise and air quality but exploitation prioritized (AH;CO;EB;IÅ;MS). Of increasing interest in Europe (UÅ).</td>
</tr>
<tr>
<td>Regulations concerning social and health aspects of densification processes</td>
<td>Not raised enough in planning or exploitation processes (AH;CO;MyP;HÅ;KT;KvS;MR;MS;UE).</td>
</tr>
</tbody>
</table>

3.4.2. Regulation regarding nature-preservation and green structures in densification

When valuating and inventorying nature-areas and trees there is a clear distinction between nature-care and tree-care, where the latter focuses on maintaining the most vital trees, while the nature-care is focusing on the ecosystem as such (AOS;MR). AOS means that ecological and natural-care seem to go through various trends and currently there is a strong focus on dead wood. Often when valuating trees and nature in relation to exploitation projects in sensitive areas AOS experiences that whereas he is recommending preserving e.g. a large and vital oak tree, ecologic experts in their valuation are instead recommending keeping the dead oak nearby, why the healthy and living oak is taken down (AOS).

Stockholm should better value and preserve its green-structures - instead of exploiting them until we are in the same position as many other European cities, that are trying to restore lost greenspace to enormous costs (CO;UE;UÅ). "The municipality must improve overall knowledge and information about connectivity of larger green structures, to avoid removal of e.g. a tiny 'green island' with no significant value, in a densified area, that in fact might be the last outpost of greenery needed to remain connectivity within the larger structure of green wedges and ecological connections" (MR).

It is important to improve knowledge regarding space in relation to ES (EN;KT;KvS). The relation between water quality and wetlands is important to acknowledge here, since building permits at increasing speed and scale are requested for wetlands (KT). "There is a need of more research regarding the effect of hardened surfaces in relation to water quality, as of when EIA or SEA is needed- today in Stockholm seemingly never!?" (KT).
Table 7b. Regulation regarding nature-preservation and green structures in densification.

<table>
<thead>
<tr>
<th>Regulation regarding nature-preservation and green structures in densification</th>
<th>7b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations regarding biodiversity and risk of degradation through exploitation</td>
<td>Recommendations in Environmental Law, but vague formulation. Tries to avoid degradation but always compromises between interests (AOS;AH; CO;CK;IÅ;MyP; KT;KvS;MR;MS;UE), where greenery has generally low priority (AOS;AH;CO;CK;MyP;LT;MR;MS).</td>
</tr>
<tr>
<td>Individual valuation of trees e.g. age, size, type, vitality in relation to exploitation and compensation</td>
<td>Generally none or shallow. In specified areas of high natural value or vulnerable biotopes valuation can take place to try to preserve certain trees or areas (AOS;AH;CO;IÅ;MR).</td>
</tr>
<tr>
<td>Regulations regarding the green wedges in relation to densification</td>
<td>Requirements on considerations, but when no other protection as nature reserves or Natura 2000, no legally binding protection (AOS;AH;CO;CK; KT;KvS;MP;UE) Connectivity often disregarded in dp (KT;MR;MP;UE).</td>
</tr>
<tr>
<td>Regulation regarding type and structure of GAF greenspace</td>
<td>Different greenery gives different credits, why you need some substance to get the right GAF. Generally too little space for greenery and often compromises with other needs (EN;AH;CK;JP;UE) GAF related to size of exploitation (IÅ;JP) General demand of implementation supported by Building Act (UÅ).</td>
</tr>
</tbody>
</table>

3.4.3. Regulations in management and everyday practice

It may take 20–40y before visible that a tree is dying from injuries of a compacted plant-bed, why it often is difficult to prove guilt in relation to harmed trees (AOS). In obvious cases of damage, penalties are generally too low regarding impossibility to replace full grown trees (AOS;AH). There has been reoccurring events in Stockholm with deliberately damaged trees, often because of blocking a sea view for a condominium. Trees growing on municipal land belongs to all residents happening to pass by (AOS;AH;LT).

Both BE and AOS explains that large trees in the city today where planted before current situation with a massive amount of cables and pipes under the streets. It is more or less impossible to move a street tree, their roots are completely entangled with everything else underground, why the new skeletal-beds are such an improvement, both for the trees that are given room to grow, and for work needed to be done under streets (AOS;BE).

"Earlier" BE claims "The city was very restrictive regarding removal of street-trees because of altering of the streets or construction work, although with the new political aim of improving bike-lanes, it has become very common to take down trees- which feels a bit awkward from an environmental position"
### Regulations in management and everyday practice

<table>
<thead>
<tr>
<th>Regulations regarding trees to preserve in relation to maintenance/construction</th>
<th>Duty to contact Tr. Adm. or Ci.Dis:Adm. regarding construction-work in relation to trees: Special procedures as no storing under &amp; closed off area around trees and protection of bole (EB;AOS;CK,HÅ).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention to regulations regarding trees in relation to construction/restoration.</td>
<td>Insufficient attention, often is contact with responsible administration made too late or no information at all, requires control that measures are taken (BE; AOS;HÅ;MyP)</td>
</tr>
<tr>
<td>General care for trees in relation to street work and exploitation</td>
<td>Poor, common to see harmed trees by hit-injuries or from soil packaging, inadequate monitoring (BE; AOS; HÅ;MyP;EO)</td>
</tr>
</tbody>
</table>

#### 3.4.4. Ecological (green) compensation

"The very thought that you should be able to compensate for something removed is ridiculous! If it is gone it is lost! Unless you make as much room somewhere else- but still, it is hardly possible to re-create a forested area with the same values!" (MyP).

When it comes to the prospect of ecological compensation to succeed, it often needs to take place before exploitation is done, otherwise the species or animals one wants to preserve will be lost when compensation is in place. This is a large issue with regulations today, where compensation is to take place within the project area (MR;MP). Another issue with compensation within the project area is the lack of space and money for doing something that has a significant effect, why there is an ongoing discussion of placing money in a fond for compensation projects, that might take place somewhere else and be a combination of compensation for many projects, resulting in a more substantial project, e.g. enhancing connectivity of a green wedge that has been affected by several exploitation projects, although not within the particular project areas (AH;CK;CO;MR;MP;UE).

The department *Environmental Analyses* at the Environmental Administration is working on a web-based databank on ideas of possible compensation strategies and enhancement of ecology and ES, that are meant to be open for usage and inspiration in planning and exploitation projects, as for overall internal and external users (MR). One example is the ongoing project on *veteranisation* of trees, deliberately injuring trees to age faster and create habitats for species needing dead wood (MR;AOS).

It is far more common with reinforcement than compensation of ecological loss and there need to be an agreement of what can be accounted for compensation and not, since most commonly so called ecologic compensation in practice is not compensating ecological, but recreational values, i.e. a forested slope is compensated with a park bench or a playground, or used to cover neglected maintenance (AOS;AH;CO;KT;LT;MR;UE). The city also need to better define what is a protective measure and what is compensation (MP). Counting street trees as a compensation is regarded double-counting by the Environmental Administration, since street trees are meant to be planted anyway, why they cannot be regarded as compensation which needs to be something additional in a project (MR).

Quite often, once construction has begun, one realises that it is not possible to keep trees anyway, due to placement in relation to construction, because of unintentional damage or unexpected circumstances, why it ends in compensation (AOS;AH;CK;JP;MP).
There is an aim with ecological compensation to raise awareness of ecological impact from densification and improve notification of values and vulnerability in projects, without it, these areas would probably have been exploited with no incentive to reduce impact at all (EN; MR; UE). Although there a risk of regarding ecology as something replaceable, that you can economically compensate for, in planning (MR). "It is as with the Environmental law: First you give a lot of really good environmental intentions and incitements, but then in the last minute you withdraw them by adding supplements as... if not harming economic interests of actors..." (MR).

Table 7d. Ecological (green) compensation.

<table>
<thead>
<tr>
<th>Ecological (green) compensation</th>
<th>7d</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practical procedures for ecological/green compensation</strong></td>
<td>Compensation needs to take place within project area, which often lack space for qualitative greenspace (AOS; AH; CO; CK; HÅ; MyP; MR; MS; EN; LT; MP; UE) New procedures under discussion (AH; CO; KT; MR; MP). No support for compensation in Building Act (UÅ).</td>
</tr>
<tr>
<td><strong>The possibility to compensate for ecological loss in real (i.e. relation to size)</strong></td>
<td>Often not possible to compensate for ecological loss e.g. of old trees or natural values in smaller space and over short time (AOS; AH; CO; HÅ; JP; LT; MyP; MR; MP; UE).</td>
</tr>
<tr>
<td><strong>Restrictions and regulations for what can compensate what</strong></td>
<td>None. Currently vague conformation of requirements (AOS; AH; CO; EN; LT; MR; MyP; UE). In progress to improve (EN; MR; CO)</td>
</tr>
<tr>
<td><strong>The possibility to conserve connectivity through street trees as a compensation for deforestation</strong></td>
<td>No evaluation of success is made, often too narrow streets for trees in new developments, important to try and keep connectivity through different greenery (AOS; BE; HÅ; MyP; KT; UE ) Seemingly insignificant greenery can be crucial for connectivity (AH; KT; MR; UE).</td>
</tr>
<tr>
<td><strong>Budgets and strategies for ecological compensation</strong></td>
<td>Separate budgets for maintenance and new development. Separate budgets for compensations in different projects although nearby areas, why budgets or space often too small for adequate compensation (AOS; AH; CO; CK; HÅ; MyP; LT MR; MS; MP; UE).</td>
</tr>
</tbody>
</table>

### 3.4.5. Summation

Legislation regarding greenery in developments is often vaguely formulated. In combination with generally unspecific measurements and regulations for greenspace makes the situation vulnerable. Theoretical awareness of ES and ecologic connections is overall high on comprehensive level, but implementation often fail locally, due to narrow sighted detail plans. There are no regulations or recommendations regarding preservation of trees or greenery in relation to housing and proximity to trafficked roads. Regulations regarding health and wellbeing is generally very poor in relation to greenspace. A need of cautious planning in relation to the green wedges and biodiversity is expressed in the comprehensive plan, although unspecified and often compromised. When not earlier protected, e.g. through nature reserves, there are no regulations to protect greenspace. New developments often lack space to manage GAF or bio-filters for runoff management, making implementation of new regulations difficult. Ecological compensation needs to take place within the project area and ecological values are often compensated with recreational values.

### 3.5. Monitoring and evaluation

To ensure functional strategies and competent management, monitoring and evaluation of outcome, preferably over time is important. Evaluation of processes will also strengthen learning possibilities and foster a culture of strategic thinking and identification of opportunities for improvements (do
To what extent are long-term consequences from exploitation considered in planning and are effects from densification evaluated and followed up?

### 3.5.1. Outcome of strategies and visions in plans

KT means that effects of strategies in RUFS on the comprehensive plan is difficult to follow, not the least due to vague formulations in both documents and various interpretations. There is no evaluation made on impact, but strategists at the County Administrative Board compares comprehensive plans and detail plans so they shall not counteract (KvS). RUFS has a very strong focus on development, e.g. Flemingsberg is pointed out as a regional core and is being intensely exploited, although in the middle of an also pointed out, important ecological connection between the two wedges Hanvedenkiilen and Bornsjökilen (AH;KT). KT hopes that the report about green infrastructure will strengthen acknowledgement of green structures in future developments, and function as a complement to regional and municipal comprehensive plans.

There is a general understanding among people involved in densification and exploitation processes that you need to be willing to, or at least accept to, compromise on greenspace for the sake of the project (AH,CO;CK;EB;IÅ;LT;MP;MS;UE) or as CK expresses it: "You need to be moderate about green structures in order to make projects go through, it is not possible to be too picky on greenery, then nothing would be doable." At the same time many respondents expresses a high concern about consequences, although still arguing that so many things needs to be considered within developments that you always have to give and take (AOS;AH;CO;CK;EN;IÅ;LT;MP;MR;MS;UE).

Many respondents experience that greenspace is considered replaceable today, although they believe it is not. Awareness of green-structures in plans and comprehensive strategies are generally high, although in reality these takes place and budgets, why the result from expressed visions are often poor (AH;AOS;BE;MR;UÅ). "It is not enough to be AWARE of problems with decreasing greenery-we need to act in relation to that knowledge developing better measurements and tools for greenery to be included in considerations, as clearer arguments and regulations" (KT).

Earlier there were programmes and strategies for all developments, but today everything is rushed so hard that there is no possibility to monitor or evaluate particular projects (CO). There is also very little room or time for contact between politicians in the City Planning Authority and project managers and planners at the City Planning Administration to discuss projects, or to get a deeper insight of what is at stake, as is made in smaller municipalities (CO).

The dependency on the constellation in project groups is high, regarding the room green-strategies will be given in a development (BE;MP). "Planning strategies and policies are crystal clear in Stockholm, but implementation fail and is extremely random."(BE).
Table 8a. Outcome of strategies and visions in plans.

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome of strategies and visions in plans</td>
<td></td>
</tr>
<tr>
<td>Strategies and visions in RUFS reflected in the Comprehensive plan</td>
<td>Often visions are changed or altered between plans; Both RUFS and comprehensive plan are political and advisory, not legally binding documents (KT; KvS;).</td>
</tr>
<tr>
<td>Strategies and visions of green structures in the Comprehensive plan reflected in Detail plans</td>
<td>Strategists in Ci.Pl.Adm reviews dp in relation to cp, difficult in practice with all different concerns (AH;CK;EB;KT;UE); low visibility in single detail plans that has a local focus (CO;CK;KvS;LT;MR;UE) Area-programmes for related dp functions as overview (CO;EB;IÅ;MS;MP).</td>
</tr>
<tr>
<td>Follow up of outcomes of strategies in comprehensive plans</td>
<td>None known of (AH;KT; KvS;), not legally binding, political plans why often changed with new majority (CK;KT; KvS;).</td>
</tr>
<tr>
<td>Follow-up and control of outcomes from agreements in Detail plans and building permits in practice</td>
<td>No follow up is made due to lack of budget, shortage of staff and time (AOS;AH;CO;CK;EB;MP) Should be self-regulating through interest in new developments (EB).</td>
</tr>
<tr>
<td>Strategies and regulations for follow-up greenspace and GAF in densification projects</td>
<td>No follow up required (AH;MP;UE). Strategies in Royal seaport but not in other developments, strategies under progress, probably through sample tests (CK;EN;EB) No follow up when sold to condominiums (AH;CK;EN;JP;MP;UE).</td>
</tr>
</tbody>
</table>

3.5.2. Monitoring, follow up and evaluation of densification processes

There is an issue of what happens over time with local greenspace in relation to development. Old trees nearby a condominium might be regarded a property-risk why felling is demanded, although the area originally was saved due to high ecological values. Here there is a large variation depending on social groups living in the area- areas with a wealthy and highly educated population tend to get their will through, since they knows how to do complaints and run a process (AOS;AH; CO;LT).

It is common with agreements on greenery between constructors and the Exploitation Administration, unless too expensive - but after construction, the city will lose control of how the space is maintained by condominiums (CK;JP). "Evaluation of GAF will generally not be conducted because of lack of budget, time and personnel, probably the city will use some sample test for large projects in future?" CK. There is no evaluation of constructors fulfilment of GAF presented in plans, although a strategy for evaluation under progress- probably through sample tests (CK;EB;EN). "An investigation of the pilot project Royal Seaport has shown severe difficulties finding strategies for monitoring and evaluation of how GAF is functioning and maintained over time in relation to condominiums and private actors" (EN).
### 3.5.3. Green-management monitoring, follow up and evaluation

"There is a large risk of handing over responsibility of bio-filter for runoff management to condominiums that mostly lack knowledge about management procedures" (JP). It is hardly likely that a caused event of flooding due to miss-treatment or removal of bio-filters will lead to penalties or other consequences, why this politically would risk to cause conflicts between politicians and presumed voters, although theoretically possible (CK; JP; MS). "There is an obvious vulnerability regarding sustainability of all kind in relation to condominiums, because of tendency of cutting costs and lack of knowledge regarding responsibilities and management" (JP).

Today we are seeing the results of many years of neglected management of parks in Stockholm. The first years after cutting costs for maintenance, the reduced management was covered by previously high standard of park management (BE; AH). There is rarely any time, budget or personnel for evaluation or monitoring of greenspace and the functionality of management. The City District Administration tries to make sample tests, and sends non-conformance reports to entrepreneurs, but not on regular basis (HÅ; MyP).

In the work on making parks more adaptable to climate change and increasing the ability to manage excess water with events of flooding in parks, MyP describes the difference between management and planning from the perspective of budgets, which are separate for continuous management and rebuilding parks for better capacity. In relation to climatic aspects of managing large amounts of water in green areas, the city is using scenarios to evaluate how to improve and strengthen functions (MyP; MS).

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Table 8b. Monitoring, follow up and evaluation of densification processes.

<table>
<thead>
<tr>
<th>Monitoring, follow up and evaluation of densification processes</th>
<th>8b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluation of future resilience in relation to densification processes</strong></td>
<td>None, risk of too extensive densification (AH; CO; HÅ; MyP; KT; KvS; LT; UE). General knowledge of importance keeping green structures, still often using them for exploitation (AH; CO; EN; JÅ; KT; KvS; MR; MS; MP; UE; UÅ).</td>
</tr>
<tr>
<td><strong>Responsibility for monitoring and evaluation of greenspace in relation to densification</strong></td>
<td>Unclear after plans are made, exploitation started and building permits are given, before that, the municipality (EB; CK; AH; MP). No foresight evaluation of consequences (AOS; AH; CO; EN; KT; KvS; LT; MS; MP; UE; UÅ).</td>
</tr>
<tr>
<td><strong>Evaluation of densification projects in relation to climate change</strong></td>
<td>None, housing prioritized and no evaluation of future consequences from densification (AOS; AH; CO; KT; KvS; LT; MS; MP; UE; UÅ).</td>
</tr>
<tr>
<td><strong>Monitoring &amp; evaluation of outcome from ecological compensation</strong></td>
<td>No requirements, rarely done (AH; CO; CK; EN; HÅ; MyP; KT; LT; MP; UE), Action plan under process, probably through sample tests (EN; MR; MP; UE).</td>
</tr>
<tr>
<td><strong>How is ecological compensation valued and assessed</strong></td>
<td>Most common with recreational compensation of ecological values, money are compensating neglected maintenance e.g. streetlight or playgrounds (AOS; MR; AH; MyP; CO; EN; LT; MR; UE).</td>
</tr>
<tr>
<td><strong>Monitoring and evaluation of ES and runoff-management in relation to condominiums over time.</strong></td>
<td>No follow-up or controls by the municipality, when sold off, constructors has no responsibility, very unclear how information is passed on within boards of condominiums (AH; CK; EN; JP; MP; UE) Earlier municipal project for evaluation of ES, but disused (MS; UE).</td>
</tr>
<tr>
<td><strong>Monitoring and follow up of GAF in the long run</strong></td>
<td>No follow up is made (AH; EN; CK; MP; UE) (except for in Royal. Seaport, (EN; CK)). Unspecified evaluation of implementation in average guarantee control after 2y, not afterwards (EB; JP).</td>
</tr>
</tbody>
</table>
3.5.4. Summation

There is no evaluation of how strategies in RUFS are reflected or acknowledged in the comprehensive plan. Both documents are political why interests among different majorities in the County Council and City Council, might counteract. Strategists at the City Planning Administration investigates the coherence between detail plans and the comprehensive plan, but there is no follow up of implementation in separate detail plans. There are plenty agreements and regulations in building permits, monitored together 2y after construction. No specified evaluation of runoff management through bio-filters or of fulfilment of GAF is made, although a method for evaluation is under progress, probably sample tests will be made in larger projects. How densification processes will affect future resilience or adaptability to climate change, is not evaluated and there is a high risk of unforeseen consequences from intense development. The city has no requirements for evaluation of ecologic compensation and very random and poor procedures regarding monitoring and evaluation of park management.

4. Discussion

4.1.1. Issues of embodying visions in practice

Most important findings from the study is the strong tendency of exploitation and densification undermining the capacity of various green structures to enhance resilience and climate adaptation. The aggregated consequences from ongoing densification of this extent, might not fully be identified until too late, when lack of connectivity and interaction in the urban landscape cause severe failure in provision of inevitable ES. At the same time, results from document reviews and interviews show generally high ambitions and interest improving green management and attendance to green structures and ES in planning and development in Stockholm. Visions and strategies to maintain biodiversity and connectivity are raised in comprehensive plans and green-programmes, although lacking clear structures for fulfilment. In densification- and other development processes this become visible through low implementation and consideration of strategies.

The study stresses a number of issues regarding implementation of comprehensive strategies and visions in developments and densifications: Despite high theoretical awareness of ongoing degradation of important green-structures within a project, other interests and considerations tend to
outweigh environmental aspects, resulting in, often poor, compensation strategies. The solely local focus in detail plans, further contributes to negative impact on biodiversity and ES production through cumulative effects from adjacent projects and inadequate understanding of the larger landscape view. Risk of fragmentation and undervaluation of greenery in relation to both temporal and spatial urban scales is also found in a study of Stockholm, by Borgström et al (2006), as in an investigation of ES provision in New York (McPhearson, et al., 2014). From the perspective of a changing climate, the importance maintaining resilience and functioning ES will be further stressed in urban areas, putting a higher pressure on existing green structures (Brink, et al., 2016). In Stockholm, that is surrounded by water, also blue structures play an important role in climate adaptation and regulation (Sydow, 2018), this might somehow balance loss of greenspace, bearing in mind the dependence on regulating services from green-structures needed, to maintain a healthy and functioning water-environment. The vision presented in the comprehensive plan of Stockholm, to improve greenery and ES when densifying on greenspace, is questioned by all respondents, meaning there is an unavoidable connection between space and ES to maintain desired functionality.

Several gaps in communication and information of important knowledge between different actors and stages was also revealed by the study. Strategies and visions regarding greenery in comprehensive plans fail to be communicated to detail plans, or are formulated in a way that give room for inadequate interpretation. Intentions in planning of preserving nature or trees in development areas, often get altered, reduced or removed because of inappropriate planning in relation to construction practices, added costs, or due to poor communication and information between different actors and levels. There is also an issue with random implementation, dependent on interest and knowledge of ES among planners or project managers that take part in development. This affects decisions made and how greenspace is treated in relation to other requisites for housing and exploitation. A general lack of monitoring and evaluation of greenspace in relation to developments, as of how GAF and runoff management through bio-filters are maintained over time by condominiums, reduces ability of learning in between projects. More important, evaluation of how immense densification and development in the extended region, affect connectivity, biodiversity and ES, hence resilience, is missing. In relation to the stressed importance of learning, knowledge-exchange and evaluation as tools achieving SER (Folke, 2006; Barthel, et al., 2013) are crucial to improve. The same issues also affect continuous management of parks and nature-areas within and in proximity to the city. A holistic understanding of larger structures, interactions and inter-dependencies is often lacking due to fragmented organisation. The low budgets from incentives of cutting costs and general absence of continuity (Embren, 2018), is proven negative for functional maintenance. Communication within the split-up organisation for green management is often failing, comprehensive visions missing, monitoring and evaluation processes for and within management are generally random and deficient.

Inclusion of ES, connectivity, biodiversity and climate adaptation are new in Stockholm, why many of the procedures and structures are still under process. This applies also for monitoring and evaluation of GAF and ecologic compensation, which gives a prospect of imminent improvements. Although from the knowledge of often poor implementation of strategies already in place, the necessity of improving transfer of strategies to action is elucidated. Decision-makers need to acknowledge the beneficial position cities with large green structures, as Stockholm, holds adapting to climate change. To strengthen biodiversity and ES, broadening an awareness of resilience thinking among citizens as in politics of planning and developments.
4.1.2. The prospect of resilience

The study indicates that the current intense densification strategy many cities are embracing, needs to be slowed down, to give room for thoroughly considerations and evaluations of consequences with a too compacted built environment. Revealed gaps in communication, knowledge and information between different stages and actors in developments are important to elucidate, to improve implementation of comprehensive strategies. Here evaluation of where along the process-chain, these gaps are likely to appear is necessary. This measure is also needed in continuous management, where the split-up organisation is regarded a problem. Structural fragmentation in combination with defective budgets, clearly affect comprehensive planning and maintenance of qualities and functionality of greenspace over time. Procedures and budgets for procurement of entrepreneurs seem to undermine resilient green structures in Stockholm, not the least since insufficient management is considered decreasing biodiversity (Colding, et al., 2006; Andersson, et al., 2014). Comparing results from interviews with the assertion that diversity in management institutions, advocated by Andersson et al (2014) to enhance resilience, this study stresses that diversity should not be mistaken for the current, spread out and fragmented municipal organisation being resilient. Emphasizing that diversity here refers to type of actors as private gardeners, allotment occupants and city farmers in relation to a municipal comprehensive organisation. The major issue in an urban context of green-management, seems to be the framing of an organisation that both holds an overriding responsibility and landscape-view, still being flexible to embrace new initiatives, as acknowledging the importance of a multifunctional management where also small patches of greenery are included. From a perspective of large uncertainties regarding the relation spatial land-use and provision of ES, that is, size needed to maintain function and avoid isolation which might differ from place to place (Faehnle, et al., 2015), monitoring and evaluation of effects should continuously be carried out regardless of management procedures and organisational structures that can improve biodiversity and connectivity. A larger recognition of urban design in relation to ES (Andersson, et al., 2014) and how different green areas interact, both ecologically and in relation to social wellbeing could strengthen valuation and understanding of the importance of urban green structures.

Looking at the inclusion of ES in urban planning as a tool for sustainable development (Cortinovis & Geneletti, 2018), acknowledgement in plans is regarded to improve understanding and consideration of ES among various actors. This fact is supported by several respondents in this study, experiencing backing-up from the comprehensive plan arguing for greenery. On the other hand, there is a risk that vaguely defined recommendations on valuation and preservation of greenspace in not juridical binding documents, become empty words, masking what is taking place as considered and evaluated, when in fact these procedures are not assured. The by some respondents expressed confidence of general attendance to ecology in planning, seem to emanate from expressed visions of ES in the comprehensive plan and Green programme. From the knowledge of low implementation of comprehensive strategies in detail plans and practice, a possibility of false safety regarding environmental considerations, particularly among citizens with low knowledge of ES, or that are less engaged in developments and green structures, is argued. In a city as Stockholm, promoting high ambitions for sustainability and green plans, it therefore seems to be a considerable risk of accepting degradation at local levels, from the perspective of improvements being cared for in other areas. With no evaluation of impact from the overall development, increasing land-use changes and fragmentation, the expressed visions and high ambitions might therefore instead become a threat of low attention to what is actually taking place.

Strategies of SER theory, stresses the need of learning and building knowledge in a SES (Hauge Simonsen, et al., updated 2017) and the ability of social change as decisive for resilience (Folke, et
al., 2010). In a planning context, a small-scale social transformation could entail learning processes to improve understanding the urgency of resilience among actors, hence reduce the risk of passing critical thresholds through intense densification. Applying resilience thinking in developments propose an adaptive governance structure, that recognizes changes in the interrelations between ecosystem and society, along with an ability to adapt to these changes. This is argued particularly important in relation to ongoing land-use change and decreased capacity of ecosystem to maintain important functions. An adaptive capacity in planning is argued to involve actions counteracting degradation and to increase environmental considerations in development processes. Unlike maintaining the static command and control- approach, a SER urban planning is likely to better enhance the ability to adapt to climate change (Schwenius, et al., 2014). Changes in society causing degradation of ecosystems through fragmentation, can be difficult to observe, since loss of biodiversity appears at a relatively slow speed and might not be visible until too late. Altered procedures in social-ecological interactions to include aspects of uncertainty is therefore crucial (Resilience Alliance, 2010). The already existing organisation in Stockholm, with explicit requirements regarding development, in combination with a SES of adaptive governance is suggested to improve valuation of ES in development. Transforming the current system where nature preservation, GAF and ecologic compensation is regulated in building permit, to be better adapted to- and acknowledging the urgency in ongoing climate change.

4.1.3. Considerations of the study

The study was executed from a limited amount of both time and resources, why results do not comprise any on-sight investigations of developments. Data is primarily collected through interviews, which include an issue of interpretation and choice of informants. The study primarily included respondents within the green- and environmental sector, implying a slightly tilted group of informants. The high proportion of professions within the environmental- and green-sphere, as environmental planners, landscape architects, ecologists and experts risk to create an understanding of higher knowledge of greenspace and resilience thinking in the municipal context, than is generally in place. It is also likely that the composition of respondents with substantial knowledge in the sphere of investigation, has resulted in a more critical view on developments, than another group of involved actors would have had. This is not considered a problem in the study, since the aspect of resilience in relation to greenery has been of main interest, hence expertise within this specific area in development was crucial. Among the external management entrepreneurs, the insight in theoretical vocabulary of ES and resilience, was more absent, although this might not necessarily imply a lack of awareness of these functions and features. The unawareness is still disclosing the fact, that these aspects of management are not brought up in procurement, which is remarkable in the light of expressed visions and strategies to enhance ES and green-structures in the Comprehensive plan (Stockholm stad, 2017a) and the Green programme (Stockholm stad, 2016a). The study only included two respondents from the political sphere, both engaged in the Environmental party, where a better spread would have been preferred, although covering both the City Planning Authority and the Exploitation Authority, which was perceived most important. The inclusion of politicians did not comprise an aim of discussing political orientation, but to get a better understanding of how considerations are made and what culture foster how decisions are taken.

In relation to average planning in Sweden, it has been revealed during the study, that Stockholm is a rather unique case. Procedures in development processes do often not follow the originally intended order in Stockholm, as do the organisation of green management differ from other cities. To some extent this fact might affect the generalizability of the study, although regarding the features focusing on strategies, valuation, communication and considerations during specific procedures, both descriptive and causal generalizability are regarded valid for the case-study (Teorell & Svensson, 2007).
5. Conclusion

The case-study of Stockholm stresses how ongoing intense densification and development is strongly risking future capacity to cope with disturbances related to environmental degradation and climate change. Three main areas of importance to improve enhancing and achieving SER were identified:

1) **The maintenance of (U)ES** through a high valuation and acknowledgement of importance and dependency on greenspace, ensured abundance of greenery, high connectivity and biodiversity and a careful urban development not fragmenting larger green structures.

2) **Enhanced learning** e.g. by increased communication, sharing of information and knowledge-exchange between different actors, stages and projects, as through monitoring and evaluation of processes and strategies, to ensure functionality of current procedures.

3) **An adaptive governance system and organisation** which recognizes and supports different actors and stakeholders at various levels in the municipality, works towards a holistic understanding of the need of greenspace incorporating both a healthy maintenance and learning capacity in a changing future.

The areas and issues are strongly interrelated and interdependent which can both be regarded advantageous and problematic, since both strengthening and weakening one aspect is likely to affect the other two. Both interviews and literature reviews highlights the urgency of addressing climate change and future uncertainty in urban areas. A reappearing issue is the need of ES through functional green structures, addressing not only regulating services in society, but health and wellbeing and possibly also future survival, ensuring water and food supply for urban citizens. In SER the inclusion of humans in the ecosystems, stresses the interdependency of social and ecological aspects and perspectives in society (Barthel, et al., 2013; Resilience Alliance, 2010). To ensure resilience we need to create an overall understanding and support of our dependency on green structures and ES, in relation to adaptive governance systems and organisations. SER research stresses the need of learning through improved communication and knowledge-exchange in relation to organisations that are open to innovations and reorganisation (Hauge Simonsen, et al., updated 2017). In the case-study of Stockholm, which is likely to apply also to other cities, recognition of importance and value of greenery is argued to be improved through an adaptive governance system, which is built on the social-ecological interdependency. The current split-up and fragmented organisation counteract both comprehensive visions and strategies for greenspace and learning capacity, through insufficient communication and sharing of information. An adaptive governance system acknowledging the wide range of stakeholders and the variety in size and function of different greenspace, is dependent on interaction and social-ecological knowledge-exchange, which suggests a better communication and improved learning capacity (Andersson, et al., 2014; Barthel, et al., 2013). A larger inclusion of actors, incorporating e.g. private gardeners, allotment gardeners, entrepreneurs and city-farmers among residents in the city in an extended municipal, adaptive organisation could support the understanding of importance of green structures in general. The study stress a pressing need of strengthening the valuation of greenery in developments and continuous management, here the issue of misleading information through ambitious visions without corresponding requirements of action in comprehensive planning and green- and environmental programmes, are crucial to amend. The high theoretical knowledge of ecological features as connectivity and biodiversity, need of redundancy and proper strategies for ecologic compensation where development cannot be avoided, need to be transferred to detail plans, communicated between
actors and fulfilled in practice. The acknowledgement of greenspace in developments need to be prioritized in planning and exploitation, safeguarding SER in an uncertain future.

Future recommended research on drivers of today's urbanisation and how SER is affected by the current economic growth perspective is suggested. Further research on the interdependencies between social health and wellbeing and ES related to various forms of urban greenery is also argued important. How can urban greenspace be enhanced by human interaction and governance and how is social wellbeing affected by governance and stewardship of urban greenspace? How can new governance structures and improved learning from participation in management, strengthen the position of urban greenspace in relation to densification and thereby improve resilience?

6. Acknowledgements

My sincerely acknowledgements to all respondents, without whose help it would not have been possible to carry out the study. I am very grateful for your participation, interest and engagement, taking your time to meet and respond to all questions!

Last but not least, many large thanks to my supervisor Sara Borgström for invaluable help and support, making this study!
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APPENDIX

1) Respondents interviewed for the study

Anne Heino, interview 28/3-2018 (Heino, 2018). Land and outdoor specialist, educated at SLU. Stockholmshem (AH).
Cecilia Obermüller, interview 16/3-2018 (Obermüller, 2018). Environmental commissioner, politician representing the Environmental Party (mp). Background as geologist with supplementary Environment and health science. The City Planning Authority (CO).
Edwin Björkefall, interview 15/3-2018 (Björkefall, 2018). Project leader in exploitation projects, the Exploitation Administration (EB).
Emmelie Nilsson, interview 10/4-2018 (Nilsson, 2018). Green consultant and Environmental Planner at WSP. Former Project Assistant in the C/O City project regarding urban ES in the Royal Seaport development (EN).
Erik Ohlsson, interview 13/3-2018 (Ohlsson, 2018). Foreman at department for park and maintenance management at Kungsholmen and Östermalm, Svevia (EO).
Helena Åkerlindh, interview 5/3-2018 (Åkerlindh, 2018). Park Engineer, Responsible for procurement and communication with park entrepreneurs at Kungsholmen. The City District of Kungsholmen (HÅ).
Karolina von Sydow, interview 12/4-2018 (Sydow, 2018). Strategic Comprehensive Planner and Specialist on climate adaptation. County Administrative Board of Stockholm (KvS).
Magnus Sannebro, interview 27/3-2018 (Sannebro, 2018). Climate strategist, has been part in developing the sky-fall mapping and flood-risk assessment for Stockholm, Environmental Assessments. The Environmental Administration (MS).
My Peensalu, interview 5/3-2018 (Peensalu, 2018). Landscape architect, working with greenspace and parks in the City Districts of Kungsholmen, Norrmalm and Östermalm (MyP).

2) Outline of study

<table>
<thead>
<tr>
<th>Analytical questions</th>
<th>Aspects of importance for resilience</th>
<th>Empirical questions/ general interview guide</th>
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<tbody>
<tr>
<td><strong>What is the prospect of future resilience, considering valuation and management of greenery and trees in relation to densification processes and climate change?</strong></td>
<td>Strategies concerning climate change and environmental degradation</td>
<td>Is there any comprehensive climate-plans or strategies to handle future disturbances in relation to densification and development?</td>
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<td>Are there any long-sight strategies for a resilient development included in detail plans?</td>
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<td>How are greenspace and ecosystem services acknowledged in relation to technical solutions?</td>
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<td>Are there specific recommendations for management of runoff in densification projects?</td>
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<td>What time-perspective is used in planning?</td>
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<td>To what extent is future resilience and likely consequences and problems from densification considered in relation to housing shortage?</td>
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<td>Which issues are prioritized and how is land-use considered and valued in the city?</td>
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<td>Is there a differentiation and valuation made between various greenspaces regarding where to build and where to preserve greenery?</td>
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<td>How is the local-identity related to parks, trees and greenspace reflected in densification?</td>
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<td>Are considerations of ES in relation to specific sites considered in exploitation and how are theses aspects valued in relation to proximity to underground, public services roads, economic interests etc.?</td>
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<td>Is information about strategies regarding connectivity and ecologic vulnerability communicated between different developments to reduce risk of fragmentation?</td>
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<td>What is the process for deciding on exploitation of a specific area? How and by whom is it initiated?</td>
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<td><strong>How are general management of greenery likely to affect ES, biodiversity and hence resilience locally and in the larger structure?</strong></td>
<td>Knowledge, communication and organisational scales</td>
<td>How is decisions and recommendations communicated between different actors in a project? Who is responsible for continuity?</td>
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<td>How is greenspace of no particular value, importance or earlier protection valued and acknowledged in exploitation?</td>
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<td>Are heavily trafficked roads in proximity to housing considered in relation to preservation of large trees and greenspace?</td>
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<td>How are green structures at the north-west of Kungsholmen valued regarding large roads, ES and health aspects of future residents?</td>
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<td>How are different organisations, administrations and actors cooperating for green-management of parks and other greenspaces?</td>
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<td>How is information communicated between planners and actors?</td>
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<td>How are detail plans followed up?</td>
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<td>How are plans for green structures and parks followed up over time?</td>
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<td>How is information and knowledge regarding vulnerable/ important ecologic areas treated between comprehensive- and detail- planning?</td>
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<td>Are there general guidelines for preservation of greenery and trees in exploitation processes?</td>
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<td>What is valued when decisions of densification are made?</td>
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<td>To what extent can the municipality decide over placement, number and</td>
<td>To what extent can the municipality decide over placement, number and size of houses in a development and what is decided by the constructor?</td>
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<td>size of houses in a development and what is decided by the constructor?</td>
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<td>Do visions expressed in the latest comprehensive plan and other steering documents regarding greenery in Stockholm, correlate to management practice and valuation of trees and greenspace?</td>
<td>Valuation of greenspace</td>
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<td>How are trees valued in the city, is there penalties on damaging trees?</td>
<td>How are trees valued in the city, is there penalties on damaging trees?</td>
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<td>Who is responsible for trimming and taking down trees in the city?</td>
<td>Who is responsible for trimming and taking down trees in the city?</td>
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<td>How are trees monitored and by whom?</td>
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<td>For how long is a tree expected to live in the city?</td>
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<td>When deciding on trimming and/or removing trees who initiates the process and how is payment calculated on branches? size? amount? per hour?</td>
<td>When deciding on trimming and/or removing trees who initiates the process and how is payment calculated on branches? size? amount? per hour?</td>
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<td>Is there any evaluation on tree management?</td>
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<td>Who is responsible for long-term planning for street- and park trees?</td>
<td>Who is responsible for long-term planning for street- and park trees?</td>
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<td>How is safety considered in relation to trees in the city?</td>
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<td>How are arborists or managers chosen for tree care?</td>
<td>How are arborists or managers chosen for tree care?</td>
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<td>How is the aim of enhancing green structures and ES reflected in detail plans?</td>
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<td>Are existing greenspace and green structures large enough to maintain resilience and provided the ES needed?</td>
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<td>Is connectivity in green structures functional enough to maintain biodiversity and redundancy?</td>
<td>Is connectivity in green structures functional enough to maintain biodiversity and redundancy?</td>
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<td>Are the current trees in the city monitored and registered?</td>
<td>Are the current trees in the city monitored and registered?</td>
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<td>What type of considerations regarding greenery and green structures are made in relation to densification and exploitation?</td>
<td>What type of considerations regarding greenery and green structures are made in relation to densification and exploitation?</td>
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<td>What considerations regarding ES and connectivity are generally made in relation to exploitation?</td>
<td>What considerations regarding ES and connectivity are generally made in relation to exploitation?</td>
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<td>Are large and grown up trees normally preserved in proximity to development or are trees generally taken down and replaced by new?</td>
<td>Are large and grown up trees normally preserved in proximity to development or are trees generally taken down and replaced by new?</td>
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<td>To what extent is densification of urban areas possible to combine with enhancement of ES and greenery and does ecological compensation function as protection of biodiversity and connectivity?</td>
<td>Regulations of greenery, Green area factor and Ecologic compensation</td>
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<td>How is ecological compensation carried out in practise?</td>
<td>How is ecological compensation carried out in practise?</td>
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<td>What type of recommendations are there for cooperation strategies and forwarding of information between projects?</td>
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<td>How are decisions regarding preservation taken in relation to developments?</td>
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<td>On what grounds is the need of compensation- and how to, decided?</td>
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<td>To what extent are recommendations of avoiding exploitation of vulnerable and sensitive areas followed?</td>
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<td>How and by whom is alternatives and outcome of compensation strategies valued?</td>
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<td>Are ecological values possible to compensate on a smaller surface?</td>
<td>Are ecological values possible to compensate on a smaller surface?</td>
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<td>What types of green structures can be compensated? How do you compensate for an old tree for instance?</td>
<td>What types of green structures can be compensated? How do you compensate for an old tree for instance?</td>
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<td>How is effectiveness of compensation safeguarded?</td>
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<td>Can connectivity be maintained through street trees as a compensation for an exploited forest-area?</td>
<td>Can connectivity be maintained through street trees as a compensation for an exploited forest-area?</td>
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<td>What happens if a compensation strategy fails? How is evaluation carried out over time?</td>
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<td>How are visions in the comprehensive plan and the green programme implemented?</td>
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<td>How is impact from densification on nearby green areas and increased wear and tear considered in detail plans and budgets?</td>
<td>How is impact from densification on nearby green areas and increased wear and tear considered in detail plans and budgets?</td>
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<td>How are these visions reflected in relation to building permit and detail plans?</td>
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<td>Do constructors need to adjust developments to strategies in plans or is it seen to in building permit?</td>
<td>Do constructors need to adjust developments to strategies in plans or is it seen to in building permit?</td>
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<td>Is there an individual valuation made of large trees in relation to developments/exploitation, regarding preservation and valuation?</td>
<td>Is there an individual valuation made of large trees in relation to developments/exploitation, regarding preservation and valuation?</td>
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<td>Is the municipality paying attention to learning processes and are monitoring procedures</td>
<td>Monitoring and evaluation</td>
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<td>How dense is good? What is considered a healthy compaction of urban areas and what are these areas meant to include?</td>
<td>How dense is good? What is considered a healthy compaction of urban areas and what are these areas meant to include?</td>
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<td>Do strategies for densification and fill-ins vary between different areas?</td>
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<td>How and why in that case?</td>
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<td>How large areas should be preserved for greenspace to enhance and maintain ES as recommended in green programme and comprehensive planning?</td>
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<td>How is impact on green structures from developments generally considered/ reflected?</td>
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<td>How are social aspects as health, recreation, stress reduction from greenspace considered in densification projects?</td>
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<td>To what extent is placement of housing in relation to greenspace, topography and point of the compass?</td>
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<td>The children perspective in planning, how is that related to densification e.g. on sport fields and green areas?</td>
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<td>How are different needs and interests weighted towards each other?</td>
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<td>Is there a recommended width on streets to make room for trees?</td>
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<td>Is monitoring and evaluation of competence and quality among entrepreneurs carried out in relation to management of parks and greenery and maintenance of ES?</td>
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<td>Who is responsible for management procedures and follow up?</td>
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<td>How is management procured and on what grounds?</td>
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<td>Has the Environmental Administration recommendations for what should be included in procurement of green-management?</td>
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<td>Is type of tree regarded in relation to space when new-planted?</td>
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<td>How is density regarded from a health and accessibility to greenspace perspective?</td>
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<td>Are green structures considered in relation to flood-prone areas or runoff management?</td>
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<tr>
<td>How is the risk of damages on city trees handled in relation to construction work, management and de-icing?</td>
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<td>How is information of ecologic sensitivity and importance communicated in exploitation processes?</td>
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3) Skeletal-soil and bio-filters

The Skeletal soils are developed from a traditional Dutch construction, originally used to prevent streets to settle over time due to compaction. As a structure for plant-beds it was started to be used during the 70-ies in the Netherlands and then further developed in the university of Hannover. The construction is, in its most modest form, structured with bigger gravel/macadam of the same size that will form holes and interstice, which will be filled by soil watered down through the space in between stones, creating a plant-bed that cannot be compacted.


What is new in the Swedish and Stockholm-model is the connected well that is basically used for air-ventilation of roots, but can also function to lead runoff water down to roots and ground that can absorb it (Stockholm stad, 2017; Embren, 2018). An investigation made 2001 by the Traffic Administration, on vitality of street trees, revealed that many trees were in a poor state. Establishment of skeletal-soils for street trees in Stockholm has since proven good result. In Stockholm, many of the skeletal-soils also function as bio-filters for runoff, where various forms of greenery, adaptable to both wet and dry periods, which together with soil-filtration are used to take up and purify water. Bio-filters are complex constructions, using fertile soil for greenery, mineral-soil and gravel for stabilizing and filtration and macadam or larger stones in bottom to improve drainage and air-ventilation (SMHI, 2015; Heino, 2018).